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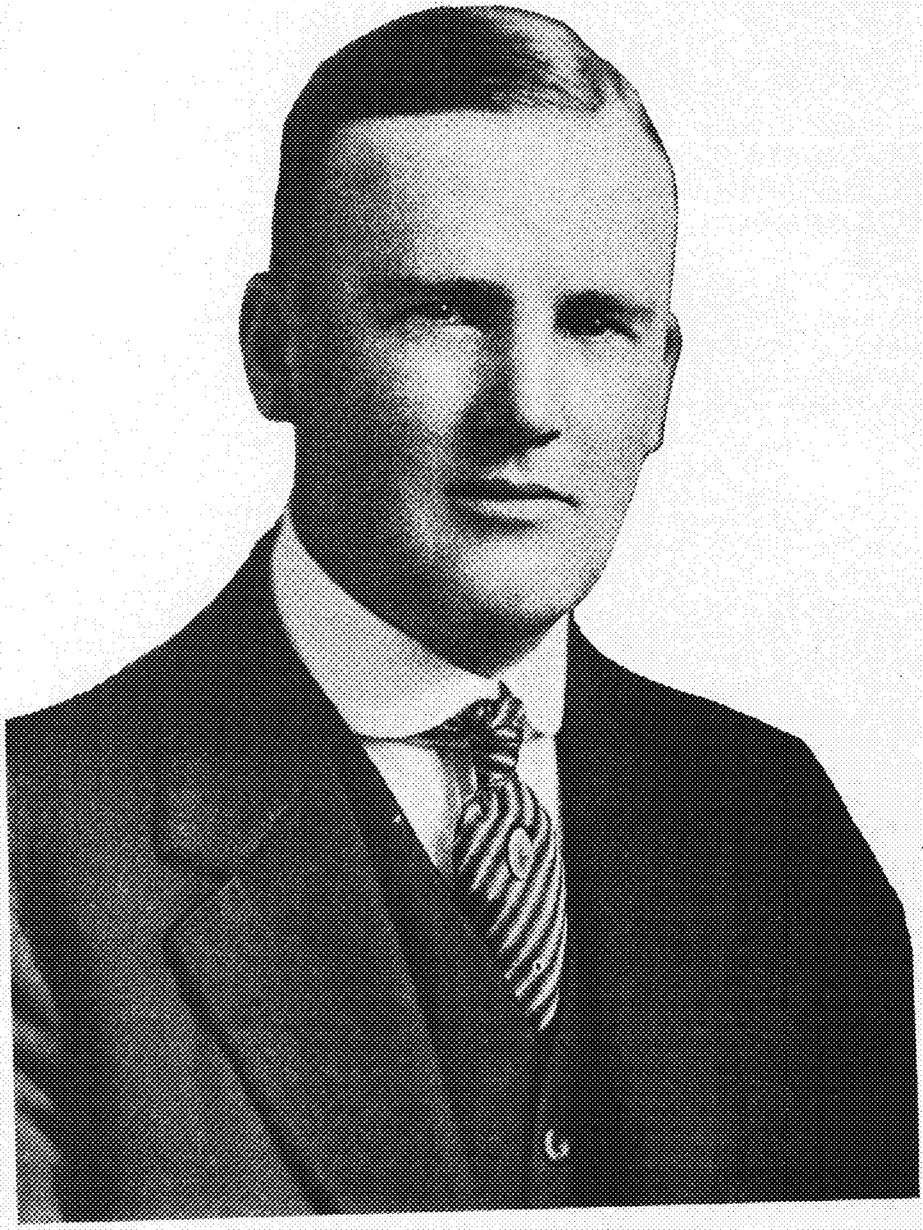


DEAN O. M. LELAND

MINNESOTA TECHNO-LOG

Volume I *November, 1920* *Number 1*

SERVICE, THE SOUL OF BUSINESS

A Talk to the Engineering Students of the U. of M. by
CHARLES L. PILLSBURY,
Treasurer of The Munsingwear Corporation.

Mr. Chairman and Gentlemen:

I am always very happy to meet with you engineering students, because I feel that I am one of you. While I have not the honor to be an alumnus, yet I am proud of the fact that I am an ex-student of Engineering of this great University.

During the last fifteen years or so, I have many times appeared over here to talk to engineering classes. So far, however, my subjects have always been of a purely technical or engineering nature. I was considerably surprised and rather disconcerted when I was asked to come before you today to talk on the general subject of "the application of religious principles in business." At first, I demurred, but I finally decided to speak briefly to you from a strictly practical standpoint. My talk today, therefore, is not to be technical, but I hope nevertheless it will be just as practical. It is needless to say that I am not here to preach.

My message is: "The Soul of Business is Service." Service, truly and broadly interpreted, meaning unselfish service of man to man, is becoming the watch-word of business organizations, the symbol of the new Era in business thought and word and deed. "He who would profit most must serve best."

And service so interpreted and so applied embraces many fundamental concepts of Christianity. It is but natural that this is so for service to God is service to his creatures, our fellow-men. Service so interpreted embraces the Golden Rule as propounded by Jesus Christ in his sermon on the Mount more than nineteen hundred years ago, "All things whatsoever ye would that men should do unto ye, do ye even so unto them." It embraces truth and honesty and equity, meaning by equity not only justice, but impartial distribution and application of justice. It embraces "Good will toward men;" and were such service universally in evidence, "Peace on earth" would surely follow.

During the latter years of my Consulting Engineering practice, having many exacting clients to deal with almost simultaneously, having small permanent engineering organizations in both Minneapolis and St. Paul, and frequently having to quickly get together comparatively large organizations in other cities for the investigation and valuation of public utilities, I had ample opportunity to acquire, and, I think I did acquire as to my profession, a fairly comprehensive acquaintance with the meaning and the need of service. It was not, however, until the wheel of fortune had turned rather sharply and unexpectedly for me and landed me in a quite different life work as executive in a large manufacturing and merchandising business that I learned anywhere near the true import and importance of that word Service.

It happened that my first assignment in my new undertaking was the conduct of a sweeping investigation, running away back through the years to 1895, of the causes, upgrowth and development, as well as the retarding influences affecting the concern's good will. Under the consulting guidance of a famous New York specialist, a staff was organized and put to work. The accounts, product, advertising, correspondence, methods, principles, policies and all the available records of the company were studied and analyzed. Over one hundred thousand old letters of the company's correspondence were read, analyzed and classified. All the dust-covered accumulations in all the old musty vaults were brought to the light of day, and their stories of the past unraveled. Many typical customers of long standing were impartially selected on a geographical basis, and all dealings with them for years back were analyzed. An historical exhibit explanatory of the company's progress and the development of its product, its advertising and its methods, was collected and assembled.

Out of all this as one good came a definite conclusion on the part of the researchers that those principles and policies of external and internal conduct of the business, and of the human relationships appertaining thereto which had endured throughout the years, and which had proven their right and need of promulgation, were those in agreement with the concepts of Christianity to which I have referred, and which I say are embraced within the term, unselfish service.

There has been a rather prevalent opinion in the past, and, for that matter, there are many who still believe that the conduct of a manufacturing business, for example, merely consists of the obtaining of orders, the buying of raw materials, the turning out of the goods, the collection of the sales moneys, and the pocketing of the profits by the owners for their own selfish gain. As to successful and enduring business, nothing could be farther from the truth.

In the first place, they who so believe are thinking only of the facilities and machinery of business, and not of the human beings who conduct those facilities and who operate that machinery. Business is very complex, and the human element is the greatest factor of all. A successful business is a builder of men just as much as it is a builder of products and facilities. And the bigger the business and the greater the executives who conduct it, the more time and thought do they necessarily devote to the great problem of humanity, of human relations, of the relation of man to man, and all that that implies.

And, in the second place, it is an unjust fallacy that the profits of business are merely devoted to the selfish uses of the owners. A large proportion of the profits, generally the major portion, must constantly be put back into the business. Just as in the case of human individuals, businesses can not for long stand still in development. They must either progress or retrograde. They are constantly moving either upward or downward. They must either grow or go. Competition sees to that. And to grow—to move onward and upward—more funds, more invested capital, is constantly necessary. Profits are largely put back into the business to create further facilities, to create further tools of production. Incidentally, there would be less criticism of capital, were it better realized to what extent profits are constantly put back to create the tools of production upon which the progress of the world so largely depends.

Now, why is it that capital is willing to take the chances and constantly re-invest in augmented facilities—the tools of production,—taking less profit today because of tomorrow? It is because of the confident assurance of continued patronage. But, men, that is what is involved in the business term, Good Will. Good will value is founded upon the confident assurance of continued patronage. Good will is measured by estimating the financial value to the concern of the summation of the friendly impulses on the part of customers and potential customers to cause them to continue to patronize. Good will is, in fact, one of the greatest assets of established going business. Whether written upon the books financially as an asset or not, the actual value of good will in dollars and cents is often more than that of all other assets put together.

The treasurer of one of the great DuPont companies was recently asked, "What are the assets of your company?" He said, "They are four: first, good will; second, capital; third, organization; and fourth, facilities (machinery and equipment)." He said, "Of these good will is the greatest of all. We might by some catastrophy lose all of our buildings and equipment—our facilities, but with our capital and our organization, we could quickly replace them. Although our organization is of the greatest value to us, yet with our good will and our capital, we could replace it. Our capital is great, but, if lost, the good name and good will of the company would quickly draw in new capital. But if our good name—our good will—should be lost, there would be an end to the business. It would be almost hopeless to try to replace it."

Now, from what attitude of mind on the part of customers does this so highly valued good will arise? The answer is, from satisfaction and confidence. Satisfaction and confidence cause the friendly impulses which insure continuity of patronage. But what gives rise to satisfaction and confidence? The answer lies in the one word—the word which represents the soul of business—Service.

Now, let us see by whom and how that service is performed, and of what it really consists.

It has become quite popular of late for large manufacturing and distributing companies, such particularly as the automobile and allied trades, to establish so-called Service Departments and Service Stations, to render certain specific kinds of technical or manual service to customers of the company. Such a department or branch is, however, only one point of contact between the company and the customer, and being dignified by the name, Service, does not insure even as to that point of contact the actual performance of service in its truest and broadest meaning. Service is rendered or not as the case may be, and the friendly impulses of continued patronage or good will accordingly fostered and built up or hindered or destroyed, as the case may be, by every point of contact throughout every ramification of the business. Every word and act of the salesman, every letter from the house, every telephone conversation, every bit of advertising, and every bit of work put into the product, either rings true, renders service and upbuilds good will, or the reverse. Even an act or a talk or a letter, for instance, which is so colorless as to be indifferent, nevertheless impairs good will, for such but create an atmosphere of indifference, and there can be no positive growth for good, but only stagnation, in an atmosphere of indifference.

It would require no argument that in every direct point of contact between the company and the customer, good will must be fostered by service rendered. But how about the matter of internal relations within the company itself? The greatest problem before the American people today is that of the relation of the three-fold internal factors of business, capital, labor and management. How does this matter of service affect us there? What, for instance, is the application of service to production, for it is in connection with production that the capital, labor, management problem is of the greatest magnitude, and the most acute.

First, let us look at this production problem strictly from the point of view of service to the customer—the point of view of creation of customer good will, if you wish. We will find that to develop such good will to the fullest extent, internal good will, that is, good will within the organization itself, must first be in evidence.

If we are to be in business tomorrow as well as today, if we are to maintain and upbuild the good will upon which the future depends, we must accomplish three conditions as to production, first, quality, second, quantity, and third, efficiency. In this I am practically repeating what Sheldon teaches in his famous equilateral triangle of quality, quantity and mode of conduct.

There can be no lasting success without quality. The quality must be all that it is represented to be, and it must be that not now and then, not even most of the time, but all of the time. Consumers will buy once, and may buy twice or even several times under certain conditions where the quality is less than they have been led to expect, or have a right to expect, but it is a proven fact, even as common sense clearly indicates, that such custom will not endure. Dissatisfaction will result, and only satisfied customers become permanent customers.

There can be no lasting success without quantity. That is, there must be the requisite quantity in the given time so that the orders of customers may be filled and filled on time. Satisfaction and confidence are only built up by the delivery of the quality desired in the quantity desired, when desired.

There can be no lasting success without efficiency, for without efficiency it is obviously impossible to deliver the requisite quality in the requisite quantity, all the time on time, except at excessive cost. And excessive cost must result in either profits so abnormally low that there can be no augmenting of the invested capital out of such profits, no building up of the tools of production so essential to growth and success, or in excessive prices charged which obviously can not lead to good will and which in competitive business would soon cause a downfall.

Now, still confining our thoughts to the production problem as affecting customer good will, it would be useless to argue that any particular degree of, or even the existence of service in the internal relations is necessary to the accomplishment of any one of the three required factors, quality, quantity and efficiency. Even under conditions of driving instead of leadership, discontent instead of contentment, quality of product can be brought about by sufficient force or sufficient reward coupled with rigid inspection and ruthless selection. Likewise, and more readily still, quantity can be produced. Efficiency would be harder to bring about with lack of service in internal relations, but even that is clearly possible.

But long and bitter experience is finally convincing even the skeptical of that which it seems should be self-evident, that the combination of the three factors, quality, quantity and efficiency, can not be brought about in the same plant at the same time, except under conditions of high morale, where all are working together all the time to a common end. High quality, in quantity, with efficiency, can only be brought about through interest and enthusiasm on the part of the workers. They must be enthusiastically interested in their work and in the success and continued success of the product and of the business as a whole. And that interest is brought about and that morale created through service in internal relationships—through the fostering of the spirit of unselfish service of man to man.

And so, through ages of contact, through long periods of total darkness into light, dim, at first, and then brighter and brighter, through much experimentation of late, and many vicissitudes, the relationship in production has emerged from master and slave, from master and servant, from master and man, to man and man, man to man, working together to a common end—morale.

So we see that good will, founded upon service, within the organization, is the first requisite to good will on the part of customers. Everywhere throughout human relationships, internally and externally, the spirit of service must rule if good will is to be attained in the highest and the business endure. Truly, therefore, service is the soul of business. "He who would profit most must serve best."

In closing, pardon a reference to a new trade mark adopted by the corporation I am with. It has one point of contact which seems pertinent to this subject. Purposely, we adopted an arbitrary symbol which we could make applicable to certain features of our business and certain principles which we wish to promulgate. After long search, we decided upon this simple symbol—an idealized form of the three tined head of the trident, this within a circle, with four super-imposed corners. The circle is intended to represent completeness and perfection; the four super-imposed corners indicate the reaching out to the four corners of the land; the trident, which you will remember was the attribute of Neptune, symbolizes what the wand is to the fairy, or the sceptre to the king. The three tines of the trident, we say, refer to many features of our business which happen to classify in groups of three, just as the National Cash Register Company find that many of their features and factors of success readily classify into groups of five. It would not be at all pertinent to the subject to recite all of this. I only want to repeat what we finally say to cap the climax as to the three tines of the trident, this: The tine on one side stands for Service—the soul of business; that on the other, for Satisfaction—the result of service well performed; and upright in the center between the two, pointing ever onward and upward, the final result, Success. Service, Satisfaction and success—what more could a symbol stand for?

WATERWHEEL TURBINE TEST

By W. T. Ryan.

About twenty-two years ago the St. Paul Gas Light Company of St. Paul, Minnesota, foresaw that it would soon be necessary to build a single modern steam generating plant or a hydro-electric plant to replace the four steam plants then in operation.

On Apple River in the State of Wisconsin, about 30 miles Northeast of St. Paul, was found a natural fall of about 30 feet. Above the fall a dam with a height of about 50 feet was built, thus affording a total head of 80 feet. The river is fed from innumerable springs and several lakes in Wisconsin, therefore the flow is remarkably uniform the year around. Accordingly there was organized under the laws of the State of Wisconsin the St. Croix Power Company, who built a hydro-electric power plant at the above location and contracted to sell to the St. Paul Gas Light Company the electric energy it could produce at Apple River Falls.

In the wheel-room were four 1,400 horse power 36-inch "Victor" wheels, mounted horizontally in nine foot cylindrical wheel-chests from which they discharge through six foot draft tubes, about eight feet long. Each wheel has two runners mounted on a single shaft which extends through the end of the bulkhead built into the partition wall and is direct connected to a 750 kilowatt generator. Each wheel chest is supplied by its own feeder pipe on which is located a 56-inch motor operated gate valve. There are two exciter wheels, each direct connected to a 30 kilowatt direct current generator. The exciters have their own branch feeder pipes, wheel chests and separate gate valves.

The four Alternators are 750 kilowatt, 3 phase, 800 volt, 60 cycle, revolving armature, separately excited machines running at 300 R. P. M. Although these machines have been in service for over twenty years and are operated on an overload in order to get a higher efficiency from the waterwheels than would be obtained at full load, they are still in good condition and operating satisfactorily. A complete description of the plant and the transmission system as originally built is given in the Proceedings of

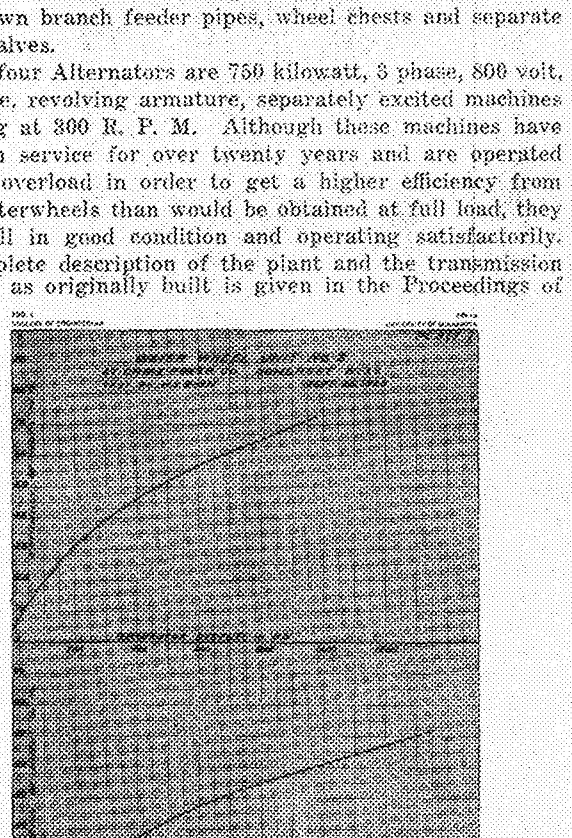


Plate 1.

the American Institute of Electrical Engineers, Vol. XVII, 1900, pages 635 to 665.

Modern waterwheels are considerably more efficient than those built 20 years ago, and the cost of producing electrical energy in steam plants has increased about 100 per cent in the last few years. The St. Croix Power Company recently replaced one of the above waterwheels with a modern one. The wheel chest and the old generator were left in place. The old draft tube was replaced by a new and more efficient one. The new wheel was guaranteed to have an efficiency of at least 81 per cent when delivering 1,300 horse power to the generator shaft under a head of 80 feet. The Holyoke tests showed a much higher efficiency for this particular runner but since the wheel was built into an old wheel chest the Manufacturing Company did not wish to guarantee any higher efficiency under the conditions.

The writer was engaged by the St. Croix Power Co. to conduct an acceptance test on the new wheel, also to test one of the old wheels so that an accurate comparison of the two might be made.

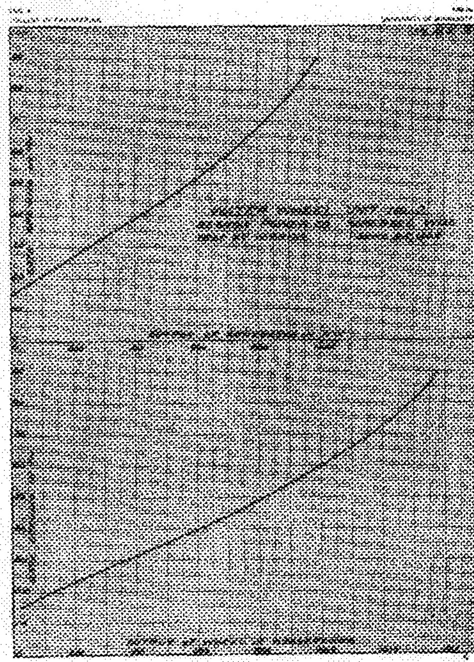


Plate 2.

MEASUREMENT OF POWER OUTPUT.

The output of the waterwheel was determined by measuring the output of the generator with carefully calibrated wattmeters installed in duplicate. It was decided to use the generator efficiency curve furnished by the General Electric Company, making the allowance suggested by them for probable increase in iron losses due to the age of the machines. The turbine builder, Allis Chalmers Manufacturing Co., reserved the right to demand a retest of the generator. The waterwheel exceeded the guarantee, therefore there was no occasion to dispute the efficiency of the generator as determined above. A portable switchboard was made up on which was mounted three ammeters, two three phase wattmeters, two three phase watt-hour meters, a power factor meter and a voltmeter. The watt-hour meters were included so that in case the load were fluctuating they could be used to check the average reading of the wattmeters. The generator was loaded by supplying power directly to the transmission line and was excited for unity power factor. The generator was thus put in parallel with several other stations and since the frequency of the system was 60 cycles, the speed was thus automatically maintained at almost exactly 300 R. P. M. The head was eighty and a fraction feet instead of the eighty feet under which the guarantee was made, therefore it was not necessary to correct the efficiency shown by the test on the basis of the

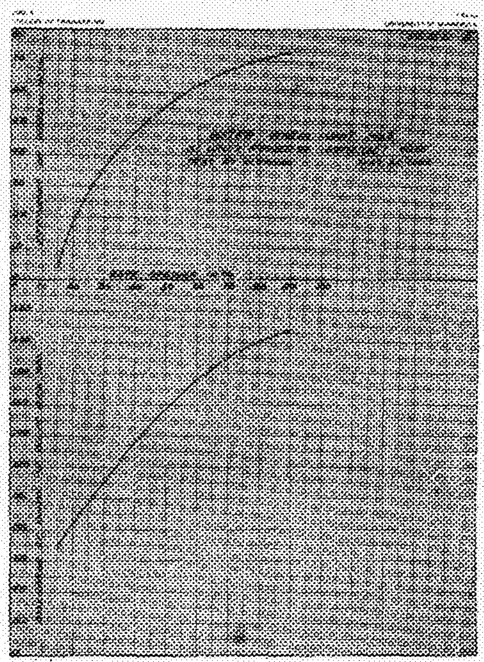


Plate 3.

Holyoke test curves for the same or a homologous turbine.

The turbine output was computed by dividing the measured kilowatt output of the generator by the generator efficiency as determined above, the result being converted from kilowatts to horsepower.

MEASUREMENT OF POWER INPUT OR WATER HORSEPOWER.

A—Measurement of Head.

The penstock pressure head was measured by four pressure gauges located in the straight portion of the penstock just ahead of the turbine casing intake. The pressure gauge orifices were one-fourth inch in diameter, were flush with the surface of the penstock wall, and the wall was smooth and parallel with the flow in the vicinity of the orifices. The center line of the pressure gauges was at the same elevation as the center line of the turbine shaft and the pressure gauge orifices were located 90 degrees apart on the circumference of the

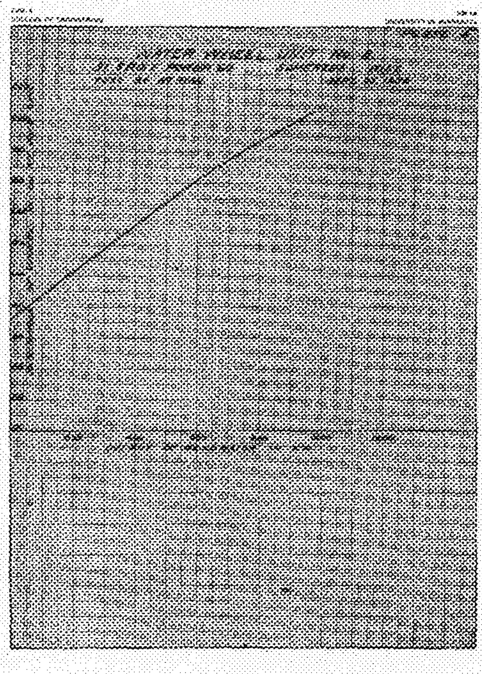


Plate 4.

penstock. Pet cocks were provided so that any air which might accumulate in the pipes leading from the penstock to the gauges could be drawn off.

The penstock velocity head was obtained by dividing the square of the mean velocity of the water in the penstock by 2g; the mean velocity being equal to the quantity of water flowing in cubic feet per second, divided by the cross-sectional area at the point of measurement in square feet.

The distance from the center of the turbine shaft to the tail water elevation was measured by two float gauges in stilling boxes, one at each side of the draft tube. The communication between the stilling box and the tail race was by means of two one-inch holes, parallel to the flow in order to avoid velocity effects.

The draft tube velocity head was taken as the square of the mean velocity at the end of the draft tube divided by 2g; the mean velocity being equal to the quantity of water flowing in cubic feet per second, divided by final cross-sectional discharge area of the submerged portion of the draft tube in square feet.

The effective head on the turbine was taken as the penstock pressure head plus the penstock velocity head plus the measured tail water head minus the draft tube velocity head.

B—Measurement of Quanity of Water.

It was decided to measure the flow with a weir. The weir was located on the tail race side of the turbine, some distance from the end of the draft tube. The details of the weir are shown in Fig. 1. The channel of approach was straight and of approximate uniform cross-section for a length of 25 feet from the crest. The end contractions were suppressed. It was necessary to run one exciter wheel during the test, also there was some water coming into the tail race from a tile drain; also some water must necessarily leak through the weir dam. It was decided, therefore, to build two weirs, a small and a large one. The quantity of water taken by the wheel under test, plus the water taken by the exciter, plus the water coming into the tail race from other sources, minus the leakage through the weir dam was measured with the large weir. Then the large weir was closed and the quantity of water taken by the exciter, plus the water coming into the tail race from other sources, minus the leakage through the weir dam was measured with the small weir. The difference between the quantity of water flowing over the large weir and the quantity of water flowing over the small weir gave the quantity of water taken by the wheel under test. It was also possible by means of the small weir to measure the quantity of water flowing through the idle wheel when the main gate valve was closed.

Fig. I.

The discharge was computed by the Francis formula in the following form:

$Q = C\,L\,h^{3/2}$ where,

Q=Quantity in cubic feet per second.

L=Length of weir in feet.

h=Observed head above crest in feet.

The coefficient C was taken from the curve shown by Fig. II, which is an average of the values computed by the following three formulae for a four foot height of crest, (p).

(1) Bazin, $Q = \left\{0.405 + \frac{0.00984}{h}\right\}\left\{1 + 0.55\frac{h^2}{(p+h)^2}\right\}\sqrt{2g}\,L\,h^{3/2}$

(2) Rehbock, $Q = \left\{0.605 + \frac{1}{320h-3} + 0.08\frac{h}{p}\right\}\frac{2}{3}\sqrt{2g}\,L\,h^{3/2}$

(3) Fteley-Stearns, $Q = 3.31\,L\,(h + 1.5h)^{3/2} + .007\,L$

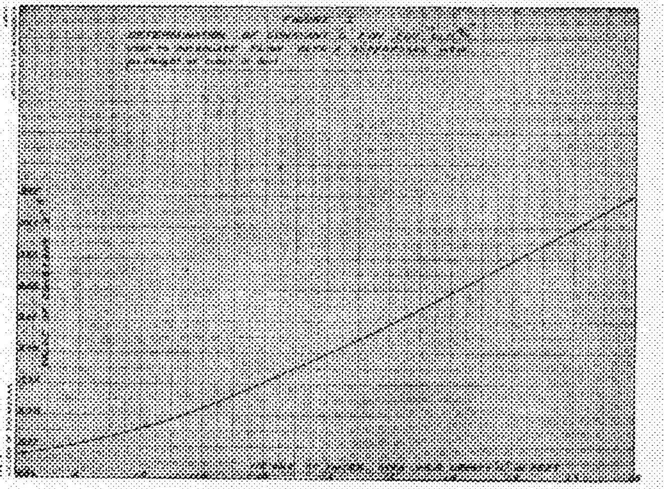


Fig. II.

The leakage through the weir dam was reduced to a very small quantity by tacking building paper on the upstream side and throwing in fine cinders wherever any water was observed to be coming through.

As will be noted from the drawing the weir was sharp crested, with smooth vertical crest wall, and free overfall. The sidewalls of the channel were smooth and parallel and extended three feet downstream beyond the overfall above the level of the crest. The elevation of the crest was taken at short intervals of its length before and after the test in determining the zero readings of the hook gauges. Zero hook gauge readings were also taken just as the water started to flow over the weir.

The efficiency of the new wheel was found to be 83.48 per cent when delivering 1,284.8 horsepower to the generator shaft. This is 2.48 per cent more than was guaranteed. The gate opening was 0.771 and the effective head during the test was 80.181 feet. The data at the other loads could not be obtained because one of the castings in the wheel chest which supports the wheel failed just after the above run was made. It is hoped that at some future time a complete set of curves will be obtained similar to those obtained for wheel No. 2, (one of the old wheels).

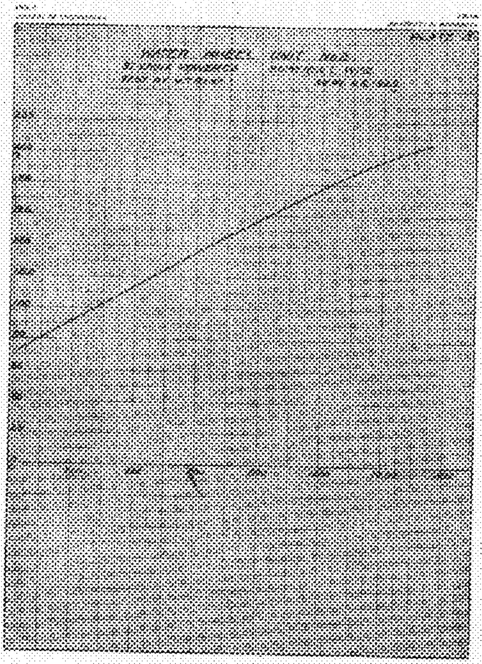
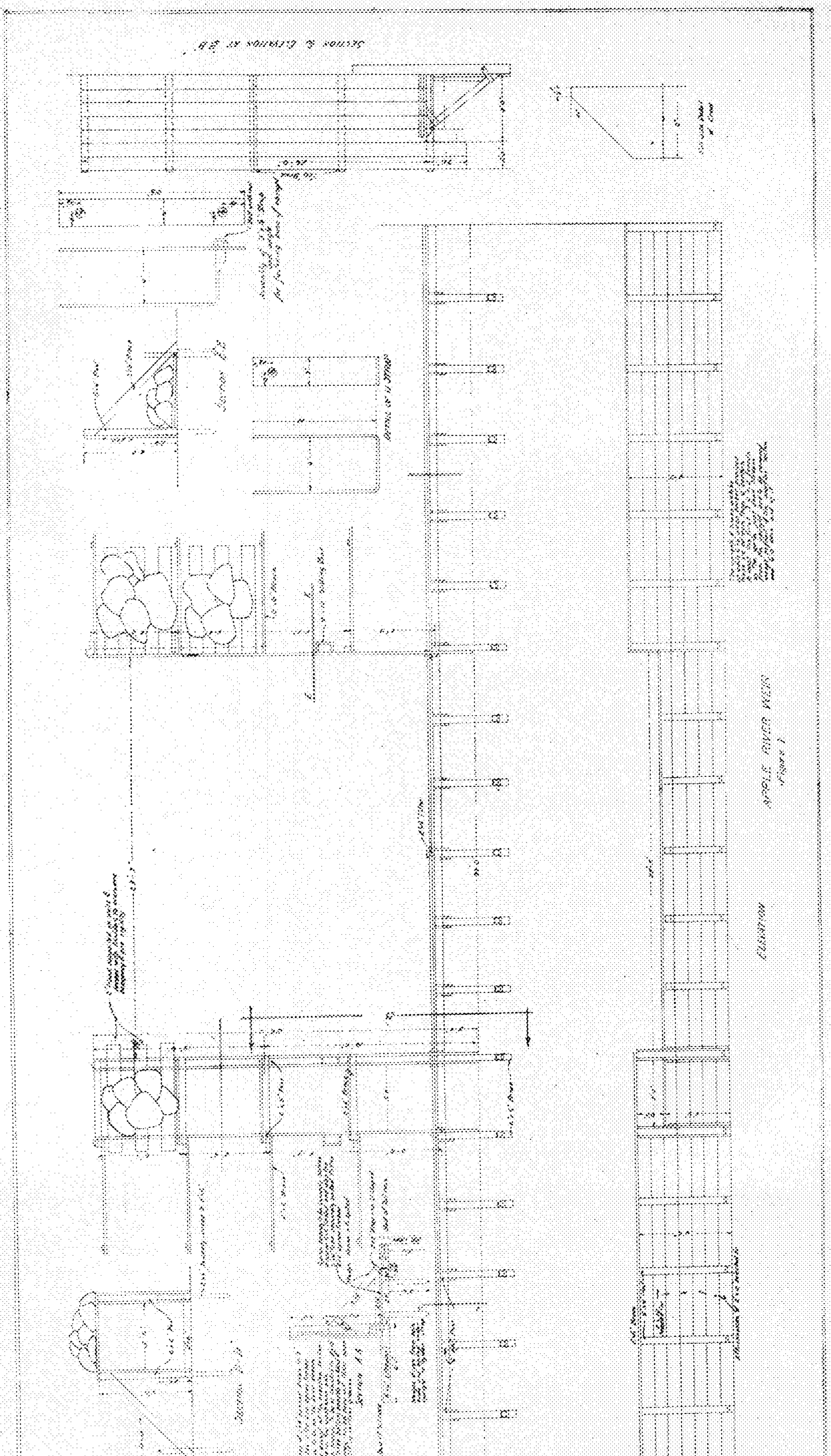


Plate 5.

Table I shows the comparative results between the new wheel and the run on the old wheel which most


Elevation
Apple River Weir
Figure 1

nearly corresponds to the run which was made on the new wheel before the failure of the supporting structure made it necessary to discontinue the test.

TABLE I.

Comparative Results Water Wheels No. 1 and No. 2.

	Water Wheel No. 1 (New wheel)	Water Wheel No. 2 (Old wheel)
Gate opening	.771	.78
Generator output in Kw.	922.18	910.98
Head on weir in feet	1.4905	1.6482
Length of weir in feet	29.215	29.215
Height of weir crest in feet	4.	4.
Water cubic feet per second	168.52	199.31
Exciter water cubic ft. per sec.	13.01	13.01
Penstock velocity head in feet	0.89	1.254
Penstock pressure head in feet	73.91	72.56
Tail water head in feet	6.246	5.996
Draft tube velocity head in ft.	.595	.770
Effective head on turbine in ft.	80.451	80.04
Turbine input in H. P.	1,539.1	1,810.
Turbine output in H. P.	1,284.8	1,270.
Efficiency of turbine (per cent)	83.48	70.25
Leakage through idle wheel		9.75

The results of the test on the old wheel are given by the curves shown by Plates I to VI. It will be seen that

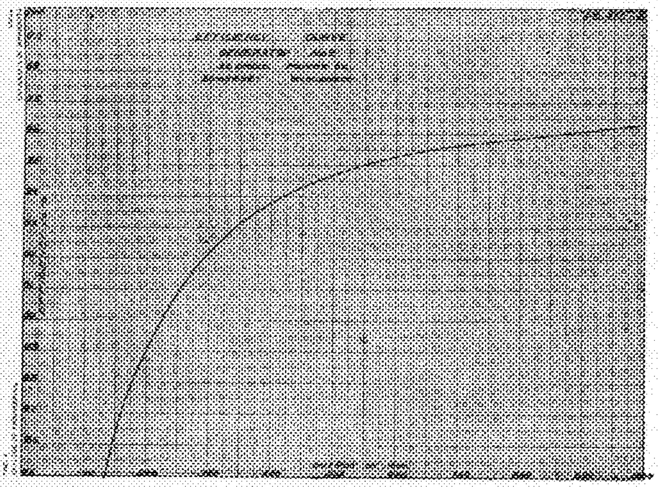


Plate 6.

when the output of the old wheel is 1,300 horsepower the efficiency it at least 13 per cent less than the efficiency of the new wheel. Since the St. Croix Power Co., owing to increased business, is now in a position to utilize practically all of the water it is quite obvious that the value of the additional energy which can be obtained each year from the more efficient wheels amounts to a considerable sum. Another outstanding feature is that the efficiency of the old wheels is very low at less than full load and at gate openings of less than 90 per cent. This is due, probably, to the type of gate used on the old wheels. It is expected that the difference between the efficiencies of the new and old wheels at the smaller loads and the lesser gate openings will be greater than the 13 per cent obtained at 78 per cent gate opening and 1,300 horsepower delivered to the generator shaft.

MAINTAINING CITY GAS PRESSURE

A. H. ABBOTT

Engineer of Gas Distribution

St. Paul Gas Light Co.

With the continually increasing demand for artificial gas for both domestic and industrial use, it has become necessary to adopt various methods of solution for some problems incidental to maintaining satisfactory gas pressures in all parts of a city. Most of the gas distribution systems in use in modern cities are the result of growth of the city and of the gas industry starting fifty years or more ago when gas was used almost wholly for lighting purposes. The results today are small gas mains in old congested districts and growing suburbs several miles from the source of gas supply. The problems involved in distributing the gas over a large area at a maximum pressure variation of from two to three inches of water column pressure, and of securing adequate future supply for growing districts have become engineering problems of considerable importance.

Most gas distribution systems were originally laid out with large mains feeding from the Gas Works, and these mains branching off and feeding the network, the gas pressure varying from a relatively high pressure at the Gas Works to lower pressure at the tail ends of the system. In large cities district holders have been built and these, fed by gas pumped at several pounds pressure, supply the gas for the districts in which they are located. Continual growth and more exacting demands for more uniform gas pressures have led to use of either more district holders or of district regulating valves or governors.

Under the latter plan, medium pressure (1 to 5 pounds per square inch) pumping mains are laid from the source of gas supply to the outlying districts, and at intervals on these mains are installed district governors which automatically reduce their inlet pressure to a distribution pressure of four or five inches water column, and feed gas out into the surrounding network. These district governors are built in manholes underground and in construction are merely large regulating valves which reduce their inlet pressure of several pounds per square inch to an outlet pressure which is practicable for consumption. The function of the governor is analogous to that of a transformer in an electric distribution system, to reduce pressure from the feeders to the distribution lines.

The operating principle of the governors is a floating valve which opens and closes as the demand for gas increases or decreases, and which always maintains a constant controlling pressure. The valves float with the aid of a supporting diaphragm, underneath which is the gas at the predetermined control pressure and on top of which are placed weights which balance and determine the amount of controlling pressure. When the gas from underneath the diaphragm is piped to the outlet of the governor, the governor will maintain a constant pressure at its outlet. With the increasing demands on distribution systems, it becomes very desirable to have a governor which will regulate the outlet pressure for the varying demands, similar in principle to that of an electric feeder regulator. More uniform pressures will result throughout the system, if the governor will boost its outlet pressure on the peak load, and keep it in proportion to the demand of the district which it supplies.

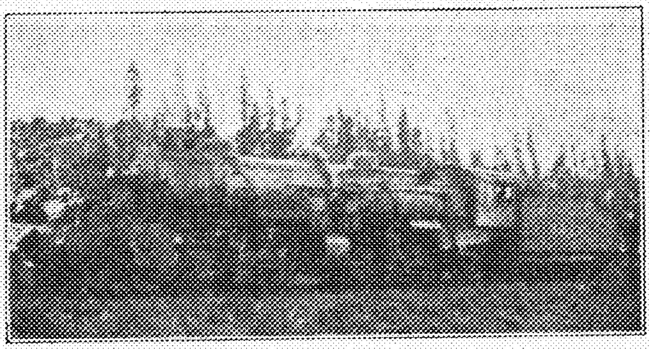
Several schemes are in use on various types of loading governors to boost the pressure on peak loads; one of the most satisfactory of which the writer has operated is a constant control governor that has its control pressure piped, instead of to the outlet of the governor, to some distant point in the district fed by the governor, the gas consumption in the immediate neighborhood of which is typical of demand of the district. The governor will in this case maintain constant pressure at the distant point, or at the "typical area" as it is called, and in so doing it will increase its outlet pressure on the peak and decrease it on the off-peak hours. Another device in use is an automatic arrangement whereby weights are shifted on and off the floating diaphragm to vary the outlet pressure with the demand on the governor.

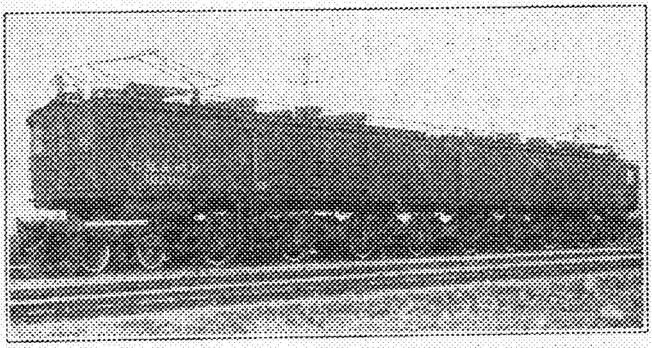
In cities where distribution pressures are maintained by district governors, the feeder mains form the arteries of the system and may supply as many as ten or fifteen or more governors, depending on the size and area of the city. The sizes and locations of the feeder mains and governors are determined by the present load conditions and future demand, and when new installations are made they should, of course, harmonize with the future distribution plans for the city.

RAILROAD ELECTRIFICATION

E. B. MARTIN, E.E.,
Assistant Professor Electrical Engineering

So much progress has been made in recent years in changing over from steam to electrical operation of railroads that the subject is becoming one of vital importance. This discussion will be limited to those cases where electric locomotives are used, although such traffic as is found in suburban, elevated, subway and some interurban service is of a class to properly come within its scope.





Courtesy of Gen. Elec. Co.

A Mallet Steam Locomotive and An Electric Locomotive Which Supersedes It.

When electric traction was in its infancy it took the form of a locomotive—even in its general outlines. This was in the early eighties. However, it soon changed to motor equipped trucks carrying a passenger body in the form of the present day street car. The development of the locomotive then lagged until the demand for a heavier electric traction unit was felt. This has grown until today the most powerful locomotives are electric.

The extent of the change-over from steam to electric operation of railroads is not yet very great. In Europe, the following countries had over one hundred miles each of electrified road in 1911,—Sweden, Norway, France, Germany, Austria, Switzerland, and Italy. England had about eighty-five miles. Little has been done there since. We have well over 2,000 miles of electrically hauled traffic that would otherwise be operated by steam, some of it being built as electric so that it really did not supersede steam. The most important installations are the New York Central; New York, New Haven, and Hartford; Pennsylvania; Norfolk and Western; Butte, Anaconda, and Pacific; and Chicago, Milwaukee and St. Paul. While the percentage of the total mileage operated electrically is small, the superiority of the electric locomotive has been demonstrated and its further application will increase.

The reason, in this country, for substituting the electric for the steam locomotive, has not often been that which usually attends an engineering project—the showing of a saving by making the investment. Some of the installations have been forced by municipal ordinances demanding the abatement of smoke and noise. Some have been installed in tunnels on account of the difficulties arising from smoke and gas. A few have been changed over to increase the capacity of existing track rather than go to the expense of double tracking. Still fewer have discarded steam in favor of electric operation because the latter promised to pay a good return on the investment and improve the service besides. Now that the railroads have secured an increase in rates and will probably soon stand on a good financial footing, the last reason for employing the services of a superior motive power will receive greater attention.

In comparing the two kinds of locomotives, there are a good many totally different features. The steam locomotive is an independent power plant, able to go wherever a track can be laid and coal and water secured. Its power is limited by the size of the boiler that can be built to clear obstructions and stand the vibration and strains of the road, together with its ability to produce steam. The electric locomotive is a utilizer of energy from a high power source, and altho it costs more to build and requires a transmission system to deliver the electric energy, it is sufficiently speedier, more powerful, and more efficient to outclass its competitor where the traffic is sufficiently heavy.

The most important item in comparing two tractive units is the draw-bar pull, or tractive effort. The maximum possible pull without slipping the wheels on dry track is equal to about one-third the weight on the drivers. Thirty per cent is frequently used. The steam locomotive is usually designed to supply somewhat less than this value at a certain steam pressure, but it can only do so up to a certain speed where the boiler is just able to supply steam as fast as the cylinders use it. Above this speed the cut-off must be made earlier in the stroke which automatically reduces the tractive effort. Also, the average pull is only about 85 per cent of the maximum, due to the pulsating nature of the force transmitted from the pistons to the drive wheels. The electric locomotive, except for the high frequency pulsating torque given by the single phase motor, gives a steady uniform turning effort. A greater percentage of its weight can be concentrated on the drivers, since it has no dead weight of coal and water to carry. Being connected to a source of high power, it can be heavily overloaded for a sufficient length of time to make ordinary grades, thus enabling it to do the work in many cases of two steam locomotives, for they cannot be overloaded even for a short time due to the reduction in steam pressure. There is great flexibility in motor connections and field excitation with series motors, permitting high tractive effort to a much higher speed than by steam. If an electric locomotive of equal weight can exert 50 per cent more pull, due to even torque and more weight on drivers, and can maintain it up to 50 per cent greater speed due to motor connections, the electric will have 2¼ times the power of the steam locomotive. The following table shows a comparison between a steam and electric passenger locomotive of about equal weight as given by the Railway Electrical Engineer, February, 1919:

Characteristics	Steam	Electric
Weight—Engine and tender . .	268.5 tons	266 tons
Weight—Engine only	178 tons	266 tons
Weight—Engine on drivers . .	121.5 tons	165 tons
No. of pairs of drivers	4	6
Weight per pair	30.4 tons	27.5 tons
Wheel diameter	69 in.	68 in.

Total wheel base, engine and tender	75 ft. 8.5 in.	79 ft. 10 in.
Maximum tractive effort	28 tons	55 tons
Maximum horsepower	2825	5860
Continuous horsepower	2825	3200

A comparison between two freight locomotives, though not built for the same service, follows for a Southern Pacific mallet and a Chicago, Milwaukee and St. Paul electric:

Characteristics	Steam	Electric
Weight—Engine and tender	300 tons	282 tons
Weight—Engine only	213 tons	282 tons
Weight—Engine on drivers	197 tons	221 tons
No. of pairs of drivers	6	8
Weight per pair	33 tons	28 tons
Wheel diameter	56.5 in.	52 in.
Total wheel base, engine and tender	83 ft. 6 in.	102 ft. 8 in.
Maximum tractive effort	45 tons	66 tons
Maximum horsepower	2500	3440 (1 hr.)
Continuous horsepower	2500	3000

In operation, the electric locomotive carries no fuel and water (except for passenger car heating) and does not need to take out time for replenishing its supply. It is not necessary to fire it up several hours before it can be used, nor does it take any time to put it out of service, either can be done instantly. There is no leaking steam through packing joints, no leaky flues or staybolts, no clinkered grates or foaming boilers, no track pounding from uncounterbalanced reciprocating parts, and no freezing up or delay on account of cold weather. There are fewer adjustments to get out of order so that it is customary to run about twice as far without thorough inspection. In fact, with greater speed and "cruising radius," and greater reliability, the number of locomotives required can be reduced to almost half. Another feature that is a distinct advantage in a mountainous country is the possibility of regenerating electric energy and pumping it back into the line. This retards the train on down grades without the application of air brakes and thus saves brake shoes, wheels, and track, besides returning energy for use elsewhere, keeping the air brakes in reserve and giving much safer and faster operation going down hill.

There is one more question of importance in continuing the present system of train haulage—the conservation of fuel. A French commission has recently studied several electrifications in this country with a view to the adoption of the best system to install with respect to economy, other things being satisfactory. They favored the high voltage direct-current on the basis of low energy consumption per ton-mile of traffic, together with low maintenance costs and absence of telephone interference. Our railroads use about one-fourth of the coal consumed in this country or close to 200,000,000 tons a year. Mr. A. H. Armstrong, in the General Electric Review, April, 1920, estimates from the performance of the Chicago, Milwaukee, and St. Paul electrification that two-thirds of this or more could be saved if the coal were burned in central power plants of fair size. With some water-power generation the saving would be greater. However, there are a good many roads where the traffic is not sufficient to pay to electrify, but these figures give an idea of the inefficiency of the steam locomotive. As time passes and coal increases in price, the newer type of motive power will invade the field of railroad transportation more and more successfully until the steam locomotive, like the team of horses before the automobile, will yield its place to the superior electric locomotive.

MINNESOTA TECHNO-LOG

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EDITORIAL

I congratulate the engineering students upon the publication of the Minnesota Techno-Log. It is encouraging to know that the students of a professional school, in association with members of the faculty, are willing to devote themselves to the publication of a dignified, strictly scientific journal. It leads one to believe that university ideals are not dead or dormant. It means that the emphasis is being placed where it should be placed. It exalts the primary thing for which the University stands, that of making practical use of carefully worked out and tested experience. This seems to be a particularly appropriate time to launch your enterprise.

The war, of course, increased the interest of every one in scientific work. It raised many new problems into relief, and necessity forced their solution. Thousands of men came back from active service, realizing that it was the work of scientists that actually saved the day. At once they found that there were innumerable new problems, all more or less scientific in character, awaiting solution, and that the great need was the need of men trained to solve them.

The world will ask for trained men in the various engineering fields. If one expects to enjoy leadership in any one of them, he must be something more than a mere technician, a day to day practitioner. He must be well grounded in the principles which underlie his profession, and in addition he should have enough knowledge of a general character to make him a good citizen. The man who thinks that he can become a professional leader in some field in six months, or a year, or two years, is doomed to disappointment. The man who thinks that he needs to know nothing of history, or of literature, or of sociology, or economics, of labor or politics, will live a narrow existence and limit his usefulness. Leadership in every professional field, in my opinion, involves three things,—first, training of a liberal academic character; second, training in all those lines which will reenforce one's special work; and, third, detailed and highly technical training in some special field.

Your journal will be in a position to emphasize these things. It can, from time to time, call the attention of students to the qualities which determine success in the various engineering fields, and to the kind and amount of training students should be willing to pursue to qualify themselves for this success.

It should also take the various technical engineering studies and perhaps rewrite them in a more popular style, so as to make the results available, both to students and to the lay public, as well as to the practical engineer. This is a service of unusual importance. The engineering profession will welcome the publication in case it is genuinely useful.

The establishment of this ournal means that you have created an opportunity and have accepted an obligation. The responsibility for success will rest upon you and your successors. Cordially yours,

L. D. COFFMAN.

GREETINGS FROM THE DEAN

TO THE ALUMNI OF

ENGINEERING, ARCHITECTURE, AND CHEMISTRY.

To many of you this will be our introduction. I am glad to meet you even at long range and trust that our relations may soon become more intimate.

The loyal support and interest of its alumni form one of the greatest assets a college can possess, particularly if it be a professional school. Their influence upon the undergraduates cannot be overestimated. The students look up to them with respect and take pride in their achievements and their public service. Moreover, the members of the Faculty receive their greatest encouragement, perhaps, in the words of appreciation contained in letters from the alumni. Here at the University, therefore, we look to you for support and assistance, for your advice and suggestions, and the inspiration which you can give to the Faculty as well as to the students.

As alumni, your aims and desires are the same as those of the Faculty. Your college must maintain a high position among the technical and scientific schools of the country. There must be a high standard of instruction, a thorough training in the fundamentals, and a broad foundation for future development and service. The needs of the college, to attain these ideals, will always be of interest to alumni.

Quality of instruction must be our watchword. This involves the three requisites,

Faculty, of satisfactory grade,

Buildings, of appropriate design and sufficient capacity,

Equipment, of reasonable quality and quantity,

all of which are absolutely essential to high grade instruction according to present day methods and standards. I mention them here because we must keep them in mind whenever we plan for the development of a technical school. We must also note the fact that, while all three items may be sufficient and satisfactory for first-class instruction at a certain epoch in the history of the institution, a large increase in the number of students concerned may render each item wholly inadequate, not to mention the necessary introduction of new apparatus which may require much additional laboratory space and even entire new buildings.

I regard the appearance of this magazine, the Techno-Log, with a feeling of satisfaction. As a medium of communication between our colleges and their alumni, it will prove very advantageous. It will assist you to keep in touch with your college and its activities and development. I believe it will be of interest to everyone and trust that you will give it your hearty support. The subscription price may well be regarded as a contribution to your college.

Finally, permit me to express the hope that each alumnus will endeavor to maintain a personal contact with his college by occasional letters and visits as well as through this magazine. Let us help you in the problems arising in your work, or to find you a better position. Perhaps we can place you in communication with younger graduates who may possess the particular qualifications which you desire in employees. The college should not cease to serve its students at their graduation when it expects their continued interest and co-operation during the remainder of their lives.

I shall esteem it a favor if you will call at my office and so enable me to meet you personally at the first opportunity.

Very cordially yours,
O. M. LELAND

GET IN THE GAME

You cannot get the most out of your Engineering course here at Minnesota unless you interest yourself in what is going on about you. Your interest in your work here will not last unless you adapt yourself to activities outside of your regular studies. Much enjoyment and satisfaction is in store for you here if you will work with us and give us your point of view and judge ours.

The Minnesota Techno-Log is your magazine and through it your college is advertised to the outside, and through it you will derive the benefit of knowing how others are solving the problems that will be yours, and what others are doing that have gone before you in lines that interest you. You owe it to Minnesota to promote the mediums of proclaiming how you receive your education here. Others want to know so that they too may share in what is their right to have.

Join the Association of Engineering Students and thus become a subscriber to the Techno-Log. You will get the true spirit of an Engineer.

Minnesota Engineers work for Minnesota, truly a great university. You are one of us, don't hold back. Engineering is constructive.

ASSOCIATION NEWS

ASSOCIATION OF ENGINEERING STUDENTS.

The Association of Engineering Students of the University of Minnesota is a recently founded organization of students of the Colleges of Engineering, Architecture, and School of Chemistry. Membership in this organization is open to all students registered in the above colleges.

The Association has for its object the promotion and maintenance of student enterprises and the co-operation with the two student councils in promoting a better spirit among the students.

The chief enterprises of the Association are the operation of a co-operative bookstore and the publication of a monthly magazine, the Minnesota Techno-Log. The Association also co-operates with the two student councils in preserving Engineering traditions, such as the annual St. Patrick Day Celebration.

The Minnesota Association is also a member of the National Order of the Guard of St. Patrick, which is at present composed of about fifteen leading Universities of the country.

Statement of Policy.

The Association stands for the promotion of all deserving college activities. It will be the policy of the present administration to maintain proper relations between faculty and students, and between students of this college and other colleges; to co-operate with all existing organizations in providing for occasional convocations of Engineering Students, at which time they will be addressed by speakers of national repute; and to promote a stronger bond between the alumni and the college.

CONSTITUTION OF THE ASSOCIATION OF ENGINEERING STUDENTS OF THE UNIVERSITY OF MINNESOTA.

Article I

The name of this organization shall be the Association of Engineering Students of the University of Minnesota.

Article II

The object of this organization shall be to promote a more cordial relationship between the students by means of meetings and social functions; to provide a means whereby the various technical societies may be united for certain activities; and to promote the general welfare of the members in such other ways as may be expedient.

Article III

All students and members of the faculties of the College of Engineering and Architecture and School of Chemistry of the University of Minnesota together with such other colleges and schools as may also be received by this association shall be eligible to membership.

Article IV

The officers of the society shall be a president, vice-president, secretary, and treasurer. These, together with a member elected by each of the several student branches of the American Society of Mechanical Engineers, and of the American Institute of Electrical Engineers, the Civil Engineers' Society, the Architects' Society, and the Chemists' Society, and a faculty member chosen by the above group shall compose the executive committee.

Article V

The first officers of this organization shall be elected at the time of adoption of this constitution. The society representatives shall be elected as soon thereafter as possible. The regular election of officers shall be held at the May meeting of the society. The representatives of the other societies shall be elected by their respective organizations as soon thereafter as possible. The newly elected officers shall take office at the end of the Third Quarter. The tenure of office shall be one year, or until a successor takes office.

Article VI

The annual dues of the organization shall be fifty cents ($0.50).

Article VII

This constitution may be amended by a two-thirds vote of the members present at any regular meeting of the society, provided such amendment shall have been presented at the next previous meeting.

BY-LAWS.

Article I

The meetings shall be held on the second Wednesday of each month, or at such other time as may be deemed advisable by the executive committee.

Article II

The meetings of the society shall be held in the auditorium of the College of Engineering and Architecture, or at such other place as the executive committee may deem advisable.

Article III

Fifteen per cent (15 P.C.) of the membership of the society shall be a quorum capable of transacting business.

Article IV

The duties of the officers shall be those ordinarily assumed by the holders of such positions.

Article V

There shall be the following regular committees and such others as may be deemed necessary and expedient:

Nominating Committee, to be appointed two weeks in advance of the annual meeting to prepare a ballot containing the names of not less than two nor more than four nominees for each office to be filled at that time.

Auditing Committee, to audit the books of the treasurer and present report at annual meeting.

Program Committee, to arrange speakers and other features of program for the meetings, and to properly advertise the same.

Article VI

The order of business shall be as follows:

1. Minutes of previous meeting.
2. Reports of officers.
3. Reports of standing committees.
4. Reports of special committees.
5. Unfinished business.
6. New business.
7. Program.
8. Adjournment.

The deliberations of the society shall be governed by Roberts' Rules of Order.

Article VII

The By-Laws may be amended by a two-thirds vote of the members present at any regular meeting, provided that the amendment shall have been read at the next previous meeting.

AMENDMENTS.

Amendment No. 1

The attached rules and regulations regarding a co-operative bookstore shall hereby be accepted as amendin gthe By-Laws of the Association.

The Engineers' Bookstore shall be formed by the Association of Engineering Students to do a general merchandising business dealing in books and other engineering and student supplies.

The management of the store shall be by a board of eight (8) directors, three (3) of whom shall be members of the faculty. Two faculty members shall be from the faculty of the College of Engineering and Architecture and one from the School of Chemistry. There shall be five (5) student members selected from the Association. These shall be elected by members of the Association, each group voting for the representative from its particular group. The five groups represented shall be Architects, Civils, Electricals, Mechanicals, and Chemicals. The student members shall be nominated by a petition of at least ten members of the particular group to be represented. All signers must be above the freshman class. Candidates must be above the grade in 75 per cent of work.

Five directors shall be capable of transacting business, provided one of the faculty men is present. The board of directors shall elect its own chairman and secretary. The president of the Association shall be an ex-officio member without vote. The manager shall attend meetings of the board to give reports and take directions but he shall have no vote. The board shall fill vacancies occurring in its membership.

The board of directors shall decide all matters of policy and shall approve all orders and disbursements except for supplies ordered through the Dean's office for immediate class use. The manager shall keep such accounts as to enable him at any time to give an accurate account of the financial condition of the store. The accounts shall be audited annually by the Senate Committee of finance and auditors or such other audits as the directors or faculty may require. Monthly reports shall be made to the Senate Committee on Finance.

As far as possible, the student members of the board of directors shall be elected at the end of their sophomore year so that, if they prove capable they may be re-elected, thus providing more continuity of policy in the directorate. The elections shall be made by the class group before the May annual meeting of the Association of Engineering Students, to take office and hold office contemporaneously with the officers of the Association.

The board of directors shall elect a manager to be directly responsible for the operation of the store who may or may not be a student of the University of Minnesota. The board of directors shall fix the compensation of the manager and such assistants as may be necessary. The manager shall be required to furnish a bond for $5,000 to be paid for by the store.

To finance and secure a means for a distribution of the profits, the store shall issue numbered tickets or certificates to students and others at a price of five dollars ($5.00). These shall not entitle the purchaser to a reduced rate at the time of sale, but the sale shall be recorded on his account. At the end of the year when a final audit is made, the directors shall declare a dividend to the holders of the above mentioned certificates. The amount of this dividend shall be based on the sales to certificate holders and made pro-rata to each holder. The certificates shall be, and shall only be redeemed at purchase price when the purchaser leaves school or graduates.

All sale of goods shall be at the regular retail price of such articles. All sales shall be for cash only.

The directors shall meet on the first and third Tuesdays of the month and at other times on twenty-four hours' notice from the chairman or secretary.

COLLEGE NEWS

If a very localized earthquake had visited the engineering campus of Minnesota University in the spring of 1920, and had demolished the entire group of engineering buildings, of which we are so justly proud, it might have caused less consternation in the midst of the faculty, less despair in the office of the Dean, less confusion amongst the student body, and less genuine regret among the alumni, than was occasioned by the announcement that Miss Eva L. Beck had resigned her position as secretary to the Dean.

It is safe to say that no one person in the entire college has come into such intimate touch with every member of the faculty and the undergraduate body, during the last ten years, as has Miss Beck. No one knew better than she, what the grave problems of the day were; whether those problems were concerned with administrative policies affecting the college in a large sense, or whether they were problems confronting some humble student who had previously failed to master problems of a more specific nature. It is noteworthy that she applied the same keen discernment to each in seeking to offer a solution. No puzzled Freshman ever applied to "Dean Beck" for assistance in unraveling some tangled skien of program tape, without having his difficulties reduced to a minimum. No Senior ever conferred with her regarding a proposed substitution, or the selection of a suitable elective, without having a vast amount of wisdom added to his own. And did ever a student body have a more loyal and staunch defender? "My boys," to use one of Miss Beck's favorite terms, are, always were, and always will be the most genuine gentlemanly group on the University campus. Their periodic displays of "pep" were sanctioned as belonging to a crowd of "live wires." Their athletic victories never failed to win her warmest approbation. Their annual parade and its accompanying display of versatile ingenuity always evoked unstinted praise from this champion of Engineers' rights. Let no one say in her presence that engineers are devoid of literary, artistic, or musical ability, or the social graces; for her personal acquaintance with the abilities of the individual students made her an invincible opponent in debate.

Miss Beck first assumed her duties as secretary to the Dean in September, 1910, under the administration of Mr. Francis Shenehon. From that time until her resignation in May, 1920, the chair of the Dean was filled successively by Deans Shenehon, 1910 to 1917, Allen from 1917 to 1919, and Jones from 1919 to 1920. These changes in leadership naturally entailed changes in administrative policy, and the smooth transitions from each administration to the next were due largely to the ability and amazing fund of detailed information possessed by Miss Beck.

This brief sketch would be incomplete without specific reference to the stabilizing effect of Miss Beck's efficiency engineering during the confusing conditions incident to the S. A. T. C. regime. Her tireless and patriotic efforts were of invaluable assistance in maintaining liaison between the faculty and the Military. In the midst of her many other duties she found time to keep in touch with a large number of the students "over there," in order that they might know that their Alma Mater had not forgotten. When the world war was over, and students came back to resume their work in all the classes, the largest enrollment in the history of the college was recorded. Work in the office of the Dean assumed tremendous proportions, but it never was so great that the return of a former student did not call forth a welcome which made him glad to be back. It was here that many of the boys learned how one of the most ardent patriots in the country had fought behind the lines.

In conclusion, let it be said that our College of Engineering must and will go on to a bigger and more glorious future, but to the "old grads" of the decade just closed, a visit to the scenes of their scholastic labors will bring a feeling of genuine regret that the college has lost the services and the presence of Miss Eva Beck, the best friend any student body ever had.

WHAT MUST THE COLLEGES DO?

By M. L. BURTON, Ph.D., LL.D.,

President of the University of Michigan

America has always believed in education. Before the war there was ample evidence that Americans had great confidence in institutions of higher learning. The large sums of money provided by private gifts and by legislative appropriations were concrete proof that this country was fully aware of the value of higher training. Since the war it is perfectly evident that America has a passion for education. The unprecedented enrollment of students this fall in colleges and universities may be attributed to the war. Multitudes of men have seen in the army that opportunities for leadership frequently go to the trained man. The people as a whole have observed that education and democracy are inseparable. Along with this splendid new passion for education has come a tendency on the part of large numbers of discriminating people to scrutinize with care, and in some cases to criticize with severity the aims, methods and results of our entire educational system.

We should lack in candor if we did not recognize frankly the present situation of the liberal arts college. In various sections of the country the Junior College plan is being promoted and is developing with considerable rapidity. It fosters the tendency for a boy to remain at home for the first two years of his college work and then to go directly to his professional training. This plan in a comprehensive system of state education aims to relieve the large state universities of the serious overcrowding of the freshman and sophomore years. Closely connected with this proposal is the demand for a complete reorganization and regrouping of the units of our educational system. Beyond, or within, these considerations is the whole problem of the economy of time in education calling for the elimination of two years in the primary grades, one year in high school and such a readjustment of pre-professional training that a student may reach at an earlier age the specific field of study which is to prepare him for his life work. Without doubt the heart of the issue concerns the student's attitude to his work. The boy in the liberal arts college is accused of "general aimlessness." He suffers by comparison with the professional or technical student whose definite aim gives a seriousness and earnestness to his work. Through all of these considerations runs the vague but certain assumption that this new day demands something new of the college. All of these factors combine to produce a total situation which leads many seriously to consider the future of the college of liberal arts.

Certain preliminary observations may be made at this juncture. The traditional answers to our question will not suffice. The colleges must teach and must foster investigation, but the present situation will not be met by the mere reiteration of those formulae. On the other hand, the colleges have stood for too much truth in the past now to be destroyed or even to experience a complete metamorphosis. No disagreement need arise in regard to the primary importance of research. The differences in this respect between a college and a university must not be overlooked. But even so, it may be said with some show of wisdom that no man can be a virile and stimulating teacher over a long period of years unless he is thoroughly at home in his field and giving occasional evidence of his eagerness and ability to make some contribution to the world's mastery of that field. So with no undue straining after something new, but with a profound conviction that the present situation demands a new emphasis upon certain phases of college work, we set out to suggest an answer to the question "What Must the Colleges Do?"

The college must place a new strong emphasis upon the old-fashioned demand for accuracy. The facts involved here are so familiar and so obvious that they need not be set forth in detail. Speaking historically, we have been a race of pioneers. From the beginning we have done the best we could. No one has pretended that we were doing as well as we should like. It takes time to develop a substantial, enduring civilization. It is frequently charged that superficiality is an American vice and no one thinks of denying the accusation. The inevitable results appear in everything we try to do. In art, in architecture, in literature and in education it is possible to find ample evidence to sustain this point of view. Temperamentally we are not well equipped for patient work. We are in such a hurry that we haven't time to recognize its evil effects. The complexity of our life is increasingly astounding. We rarely settle down with the single aim to do a job the way it should be done. These tendencies have affected our standards. Our aim is to turn off the task. Our ambition is to see how quickly a thing can be done. It sometimes seems that our chief thought is centered not about doing something, but merely appearing to do it. In many of our common activities, notably in politics, we have developed persons who are masters in passing responsibilities to others. It is not surprising that these tendencies and qualities have manifested themselves in American education. Our educational institutions inevitably reflect the spirit of our civilization. A decade ago, the attack upon our colleges was bitter. In many respects the accusations were entirely justified. America's hurry and superficiality found one form of expression in the typical under-graduate who had little concern for the real work of the college. On the other hand, we have a right to expect that some of the best products of American colleges would appear among the Rhodes Scholars. There are many qualifications to such a statement and many extenuating circumstances which might be cited, but the Rhodes Scholars of the last ten years have certainly been above the average of the men produced by our entire educational system. It is interesting, therefore, to know how these men have impressed their Oxford tutors. In general, Oxford has recognized generously and sympathetically the good qualities of the American scholar. But his educational equipment has not been eulogized. Among large numbers of published statements one finds such expressions as these: "They seem very deficient in scholarship in a wide sense." "They seldom or never settle down to a long spell of thorough work." "They have been taught nothing very precisely." These are serious and severe indictments not only of a few Rhodes scholars, but of American educational standards as a whole.

Fortunately, the war has established a whole set of new facts. America has emerged from the conflict with a new sense of thoroughness. We have seen our waste and extravagance in their true light. We learned, under necessity, how to bring to bear all our resources upon a common problem. Almost over night, we discovered how we could do something when we really wanted it done. The mobilization of our financial and industrial strength was magnificent. We did the job thoroughly. The war itself has produced excellent results in the students. While many of the men are physically restless, and while regular courses have been interrupted and normal procedure in their educational career disrupted, they come back with a new spirit. Many of the specific duties of army life have intensified the demand for real accuracy. They actually see now why accuracy is a prerequisite of all worthy effort. Perhaps nothing could have engendered this new point of view except the frightful necessities of war. These men are more mature than any students we have known. They have been face to face with the sternest realities of life. They understand now what the world expects of them. Even before the war a new sense of intellectual seriousness was developing in the colleges. Running all through our national life is a new emphatic note of obligation. The colleges must seize this occasion to drive home in a new day the old demand for accuracy.

It may be valuable here to look more carefully at this quality. It obviously is derived from ad and curare and therefore connotes carefulness, preciseness, exactness and definiteness. Speaking negatively it calls forth absence of defects, the elimination of mistakes and freedom from errors. From the positive point of view it calls for exact conformity to a standard or to truth. It inevitably requires delicacy, nicety, precision and fineness of thought and action. There is something about it which insists upon the quality of "rigor and vigor." Practically it demands of the student that he make some definite and final choices out of the superabundance of riches which college life hurls at him. It says that not by a haphazard, ill-considered jumbling of all of the elements of under-graduate life but by concentrating completely upon a few of them, will he save his soul. It suggests to him that he settle down to the task in hand. It hints at patience and thorough-going effort. It proclaims the stern doctrine that there is high value in hard work. It is the old-fashioned, insistent demand lying back of all worthy effort in any field. The colleges of liberal arts have said much about culture. It may be valuable to insist here that accuracy and culture are inseparable. Professor John Dewey spoke wisely when he said that "there is perhaps no better definition of culture than that it is the capacity for constantly expanding in range and accuracy one's perception of meanings."

But how shall the colleges perform this function? It is at this point that serious disagreement will arise. Some will insist that the demand for accuracy is only another way of advocating a renaissance of classical study. Others will find here a defense of mathematics and scientific subjects. No doubt there are large elements of truth in these contentions. The outstanding fact, however, which we must not fail to recognize, is that accuracy does not depend upon the specific content of this or that course of study. It is not, I take it, primarily a question of curricula or their organization with which we are dealing. It is rigid discipline in all subjects that we must have. The duty of the liberal arts college is to "cultivate the fundamentals." No one can pretend to have sufficient wisdom to anticipate the specific issues of the day in which the present generation of students will do its work. Therefore the prime consideration is not the pursuing of this or that subject, but the acquiring of a highly sharpened tool which will cut its way straight through the twisted materials of a rudely shaken social order. If the colleges can send out men who will instinctively demand the facts, and who will constantly insist upon wise and timely legislation in keeping with those facts their service to the country will be quickly recognized and highly appraised. The colleges of liberal arts will have a right to exist if they produce a generation of citizens trained to work thoroughly and patiently and to think cogently and accurately.

The college must stimulate and awaken its students. Any careful student of American education recognizes that a very significant change is coming over some of our institutions of higher learning. A decade ago, the first consideration was research. The teacher was quietly disregarded for the man who could "produce." Today the teacher is coming into his own. This tendency does not mean that investigation has fallen or is to fall into disrepute. Research will always be of primary importance to a true university. But it does mean that colleges are frankly recognizing their obvious obligations to students.

The assertion that colleges must awaken their students will arouse the concern, if not the opposition, of three groups of people. The technician desires to emphasize the acquisition of some particular skill or dexterity. Surely there need be no essential disagreement at this point. The advocate of vocational education or the defender of professional training seems to surpass others in stimulating his students. The investigator insists that contributions to knowledge are his first, if not his only, concern. Again there is no possible incompatibility between the two points of view. There are some, however, who, conceding their good taste look down with disdain upon "inspiration." They are highly to be commended, if by inspiration they mean more excitement, shallow emotionalism or flitting enthusiasm. They are utterly mistaken if inspiration means the awakening of a human being to some appreciation and realization of the meaning of life.

The demand that our colleges awaken their students is grounded in some very serious facts. The externality, mechanism and formalism of American education are notorious. Consider for a moment our prevailing methods for admission. Think how we have counted units, hours and minutes! If a boy has had fifteen units he has been admitted and if he has had fourteen we have said that he is not "college material." The rapidly changing plans for entrance are clear indications that we have revolted against some of the methods prevailing in the past. Our system of examinations within colleges are scarcely intended to encourage the habit of becoming thoroughly at home in any given field of knowledge. A student at the end of the first semester takes a set of examinations and, if he passes, the grades are piled away like so much wood that has been sawed. He repeats the process eight times and we call him "educated." The multiplicity of rules, regulations and statutes produce a wholesome effect upon the freshmen, if bewilderment is good for the soul of a new matriculant. The spirit of the average class room is rarely intended to arouse students to new levels of thought and action. Doubtless if Henry Adams were teaching in any first class American college today, he would say just what he did of his students at Harvard College. "All were respectable, and in seven years of contact, Adams never had cause to complain of one; but nine minds in ten take polish passively like a hard surface; only the tenth sensibly reacts."

We need not, however, rest the case here. This generation of students faces prodigious tasks not only of national but world wide proportions. Mr. Frank Vanderlip's book entitled "What Happened to Europe" suggests the magnitude of the gigantic work that must be done. Huge war debts, the demoralization of transportation, the disruption of industrial processes, the disorganization of life as a whole, have created a world situation which calls for all of the skill and ability which

America can produce. Back of these considerations, is the fascinating, challenging fact that the present generation of students has almost unlimited potentialities for coping with these momentous tasks. These potentialities must be utilized. The colleges simply must awaken their students to new comprehensions of the possibilities just ahead. The achievements of our armies in this war substantiate the assertion that marvelous capacities lie dormant in American youth awaiting only the stimulus of a great cause and a great occasion.

The Century Dictionary says that "stimulate" means to "animate to action or more vigorous exertion by some effective motive." Surely the motive exists. Physicians sometimes speak of "stimulating baths." The colleges must surround the student with a quickening, thrilling environment. It can only be done by the contact of spirit with spirit. The world still responds to the quickening touch of a great soul.

If the colleges are to stimulate their students, certain requirements must be met. First of all, Boards of Trustees, and college administrations must place a higher evaluation upon the art of teaching. Concretely, the salaries of professors must be advanced at once to the point where mere self-respect is possible. And then we must have teachers who teach. That is to say, we must have persons who actually proceed upon the hypothesis that the thing which counts in the class room is not the amount of material which is presented but the actual, positive awakening of a human being to some faint understanding of the responsibility of being alive. Let us hope that then we may have students who study. That is to say, young men who without losing the respect of their colleagues can show actual concern for their understanding of truth and their interpretation of life.

The plea we make is for the simple recognition of the commonly accepted truths of educational psychology. In his work entitled "Education and Democracy" (page 46), Professor John Dewey has expressed it this way. "That education is not an affair of 'telling and being told' but an active constructive process, is a principle almost as generally violated in practice as it is conceded in theory." By some method the college of liberal arts must stab its students broad awake. The present hour will tolerate no other result. Emerson preached the same idea most eloquently. He insisted that "the one thing in the world, of value, is the active soul. This every man is entitled to, this every man contains within him, although in almost all men obstructed, and as yet unborn." Here is the tragedy of education. Henry Adams knew full well that only one mind in ten sensibly reacts to the presentation of truth. It is the fascinating, divine task of the college of liberal arts to remove the obstructions and to demolish the obstacles which stand in the way of every man possessing an active soul. As Carlyle would say "in one way or the other it will have to be done." We shall have to pull down the brute god, Mammon, and put a spirit God in his place!

Again the colleges must reckon seriously with the present. The student must be made to live in the new day. Students have acquired accuracy and their spirits have been thoroughly aroused by the study of Sanskrit. These results are obtainable by the use of many disciplines dealing with the past. Mankind, however, has just emerged from the most direful cataclysm it has ever experienced. The country will demand of the colleges, and rightly so, that the students be thoroughly at home in their own day.

By some method, the college man must come to understand the great movements of the present day. The war has placed great burdens upon mankind everywhere. Marvelous new forces have been liberated. Strange and mysterious movements have been inaugurated. Great outstanding issues must be met and extremely intricate and complicated problems must be solved. The facts are not at hand. Moreover, the facts, particularly in all the social sciences, are not dead, rigid, static things which can be tabulated. They never congeal. The situation tomorrow will be different from what it is today. Consequently students cannot be sent forth with ready made opinions. The must, however, become aware of our situation and feel at home in dealing with these gigantic questions. They can acquire a background upon which sound and substantial judgments can be formed as the facts develop and the tendencies of their day become discernible.

For example, every discriminating citizen for decades to come must have some real knowledge of international law and the whole field of international relationships. The ratification of the peace treaty, while important, will only mark the beginning of a new era in world relationship which will call constantly for wise and statesmanlike action. Or again, the whole problem of our industrial relationships must be worked out in the years just ahead. The great questions of "representation in industry," of collective bargaining and the rights of the public will demand the most patient and careful reasoning. Mr. Albert Mansbridge, writing in THE ATLANTIC for August, solemnly asserts that "no community can afford to let the powerful forces of education and labor develop otherwise than in conscious co-operation." Every citizen must understand the labor movement. Beyond these highly important subjects lies the crucial question of the hour. All about us are groups who insist that the ballot box is too slow in producing results, and that we shall never achieve social progress by the regular constituted agencies of the government. Therefore, they appeal to the direct method of violence, revolution and destruction. The issue now is quite similar to the one which Abraham Lincoln faced in 1861 only it is upon a far wider scale and more subtle and insidious in its operations. Mr. Lincoln raised seriously the question whether all republican forms of government have this inherent weakness: Must they be too strong for the liberties of their people or too weak to maintain their own existence? That certain groups believe the first and hope for the second cannot be questioned. College men of today should be compelled to think clearly and decisively upon this paramount issue. Unless democracy can insist upon an unqualified, unconquerable respect for law and order, then only disaster is ahead.

Doubtless there will be little difference of opinion concerning the end to be attained but there will be serious disagreement as to the methods to be employed in seeking that end. It goes without saying, that we must be prepared in our colleges of liberal arts to offer excellent and thorough training in all the social sciences. If a man gets a thorough grounding in history and some real understanding of political economy, political science, and sociology he will surely be ready in a measure to cope with the main movements of his day. Likewise, modern languages will be increasingly essential for the man who is to acquire a real understanding of world tendencies.

The vital necessity, however, is an atmosphere of cogent discussion. Every class room must be a place where mind meets mind, where there is little, if any, appeal to external authority, and where there is much devotion to clear sequacious thinking. A real college will be a place where members of the faculty and students, with mutual respect for each other's opinions, will associate in perfectly natural and normal ways and exchange views upon the developing life of the world. Perhaps the highest test which a college has to meet, is whether its students actually discuss among themselves their serious intellectual interests. If an atmosphere could prevail where a student could retain the respect of his colleagues and still raise with them in groups, large or small, his intellectual difficulties, then our problem would be largely solved. Every college should have a public forum, where the vital issues of the day are faced with frankness and candor. To achieve recognition here should be the highest distinction open to a student. By some such method, and under the guidance of some such motive, unlimited possibilities for greater effectiveness in college training lie before us. However it is done, we must have students who understand their own day. The facts are so elusive, the conditions are so fluctuating, and the ramifications of our problems are so extensive, that prolonged, careful thought is absolutely essential. Students must acquire a habit of mind which will serve them faithfully in the actual conflicts of the world. Such mental equipment Bacon must have had in mind when he said:

"Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider."

The colleges must inculcate integrity. This is a strange utterance. It involves no accusation of the colleges and is not intended to establish the inference that dishonesty has characterized our work. Nor is it intended to contradict the Socratic doctrine that knowledge is virtue. No doubt, any one who really understands life is a man of integrity. At any rate this seemed to be true until the war revealed to us the real motives and character of the representatives of the Imperial German Government. Prior to that time we may have believed that there was no such thing as an "educated villain!" Now we face a situation which tests the consistency of our thought. Emerson was entirely correct in reminding us that "consistency is the hobgoblin of little minds." However we may state the matter in terms of logic or philosophy our colleges must be places where men are marked by plain honesty and sheer integrity.

The world situation today accentuates if it does not originate this demand. The war destroyed confidence everywhere. Mutual understanding and good-will between all groups within our country and between all nations is the primary need of the hour. But confidence can be established only on the basis of character and integrity. A very serious situation for the colleges arises out of the fact that all the world knows the part German education played in fashioning German ideals and motives. All mankind disapproves morally and spiritually of Germany. Our people trace the causes directly to a false educational system. It is not surprising, therefore, that our country is watching with considerable care, if not suspicion, the actual operation of our entire educational system. The unescapable lesson of the war is that Germany lacked in integrity—plain, sheer uprightness. The duplicity and mendacity of her diplomatic representatives combined with her repeated efforts to eliminate all ethical considerations from international relationships sustain this statement beyond all danger of successful contradiction. At the present moment, all nations and all mankind trust America. Just so America must be able to trust her colleges and her educational system as a whole.

Our institutions of higher learning, therefore, must be synonyms for integrity. Today as never before the college of liberal arts must stand for absolute, unqualified devotion to the truth. In all of the complicated relationships of a new day when vital issues are at stake, all groups and all interests must understand that the colleges will teach the truth regardless of the consequences to their endowments, their enrollments and their equipment. No man must be permitted to suggest that a muzzle be put on a college professor so long as he lives in keeping with the normally accepted moral standards of the community and is a loyal defender of the constitution and government of the United States. In spite of the effects upon himself, his job, his family and his future, the true professor, in sheer self-respect, must know that he can teach the truth as he sees it.

The whole institution must be saturated with this spirit and point of view. Honest work must be done in every class room by every student. There should prevail everywhere the general, unquestioned assumption that every person instinctively maintains a standard which requires the finest type of honesty in every collegiate relationship.

The extremely difficult and highly significant phase of this truth, however, is not only that the college should be honest but should be accepted and recognized as honest by the people. Therefore, we must avoid all appearance of evil. We must keep our hands clean. There must be no smell of smoke on our garments. We must be able to put into the world men who will instinctively and incessantly oppose all forms of social evil and who will co-operate with every good movement looking to the welfare of the people as a whole. It will not always produce agreeable results. Righteousness occasions much discomfort for large groups of people. The trained citizens of tomorrow will actively oppose the business man who profiteers, the laboring man who shirks, the politician who sets private gain above public weal, the citizen who selfishly enjoys the blessings of democracy without meeting its demands and the man of means who fails to accept his wealth as a social trust. He will recognize that truth knows no time distinctions, that policies and principles are not true or false because they are old or new. Therefore, he will attack both the radical who forgets the wisdom of the past and dreams of an impossible future, and the conservative who idealizes the past and neglects the plain duties of the present.

These are critical days for the college of liberal arts. Obviously there is more need for it today than ever before. It simply must function mightily in the midst of marvelously fascinating conditions. Its future is secure if, even in a measure, it can train students to work thoroughly and to think accurately, if it can awaken men to some realizing sense of the meaning and glory of being alive, if it can enable students to know their own day and, above all, if it can make them men of integrity.

These are not new duties. They are the old demands accentuated by the needs of a new day.

John Robins Allen, Dean of the College of Engineering and Architecture from 1917 to 1919, died suddenly on Tuesday, October 26th, at Pittsburgh, Pa.

The esteem in which former Dean Allen was held in the Engineering College is expressed in the following resolution of the faculty:

"In the death of John Robins Allen, engineering education has lost a most able teacher and administrator and the field of engineering, a scholar and investigator of rare ability.

"Gifted with a scholarly mind, clear judgment and high ideals, he rendered effective service to the cause of engineering education; as an engineer, his writings and investigations won for him merited honor and recognition in this country and abroad; and as Dean of the College of Engineering and Architecture of the University of Minnesota, he rendered potent service in the organization of its work of teaching and investigation and stimulated high ideals of scholarship and professional attainment among the members of the student body and stirred them to a high sense of loyalty and service to their country.

"It is, therefore, with a deep sense of personal loss that we, the members of the teaching staff of the College of Engineering and Architecture of the University of Minnesota, record this expression of our esteem and appreciation of one who was not only an honor to the institution, but in his personal relations a genial and sympathetic friend. We unite with his wide circle of associates in acknowledging the loss that has been sustained, and we hereby extend to the members of his family our sympathy in their bereavement and instruct the secretary to spread this resolution upon the minutes of the faculty."

COLLEGE NEWS

Orlin Kruse, E.E., '20, now in the employ of the Western Electric Co., Chicago, was renewing old acquaintances here October 16.

Glen G. Cerney, M.E., '20, visited the college on October 16 and informed us that he was leaving for India to work for the Standard Oil Co. He has been in their employ at New York City since June. While there he met Russel Strothman, E.E., '20, and Albert Mayer, E.E., '20, both of whom are in the employ of the American Telephone and Telegraph Co.

The Electrical faculty has been enlarged by the addition of Mr. J. H. Kuhlman, Iowa U., '17, recently employed by the Electric Machinery Co., Minneapolis, in the Engineering department. He teaches design of electrical machinery.

Mr. Todd, S. D., '06, Minnesota, '09, who was at the head of the North Dakota State School of Science at Wahpeton, N .D., and was employed in the Engineering department of the Electrical Machinery Co., and also as an instructor at the Dunwoody Institute, is an instructor in E.E. of the Sophomore class and also assists Professor Ryan in A.C.

Mr. H. R. Hurd has ben employed as equipment man to repair and keep in order all the instruments.

The Electrical department has received a large quantity of signal corps equipment from the Government. This is used by the signal corps men of the R. O. T. C. as well as the students of radio communication.

Instructors Swensen and Jansky of the Electrical department spent the summer at the research laboratory of the Western Electric Co., New York City.

The wireless club of the E.E. are sending out the weather reports at noon every day in connection with the U. S. Weather Bureau, and also football results, so that any wireless station in radius of our station can get the reports.

Freshmen, wear your ties!

HOME-COMING.

Home-coming the nineteenth and twentieth!

Hear ye, all Alumni, and heed the call! Lay aside your daily toil and join with us in a mighty "Locomotive Yell" that will shake old Northrop Field as never before. Join with us in a cheer of the heart, and let our devotion to our Alma Mater be the great Diapason uniting us in harmony under a great banner, "Minnesota!"

The same old walks that used to guide you;
The same old streets that you used to ride thru:
The same old trees, as sentinels stand,
All reaching out a welcome hand.
The same old gate, unchanged by time,
Bids you enter again into this shrine
Of memories of old, of a former day,
Yet ever before you as molded in clay—
Come, "Child of Minnesota," you're not far away,
Come be with us, just for today.

ALUMNI NEWS

NOTE:—This department has been organized to secure the assistance and co-operation of the engineering alumni in order that we may have a worthy magazine in the Engineering College, and a "Better Minnesota."

A very welcome letter was received from D. C. Smith, B.S., informing us of the permanent organization of Minnesota Engineering alumni in New York City and vicinity. It is the purpose of the organization to have "talks on live engineering and manufacturing subjects." The organization at present consists of:

W. W. Simons	B.S., '18	R. A. Strothman	B.S., '20
D. K. Gannett	E.E., '17	Helmar Anderson	B.S., '20
David Grimes	B.S., '19	D. P. Loye	E.E., '17
A. F. Mayer	B.S., '20	D. C. Smith	B.S., '18
H. H. Wheeler	B.S., '17		

W. B. McPherson, E.E., '02, is employed in the electrical department of the Minnesota By-Products Co. Since graduation he has been on engineering projects with the Chicago, Great Western, Northern Pacific, American Locomotive Co. and Canadian Pacific, which has enabled him to travel over western U. S. and Canada. Mr. and Mrs. McPherson and two children are living in St. Paul.

Malcolm B. Moyer, '09, writes from Montevideo, Minn., that he is engaged in managing a family of four children—three girls and a boy—and a "baby corporation." We judge him to be quite successful, as he is now a member of the A. S. M. E. and the "baby corporation" is in the $200,000 class, with an annual business of a quarter of a million.

After three years' research work in the Forest Products Laboratory at Madison, Wisconsin, A. C. Knauss, C.E., '17, is in the Technical Service Department of the J. W. Darling Lumber Co., Cincinnati, Ohio. This department extends to the lumber industry in general technical information concerning the properties and uses of red cypress.

K. P. Swenson, B.S., '09, holds the official title of "Oriental Manager of the Allied Machinery Co.," with offices in New York. The activities of this company consist of promoting banking, trading, and engineering projects extending over practically all the world.

Neil Currie, Jr., is with the General Electric Co. in their Power Engineering Department at Pittsfield, Mass.

"Ernie" Seemann, B.S., '20, is designing and estimating costs for the Chicago Outer Belt or Elgin, Joliet and Eastern Railway Co.

G. G. Cerney, '20, and H. R. Shellenberger, '20, are taking the apprentice course in the Standard Oil Training School, New York, after which they are going as lubricating engineers for that company to Calcutta, India.

The Klearflax Linen Rug Co. of Duluth has a new assistant chemist, John E. Hoff, Chem., '20.

Besides helping care for a two month old son, James Harrison, Harry Cook, M.E., '16, is operating the Red Wing Iron Works, specializing in Sorghum Syrup Machinery and Marine Capstans. Harry wishes the Techno-Log and the football team the best of luck. Our regards to young James.

Harry E. Lovering, C.E., '14, is engaged in building construction with the Lovering-Longbotham Co., general contractors in St. Paul.

Leon E. Battles is in the employ of the Oliver Mining Company at Coleraine, Minn., his work being chiefly at the Canisteo Mine.

The staff of the Techno-Log have the sympathy of Mr. O. B. Robbins, who was at one time on the Minnesota Engineer. Mr. Robbins is with the Bureau of Valuation, Interstate Commerce Commission, Chicago, and the entire Robbins family, consisting of Mother Robbins, formerly Mary E. Fisk, '04, and the little Robbins, are nesting in Morgan Park. Permit us to state for the benefit of those alumni from whom we have not heard that "we don't want sympathy; we want news."

F. W. Horsler, '17, with the U. S. Radiator Corporation of Detroit, sends his own best wishes, and regards from former Dean John R. Allen. His advice to engineers is to take all the economics possible and all the practical work in shop and foundry.

Edward P. Burch, '92, Minneapolis, who has been doing public utility valuation in St. Louis, Cleveland, Detroit, and Newark, has developed a new system of cost appraisal based on actual investment in place of the hypothetical reproduction theory. His reports from Detroit have been received in book form at the University Library.

We are in receipt of a three page letter from John S. Peoples, '05, now with the Cutler-Hammer Co. of Milwaukee. Mr. Peoples has been engaged for the past year in perfecting a recording gas calorimeter in which electric thermometers are used in conjunction with meters of special design. He predicts success for the device as it makes all corrections, and records accurately and continuously the total heating value of gas.

Frank R. Donaldson, president of the Donaldson Co., Inc., of St. Paul, manufacturers of a cleaner for tractors, sends us two pages of first class advice and encouragement. We quote: "The best way for an engineer to fit himself for a good position is to get everything out of his college work and augment this knowledge with practical summer work......I do not believe that any student should have the big head, but I do believe that he should have enough self-confidence so that when opportunity offers, he can hold a big job and make good."

Were it possible, we would print the entire letter of H. M. Woodward, '90. He is the oldest engineer in our correspondence file and we were more than pleased to hear from one who graduated in the early nineties. Since graduation he has been engaged in the Mechanics Arts High School of Boston, a secondary school, giving industrial and mechanical preparatory courses. During a portion of this period he has had charge of the pattern and woodworking department; the remainder has been spent in teaching mathematics and academic subjects. Mr. Woodward's two daughters are graduates of Radcliffe and Simmons, while Woodward, Jr., is attending Harvard Engineering college.

What about you? We want your name in the next issue. Give us just fifteen minutes of your time and a two-cent stamp; we will do the rest.

Conders and Ronders, both being the fathers of growing families, discussing the rearing and upbringing of children:

"Yes, yes," said Conders very gravely. "A great deal depends on the formation of early habits."

"I know it," said Ronders, with a wry little smile. "When I was a baby my mother hired a woman to wheel me about, and I've been pushed for money ever since."—Woodworkers Record.

Hairbreadth Escape.

A letter from O. Goode states that he and his wife enjoyed a visit from Mr. and Mrs. O. U. Stone. While they were on their way to the train they passed thru a very exciting accident which might have badly injured Oscar had he been riding on the bumper in place of in the back seat. While driving along the highway, a cow jumped the fence and ran in front of the car, and before the car could be stopped it struck the cow between the two fences, badly breaking the lamps, fenders and radiator.

Professor lecturing to the class on the mysteries of Electricity: "We don't know very much when we really test ourselves, do we?. Take, for example, 'Force.' We know the reactions; the results, but do we know the thing itself; can we see it? Has any one present ever seen a Force?"

A Junior: "Yes, sir, a Police Force."

Lazy Louie and Dog-tired Dick were discussing something they knew very little about, namely, "Work."

"I think," said Lazy Louie, "that if they did away with work entirely it'd put an end to these 'ere strikes."

"Yes," said Dog-tired, "that will be the time when everything's done by electricity; only got to press a button and the work's done."

A slow horror dawned in Lazy Louie's eyes. "That won't do," he said emphatically. "Who's goin' to press the button?"

I have been thinking about buying a large touring car, but I can't afford it. I have decided to buy what I can, "a Ford."

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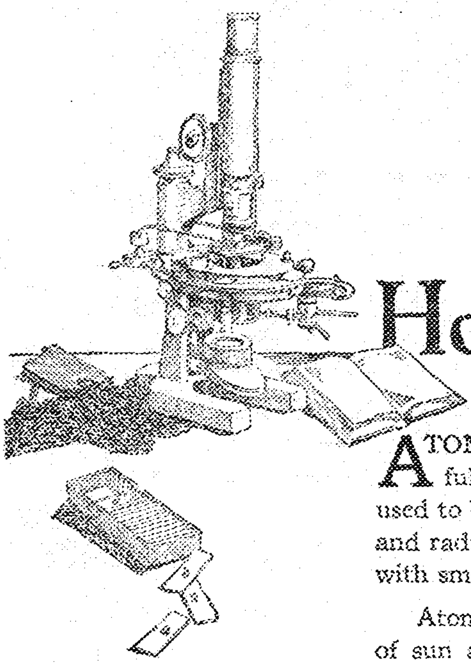

How Large is an Atom?

ATOMS are so infinitesimal that to be seen under the most powerful microscope one hundred million must be grouped. The atom used to be the smallest indivisible unit of matter. When the X-Rays and radium were discovered physicists found that they were dealing with smaller things than atoms—with particles they call "electrons."

Atoms are built up of electrons, just as the solar system is built up of sun and planets. Magnify the hydrogen atom, says Sir Oliver Lodge, to the size of a cathedral, and an electron, in comparison, will be no bigger than a bird-shot.

Not much substantial progress can be made in chemical and electrical industries unless the action of electrons is studied. For that reason the chemists and physicists in the Research Laboratories of the General Electric Company are as much concerned with the very constitution of matter as they are with the development of new inventions. They use the X-Ray tube as if it were a machine-gun; for by its means electrons are shot at targets in new ways so as to reveal more about the structure of matter.

As the result of such experiments, the X-Ray tube has been greatly improved and the vacuum tube, now so indispensable in radio communication, has been developed into a kind of trigger device for guiding electrons by radio waves.

Years may thus be spent in what seems to be merely a purely "theoretical" investigation. Yet nothing is so practical as a good theory. The whole structure of modern mechanical engineering is reared on Newton's laws of gravitation and motion—theories stated in the form of immutable propositions.

In the past the theories that resulted from purely scientific research usually came from the university laboratories, whereupon the industries applied them. The Research Laboratories of the General Electric Company conceive it as part of their task to explore the unknown in the same spirit, even though there may be no immediate commercial goal in view. Sooner or later the world profits by such research in pure science. Wireless communication, for example, was accomplished largely as the result of Herz's brilliant series of purely scientific experiments demonstrating the existence of wireless waves.

General Electric Company

General Office Schenectady, N.Y.

MINNESOTA TECHNO-LOG

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IN THIS ISSUE

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by the students of
The College of Engineering and Architecture and the School of Chemistry
University of Minnesota

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VOLUME I DECEMBER, 1920 NUMBER 2

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University of Minnesota Branch of American Association of Mechanical Engineers.—Pres., Joachin; Vice-Pres., Lloyd Elmer; Secy., Olmstead; Treas., Roy Aure.

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C. E. SUMMER CAMP

By

L. J. SVERDRUP, B. A. B., C. E., 1921.

The C. E. class of '21 had several discussions last year as to what they could do to minimize the loss of time due to summer camp. We all felt that the summer would be practically ruined as far as earning any money was concerned as long as we had to go to summer camp the first part of August. The class finally decided that the best thing to do would be to take the senior Bridge Analysis course during summer school, and have the senior courses so arranged that the work could be covered in two quarters. By doing this we would be graduated in March instead of in June, and would have a chance to go to work a quarter earlier. A petition asking for the course in Bridge Analysis to be given during summer school was granted; and practically the whole class of '21 stayed for the course, and as soon as it was finished went directly to summer camp.

One day in July as the bunch was busy selecting I-beams and angles, Professor Cutler came in and said he had a few things to say to the class in regard to the summer camp. "This year," Prof. Cutler said, "the camp will not be held at Lake Koronis as in previous years. The Minnesota & Ontario Power Company has asked us to take the class up to the Canadian boundary to do some work for them, in turn they will pay all expenses in connection with the camp." After the yelling and cheering had died out Prof. Cutler gave some instructions in regard to where the camp was to be located, when we should leave, what things to take along, etc. From then on, until we left, the only topic in the class-room was summer camp. The events that led up to this arrangement should be explained.

In 1919, while Prof. Zelner was working for the M. & O. Power Co., spending part of his time up in the woods along the boundary, Mr. Backus, the president of the company, asked him to go back up in the country where this summer's camp was located to do some work. Prof. Zelner was, however, obliged to return to the Engineering College, but suggested that the class of '20 be taken up to do the work. Nothing was done that year, but this spring Mr. Backus wrote Mr. Zelner, asking him if it would be possible to take the class of '21 up there for their summer camp; in that way combining University and practical field work.

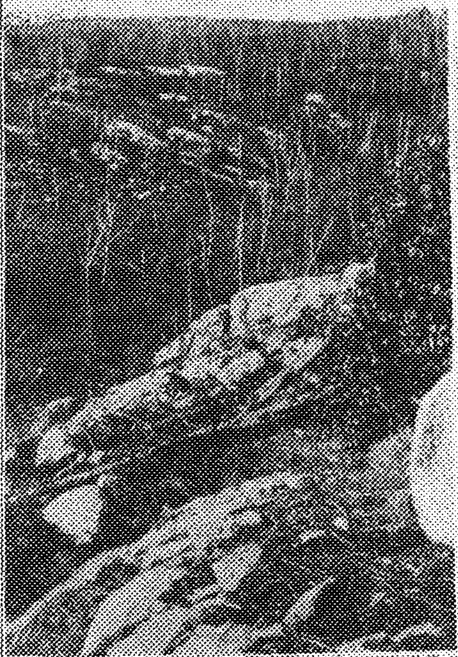
But to get back to the subject, the 12th of August we pulled out from the Great Northern station, in a special car provided by the company, headed for International Falls, where we were to meet Profs. Cutler and Zelner, who had gone up there about six weeks ahead of us to do some reconnoitering, and locate the different camp sites. Prof. Bass, who had some business to attend to up in International Falls went along with the bunch, and sat around, talked, laughed, and told stories as well as the next fellow. Friendly games were started, the galloping dominoes could be seen, in short it was a regular engineering bunch. Some of us would like to know, however, who the nurse was that tried to kill Greenman and some of his friends.

The next morning we reached International Falls, where we found Profs. Cutler and Zelner waiting for us, looking like two regular lumber jacks. The bunch was sent out to get breakfast while the baggage was loaded on a dray and taken to the good ship "Manitowoc" and barge Moose, which were to take us up as far as Kettle Falls, a distance of about 50 miles. A few of us wondered just how far it was to Canada, and we had a suspicion that some of the bunch had found out when four of the party were missing when we were to leave. Erickson, the captain of the boat swore up and down he would not wait even for the king of Jerusalem, so the boat pulled out, leaving word for the stray sheep to come after as soon as they could. They came down to the dock in time to see the stern of the boat as it left the harbor, and didn't at first know what to do. Then Ed Sherwood, a member of last year's class, who happened to be there told them that the boat would stop in Ranier—only a few miles away—and that he would take them over in his Ford This he did, and he certainly must have gone fast, as he lost one of the rear tires going over, and never noticed it.

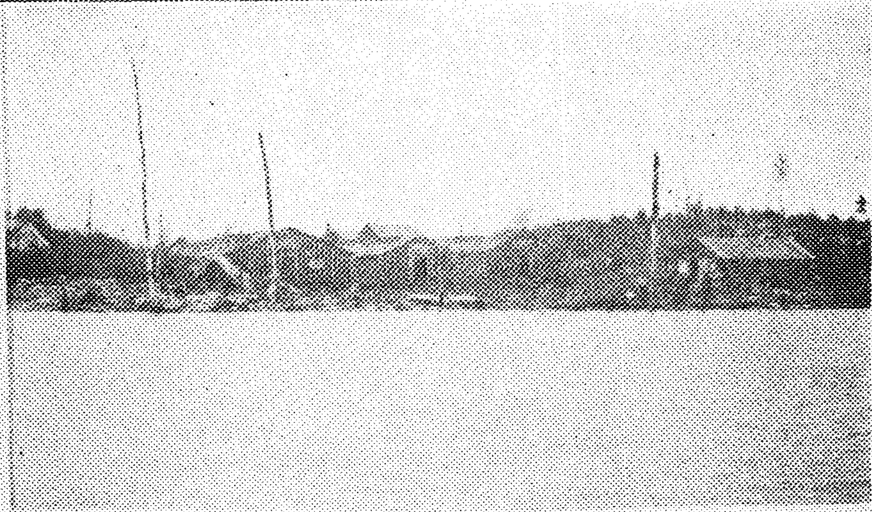
The 50 mile trip up to Kettle Falls was a real pleasure. Sunshine—a blue sky—a gentle breeze, and lots of ham and cheese sandwiches—what more could a bunch of engineers want? We reached Kettle Falls in the evening and had supper (a slice of bread, three beans and a prune). After this heavy meal, we sat around on the porch had a little song fest, a jig and shimmy exhibition, and then rolled in. The next morning we portaged our stuff from the boat over to Namigan Lake, where motor boats were to get us and bring us up to our first camp. Camp No. 70, a lumber camp belonging to The Virginia & Rainy Lake Lumber Co. The camp was located on Loon River, about 35 miles from Kettle Falls. The last party did not leave until late in the afternoon, and as it was impossible to make the camp that night, we pitched tents before coming to Sandy Point Lake, and continued the next morning, reaching camp towards dinner time. When we came in we heard wild tales about the wonderful pies the rest of the bunch had been eating, and when we saw a party coming in with 12 quarts of raspberries we had an idea we might get some pie ourselves.

It was Saturday we pulled in, and the rest of that day, and part of Sunday was spent in pitching tents and getting equipment ready. The keeper of the camp, Jim Gannon—or Dad as we all called him—and his dog, "Blutcher mein boy" soon got to be part of the outfit, and old Dad's shack was a mighty popular hang out, especially with the cribbage players, who in vain tried to best old Dad at the game.

The object of the camp, from the M. & O. Power Co.'s point of view, was a two-fold one, to locate a site for a dam, so power could be developed and transmitted down to their pulp plant in International Falls, and then to locate a logging rail road on which they could haul the logs to their plant. So the work logically divided itself into two classes, first the railroad work, under Prof Cutler, which consisted in all kinds of work connected with the location of a rail road, such as a preliminary survey, levels, topography, etc., and secondly Hydrographic and Topographic work



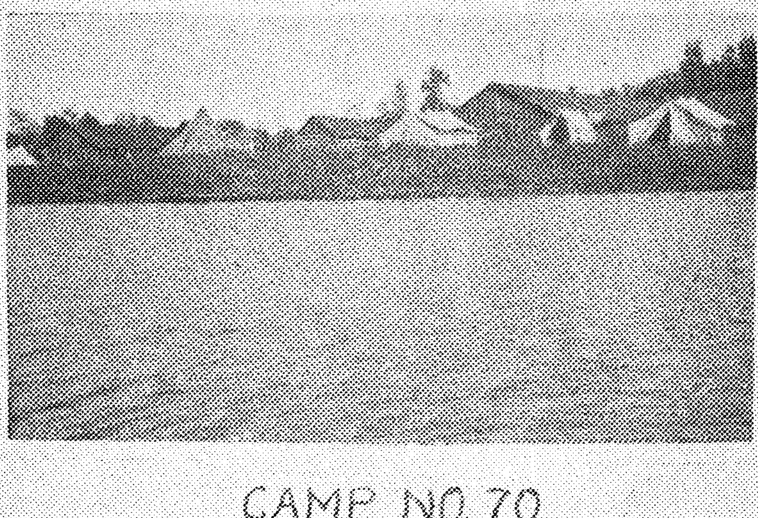
BURNED OVER COUNTRY



CAMP NO. 42

THE BUNCH

TRIANGULATION



CAMP NO. 70

under Prof. Zelner, in which was included triangulation, stadia, plain table, soundings, and cross sectioning. A schedule was made out and posted every day, assigning each man a job, and also assigning an axman to parties where it was needed. Originally there were 42 men in the party, this included 12 axmen, and two cooks. After a while one of the cooks and some of the axmen left, but the one cook, Lovejoy, could easily handle the work, at least everybody looked like Christmas pigs by the time camp was over. Towards the last Prof. Zelner had to diet to reduce some—cut down his dinners to five or six pork chops, a quart of stewed prunes, and only three pieces of pie. Prof. Cutler did not even try to resist the temptation, but declared that he knew that he ought not to eat so much.

Monday morning work started with a bang; parties were sent out to establish bench marks at different places, the true elevation being gotten from reference marks established by the International Boundary Commission, a base line for a triangulation system up on Loon Lake was started, boats and canoes were painted and looked after, and the faithful little Evinrude was limbered up. The next morning a party of 12 under the supervision of Prof. Zelner left for Sandy Point Lake Narrows, to take soundings, cross sections, and in general determine the possibilities of locating a dam, giving approximately an 80 foot head, at that place. The party stayed down there a week, and though the work was hard, and long hours were put in, the whole bunch claimed they had a better time that week than any other time during camp. Frank, an old woods man, and Greenman did the cooking for the outfit, and got away big, especially when they put blue-berry pies, a couple of inches thick, on the table. Talking of blueberries, all you had to do was to sit down any old place and eat all you could hold without moving, and as for size, Prof. Zelner claimed he saw some as large as basket balls. Enke had to better that, and claimed he had to tie a rope around some he found in order to lower them to Daly down below. Saturday morning we finished up the work, and started back for camp in the afternoon, loading our stuff in two boats, took most of the men in a third Evinrude equipped boat placed in the middle. Three men went ahead in a canoe, to investigate a certain low spot.

When we returned we found Prof. Cutler and four or five of the men rather sick. Dysentery and fever had struck the camp, "Doc." Ahrens, a medical student, who went up with us was as busy as a nurse during the "Flu" epidemic taking care of them. Prof. Cutler got worse instead of better and next afternoon he was taken to Harding with the Evinrude. From there he went to Minneapolis and in a week's time was back all O. K. During the next few days things got worse instead of better—at one time only fourteen of the boys were able to go to work; so Prof. Zelner decided to move up to Camp No. 42, an old deserted lumber camp belonging to the Virginia & Rainy Lake Lumber Company. Some of the stuff was left at Camp No. 70; the rest was taken by boat up Loon River, over the portage and then about a mile and a half up Loon Lake to the camp mentioned. Seven or eight sick men were left at Camp No. 70, to be taken up later; the others portaged the stuff and got the camp into shape.

Late Saturday night Dougherty, who brought supplies and mail up to the camp once a week, came in his motor boat bringing with him Mr. Hussey, the Chief Engineer for the M. & O. Power Company and Dr. Craig from International Falls. They informed us that we would probably have a visit of some game wardens next morning.

Dr. Craig remained to examine the sick men while the rest went on up to Camp No. 42. Dr. Craig found that all the men were getting along fine, and that "Doc" Ahrens had done everything according to Hoyle. In the morning the game wardens came as predicted. It may be added that the camp was located in Superior National Forest which is a National Game reserve, and that no hunting is allowed, and it is illegal to have any guns there unless they are properly sealed. The game wardens were rather hot when they first came—claiming that there had been quite a lot of shooting going on. But when they could not find any evidence whatsoever, with the exception of old Dad's automatic rifle, which they took with them, they proceeded up to Camp No. 42. They did not find anything unlawful there, and when one of them found a "brother Bill" in Professor Zelner, and all of them had gotten a square meal, they left, feeling quite a little better.

After the camp had been moved up to No. 42 there was no more sickness, and the work went better than ever. The railroad work which had gotten a good start while at No. 70 was continued right along. First a preliminary survey was made by a party consisting of an instrument man, a head and rear chain man, a head and rear rodman, a stake man, and two axmen. Right after this party came two men taking precise levels, establishing the elevations of hubs, stations, and other points wanted. Then came a party—usually two of the boys and an axman—taking the topography of the country. The positions in the parties were rotated so as to give each man a chance to try the different positions. Each night the notes were entered in the office notebook, and then each man was assigned to office work certain days, plotting the notes on detail paper, tracing a map, or whatever it might be. Mr. Gebert, (better known as the "Count") an engineer working for the M. & O. Power Company, spent most of his time in the office helping to keep things straight. The work had run along smoothly until the Devil's Cascade was reached. Here several lines had to be run in order to find a grade that would satisfy the requirements. The country was very rough, deep ravines cutting through, making an even grade next to impossible. The Devil's Cascade proper is a deep gulch running from Bauness Lake to Loon Lake; it is about 150 feet deep and about 250 feet across. A great deal of stadia work was done here to get the exact topography of the country. The line, until the Devil's Cascade was reached, went over comparatively flat country, partially swampy—muskeg, as it generally is called. The going was fairly easy and little cutting had to be done. But on both sides of the Devil's Cascade the country was rough and progress was slow and as so many different lines had to be run, at the close of camp the line was only a short distance beyond the Devil's Cascade. This was, however, as far as

LOON FALLS DAM
SANDY POINT NARROWS
LUNCH
SETTING UP
ON P_1 LINE
MAIN R.R. LINE
MOVING
HALF HOURS CATCH
LOON LAKE
DOC DROPS IN
PLANE TABLE WORK
CHARLIE OTTERTAIL
WITH THE SEXTANT
OFFICE WORK
NEXT
OFFICE LIZZARDS
INDIAN BUNGALOW
CHOW

the line had been expected to be run in such a short time. The work was most of the time pretty far away from camp, so lunch was taken along and eaten in the field. While working around the Devil's Cascade, the men went up in the Evinrude in the morning, and came back about five thirty in the evening. The work was stopped for an hour at noon while coffee was boiled and lunch eaten. Prof. Cutler, by the way, got quite a renown as a coffee maker on these "picnics." After lunch was eaten the old corncobs came out and they certainly tasted fine up there in the woods. That short dinner hour sure was a cozy one—everything was talked about—from war to calculus—while bread was toasted over the fire and hard boiled eggs peeled. Andy and Steve, the two axmen who usually went with the party, were half of the fun and usually pulled quite a few things—as when Steve opened the back of Dill's camera to see a moose he had taken a picture of. Steve had an idea the moose was in the camera, and was very disappointed when he couldn't see it.

In the meantime the Hydrographic and Topographic work had been going fast. A party had been sent down to investigate the little Vermillion Narrows. Cross sections and soundings had been taken, and maps made of these narrows, as well as of the Sandy Point Lake Narrows. Parties were sent out to take soundings at the foot of Loon Falls and the upper part of Loon River. All this work was plotted and later traced. The triangulation system which had been started had been continued on both sides of the lake. Triangulation stations were built at some points, while at some others triangulation towers erected by the International Boundary Commission when they surveyed up there were used. One of these towers is shown in the accompanying picture. On the north side of the lake—the Canadian side—the system was carried up to Lac LaCroix. On the south side it went partly up to the Devil's Cascade, while some stations were established on islands to complete the system. The triangulation stations were later on used during the plane table work, the table was set up over the triangulation station and in that way located. Plane table maps were made of a great part of the lake. The party went out in a boat, leaving the instrument man at some triangulation station, and then followed the shore line, giving him shots wherever needed to locate different points. The work went fast and was a mighty pleasant one. Two different parties were "chasing" the 1200 foot contour (nobody ever caught it, though Westcott claimed he had it by the tail once). On the south side of the lake the work was done by means of stadia, the distances being read directly and vertical angles taken, and triangulation stations tied into as often as possible as a check. On the north side compass and hand level were used, distances being paced and angles read by both rodman and compassman as a check. This work was done in order to determine how far out the lake would spread in case it was raised 40 feet. A great deal of work was also done around the portage between Loon and La Croix Lakes. Most of the work consisted in taking cross sections—a Jacob's Staff was used extensively during this work. The last week of camp all the boys had to figure out the Eastern Elongation of Polaris, and later make observation in the evening on this star, in order to determine the true azimuth of a line between two triangulation stations. The last day in camp a great many of the boys worked in the office in order that all maps and tracing might be finished and office notebooks be put in good shape.

During the whole camp a feeling of good fellowship prevailed. Everybody stuck together in work as well as in play. Indoor baseball was played nearly every evening, and some real games were played, too—the only trouble was that "Al" Johnson was such a darn good pitcher that his side usually won. Every evening a large camp fire was built and a bunch gathered around it and sang all the songs they knew—including some they ought not to have known—while Greenman played the Ukelele, with two or three strings as the case might be. After a while "Doc" Ahrens might give a little lecture, rivalling "Dad" Elliot at times. By and by, the bunch would leave to hit the hay, and usually the whole camp would be snoring by nine o'clock.

Towards the latter part of camp we had quite a surprise when "Doc" Williams and "my son Henry" came paddling up. They stayed over that night, then went up for a couple of days to Lac La Croix, to do some fishing. On their way back to Minneapolis they stopped in camp again for a couple of days. "Doc" Williams, the nights he stayed with us, gave a demonstration in snoring—and he sure knew how to do it. At first he would not sleep in the shack with Prof. Cutler and Zelner at all, saying that he would keep them awake all night with his music. He finally went in with them, however—and both Prof. Zelner and Cutler must be sound sleepers, as neither one heard him snore during the night—so they said at least.

Sundays were glorious days up in camp—nothing to do but to eat and loaf—though most of the boys either went out "exploring" or fishing—Simmons and a few others might know something about this, the former after having pursued a couple of squaws half way across La Croix—to get a picture. To get a boat one would have to be up comparatively early for they were in high demand. Fishing was good, and then some—the picture shows about half an hour's catch. After the boys started to bring 8-12 pounders regularly, a fellow was laughed at and asked what he was going to do with the minnow in case he brought in a 3-4 pounder.

Members of a tribe of Chippewa Indians from up La Croix came to visit us a couple of times. First "Sore-eye"—the son of Chief Blackstone—and a brave came down to trade three sturgeons and a pair of moccasins for "eatum." Prof. Zelner had ordered the one pair of moccasins while up at the village, from Blackstone. But before the Indians left he had that pair plus the pair the brave wore—while the brave marched off in Prof. Zelner's hobnailed shoes. "Sore-eye" was very anxious to get some raisins—very modern Indians—and was very disappointed when he found out we didn't have any. They got some prunes instead, but whether they filled the bill or not is a question. Later on other Indians came down with more moccasins and they all went like hotcakes—Prof. Zelner getting most of them.

Then the last day of camp came—and although everybody had enjoyed the camp, the majority were rather anxious to get back to civilization again. "Pat" Tierney and Fred Enke had left a couple of days early to get back to football practice, while Horwitz left a day before the rest to attend to some business in Minneapolis. Most of the stuff was taken to the Loon Falls portage, over this, and loaded on two barges which Neal Berger, the same man who took us up, had brought, while some was taken in rowboats to Camp No. 70. Everybody was soaking wet by the time the work was done, but as soon as the stove in the bunk house was going full blast things cheered up again. During the night a skunk came in, walked around to see what was going on, and after having satisfied his curiosity marched out again. Quite a few of the boys put their heads under the blankets to be out of range during the visit. Another skunk marched around in the kitchen, where some of the men slept, and opened barrage when old Frank tried to chase it away. The next morning everything was loaded, and the two barges pulled by two motor boats, with boats and canoes trailing after, started for Kettle Falls. Everything went fine until we were a couple of miles from Kettle Falls, when one of the barges, started to fill with water. McCubry and Gebert who were sleeping on some boxes on the barge came mighty close to getting a cold bath. Things looked rather bad for a minute as the barge started to sink, and the different things started to float off the barge into the lake, but everything went O. K. The boys got into the boats and canoes and salvaged nearly everything, while the barge was towed to shore and unloaded. After all the water had been baled out the stuff was reloaded and the journey continued. We stayed over night in Kettle Falls, portaged our stuff in the morning and loaded it on Erickson's boats and were off for International Falls. A party of more or less drunken people—mostly more—went with us as far as Ranier; and if nothing else was learned on the trip some of the fellows found out that cheese sandwiches don't always taste good when some of the passengers insist on "feeding the fish." We reached International Falls in the evening, too late to catch the train, so we had to stay over until the next evening. The following day Prof. Zelner took the party on a very interesting trip through the lumber and paper mills of the M. & O. Company. It was a pleasant sensation to get back to town again, to enjoy a hot bath and other advantages which go with civilization. Although we had plenty of chances to go swimming while up in camp there is all the difference in the world between diving into the cold lake and sitting comfortably in a bath tub. We came to Minneapolis the morning of the 23rd of September—the train ride was a joyous and festive one—though some of the boys didn't get very much sleep.

In the short six weeks at camp the gang learned something besides practical surveying. They found out that it pays to stick together through thick and thin—and you will have to hunt some before you find a class which sticks together like the C. E. Class of 1921.

In conclusion, every man who was up in camp, wishes to thank the M. & O. Power Co., for their generous offer which made it possible for the class to enjoy a summer such as never has been enjoyed by any other class during their summer camp.

The Development of Processes for the Manufacture of Organic Chemicals.

BY W. M. LAUER.

The American industrial organic Chemist has made great progress during the last few years and the time is not far distant when the organic chemical industry will occupy a position along with the other well-established American industries. This industry has as its object the manufacture and sale of organic chemicals and the economical production of these products is of vital importance to the manufacturer who must meet a market price. The degree of success achieved in the solution of this problem determines the success or failure of the undertaking, up to the point where the sales organization comes in. This problem is of equal importance to the professional organic chemist and to the chemical engineer since their success in the manufacturer's organization is dependent upon the results obtained in the solution of the manufacturer's chemical and engineering problems. The evolution of industrial processes for the manufacture of organic chemicals therefore has a real significance for the student of organic chemistry and chemical engineering.

Let us take the simplest and fortunately the most common case, namely that in which the compound to be manufactured is already known and follow the compound from the literature to quantity production. Obviously, the first thing to do is to find out through the literature what has been done along the particular lines in which the manufacturer is interested, what methods of preparation for the desired product are known, and what information there is concerning these methods. A thorough search of the literature, including the patent literature is therefore necessary. A mere gathering of the information available from the literature is insufficient however, and must be followed or accompanied by a critical review. In other words, are the conclusions arrived at by previous workers justified by their results, or does this or that merely appear to be the case? The correlation of the results obtained by previous workers must then be followed by laboratory investigation.

In the majority of cases, a literature review will reveal a number of different reactions which may be used in the formation of the desired product. For example, in the production of phenylglycine, which substance is an intermediate in the manufacture of indigo, there are several possibilities. This intermediate can be made very easily by treating aniline with chloracetic acid or by the hydrolysis or phenylglycine nitrile with dilute alkalies. Sufficient laboratory investigation should therefore be carried out on the different methods of preparation so as to determine the most economical method and that which will give the product of highest purity. These two are not always the same and a choice must be made here.

A thorough study of the reaction or reactions involved in this chosen method is then necessary. The preparations of any organic chemical involves the following steps, namely, formation, isolation, and purification. Formation consists of the bringing of the raw materials together under conditions which allow the desired reaction to proceed, whereas isolation deals with the separation of the desired product from the reaction mixture. Purification may well be included in the term isolation since it involves the isolation of the pure product from a comparatively small amount of impurities.

First let us consider the formation of the compound. Many reactions between inorganic substances can be represented by equations which express definitely the quantitative relations that exist between the substances entering into the reactions and those formed. In most chemical transformations in which organic compounds take part, however, a number of independent reactions take place simultaneously. By varying the conditions one or the other of the reactions may be made to take place to a greater or lesser degree, so that particular attention must be paid to the conditions under which a reaction is brought about, as these conditions affect the yield of the desired product. The conditions which are most commonly controlled are:

(a) The temperature at the reaction is carried out.
(b) The time of reaction.
(c) The relative concentrations of the reacting constituents.

A study of the effect of these various factors upon the completeness of the desired reaction or reactions must therefore be made in order to determine the proper conditions for plant operation. In order to make a study of this kind it must be possible to analyze the reaction-mixtures for the various products formed. This in most cases involves original methods of analysis. The method of isolating the product from the reaction mixture is dependent upon the properties of the materials in the reaction mixture. Can the product be separated satisfactorily by distillation, evaporation, precipitation, or extraction with some immiscible solvent? If so, what is the proper procedure for carrying out this operation? If not, what method can be employed to attain this end? The process of purification is largely determined by the degree of purity required in the final product. What impurities are present in the product isolated from the reaction mixture? Which of these must be further decreased or eliminated? How can this be accomplished most economically? These questions together with a number of others the organic chemist must answer by thorough laboratory investigation.

Laboratory investigation should be followed by semi-works experimentation. The semi-works units used for this purpose should be of sufficient size to furnish practically all of the engineering problems which will present themselves in plant operation. The process is then carried out in these semi-works units adapting those conditions which were previously shown by laboratory investigation to be necessary for the maximum yield. A few of the problems which confront the investigator at this stage are, what type of apparatus is the most efficient for each step in this process, what materials of construction can be used for this apparatus, and what is the most satisfactory arrangement of apparatus. Experimentation of this type should enable the designing engineer to lay out a plant of a certain capacity. In addition, by this means a fair estimate of the cost of the finished product may be made. This semi-works type of experimentation plays a very important role in the development of an industrial process. A process which is thoroughly satisfactory from the laboratory man's point of view may present great difficulties when attempted on a larger scale. The solution of these engineering problems is the chief object of semi-works experimentation. After a process has been thoroughly studied in the semi-works, ordinarily very little difficulty will be experienced when the units are enlarged to plant size. Semi-works experimentation involves considerable expense, but it has been the experience of manufacturing chemists that this cost is small when compared with the works experimentation, which would be necessary to obtain the information resulting from a semi-works study.

This is intended as a mere outline of some of the important problems which are met in the evolution of an industrial process, and should by no means be considered as an all-inclusive and never-failing recipe. Every progressive organization manufacturing chemicals or allied materials employs a staff of chemists and engineers whose duty it is to solve problems of this nature.

The Application of Photography to Industry.

BY GLENN E. MATHEWS.

There are few industrial heads who realize the extent of the application of photography in our modern industrial practices. Those who have heeded the call have installed in their plants photographic departments which are recognized as important as the other, better known departments of their business. But there are still many concerns who seemingly have failed to realize fully the distinctly beneficial results which are to be obtained from the proper application of photographical knowledge and equipment to their business. In this paper, a brief summary only will be given of some of the more recent uses of photography.

Probably the most common use is that of copying, reducing, and enlarging of prints, documents, maps, drawings, blue prints, pencil sketches, typewritten matter, photographs, paintings, and magazine articles. This is done by several different processes. In discussing the work of one firm, E. W. Davidson of the General Electric Company in an article published in *The Nations' Business*, states:

"The ordinary photograph preserves records, helps keep stock, is a bulwark of invention and research, aids materially in clinching sales, figures in establishing patent rights, teaches lessons of safety as they cannot be taught any other way, puts punch and pull into advertising and helps make good citizens out of aliens in scores of plants which conduct Americanization classes for their workers.

"Imagine a line of pictures 104 miles long. That line would represent the total production by a staff of thirty photographers and photographic workers in the headquarters of one American industry alone. This staff turns out on an average 10,000 blue-printed photographs and about 2,000 ordinary prints every week of the year.

"In this mass of pictures are innumerable photographs of practically every new machine the company makes, not to mention the thousands of views of single parts. These are used not only for sales and record purposes, but also to make replacements easy and accurate. Hundreds more show ways of packing and anchoring heavy goods on cars."

One of the most convincing examples of the use of photography as a record of events was the work of the United States Signal Corps in the recent World War. The unfailing accuracy and extensiveness of this record together with its great historical value make it stand out as a monumental mark of achievement. And furthermore when we realize that fully fifty per cent of the pictures were taken while under fire, when the photographer had to expose himself to the enemy in order to know what he was taking, a great feeling of admiration and respect for the men who so risked their lives comes to us, and we appreciate even more the value of this wonderful collection. Those who have had the good fortune to see the enlargements made from the photographs as they have been exhibited in many of our larger cities voice a unanimous praise for the excellence of the work.

Another more direct application in the photography of the progress of the construction of buildings, the manufacture of tools, instruments and apparatus. These records have many uses and are to be filed away with the same care that is used with important documents and papers. From them, copies may be made later for salesman's samples and for advertising purposes. Quoting Mr. Davidson again, "A salesman of electrical apparatus approaching the Government of Chile 'wouldn't think of going in without a complete set of perfect pictures of everything he had to sell' as recently commented J. G. Barry, an American sales manager. 'No amount of expertly written description of machinery can tell the story as well as a high grade photograph. The picture is of greatest value in visualizing machinery for non-technical men, such as the average board of directors but it also goes a long way in getting the interest of engineers.' "

For identification purposes, the photograph has long been known and has proven inestimably valuable. In the Bertillion System of Finger Print Identification, in criminal records, and as evidence for court cases, the camera has played no small role in upholding law and order. The United States Government has long recognized the value of a photograph for identification purposes in its use of photographs on passports. Many of our large industrial plants have started the practice of photographing every new employee. At the Kodak Park Plant of the Eastman Kodak Company at Rochester, New York, for example, every person on becoming an employee of the company has to submit to being photographed and later receives a pass which contains this photograph as well as his signature.

The phrase, "Picture Talk" has become a hackneyed expression but it continues to hold true, and we might add that the conversation is convincing. It is a universal language understood by all nationalities. Show an alien a picture of some of the results of handwriting experiments of one of his brother workmen and as Mr. Davidson states he will say, " 'Did Tony do that? If he can I can,' whereupon the mastering of the English language ceases to look so impossible and they plunge in with a will." Again in the case of campaigns for public health and safety, the universal appeal of pictures is undeniable. In the campaigns for the eradiction of the fly conducted several years past under the slogan of "Swat the Fly," the lessons shown of the effects of unsanitary conditions in large cities was impressed upon the public forcibly by pictures. And now when accident prevention with its by-word of "What's your hurry?" occupies the minds of every one, photographs of causes and effects of accidents are probably the next most convincing arguments to a smash-up itself. The Accident Prevention Department of our Industrial Concerns has been slowly coming into its own and now such a department is recognized as a necessary adjunct to plant organization. At the plant of the Eastman Kodak Company, previously referred to, different pictures appear on the bulletin boards in all departments about every two weeks. These cuts show how an accident occurred or may occur and urge employees to exercise more care in the future. At this plant, whenever an accident does occur, an X-Ray photograph is made of the injured part and put away for record purposes.

The use of photography in the air service, both at the present time and during the recent war developed a new and special field. New cameras had to be designed and tested out and the aviators instructed in the use of them. When successful enough, this mode of photography came to be applied to the preparation of maps of countries inaccessible to the army engineer and surveyor. Throughout the Balkan region, it is now known that almost all the fighting of the English troops was conducted with the aid of maps made from pieced-together air photographs. While now in our modern factories, it can be understood how relative positions of avenues and buildings of large plants could be clearly and accurately gained by the use of such photography. No doubt further development of this type of photography will be seen in the near future accompanying the rapid growth of aeroplane construction and design.

Some of the special uses to which photography has been applied may be briefly mentioned. During the past few years, the "Animated Cartoon" sprung into being and has continued to expand in its applications. Among its most recent special applications were several worked out by the Bray Studios in Chicago, during the winter of 1917. It had long been known how difficult it was for soldiers to understand the workings of a time fuse on some of our high explosive shells. Mr. Bray saw and recognized an adaptation of animated photography. With his staff of artists, he made drawings of the different stages of the details of the action of the time fuse. When this clear-cut picture with its changing parts was shown to an audience of students of Ordinance hours of lecturing were avoided with results that well repaid those who created the pictures for them. Numerous other uses suggested themselves soon after the successful application of this one. Another special application is the following one. Consider, for instance photographing the difference in time between the explosion at each end of a stick of dynamite! Mr. Davidson describes how this and several other highly interesting procedures are carried out. "The highly sensitive machine which can achieve the seeming impossibilities is the oscillograph, which photographs the 'waves' of electricity with an ordinary camera attachment.

"The operator of an oscillograph can set the instrument so that he will know the exact time in fractions of a second it is going to take the machine to make an inch of a jiggling line. Then in the dynamite explosion, for instance, he is able to tell the exact lapse between the burning of the two ends of the stick as registered by the breaking of wires passed through those two ends." In a similar manner, the speed of a bullet is registered, the human voice recorded, the noise made by an automobile transmission gear photographed, and the amount of electric current a machine or a whole factory uses from minute to minute pictured. With these photographs, experts can study the needs and make recommendations as to how to improve conditions.

That the science of photography has earned its place in industry along side of many other branches of science is now unquestionably true, for more and more our large industries are recognizing the need of photography, in their departments. We can therefore predict that the future will bring forth an urgent need for men specially trained in the technical use and application of photography. Industry needs such men at the present time and with few exceptions is lacking in them. When the demand becomes insistent enough, our large universities will no doubt respond and install in their regular curriculum a course to prepare men for such work. Photography has firmly established itself and proven thoroughly its adaptability to industrial processes and as John H. Graff, technical photographer of the Berlin Mills Company, fittingly remarks as, "applied to science engineering, industry and commerce, it has come to stay."

A Graphical Study of the Use of Engineering Library

The Engineering Library with its 16,000 volumes, its inviting atmosphere and its efficient supervision should be a source of pride to every engineering student and instructor. Whether it is used as well and often as it should be by members of the college is a debatable question. The record of attendance shows a steadily increasing number but the college registration is also increasing rapidly so that the increased library attendance must be analyzed before it is accepted at its face value.

In the spring of 1918 a preliminary study by means of graphs was made which showed clearly the yearly increase in attendance, the influence of the Thanksgiving, Christmas and Easter recesses as well as the effect of warm spring days. Another significant point that was apparent was the crest in attendance the first month after the beginning of each semester. Other influences which were more far reaching, as in the spring of 1917 when the college registration was cut by enlistments from 530 to 405, or 25 per cent of the student body. This showed of course in the library attendance, and since that time the college registration and library attendance have not followed the curves established from the opening of the library in January 1913 to April 1917.

A glance at the chart will show the falling off in registration in 1917-18 and the great increase in the years following. An examination of curve Number 7 will also show that the number of times each student has made use of the library has fallen off since 1917. This is caused, I believe, by the large proportion of first year men since the beginning of the 1918-19 college year. The first year students do not have as much occasion for library study as upper class men and the result is a falling off in attendance per man when comparison is made between total attendance and total registration.

The accompanying record of freshmen registration for the past three years is of interest:

	Total Reg.	Freshmen	Pct. Freshmen
1918-19	959	258	27
1919-20	1149	618	54
1920	997	372	37

Attention should be called to two or three points on the chart. Extremely high points on curve Number 2 in October, November and December 1918 are due to the S. A. T. C. supervised study in the library. The second half of that college year, however, is far enough below normal to pull down the average per man to a point below the previous year. Another portion of curve Number 2 which does not look well is the steady falling off in attendance from October 1919 to June 1920.

In conclusion a few words of explanation may be necessary. First: The record of attendance is taken by counting the number of persons in the library each hour of each day. Curve Number 2 is compiled from a summation of these daily records.

Second: Curve Number 3 is compiled by deriving means from total attendance for the number of months in the college year.

Third: Curve Number 4 is compiled by dividing the total attendance for the calendar year by twelve.

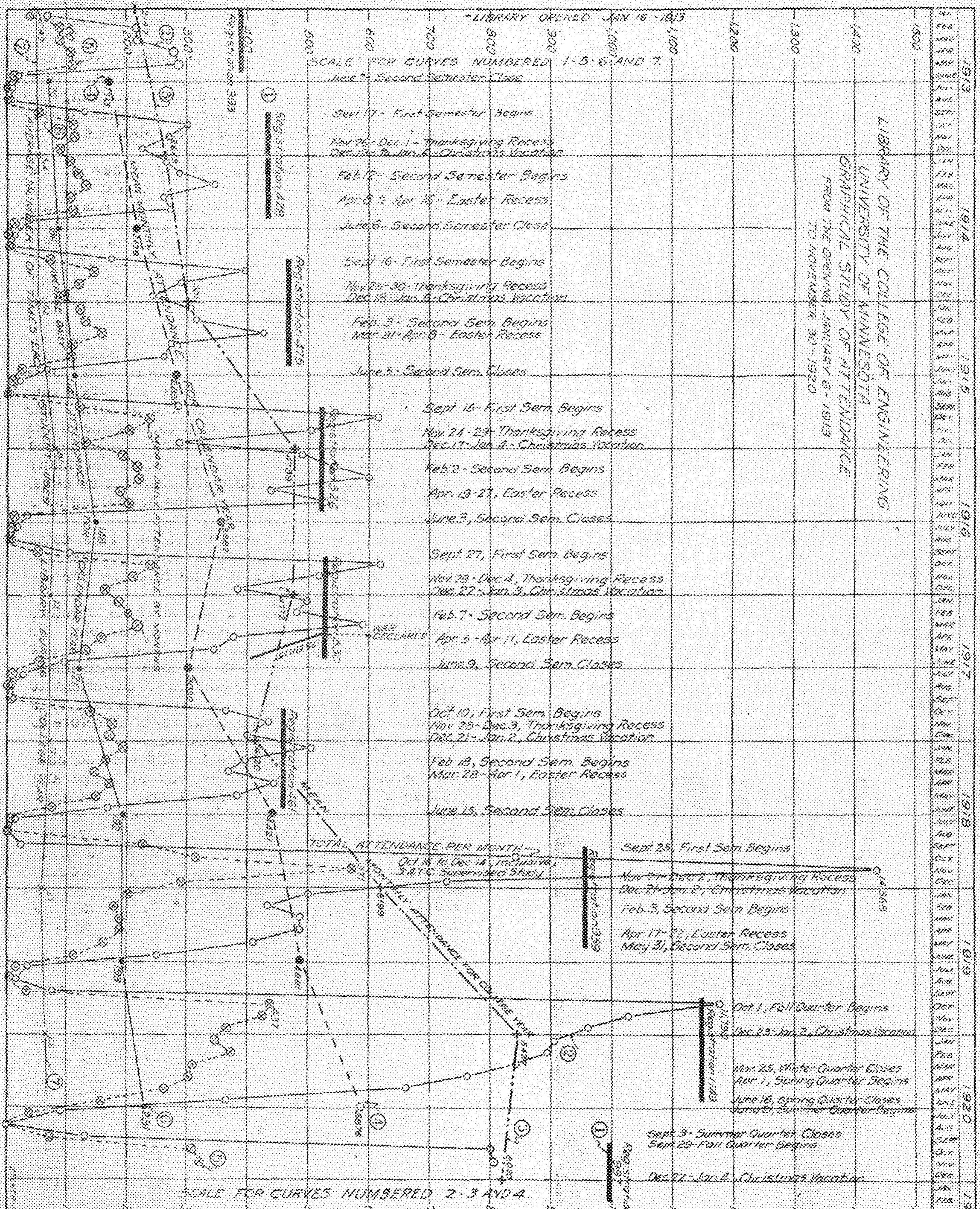
Fourth: Curve Number 5 is plotted directly from the librarian's record of mean daily attendance.

Fifth: Curve Number 6 is compiled from the monthly records of daily means.

Sixth: Curve Number 7—the most significant curve on the chart, is compiled from records of total attendance and registration during the college year.

In preparing this study it has been my aim to make the graph as nearly self explanatory as possible. If its presentation leads to increased use of the library by the student body and some serious consideration by the faculty, its purpose has been realized.

O. S. Zelner.


LIBRARY OF THE COLLEGE OF ENGINEERING
UNIVERSITY OF MINNESOTA
GRAPHICAL STUDY OF ATTENDANCE
FROM THE OPENING JANUARY 6 - 1913
TO NOVEMBER 30 - 1920
LIBRARY OPENED JAN 6 - 1913
SCALE FOR CURVES NUMBERED 1-5-6 AND 7.
SCALE FOR CURVES NUMBERED 2-3 AND 4.
TOTAL ATTENDANCE PER MONTH

TERRA COTTA
A RECENT EXAMPLE OF ITS USE IN BUILDING

BY ROY CHILDS JONES.

Terra Cotta such as was used in the Hamm Building, St. Paul, has a relationship to each phase of engineering taught at the University of Minnesota. First consideration leads one to think that the problem is purely architectural and is confined to design and color, but these two features are related to illumination, which must be properly considered by the electrical engineer. The original process of manufacture is a mechanical problem, the ingredients must be considered by the chemist, and the strength and structural features by the civil engineer. If all engineers would look at all phases of construction and achievement as extending beyond his own field, his own "understanding" would increase to the betterment of the whole technical field.

The author of the following article, Professor Roy Childs Jones, holds a master's degree in Architecture from the University of Pennsylvania, where he studied for five years, preceded by a year at Purdue. Prof. Jones was in the final competition for the Rome scholarship, and later made two different trips abroad to sketch and study.

Prof. Jones worked in a large Chicago office as architect, and also in the office of McKim, Meade and White in New York. He taught at Illinois for three years and then came to Minnesota with Professor Mann, who is head of the Department of Architecture. At the beginning of the war, Prof. Jones enlisted in the Camouflage section of the Engineering Corps as a private and was discharged eighteen months later as a lieutenant, having served a year overseas.

As a consulting member of the firm of Engineers and Architects who designed the Hamm Building, he is qualified to speak with accuracy concerning terra cotta as exemplified by this building.

Probably that feature of the new Hamm building which strikes the beholder most forcibly is the use of terra cotta for the entire exterior facing.

The choice of this material presented a welcome opportunity to the designers of the building. Its use under the conditions attending the project assured to the building qualities of distinction which could have been obtained in no other way.

This is not because terra cotta is new or has been little used heretofore. It is, in fact, one of the oldest of building materials. The Assyrians, the Greeks and the Romans all knew it and made generous use of it. The development of one very interesting phase of Renaissance architecture, that belonging to the northern part of Italy in the 14th, 15th and 16th centuries, was by it very largely controlled and directed.

Terra cotta is made of baked clay. In this respect it is no different from brick. Unlike brick, however, which is molded into solid blocks of a uniform size, terra cotta is molded into larger hollow blocks of any desired size and pattern. The finish and color are controlled by coating the blocks with various mineral compositions. The molded and coated blocks are then subjected for many days to intense heat in specially constructed kilns. The whole process is not unlike china making on a grand scale.

The architectural possibilities of terra cotta are the direct result of these three processes—that is, of the burning, the molding and the applied coatings.

Because of the burning the material becomes absolutely fireproof and indefinitely durable. No possible conflagration would ever equal the test withstood by the blocks in the kiln. The disintegrating action of the elements is powerless to affect them. To clothe the steel skeleton of a modern building with such material is therefore to protect absolutely the vital structure.

Because terra cotta is molded and not cut, endless possibilities exist in the way of shape and ornamentation, at a minimum of cost. It is obvious that there is no more labor involved, once a mold is made, in producing a thousand highly elaborated blocks than there is in producing a thousand plain ones. This puts terra cotta in direct contrast to stone, any detail or ornament of which must be laboriously cut, piece by piece. Terra cotta has a further advantage in that its pieces are very easily fitted and hung to steel construction.

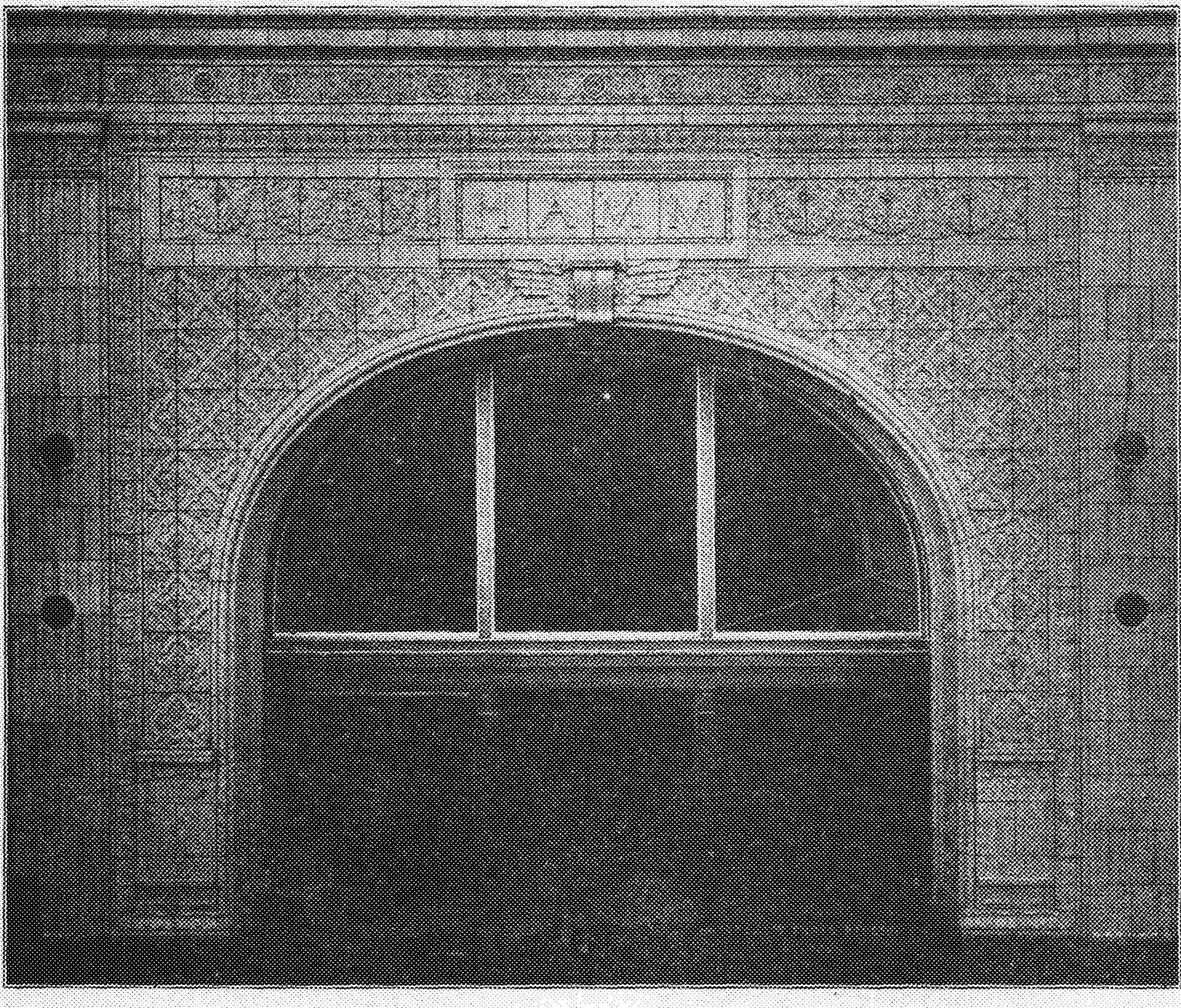
The surface textures and colors possible with terra cotta are limited only by suitability and cost. Manufacturers are able, by various combinations of the applied coatings, to produce any desired result, from quiet and subdued monochromes to polychromatic effects sparkling with life and brilliancy.

These finishes, though agreeably soft and varied in appearance, are in realty very hard, impervious glazes. Considering the sooty atmosphere of modern cities this characteristic is of tremendous importance. Dirt has small chance to cling to the hard surface of the material; what does collect is partly washed off by rain; and if necessary the whole wall can be washed down like a giant dish. The original freshness of the building is thus preserved indefinitely and the dreary fate of many well designed buildings, their architectural excellence obscured by many years' absorption of grime, is happily avoided.

One cannot help interjecting here the wish that it were possible for owners and architects to be more generally governed by such consideration. If our downtown buildings were built to shed dirt, rather than to collect it, if instead of dull dinginess we might have everywhere clean color and sparkle, what a transformation would be wrought!

To go at least a portion of the way toward realizing such an ideal was the purpose of owners and designers in conceiving the Hamm building. The particulars of the technique by which something of the desired result was arrived at are of course very interesting to the people concerned. Possibly they may prove of some small interest to the reader. Architects and engineers are not much given to exploiting their work. Probably not enough so; with the result that an innocent looking "blue-print" is taken by the public at its face value merely, without any realization of the years of general professional training, or the weeks and months of special intensive study that lie behind it. This is very true in the present instance, even though the particular subject of this article represents only one phase of the work involved in designing the complete building.

Having once determined on using terra cotta, the first consideration was to avoid a mistake that has very commonly been made. That is the mistake of using it as an imitation of stone. Very often a building, in a moment of enthusiasm, is designed in stone. Cold reflection leads later to the necessity of cost reduction. The stone design is executed in terra cotta with a result that is invariably disappointing. The two materials are entirely different, each having its own charactistics, demanding different expressions. The fundamental molded character of terra cotta, and the cut quality of stone, make any proper interchangeability of design impossible. The plain surfaces so beautiful in stone become unsatisfactorily wavy in terra cotta, while the richness of duplicated patterns appropriate and easy of execution in terra cotta become prohibitively expensive in stone.



So the problem was to realize to the full the indigenous advantages of the material. Fortunately, terra cotta being the old and time tried material that it is, there is no lack of suggestion in past architecture for its treatment.

Near at home there is the very beautiful Madison Square Garden in New York. There is also in the same city the giant Woolworth building, by the former St. Paul architect, Mr. Cass Gilbert, an outstanding example of the application of the material to steel construction. Most suggestive of all, however, are the buildings of that period of the Renaissance in Italy already mentioned in this article. The northern part of Italy is not specially favored as to building stone.

Baked clay materials were used of necessity. The early Renaissance churches and palaces of

such cities as Milan, Brescia and Bologna, depend for their peculiarly beautiful character on a successful development of the possibilities of terra cotta.

The essence of this success lies in a recognition of the molded quality of the material, as opposed to the cut quality of stone or wood. The resulting characteristic features are units of ornament indefinitely repeated to form a general allover pattern or texture, and the avoidance of plain surfaces; thereby emphasizing the advantages of the material and minimizing its disadvantages.

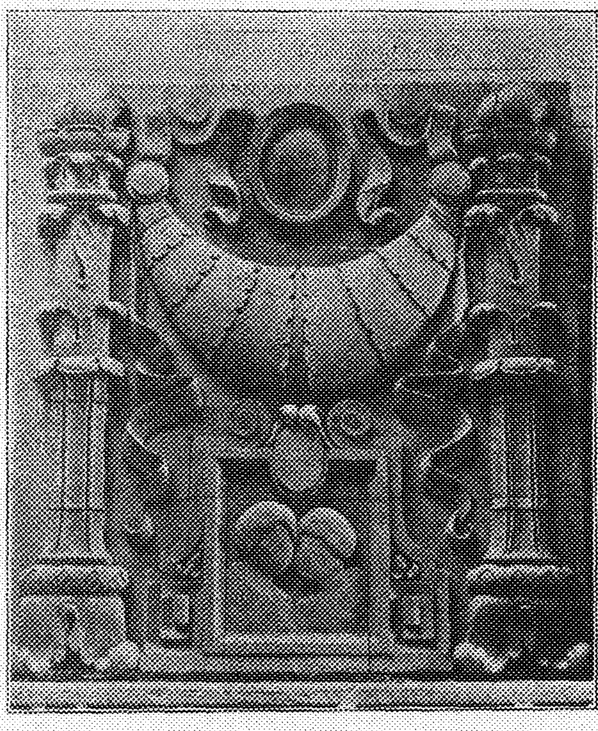
Coming to the application of these examples in the Hamm building there are several things to be spoken of. In the first place there was a story of construction to be told quite different from that of the old wall supported buildings. Here there was a frame work of steel lines that had to be closely followed. The outside face of the building becomes thereby a skin more or less tightly drawn about the steel bones underneath.

The resulting composition is one of lines rather than of surfaces. But the treatment of these terra cotta lines offered an interesting chance to express the material as the historic examples have shown it should be expressed. By repeated ornamental motifs, by various details of section and jointing, a surface pattern of low relief has been developed. This ornamental pattern does not exist so much for its own sake, as for the creation of a totality of light and shade texture into which all the individual motifs merge. It was always to be remembered that the building was fundamentally a business structure and should be characterized by a rich but quiet dignity, except in the case of the theater facade, where the consulting architects have very properly introduced a note of gayety by greater elaboration. It is noteworthy that such richness or elaboration as exists has been obtained at no appreciable increase in cost over plainness.

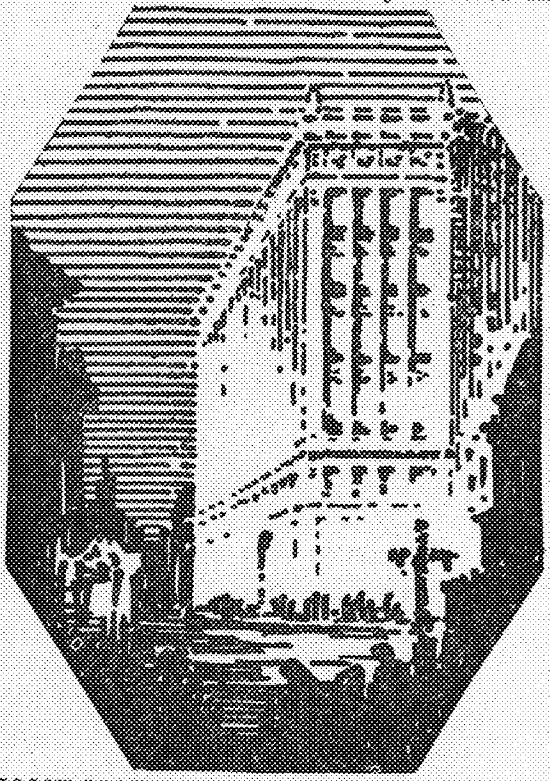
Form and ornament are only the first of the considerations involved. Scarcely less important is the matter of color. Almost every one is familiar with the bas-reliefs in terra cotta by some of the old Italian sculptors, with their exquisite blues and greens, and yellows. Many of the old terra cotta buildings, too, show a rich glow of color. We moderns seem to be afraid of using any strong or elaborated color schemes. This is not because they are difficult to have. The manufacturers have developed in late years the possibilities of colored terra cotta to a remarkably interesting degree. Especially is this true as to the matter of general tone.

In the Hamm building, for instance, after much experimenting, a general color was arrived at that seemed particularly fortunate. It has liveliness, warmth and sparkle, and probably contributes more than any other single element to the total effect of the exterior.

In all building projects the steps that intervene between conception and realization are many and various. Merely for the work belonging to the exterior of this building an enumeration of these steps is impressive.



First of all there were drawings, literally hundreds of them—preliminary studies in pencil and color; working drawings showing all the exact details of construction, charcoal drawings showing the details of ornament at actual size; manufacturer's drawings showing the size and shape of every different piece of terra cotta in the structure. After that there was the modeling by sculptors of all the ornamental detail, where designer and modeler collaborated to carry on the ideas begun in the two dimensional drawings to a three-dimensional reality complete and accurate enough for the molds. Then came the work of the factory, molding, coating, and burning the clay blocks, a matter of weeks of scientifically directed effort.



A HOME MADE HYDRO-ELECTRIC PLANT— M. L. HOPKINS.

Lastly, there came the fitting together, piece by piece, of the complete material at the building, finally and irrevocably translating into solid actuality the ideal pursued through all the intricate first steps.

When a man owns a piece of land which, besides being valuable as far as land value is concerned, also has a spring that furnishes excellent drinking water without any human or mechanical effort, he may be considered very "lucky" by those who have to drill wells for their drinking water. Undoubtedly there are many farms, which boast a spring of fair size, where water power that could be utilized very advantageously and also economically, is permitted to run as it always has —with Nature's free will. Understanding the possibilities of water power, a hydro-electric plant can be installed providing the conveniences of electric lighting in all buildings on the farm. The following description is of a hydro-electric plant installed about six years ago which has proved very satisfactory.

The quantity of flow of the spring is twenty-seven gallons per minute. The water is collected in a reservoir near the source of the spring and conducted through about three hundred feet of two-inch pipe. The total head obtained is forty-five feet, which gives about three-tenths theoretical horse power. With a spouting velocity at the nozzle of approximately fifty-four feet per second, the water strikes the blades of a six-inch Pelton wheel and produces an economical speed close to 1000 r.p.m., which made it necessary to use belt transmission to the generator since no suitable generator for direct connection at this speed was available.

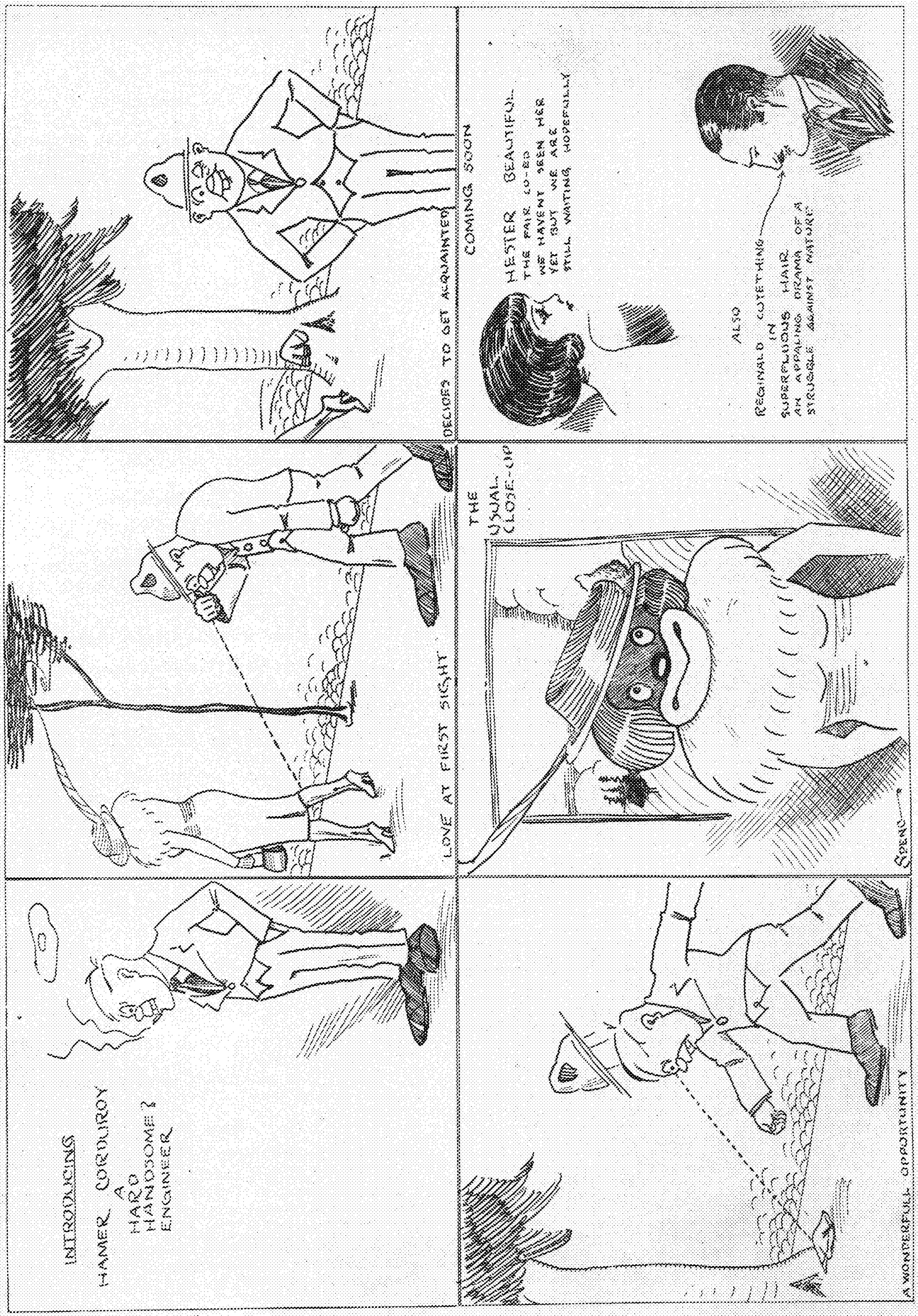
The generator is a 75 watt, 32 volt, shunt wound, direct current generator with a rated speed of 2250 r.p.m. Power generated is transmitted to a 40 ampere hour storage battery placed in the basement of a house nearly one thousand feet away, by means of a No. 10 bare copper telephone wire. The negative side of the battery is grounded at the building on a water supply pipe from a hydraulic ram located just above the reservoir for the Pelton wheel. The water pipe at the ram and the two-inch supply pipe for the Pelton wheel are tied together and connections are made at the generator to the two-inch pipe, thus giving a complete metallic circuit. The over-all efficiency of the hydro-electric plant is a little better than 25 per cent.

Current from the battery is used for lighting. In operation the battery floats on the line, all the time supplying power only when the demand is greater than the output of the generator. When the demand is less, energy is being stored. The maximum output therefor is the output of the generator plus the output of the storage battery when fully charged.

There should be installed a reverse current circuit breaker to prevent the battery from discharging back through the generator when the Pelton wheel should stop for some reason. At the time the plant was installed no such breaker could be found for so small a current, so the plant was operated with fuses as the only protection. It has been in service over six years and has furnished light for a farm house of eight rooms, a barn and a shed.

The positive plates of the battery have been renewed twice since the installation of the plant. The generator has required a new set of brushes about every six months. Leather belts have not given satisfactory results due to the weather conditions it was subjected to, so a belt made of a short section of a seamless cotton grain sack was tried and this has been in service for over a year and shows no appreciable signs of wear. The bearings have worn so that those on Pelton wheel have renewed once and those on the generator, so that the armature was striking the pole pieces. The armature was turned end for end and direction of rotation reversed so that the generator will run for a few years more without repairing. The commutator has to be smoothed up occasionally and the mica strips cut down.

The water temperature at the source of the spring is at 45 degrees Fahrenheit and does not freeze as long as it keeps flowing. One time, however, a bullfrog crawled around the screen at the reservoir, went down the pipe and plugged the nozzle. This was in cold weather, so the water froze in a short section of the pipe, but the trouble was soon discovered and consequently no damage was done.


INTRODUCING
HAMER CORDUROY
A
HARD
HANDSOME?
ENGINEER
LOVE AT FIRST SIGHT
DECIDES TO GET ACQUAINTED
A WONDERFULL OPPORTUNITY
THE
USUAL
CLOSE-UP
SPENC
COMING SOON
HESTER BEAUTIFUL
THE FAIR CO-ED
WE HAVENT SEEN HER
YET BUT WE ARE
STILL WAITING HOPEFULLY
ALSO
REGINALD COTETHING
IN
SUPERFLUOUS HAIR
AN APPALING DRAMA OF A
STRUGGLE AGAINST NATURE

Sons of "St. Pat."

If some of the humor is antiquated, remember that it is as "St. Pat" originally told it, and is now retold with reverence.

The Thinker.

"Pat."
"Phwat?"
"I wuz jist thinkin—"
"Begorra, an' phwat hev ya got to think with?"
"That's phwat I wuz thinkin'."—L. A. D.

That All Depends.

"They say Edison is working on a machine that will enable us to talk with the departed."

"I suppose the proper call will be Heavenho instead of Hello."—Boston Transcript.

Physical Characteristics.

"They say that Paderewski has fascinating manners."

"Yeah, one of those magnetic Poles I suppose." —Science and Invention.

And Papa Was an Engineer, Too.

His Aunt—"Tommy, was Santa Claus good to you and did he bring you lots of things?"

Tommy—"You can't fool me. There ain't no Santa. It's dad—and he's the stork, too."

Objection Sustained?

An ad from the Clarendon (Eng.) Mercury: WANTED—A really plain but experienced and efficient governess for three girls, eldest 10. Music, French and Latin required. Brilliancy of conversation, fascination of manner, and symmetry of form objected to, as the father is much at home, and there are grown-up sons.

Boy, Page That Male Co-ed, "Academis, Jr."

Fifi—"You seem to find a lot of difficulty in getting your whiskers to grow, Algy."

Algy—"Yes, it's a bally nuisance. Can't understand why, either; my father had plenty of 'em."

Fifi—"Well, dear, perhaps you take after your mother!"

The civils do not take "Railroads" without results, judging from this year's class elections.

She Put Him Wise.

He—"I have your permission to call this evening?"

She—"I shall be very pleased; but don't forget that father switches off the lights at ten o'clock."

He—"That's kind of you. I'll be there at ten sharp."

The Old Race Horse?

She—"I wouldn't dance with your cheek next to mine if I were you."

He—"Aw, why? All of 'em are doin' it."

She—"I know, but the other girls haven't got poison oak."—Chaparral.

A Christmas suggestion for the experimental laboratory: Two brass cuspidors.

Presence in Mind.

Pat and Mike were working on a new building. Pat was laying brick and Mike was carrying the hod. Mike had just come up to the fourth floor when the dinner whistle blew. His lunch was on the ground. "I hate to walk down after it," he said.

"Take hold of this rope," said Pat, "and I'll let you down." Pat let him down half way, and then let go of the rope. Mike landed in a mortar bed, not much hurt, but terribly mortified.

"And why did you let go of the rope?" he demanded.

"I thought it was going to break," said Pat, "and I had presence of mind enough to let go."

Ikey (looking up from his book)—"Fader, vat is der meaning of Vortex?"

Father—"Vy, Ikey, don't you know? Dats der extra cent they charge on movies und ice cream cohns."—Science and Invention.

"You Win the Stripes."

Peppery Female—"Why weren't you in the army?"

He (with one arm)—"For the same reason, ma'am, that you weren't in the beauty chorus—physical disability."

Visions of "The Greasy Spoon!"

Harry took Mary to lunch one noon; just off the campus.

The waitress started them off with a liquid concoction in a round bowl.

Harry tasted it and then called her and asked: "What is this stuff?"

"It's bean soup," she replied.

"Never mind what it's been," said Harry, "I want to know what it is now."

Quite clever for Harry, seeing he's an engineer; but Harry sure made a break there. It mita been coffee.

Permissible by Law.

An Atlanta judge says a man has a right to kiss his stenographer. If he has a right to take his pen in hand, surely he has a right to take his typewriter in his arms.

A Nite Errant.

1921—"You look tired, Bob; you must have been missing sleep."

1922—"Yes; I haven't been to economics this week."—Voo Doo.

Bone Sewer!

Sorry I can't write a joke on each and every one of you, but it wasn't guaranteed in the subscription, and in these days even Bryan has ceased to be funny. All that's written about him is "dry humor."

As Prof. Shoop said, to the senior civils the day following Thanksgiving: "Things are all like a poisoned pup, all blowed up."—Somi, "Pickles."

ELECTRICAL HAZARDS IN INDUSTRIAL PLANTS

BY FRED G. DUSTIN '96.

The subject of electrical hazards considered from a personal and not a fire hazard has of late years received a great deal of attention in the public mind. Time was, when inspection rules had but one object in view, namely, to prevent loss of property by fire, but within the last few years and particularly within the last few months a great deal of consideration has been given to the subject of the conservation of life as well as that of property.

All of the insurance rules bearing on electrical hazards were designed to prevent fires only, with no regard to the consideration of personal hazard involved. This was, no doubt, entirely logical because the rules governing such matters were largely the result of the investigation of fires by underwriting interests and the formulation of these rules was left largely in the hands of the fire insurance interests. Such being a fact, the rules naturally assumed the characteristics of such environment and in their formation and interpretation were directed almost exclusively along the lines of fire prevention.

Looking back over the several bi-annual editions of the Electrical Code one can scarcely find any rules which have any consideration for the prevention of the injury to people, except incidently, in the endeavor to prevent fire, persons were less apt to be burned to death.

In later years, especially since other than fire insurance interests have gained recognition in the deliberations of the so-called Code Council, a change has been observed in the plan as well as in the spirit of the Rules. Heretofore, the excuse has been that as long as the Underwriters were to enforce these rules they could not reasonably ask for anything outside of specifications for fire prevention, such as could have no bearing on the insurance rate.

For this reason municipal ordinances have been formulated to supplement the Code Rules with the additional object of preventing accidents or injuries to persons. Along this same line, life insurance interests, employers associations, councils of workmen, and the United State Government through the Bureau of Standards have done much to standardize safe practices in the handling of electrical apparatus with a view of preventing injuries to persons who might, in their daily work, be subject to electrical hazards, especially in the industrial world.

Such Employers' Associations and Workmen's Councils have been organized for the distinct purpose of conserving human life and limb, and for the conservation of human effort as contrasted with the conservation of materials.

Electricity is considered so mysterious to those unfamiliar with its behavior that until recent years the average person was deterred from meddling with it through fear and respect, but recently electricity has so entered into our every day lives that we are all becoming more or less familiar with it in one form or another and the novice is often inclined to take undue liberties with electricity and frequently with disastrous results. While I refer to the behavior of electricity as mysterious I should supplement this remark with the thought that this, like all other forms of force, follows natural and well defined laws and if one thoroughly understands these laws absolutely no hazard need exist in handling electrical apparatus.

It is this general lack of definite information that causes so many electrical accidents to persons who take chances and really tempt Providence in their careless treatment of this subject.

The principal element of danger in electricity is due to the fact that the presence of this energy is not readily detected until the accident has already taken place. Therefore, the first rule for safety should be to treat every piece of electrical apparatus and every wire as charged with a dangerous voltage. The reason for this is obvious. In most industrial plants the electrical energy is brought to the building by means of outside wires at such a high pressure or voltage, as it is termed, that the mere contact with these wires will cause an almost instantaneous death. Therefore, whenever these outside wires are deranged or disturbed by storm, fire, or other cause every one is warned to leave them strictly alone and notify the electric company or the plant electrician, if any, who will come prepared with proper safety apparatus to handle the wires without danger to themselves.

These high potential wires are usually brought to the interior of the building through properly insulated cables where by means of transformers the pressure is reduced to a reasonably safe limit. From this point the current is distributed through the plant to the various motors, lamps, etc., and if the condition of the apparatus and wiring is kept up to a proper degree of safety there will ordinarily be but slight danger in using the same. We should always bear in mind, however, that all electric wires and apparatus should be treated as if alive and guard ourselves accordingly.

In many of the larger industrial plants some of the larger motors are designed to operate on a very high voltage and with these the electrical hazards are, of course, proportionately great. Many safe-guards are provided to obviate danger from these in the way of insulators, grounding of the frames, and other metal cases of the apparatus thus ordinarily, even these high potential motors should be safe.

The average worker who has seen the electrician making connections to motors and lamps has the idea that his work is very simple and can be performed by anyone possessed of a small amount of mechanical skill. Such, however, is not the case. The electrician learns his business only through long study and apprenticeship in his trade and he performs his work by carrying out hard and fast rules which have been formulated for his guidance in safe construction work.

Generally speaking it is a simple matter to make an electrical connection for an additional light, portable cord, or small motor but even this relatively unimportant work cannot be done properly without special knowledge and proper material and should never be attempted by anyone who is not entirely familiar with that particular kind of work.

Even the replacing of burned-out incandescent lamps and especially of fuses, should not be attempted by anyone not familiar with electric circuits and other conditions and should never be done while the current is turned "ON." If it is imperative that this be done, unusual precaution should be taken to guard the face, and especially the eyes, from the possibility of a flash, and in protecting the body from shock by keeping one's self entirely insulated from, not only the ground, or cement floor, but from all other metallic objects which may be present and subject to connection with the ground.

In making an electrical inspection of the average industrial plant the trained observer will notice many defects which are not apparent to those less familiar with them and it is these sometimes minor defects which really do the most mischief, as proper precautions cannot be as readily observed against defects which creep in through deterioration as they can be with other known defects.

There has recently been placed on the market a number of very satisfactory power and light switches which are placed within steel boxes and the latter so designed that they cannot be opened when the current is on but which permit the current to be turned on and off by means of a handle entirely outside of the case. This type of switch has already done much to prevent accidents especially in industrial plants and the use of them is growing very rapidly both on account of their obvious advantage as well as the requirements of the industrial safety boards of our various states and cities. Here is one way that foremen and superintendents of industrial plants can help materially, namely, by calling attention to this improved method of switch control, to the owner of the property. This type of switch not only prevents accidents to persons but is also a splendid protection from the danger of fire incident to the older type of open knife switches. These switch boxes if properly installed have their cases well grounded which thereby prevent the possibility of current passing from such apparatus through the person to ground, even if a breakdown should occur in the switch mechanism itself.

This reminds me of a remark once made by a professor of electrical engineering at our University who advised his students the best method of touching a piece of electrical apparatus was with one hand in his pocket. The writer's observation has been that a still safer method for the layman, or man unfamiliar wtih electrical apparatus is to keep both hands in his pockets.

Switchboxes and fuse boxes should be kept locked if possible and with the type of switch above described this becomes readily practicable. If the fuse boxes are left unlocked there is a great temptation for the employee to tamper with the contents with the possibility of not only changing the fuses from one circuit to another with a probability of over-loading some of the lines together with the danger of personal hazard in handling same, but there is also the danger incident to placing metallic objects within this compartment, using the lighting compartment as a receptacle for tools, oil cans, etc. This is very dangerous practice as a grounding of the circuits or a short circuit is almost certain to result in a burn-out of the electrical apparatus which may be more or less serious, as well as the danger from a fire, either of which may cause a shut down of that portion of the plant and consequently a loss of wages to the workmen.

Speaking of electrical fires, attention is especially called to the great danger from endeavoring to extinguish the fire by means of water because of the fact that water is a conductor of electrical current and is much more apt to increase the trouble rather than curtail it. There are a number of approved methods of extinguishing electrical fires These should be used whenever available. However, in want of such approved methods of extinguishing fire, a fair substitute for the smothering of an electrical blaze would be the use of dry sand or dust which can usually be procured on short notice.

The use of electricity in locations where explosive, inflammable gases, or flying bits of inflammable material are found is decidedly dangerous. When one stops to consider that the explosive gases in all automobile engines are ignited by means of an electric spark thereby developing the tremendous power contained in these explosive gases one will readily appreciate the importance of this remark. From the workers' standpoint the best way to avoid danger of this kind is to be on constant guard never to bring electric light cords into the presence of gasoline or other explosive fumes as well as to prevent the formation of such inflammable gases in the presence of knife switches, lamps or electric machinery of any kind. All rooms containing such gases should be thoroughly ventilated at all times.

Attention has been called to the danger of a workers' body forming an electrical path between a live wire and a grounded conductor. It has been proven that in many cases one-tenth of an ampere is often sufficient to give disastrous results and that about one-fourth of an ampere is usually fatal. These amounts are very small compared with commercial currents with which we are familiar, as an ordinary 25 Watt Mazda lamp consumes one-fourth of an ampere in its operation. The only reason that more fatalities do not exist is due to the fact that ordinarily the resistence of the body is so very high compared with metallic conductors that an unusually high pressure is necessary to force this relatively small current through the body. However, it is extremely important that even with the ordinary lighting voltage there is a danger to persons and it has come under the writer's personal observation that fatalities are possible even with this low voltage. One case in point was at a Minneapolis Hospital where an assistant engineer had gone into an empty boiler for the purpose of cleaning the same, and in order to give himself sufficient light took into the boiler with him, a portable cord to which was attached a brass shell socket. After he had been in there for a matter of perhaps an hour someone desiring to speak with him made an investigation as to why he was so long at this work and discovered that the man was dead. Although his left hand was tightly gripped on the brass shell of the socket referred to, there was no apparent marks of burns on his hand. Immediately a complete investigation of the electrical conditions was made and it was found that the transformer was entirely intact, no break down having occurred and that the man came to his death merely through the leak of the current through one of his arms and his body to the grounded floor of the boiler in which he was lying.

To avoid a repetition of this accident foremen should see to it that none of their men are allowed to use a portable cord to which is attached a brass shell socket or any other piece of metallic material which could possibly become alive and conduct the current through the body to ground. Special sockets and other materials are available for extension cord work and their use should always be insisted upon.

The use of danger signs calling the attention of the workers to dangerous electrical conditions is advisable if a proper and limited use is made of them but many such signs placed indiscriminately is apt to cause a disregard of such notices, from the workers' constant familiarity with them.

Your attention has already been called to the danger which may be present on all electric conductors, warning you that all such conductors should be treated as if bare. This is because of the fact that through even ordinary wear and tear of such conductors the insulation may be worn off in a few spots so that the workers' hands may as readily come in contact with the wires themselves as if no insulation was present. Even with lampcords which show no abrasion there is the ever present danger of some of the broken stranded conductors within penetrating the insulated covering thereby becoming as dangerous as if the covering has been removed.

In general there are two types of injuries caused by electric currents: (1) Electric Shocks and (2) Electric Burns. In the first case a person may, through an electric shock, receive a certain amount of current through the vital parts of the body thereby causing a severe accident or perhaps death as above described and in the second place through the arcing of a switch or broken wire a very severe electrical burn may result and as these burns are sometimes very deeply seated they often become very difficult to properly heal and considerable lost time may result from such an injury. To these two general types we might add another form of injury which seriously effects the eyesight. This is caused by a sudden blinding flash in the eyes of the worker which may cause almost instant blindness or the effect of a bright light constantly in the eyes of the worker may result most injuriously to the eyes but which comes on so slowly as to be ignored.

Lamps of all kinds should be so placed as not to be in the direct vision of the worked which may be accomplished by properly placing them above the line of vision or by shielding the eyes by means of suitable shades around the lamps or protection to the eyes themselves.

While the above seems but a fragmentary discussion of this extremely important subject the writer hopes that the few points mentioned have been sufficient to call the reader's attention to some of the more common sources of danger from improper electrical conditions in industrial plants.

Fred G. Dustin, '96 Eng.
President, Standard Electric Service Company,
Minneapolis, Minnesota.

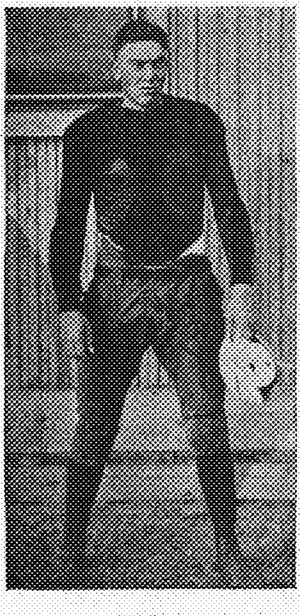
COLLEGE NEWS

ENGINEERS IN FOOTBALL

BY HARRY BEEMAN.

It is not the purpose of this article to tell what Minnesota did in football this year, but to tell what the engineers did in Minnesota football. Doc Williams could have slipped a few integrals into the signals this year and several of the squad would have been hep as there were seven Knights of St. Pat battling for Minnesota on the gridiron.

By far the most powerful man on the Gopher line this year was Festus Tierney. Pat, playing his second season at right guard, did more to ruin our opponent's chances than any other one man on the forward wall. Pat was the only man picked by Eckersall to represent Minnesota on the mythical All-Conference team. He was a much feared man at all times and messed up many an attempted gain through our line. Two years ago Tierney and foot-ball were strangers. It was the fall of '18 when many of us were doing time in the S. A. T. C. that one of the officers spotted the big boy and ordered him to report to Doc. Williams for football. Even in the S. A. T. C., orders were orders, so out he went. That happened late in the season, and Pat never appeared on the team until '19. He has been a fixture ever since, and we predict a place next year on the All-American team for the fighting Irishman that hails from St. Paul.



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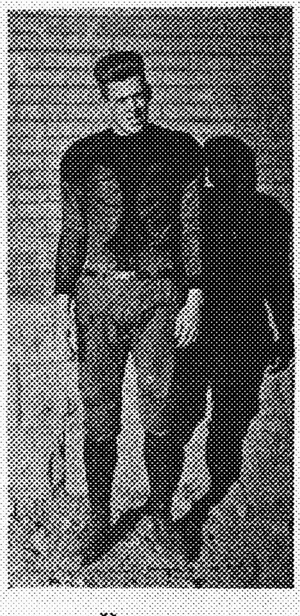


Brown

Larry Teburg very capably filled the hole left open by Captain Johnson's absence. He was a hard fighter on defense and could be depended upon to open a hole when yards were needed. A bad shoulder held him out at the first of the season, but he finished strong. Larry was on the squad back in '16, but went across in the big game, and didn't get back until this fall. Larry is a Junior Civil, and next year he should go bigger than ever.

Harry Brown also took a couple of years training under Coach Pershing, but when he dons moleskins, he forgets the war. He is, I believe, the scrappiest player on the squad, and has worlds of speed. This is his first year of conference football. Besides being a speedy half-back, he also has an educated toe, and next year should win a few games a la Steketee. Right-half is his regular position, but he has called signals, and he may be the man to fill Arnston's shoes next year.

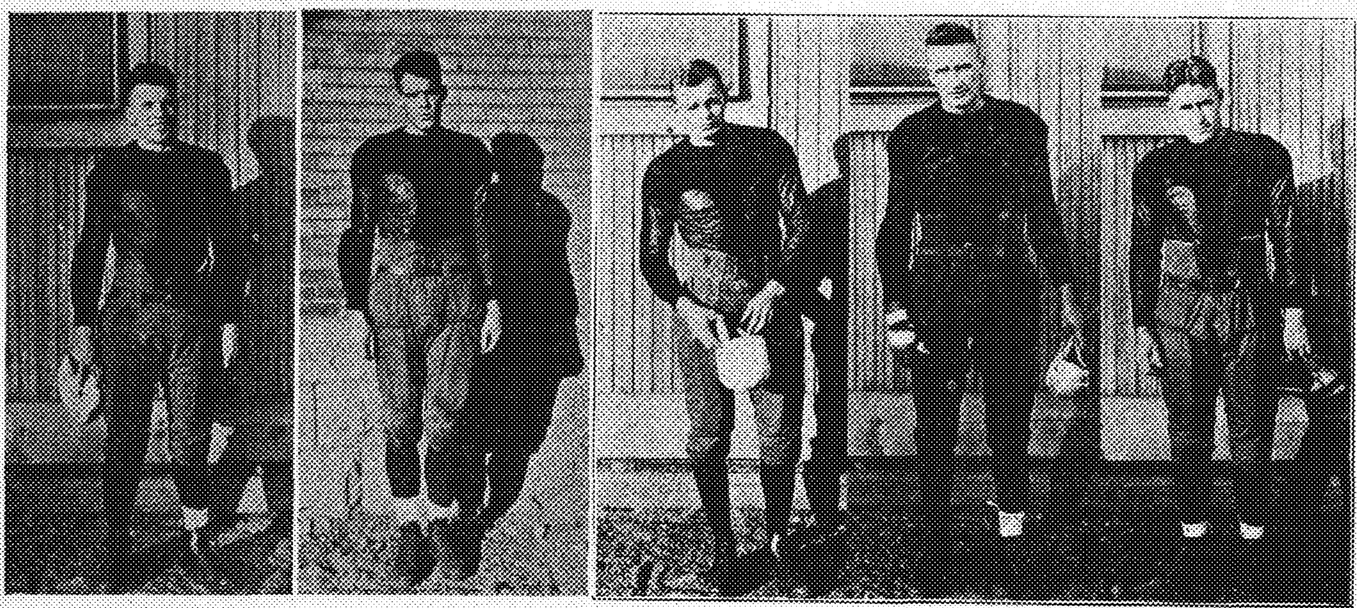
This season marked the completion of Fred Enke's third season of varsity football. Fred was a regular tackle in '18, and a bum leg held him out most of last season. He has played all along the line and could be depended upon to do his bit. His great work at center in the Wisconsin game will long be remembered. The Badgers had found the weak spot in our line, and had carried the ball from mid-field to within spitting distance of Minnesota's goal-post when the Doc sent in Fred to relieve our crippled center. From that time on, the Badgers made about as many yards through our line as Billy Brooke issues A's. Fred is a Senior Civil, and his loss next year will be keenly felt.

promise as a football man. He was a reserve back this year, and will give somebody a hard run next season.

From the above, it can be seen that the wielders of the slip-stick were a considerable factor on this year's Varsity. With only two of these men graduating this year, we can expect bigger things from the representatives of this college next fall. Too much credit can not be given these men for carrying engineering courses and going out for Varsity athletics, as the Student Work Committee plays no favorites.

This year was a disastrous one, but we gave every team a battle. We had a typical fighting Gopher machine. With most of this year's squad back next year, I predict the most powerful combination that has worn the Maroon and Gold in recent years.

The College of Engineering is behind Doc Williams and his squad all the time. Win or lose, we know they always fight and fight clean, and that is all we can ask.



Enke **McClintock** **Bailey** **Tierney** **Gillian**

Don McClintock played his first football with Minnesota this year. In 1916 he played center for Occidental College in California. Then he played Lieutenant in the army for a couple of years. He looked like our best bet for center this fall, but Old Man Jinx was on his trail and gave him a sprained ankle. He played full-back in the North Dakota and Northwestern games. Mac was a second Ruben at backing up the line. It is hard luck that Mac has not another year to play, because he has all of the requirements for a star. His home is way down in Mississippi, and no one can say that the Southern boys lack pep.

John Gillian substituting at right guard showed himself as a comer this fall, and will bear watching next season. He weighs 180 and is a hard hitter. John is a Junior Civil, and calls Stillwater his home.

Bill Bailey is another Junior Civil that shows

Editor's Note

"Doc" Williams' latest find, Arthur Gilstad, has not been mentioned in the foregoing article, due perhaps to the fact that the "big boy" stepped into the limelight unheralded and unknown. For this reason the author of the article, as many other students, undoubtedly did not know Gilstad is a sophomore mechanical engineer.

Gilstad made his first appearance in the Iowa game, in which he played offensive left end and defensive fullback position. From then on his rise was rapid until the Michigan game, in which he held down the position of full back. Gilstad's playing against Michigan was marked by his out-punting Steketee, Michigan's All-American left half.

Due to Gilstad's late appearance he seems to have been missed by the campus photographers. We keenly regret that we were unable to secure a picture of Gilstad to accompany this article.

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EDITORIAL

Where Does the Publicity Go?

Engineering needs advertising, now more than ever before. It is true that very marked strikes have been taken in really bringing the engineering profession before the eyes of the world as the keystone upon which universal accomplishments depend, but in comparison with the great many fully remarkable works accomplished by engineers, the publicity that should have been given to such, has been below that which the engineers had a right to expect. Is it not true that when some surgeon performs a difficult operation successfully, he is acclaimed as having performed a great service to mankind and his name and the particulars of the operation are spread broadcast over the pages of newspapers from the largest city paper to the smallest rural weekly. He gets publicity and it is just that he should. On the other hand, however, when some engineering firm or engineer designs and constructs some large power plant; some great highway; some new device for saving time, energy and also human life, or in fact, anything that relieves the burden of mankind, what is the result; where does the publicity go? Some of it may go to the engineer whose ingenuity and perseverance brought about a successful completion of the project, but where does the bulk of it go?

Take as an example an illustrated section of almost any newspaper devoting several full pages to some new and modern building. First you see the photographs of the owners of the building and a page devoted to their life history, then you read of the great asset the building is to the community and how many people will be given employment in it. You turn over a page and see pictures of the building both inside and out, showing the beautiful furnishings and the exquisite fixtures. To fill up the remaining space, large advertisements of the different companies that furnished material for its construction, are inserted. You gaze at the pictures and you marvel at the greatness of it all and perhaps the question might occur to you, "who built it; who was the man or who were the men that designed this wonderful structure?" You page back and forth through the illustrative section and finally you find a small insertion somewhere stating that such and such an engineering firm designed and built it.

Where is the publicity that is due to the man or men who really made it possible for others to enjoy a voiced appreciation of their services? Where is the publicity that should go, not to his tools of construction, but to the constructor? Does the publicity in the case of the surgeon go to his instruments? No, the surgeon gets his just credit. Does the engineer get his?

Prof. O. S. Zelner's Graphical Study of the Use of The Engineering Library shows very clearly the status of attendance. As is stated in the article, the library has on its shelves 16,000 columes at the disposal of students and faculty. Such a collection should indeed be a source of pride. However, a source of pride is not always of material benefit unless applied to our actual needs and desires, and the question arises whether or not the students are making the library applicable to themselves to the extent that they should, and with this question arises another, namely, is it the lack of desire of the students to use the library or is it the fault of the professors and instructors assigning lessons which adhere too strictly to the contents of one text and of such length as to reduce the time that a student might spend in the library to a minimum. A change in anything is usually productive of a new interest and a deviation now and then from the teachings of one text to some other view of the subject under study contained in other books or periodicals which would be found in the library, would be very conducive to increased library attendance provided that enough time be allowed the student to avail himself of the opportunity of making use of the library to cover the assignment given.

The attendance in the library as shown by the curves, does not bring out the fact that all students making up this attendance do not use the library for looking up reading matter but that the greater percentage of them use it as a place to work out there problems or to read their "Daily."

One function, of course, is, to provide facilities for reading and writing to the student but the function of providing books and periodicals for the student and the faculty should be catered to more in the future than in the past.

The question of beneficial attendance, therefore, is one of concern to both faculty and students and should be considered seriously for solution.

The management of the Engineer's Book Store closed a long-time contract on November 20th. This being "Home-Coming" day, Howard C. Jacobsen in his role of manager, interpreted "Home-Coming" into "Own Your Own Home," and took in as a partner Miss Lucy Ashenden of Minneapolis. They drew up a contract for life and will have headquarters at 1085 24th Ave. SE.

"Jake," as he is known to us, entered Minnesota in 1914 and has been one of its most prominent and active students. After serving two years in the U. S. marine corps and wounded in France, he came back and was elected the first president of the Association of Engineering Students. He was the organizer of the Book Store and is the present manager. He also holds the office of president of the Y. M. C. A. of the university.

We extend our congratulations and sincere wishes for a happy and successful married life for "Jake."

SKI SLIDE TO BE ERECTED

The state of Minnesota is especially adapted to the sport of skiing. More so around the university than any other place in the Twin Cities. The state here is noted for its prominent skiers and there are many of them right here at the university. The ski slide will then provide a prominent winter sport for a larger number of the student body. Smaller hills will be made which will provide amusement for those who are not so proficient.

At Dartmouth the sport runs at high pitch and moving picture concerns flock to take pictures of the interesting ski meets held there during the winter months. These pictures are shown all over the country and world. Think what advertising Dartmouth gets out of such publicity. Now consider what it may mean to Minnesota to have such a sport established here. It will mean a "Better Minnesota," and that is the one thing paramount in efforts here.

In 1917 there appeared in the National Geographical Magazine a lengthy article on skiing at Dartmouth College. What a profitable thing it would be if Minnesota could be put on the map in a like manner.

A ski club has been organized and officers have been elected for the ensuing year. Membership has been placed at two dollars per year to defray the expenses of erecting and maintaining the slide and hill. Students are urged to join, and only students who are members will have the privilege of using the slide. Memberships are going fast and everything points to a successful season. About one hundred men have so far joined the club, and some girls have applied for membership.

As the slide is to be erected on the River Road Park, the permission of the Minneapolis Park Board has been secured on the condition that the slide be removed in the spring of each year so that the beauty of the park shall not be marred. The board has agreed to take out the necessary trees free of charge in order to construct a proper landing.

The health department has been intensely interested with the slide from the standpoint of the benefits to be derived from such a healthful sport. It is understood that the department is backing this movement heart and soul.

The only support to be desired now is the most important of all, namely, that of the student body of the university.

Let's all get behind this ski slide and push for "A Better Minnesota."

ALUMNI NEWS

We are in receipt of a very interesting letter from Mr. Lewis S. Gillette, C. E. '76, the third oldest alumnus on our list. At the present writing, Mr. Gillette is attending the inauguration ceremony of President Obregon of Mexico.

Mr. Gillette, who is a member of the A. S. C. E., has, during recent years been closely connected with the Civic and Commerce Association of Minneapolis, is a member of the Board of Directors of the United States Chamber of Commerce and has but recently returned from Paris where he assisted in the formation of the International Chamber of Commerce for the purpose of improving the trade relations between the various nations. He is on the Board of Pillsbury Academy and a trustee of Carleton College. We hope at some later date to obtain an article from Mr. Gillette.

Adolph Wagner, E. E. '98 heads the H. T. Electric Co., of Indianapolis, which deals in electric parts for any system on automobile, motorcycle or tractor.

H. B. Avery, Excelsior, Minn., desires subscription blanks immediately. Boy, page "Special Delivery."

From Fred Benedict, '03, who is connected with the Public Works Department of the Puget Sound Navy Yards at Bremerton, Wash., we have these words of commendation. "I take great pride in being able to say that my Alma Mater is the U. of M., for universally she has a good reputation and deservedly so."

Mr. E. J. Cheny, E. E. '04, consulting engineer located at 61 Broadway, New York City, has recently published a pamphlet entitled "Principles and Methods of Water Power Valuation," which will be of great value to public utilities and public service commissions.

Arthur B. Fruen, C. E. '09, has left the engineering game and is supplying human needs in another line. He is president and treasurer of the Fruen Cereal Co., with offices in the Corn Exchange Bldg., Minneapolis. His home address is 57 Oliver Ave.

C. Hugo Nelson, E. E. '10, is superintendent of the Grays Harbor and Light Co., located at Aberdeen, Wash.

Minnesota is represented at the Michigan Engineering College by M. J. Orbeck, C. E. '11, who ranks as assistant professor, teaching Descriptive Geometry and Engineering Mechanics. Prof. Orbeck, knowing the joys connected with the publication of this magazine, sends the staff his very best regards.

F. A. Burmingham, Chem. '18, and wife, hold an open door to any alumnus who may visit their "neck of the woods," being Berlin, New Hampshire. Mr. Burmingham is with the Brown Company, manufacturers of wood pulp, paper and numerous incidentals and to quote, "My job keeps me on the jump most of the time."

Harvard S. Rockwell, B. S. '14, has sent us the names of other alumni who are working with the Minneapolis Steel and Machinery Co. They are: H. N. Weigel, C. E. '15; Walter Brenchley, C. E. '15; Harris Mayer, M. E. '15; H. E. Brenchley, C. E. '10 and Chester Moody, M. E. '16.

As there are other Minnesota men out there, we suggest that they start an alumni club.

Boy, page the Aerial Mail to Alaska for O. M. Rufsvold, C. E. '16, desires subscription blanks immediately. Rufsvold is with the Alaskan Engineering Commission, in the bridge department at Anchorage. We expected to find some gold dust or seal skins enclosed in his communications, but no such luck.

After shedding the silver bar of the U. S. Army, Mr. W. G. Dow, E. E. '17, entered the Graduate Student Course of the Westinghouse Electric at East Pittsburg. He is at present with the industrial sales department of that company.

The following engineering alumni are with the St. Paul Gas Light Co.

A. H. Abbott, B. S. '17, gas distribution engineer.
L. W. Wilcox, Elec. Distribution Supt.
E. C. Cotton, B. S. '19, Engineer.
O. S. Hagerman, B. S. '18, Engineer.
Allen DeWars, E. E. '15, Distribution.
Victor Engquist, B. S. '20, Engineering Dept.

H. M. King is teaching in the school of Architecture at the University of Oregon at Eugene. He speaks highly of the school and courses offered but even at that, "there is no substitute for one's own Alma Mater."

Ray McKibben graduate from the Electrical department in 1917 and received his E. E. in 1918. After leaving the university he took a government course in metalurgy at Pittsburgh, Pa. He then was employed as inspector in a shell manufacturing company at Walkerville, Canada. During the summer of 1919 he was employed as city engineer at Webster S. D., and designed and surveyed the sewer system of that city, after which he became inspector at Oil City, Okla., where he remained until December. In the spring of 1920 he entered the employment of Bardwell Robinson as draftsman. In May, 1920, he accepted a position in the Highway department at Pierre, S. D., from which he was transferred to Mobridge, S. D., where he had charge of that section. While at Mobridge he contracted a cold which developed into pneumonia. He was taken to the hospital October 30 where he died November 7.

In the November 3rd issue of "Engineering and Contracting," Donald Bleifuss, B. S. '20, describes the construction of a piece of cement paving on the Jefferson Highway, 1072 feet of 18 foot paving being laid in 10 hours, 21 minutes, mixer running time. Mr. Bleifuss gives the organization of the various crews, the method of haulage and construction. It may well give valuable hints to anyone interested in highway construction.

Mr. Geo. Warner Swenson, E. E. '17, instructor in the electrical department was married on September 4, to Miss Verine E. Larson, a University of Minnesota graduate. Mr. and Mrs. Warner are living at 311 9th Ave. S. E., Minneapolis.

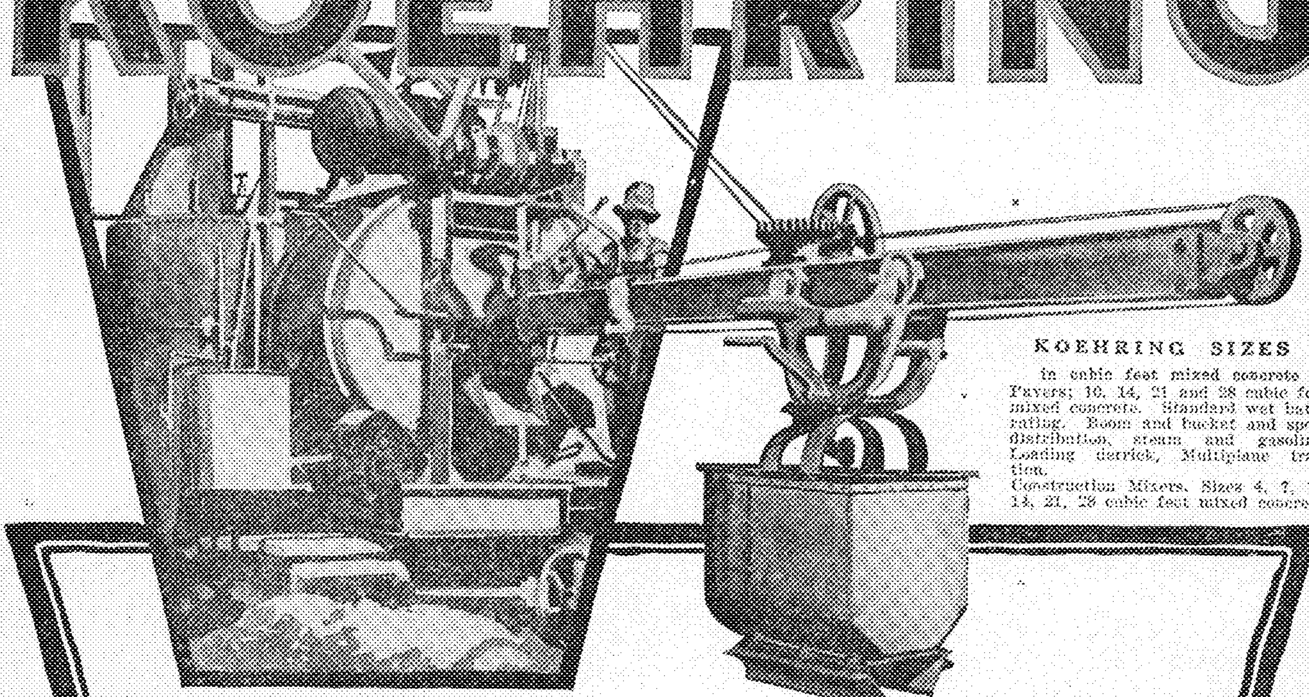
C. Q. Swenson and J. H. Murray are in Detroit with the Detroit Heat Treating Co., and Hudson Motor Car Co., respectively. They visited here during Home-Coming Week.

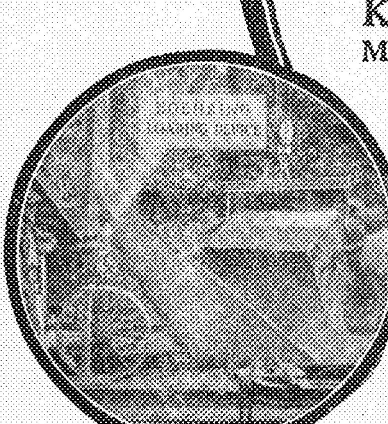
HE HAD A REAL HOME-COMING

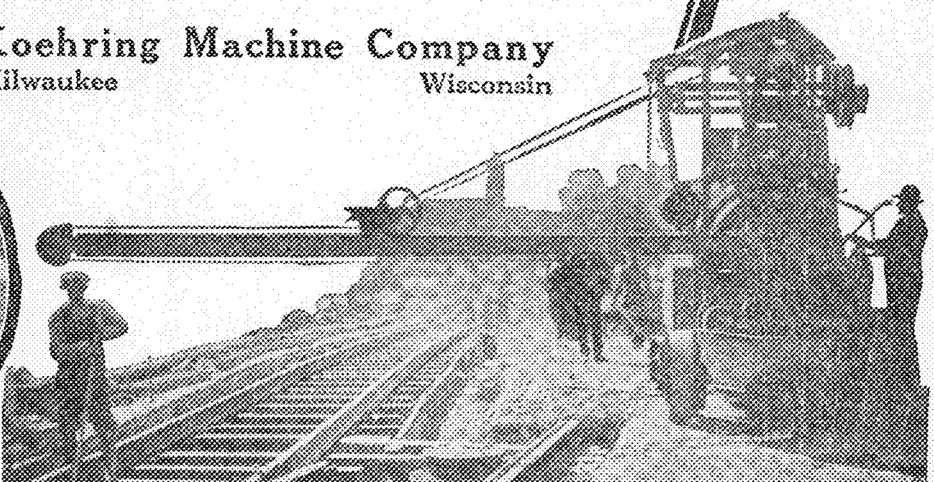
Minnesota's sons responded to the call on November 20th and came back and renewed old friendships, went through their college course again in memory. They exchanged stories of happy days spent here, and of struggles since that time. Business cares were cast aside for the day and they thought only of Minnesota and having thought and talked they went home feeling the better for having been with us. Life looked just a bit more cheerful, and Minnesota meant more to them.

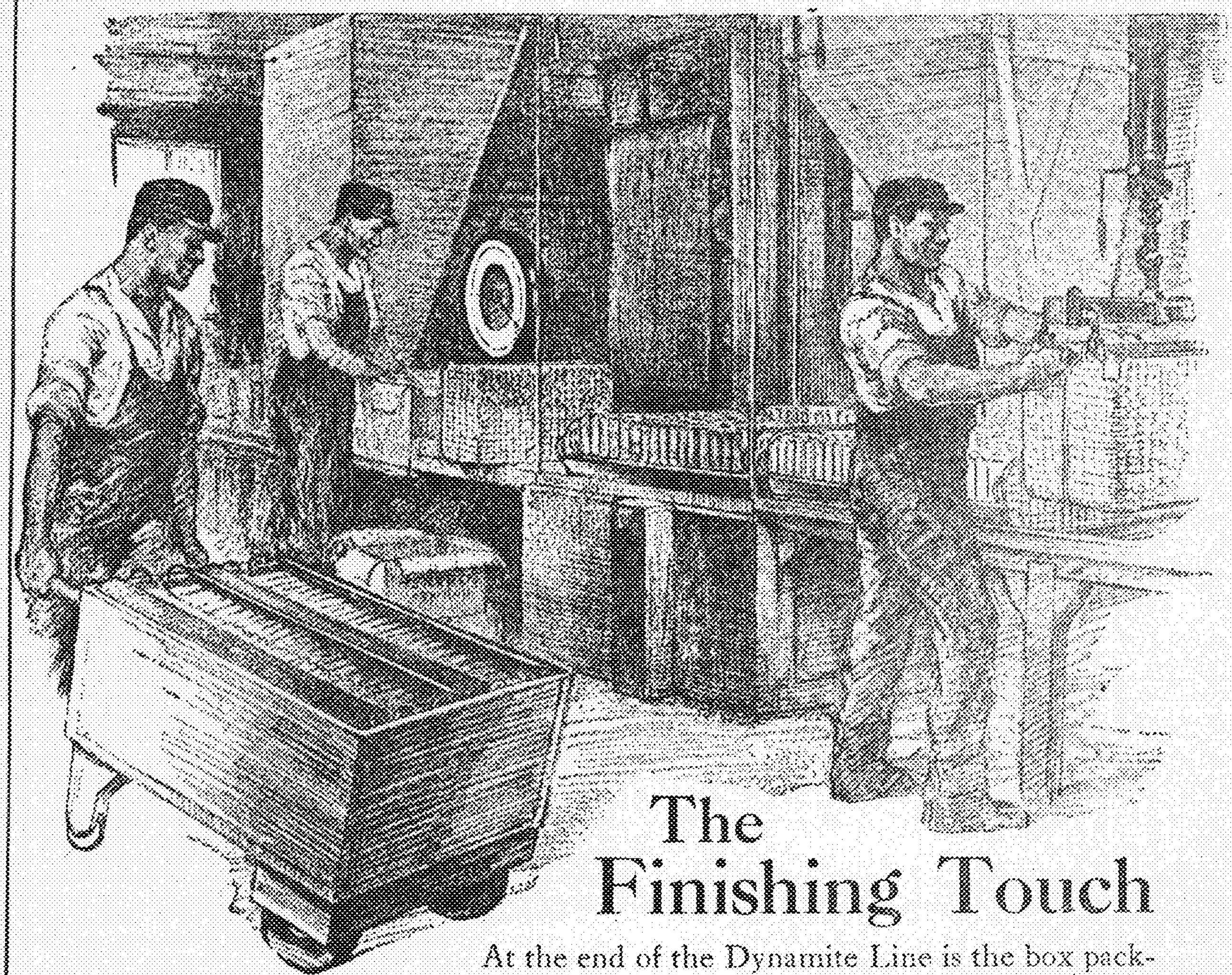
We had with us:

Edward S. Gould, 315 Ontario St. SE., C. E. '20.
N. W. Kingsley, 814 Essex St. SE., E. E. '20.
Henry M. Lende, Y. M. C. A., Superior, Wis., C. E. '20.
R. A. Lockwood, 510 Ontario St. SE., E. E. '20.
Louis Merrill, 3124 5th Ave. So., M. E. '20.
R. M. Peterson, 959 14th Ave. SE., E. E. '20.
John Hannah, 959 14th Ave. SE., C. E. '20.
L. E. Battles, Oliver Mining Co., Coleraine, Minn., C. E. '18.
H. N. Bruce, 3600 11th Ave. So., C. E.
George Cottingham, Helena, Mont., C. E. '11.
W. A. Cuddy, 3452 10th Ave. So., '15.
J. C. DeBooy, Elk River, Minn.
C. E. Doell, 1810 Girard Ave. So., C. E. '16.
G. O. Fossen, 1810 Girard Ave. So., C. E. '15.









The Finishing Touch

At the end of the Dynamite Line is the box packing house. Here Hercules Dynamite receives its finishing touch.

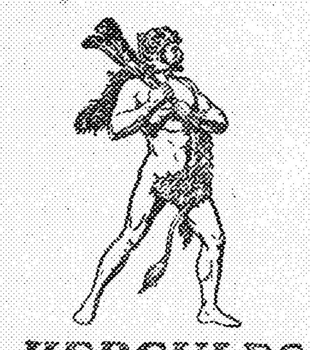
In this house three operations take place. The cartridges are dipped in melted paraffine and made thoroughly moisture proof. They are given a final inspection. They are weighed and packed, and every effort is made to see that each box contains not an ounce less than its 25 or 50 pound of dynamite.

The hands of the men who do this work are the last to touch, their eyes the last to see Hercules Dynamite before it reaches the scenes of its appointed tasks. Their care, their thoroughness, supplies the final check necessary for the successful use of over fifty million pounds of Hercules Dynamite a year.

* * *

A farmer in Minnesota is clearing a field of stumps. A miner in Pennsylvania is bringing down a breast of coal. Engineers are driving a great tunnel through the heart of the Rockies. In a great city the foundation of a skyscraper is being carved out of solid rock.

Hercules Dynamite is on the job in every case—dynamite which a few short weeks ago passed under the hands and eyes of men at the end of a Hercules Dynamite Line—dynamite which has made the name Hercules a synonym for dependability in explosives.



HERCULES POWDERS

HERCULES POWDER CO.

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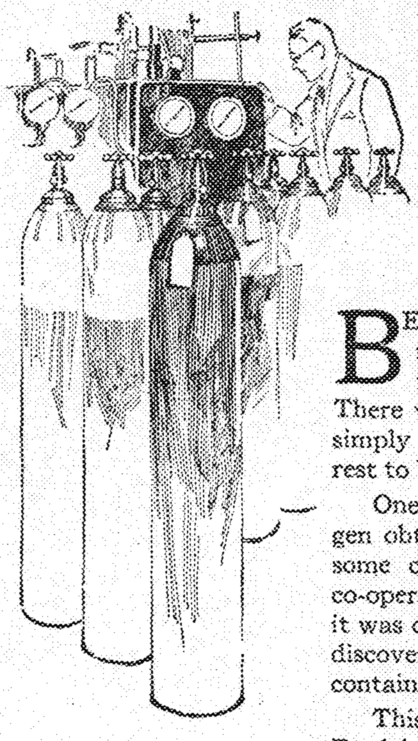
Chattanooga	Pittsburgh, Pa.	Wilmington, Del.



What Is Air?

BEFORE 1894 every chemist thought he knew what air is. "A mechanical mixture of moisture, nitrogen and oxygen, with traces of hydrogen, and carbon dioxide," he would explain. There was so much oxygen and nitrogen in a given sample that he simply determined the amount of oxygen present and assumed the rest to be nitrogen.

One great English chemist, Lord Rayleigh, found that the nitrogen obtained from the air was never so pure as that obtained from some compound like ammonia. What was the "impurity"? In co-operation with another prominent chemist, Sir William Ramsay, it was discovered in an entirely new gas—"argon." Later came the discovery of other rare gases in the atmosphere. The air we breathe contains about a dozen gases and gaseous compounds.

This study of the air is an example of research in pure science. Rayleigh and Ramsay had no practical end in view—merely the discovery of new facts.

A few years ago the Research Laboratories of the General Electric Company began to study the destruction of filaments in exhausted lamps in order to ascertain how this happened. It was a purely scientific undertaking. It was found that the filament evaporated—boiled away, like so much water.

Pressure will check boiling or evaporation. If the pressure within a boiler is very high, it will take more heat than ordinarily to boil the water. Would a gas under pressure prevent filaments from boiling away? If so, what gas? It must be a gas that will not combine chemically with the filament. The filament would burn in oxygen; hydrogen would conduct the heat away too rapidly. Nitrogen is a useful gas in this case. It does form a few compounds, however. Better still is *argon*. It forms no compounds at all.

Thus the modern, efficient, gas-filled lamp appeared, and so argon, which seemed the most useless gas in the world, found a practical application.

Discover new facts, and their practical application will take care of itself.

And the discovery of new facts is the primary purpose of the Research Laboratories of the General Electric Company.

Sometimes years must elapse before the practical application of a discovery becomes apparent, as in the case of argon; sometimes a practical application follows from the mere answering of a "theoretical" question, as in the case of a gas-filled lamp. But no substantial progress can be made unless research is conducted for the purpose of discovering new facts.

General Electric Company

General Office Schenectady, N. Y.

MINNESOTA TECHNO-LOG

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IN THIS ISSUE

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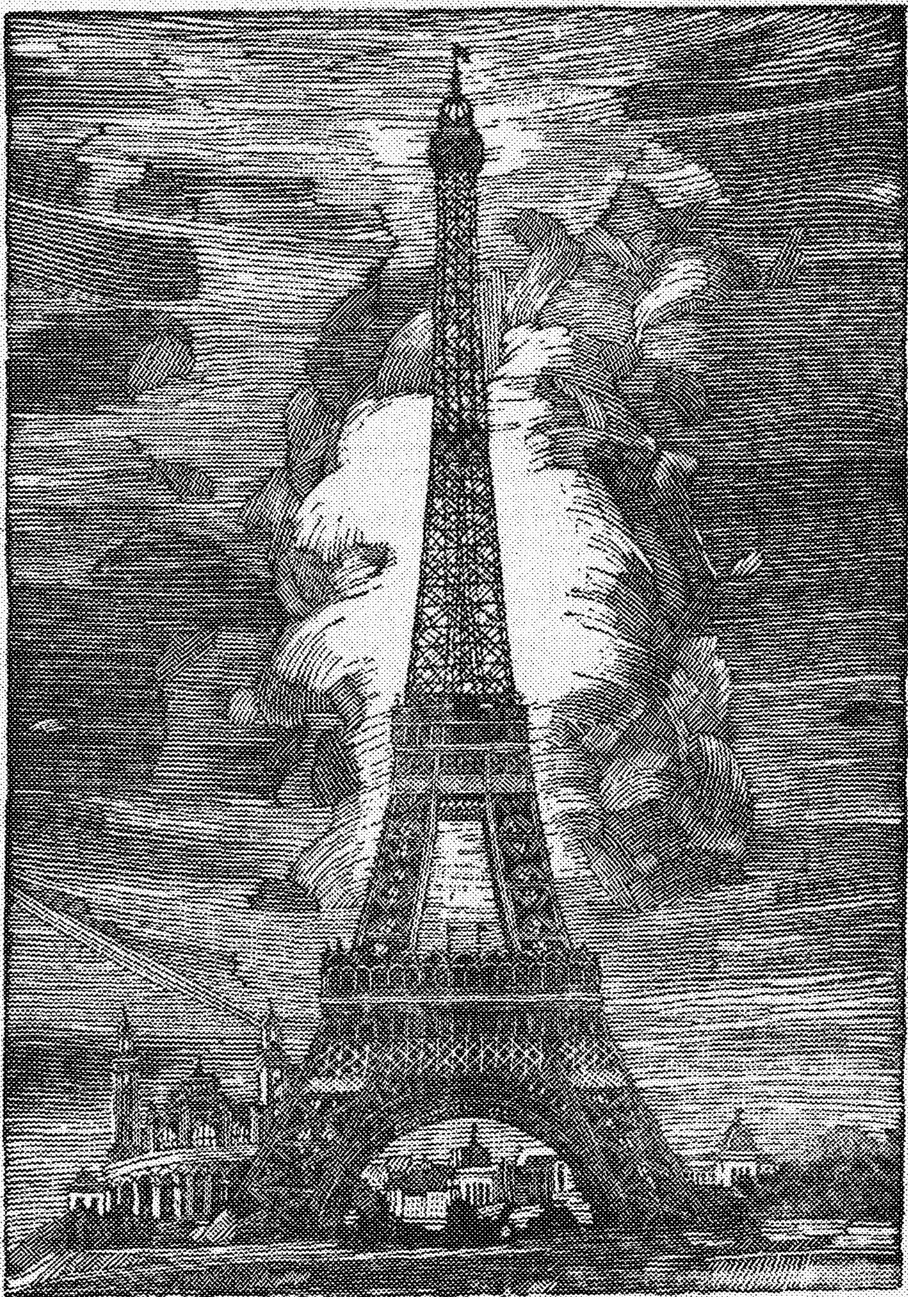

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VOLUME I JANUARY, 1921 NUMBER 3

SOCIETIES

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PHYSICO-CHEMICAL METHODS FOR DETERMINING THE GRADE OF FLOUR.

By C. H. BAILEY,
Division of Agricultural Biochemistry,
University of Minnesota

The usual method of ascertaining the grade of a wheat flour is to determine the percentage of ash which it contains. This method is somewhat slow, requiring several hours for the complete combustion of all carbonaceous matter. It does not adapt itself well to plant operation, since the time elapsing between the drawing of the sample and the returns from the laboratory is frequently too great.

In an effort to develope a more rapid method, it was found that a close parallelism existed between ash content and the specific electrical conductivity of the water extract when the latter was prepared under uniform conditions. A study was made of the effects of time and temperature as variables in extracting the flour with water, and both of these factors were found to affect the results. A standard and uniform procedure was therefore adopted. Ten grams of flour at 25° C. were vigorously shaken with 100 cc of redistilled water (suitable for conductivity work) at 25°, and the mixture in a suitable flask was submerged in a water thermostat at the same temperature. The flour was kept in suspension by intermittent shaking for exactly 30 minutes, and then thrown out of suspension by whirling rapidly in a centrifuge. A portion of the decantate was passed through a filter to remove floating particles, and at once placed in a conductivity cell, and this immersed in a water thermostat at 30° C. All operations up to this point have taken about 40 minutes. A few minutes are allowed for the contents of the cell to reach the temperature of the bath, the time being shortened, when desired, by occasional gentle agitation. The final readings can be made in such time that not more than 50 to 60 minutes are required to complete the test.

To conserve both time and material a special Freas conductivity cell has been constructed for this purpose. This has the side walls elongated about an inch below the bottom of the electrodes, and the bottom cut off so it can be used as a dip electrode. The extract is placed in at least two vials, the electrode is rinsed in the first of the pair of vials, and then transferred to the second vial, where the reading is taken. Several such pairs of vials can be placed in the thermostat, and the readings taken by shifting the dip electrode from vial to vial.

In Table I is shown the relation between the ash content of a series of flours, and the specific conductivity of their water extracts prepared as described. A close parallelism will be observed between the ash content and the conductivity.

Table I. Ash content, and specific conductivity of the water extract of a series of wheat flour samples.

Grade of flour	Total ash per cent	Specific conductivity of water extract $K_{30}x10^4$
1st middlings	0.44	5.36
2nd middlings	.45	5.49
3rd middlings	.55	6.26
2nd break	.58	6.67
5th middlings	.61	6.69
3rd break	.67	7.59
4th middlings	1.17	10.00
1st break	1.34	11.24

As one phase of the study of wheat flour grades, the hydrogen ion concentration and buffer action of their water extracts were determined. Again it was found that time and temperature of extraction must be uniform to insure comparative results, especially insofar as the buffer action of the extracts was concerned. Increases in either time or temperature, within the limits studied, resulted in an increased buffer action. A standard procedure was accordingly adopted, flour and water in the proportions of 1:5 being mixed at a temperature of 25°, and the flour maintained in suspension by intermittent shaking for exactly 60 minutes. The mixture was then whirled in the centrifugal for a few minutes, and the decantate pipetted off. To several portions of the extract were added different quantities of N/50 HCL, and N/50 NaOH, and the hydrogen ion concentration of these preparations and of the untreated extract were determined with a hydrogen electrode and potentiometer. Since four different proportions of the acid and alkali solutions were used, there were accordingly nine points that could be plotted on an electrometric titration curve.

It appears from this data, given in Table II, that the hydrogen ion concentration decreases, and thus the pH increases slightly with the ash content. This appears surprising at first thought, since the total acidity of flours, as determined by titration with standard alkali solutions against phenolphthalein as an indicator, usually increases with the ash content. The observations are to be explained by the higher buffer action which appears with increasing ash content. While the differences in the pH of the original extract are neither large, nor consistent enough to afford a satisfactory index of grade, the buffer action of these extracts varies widely. Compare, for example, the high grade 1st middlings flour contain- 0.44 per cent of ash with the inferior 4th middings containing 1.17 per cent of ash. On adding 20 cc of N/50 NoOH to 100 cc of the extract of these flours, we found the pH of the resultant mixture to be 9.28 in case of the 1st middlings, and only 7.29 in the 4th middlings. Thus the pH of the 1st middlings extract had changed through an interval of 3.21 units, and was decidedly alkaline, while the pH of the 4th middlings extract on the addition of the same quantity of NaOH had changed through an interval of only 0.87 units, and was only slightly on the alkaline side of absolute neutrality. It appears that the data secured through the addition of 20 and 30 cc of N/50 NaOH to 100 cc of extract are of the most value in indicating the relative grade, because of the greater differences, and more consistent variations which are thus obtained.

While the data reported in Table II were obtained through the use of the hydrogen electrode, a colorimetric procedure can be evolved which is of practical value in this connection. Since phenolsulfonephthalein ("phenol red") is one of the most delicate indicators, and is readily obtainable, it is recommended that the treatment be such that the preparations are rendered sufficiently alkaline to have a pH within the limits of color change of this indicator (pH of 6.8 to 8.4). This can generally be accomplished by the addition of 10 cc of N/40 NaOH to each 100 cc of the extract. The resulting pH will not exceed the limits of color change on the alkaline end of the range of phenol red unless the flours contain less than 0.44 per cent of ash. In the event that this proves to be the case, less alkali must be employed, and 10 cc of N/50 NaOH may be added. Suitable graphs may be prepared for converting the readings in terms of pH, as determined by comparison with standard solutions of known pH containing the same indicator, into terms of flour grade.

The data accumulated in these studies were secured through the collaboration of Mr. Ferdinand Collatz and Miss Anna C. Peterson, graduate students in the University of Minnesota.

Table II. Hydrogen ion concentration in water extracts of flour before and after the addition of acid and alkali.

Grade of Flour	Total Ash Per ct.	Original Extract pH	pH After Addition of N/50 HCL to 100 cc of Extract				pH After Addition of N/50 NaOH to 100 cc of Extract			
			10 cc	20 cc	30 cc	40 cc	10 cc	20 cc	30 cc	40 cc
1st middlings	0.44	6.07	4.48	3.60	3.11	2.87	7.48	9.28	9.89	10.62
2nd middlings	.45	6.10	4.65	3.64	3.25	2.96	7.27	8.72	9.79	10.32
3rd middlings	.55	6.22	4.94	3.96	3.45	3.04	7.22	8.59		10.35
2nd break	.58	6.25	5.00	4.11	3.45	3.15	7.12	8.52	9.53	10.21
5th middlings	.61	6.31	5.04	4.14	3.53	3.16	7.15	8.38	9.62	10.22
3rd break	.67	6.22	5.19	4.18	3.62	3.46	6.96	7.89	9.25	9.77
4th middlings	1.17	6.42	5.85	5.11	4.46	4.06	6.86	7.29	7.91	8.79
1st break	1.34	6.34	5.86	5.15	4.56	4.04	6.77	7.17	7.66	8.59
4th break	1.62	6.36	6.02	5.43	4.78	4.26	6.76	7.08	7.49	8.20

THE CURRENCY OF CHINA

By W. A. CUDDY, C. E., '16

China is just beginning to assume her place of importance in the eyes of the world. The world needs China's great undeveloped resources of raw materials and in order to develop these for the world China needs capital and machinery. Thus China and its problems should be of interest to the professional and business man alike.

No matter what the undertaing is in China, money is involved and this article is an attempt to give in the simplest way possible an idea of the currency of that country.

To the occidental just starting to do business in China the intricacies of the currency and exchange are bewildering almost to the extent of being an absolute mystery.

As a starting point to obtaining even a slight understanding of the currency of the country and its relation to international exchange, it must be remembered that what monetary system there is in China is on a silver basis.

This is of primary importance to the merchant or capitalist operating in China because the merchandise sold on the investment made in China is in the currency of the country, namely, silver. The foreign operator naturally wishes to convert the proceeds of his operations into the currency of his own country, which in practically all cases is on a gold basis.

Theoretically, in order to do this he takes the silver proceeds from his operations and buys gold, which he transfers to his own country, but of course in practice no actual metal is handled, he merely buys a bill of exchange on his own country.

On account of the fluctuating demand for silver its value has fluctuated accordingly. At the outbreak of the Great War silver was worth approximately 50 cents gold (U. S. currency) per ounce. During the period of the war its value rose until the latter part of 1919, when it was worth over one dollar gold per ounce.

During a period when the value of silver is rising the foreign importer into China is benefited while the exporter is at a disadvantage. During a period of falling silver value the positions are just reversed, the importer is at a disadvantage and the exporter is benefited.

For example, take the American importer into China; that is, the one who imports his merchandise for sale in China from America.

The cost of his goods laid down at Shanghai is in U. S. currency (gold). Suppose that they are imported at a time when silver is worth 50 cents per ounce and are to be paid for in 60 days.

Now suppose that the cost per unit which the importer must pay in America for the merchandise is 50 cents. If paid for at the time of importation, one ounce of silver would just cover the cost of one unit of merchandise.

Assume that at the end of 60 days all of the merchandise has been sold, the proceeds being in silver, and that during that time the value of silver has risen to 75 cents per ounce. One ounce of silver now, instead of covering the cost of just one unit will cover the cost of one and one-half units.

Suppose that the proceeds from the sale in China are equivalent to 1½ ounces of silver. At the time of the importation of the goods this would be equal to 75 cents gold (U. S. currency) and the cost being 50 cents would yield a profit, in gold, of 25 cents per unit.

At the end of 60 days the value of silver has increased to 75 cents per ounce and the 1½ ounce proceeds from the sale are worth $1.125. After paying the cost, 50 cents, the gross profit per unit in gold is 62½ cents.

Take the case of a falling silver market. Suppose that during the 60 days silver had fallen to 37½ cents per ounce, then when the importer wishes to liquidate his debt he finds that it will now cost him 1 1/3 ounces per unit instead of one ounce. This means that in order to cover his gold cost he will have to raise his silver selling price and thus gradually cut off the demand for the product.

It can thus be seen how a rising silver market operates to the benefit of the importer and reversing the conditions it should easily be seen how a falling silver market operates to his disadvantage.

Now take the case of the exporter from China. The goods for export are purchased in China and must therefore be paid for in silver. Being exported they are usually sold in a country whose monetary system is on a gold basis, consequently the proceeds are in gold.

It should now readily be seen how a rising silver market adversely effects the exporter. The cost of the merchandise for export being in silver, as the value of it increases, the selling price in gold must be increased accordingly so that when converted back into silver the proceeds from the sale will cover the cost and yield a fair profit.

Thus it should be clear that as the value of silver increases and the gold selling price of the merchandise is increased accordingly, the demand for them automatically decreases to the point where the exporter must go out of business entirely.

Now, on a falling silver market the exporter can afford to reduce his gold selling price to the point where there will be a demand for all of the merchandise which he can handle and the gold proceeds when converted back into silver will cover the cost and yield a substantial profit.

The above is somewhat of a digression from the subject of Chinese currency, but is given to show what the foreign merchant is confronted with when operating in a country like China, whose monetary system is on a silver basis, especially during the period of a widely fluctuating silver market.

Of course it must be realized that the transactions outlined above have been reduced to the simplest terms in order to make the principles involved as clear as possible.

Now, coming to a consideration of the currency of China, the unit in terms of which practically all large transactions are made is the tael.

All large operations, settlement of balances between banks, investment of funds, payment of import duty, purchase of exchange on foreign countries, etc., are made in terms of the tael.

The tael is not a coin but a weight of silver of a specified fineness. This is moulded into little ingots of silver shaped like a shoe, known as sycee. The ingots or sycee vary in size from one to 50 taels.

To further complicate the system the tael varies in weight and the fineness of the silver in different parts of China from 37.5317 grammes of fine silver in the Haikwan tael to 34.0732 grammes of fine silver in the Swatow tael.

There are supposed to be approximately 70 different varieties of the tael in China, but many of these are in use only in the very remote and almost inaccessible parts of the country. There are in common use about 15 different varieties and of these the three best known are the Haikwan, Kuping and Shanghai taels, their relative values being:

100 Haikwan taels=101.642335 Kuping taels
100 Kuping taels=109.6 Shanghai taels
(From "Trade and Administration of China," by H. B. Merse.)

The Haikwan tael consists of 583.3 grams of silver 1000 parts fine and must be used in payment of all customs duties.

The Kuping tael for receiving consists of 575.4 grains of silver 1000 parts fine and for paying consists of 573.9 and is used for paying all other dues to the government than customs duties.

The Shanghai tael is probably the most widely used unit in commercial transactions and consists of 545.25 grains of silver 980 parts fine. By convention 98 taels calculated in this manner will liquidate a debt of 100 taels.

In practice the actual silver does not often enter into the transactions, as the large foreign and native banks issue tael bank notes against a silver reserve and carry tael bank accounts against which checks are drawn.

The settlement of balances between banks is usually made by transfer of the actual silver sycee. Although the tael forms the basis of the monetary system of China, its issue is not directly under the supervison of the government but is largely in the hands of those who cast them and of the bankers and money lenders.

Next in importance to the foreigner operating in China is the silver dollar of which there are many different varieties. The silver dollar was first introduced into China by foreigners and the first to be used extensively was the Carolus or Spanish dollar. This dollar weighs 402.5 grains. Except at Wuhu, one of the treaty ports on the Yangtze river, it has almost entirely gone out of circulation.

The next to be introduced was the Mexican dollar weighing 417.74 grains. This coin became exceedingly popular with the Chinese and in the Yangtze valley today is probably the most widely used silver coin.

The Hong Kong dollar, weighing 416 grains, issued by the British government for use in the crown colony of Hong Kong, has a wide circulation in southern China.

The various provinces in China issue what are called dragen dollars, but these are very seldom used outside of the province in which they are issued, as they will be accepted only at a discount outside of that particular province.

Recently the Central or Republican government issued a dollar, or yuan as it is called in China, which it is trying to make the standard for all of China. This coin is known among the foreigners in China as the Yuan Thih Kais dollar and contains 26.8567 grammes of silver 900 fine.

The Hong Kong, provincial or dragen, and Republican or Yuan Thih Kai issues are coined in subsidiary silver pieces of ten, twenty and fifty cents each.

Most all of the ordinary retail business in China is conducted in terms of dollars.

The copper coins are to the natives the most important coins in China. These are issued both by the central government and by the provincial governments. The Republican coppers bear the inscription one cent and are nominally 1/100 part of a dollar. The provincial coppers bear the inscription 10 cash and are nominally 1/100 part of a tael. These are merely token coins and the Chinese will never take them at their face value, irrespective of their intrinsic value. The accepted value of the coin is influenced by the actual value of the copper contained in the coin and has varied all the way from 88 to 125 to the silver dollar.

In Hong Kong one hundred cents in subsidiary Hong Kong silver will equal one dollar; that is, ten 10-cent pieces, five 20-cent pieces or two 50-cent pieces.

The same applies to the recently issued Yuan Shih Kai dollar—100 cents in subsidiary Yuan Shih Kai silver can be exchanged for any silver dollar.

When it comes to the provincial or dragon issue a further complication is introduced, namely, 100 cents in subsidiary silver wll not equal one dollar. In this instance the 100 cents in subsidiary dragon coinage is known as "small money" and will not be accepted as one dollar, known as "big money." That is, in order to pay a debt of one dollar, "big money," it is necessary to pay in subsidiary dragon coinage, "small money," all the way from one dollar and eleven cents to one dollar and sixteen cents, depending on the rate of "small money" exchange which fluctuates from day to day.

Ricksha fare, street car fare, coolie hire, etc., are paid in small money, so it is necessary to always keep some on hand. To obtain this small money, one will take a silver dollar to an exchange shop and receive in exchange eleven 10-cent pieces and from one to six coppers.

In dealing with the actual silver dollars or "hard coin," as they are called, it is necessary to be constantly on the look-out for bad money. This consists of actual lead or alloy counterfeits, small sized dollars which have been shaved down in order to get the silver, and brass dollars which are silver dollars cut in two, hollowed out and then filled with lead or brass and soldered together again.

All of the large business houses and banks employ men known as "shroffs," who are expert in detecting bad money. These men pass on all of the hard coin before it is finally accepted.

The most widely used coin among the great mass of the Chinese people, and really the most characteristically Chinese of all the money in circulation in that country, is the copper cash. This is a copper coin just a little bit larger than the American penny with a square hole cut in the center.

These cash are strung on strings in rolls of 100 each. Ten of such strings form what is called a tiao, which was originally intended to be the equivalent of one tael silver. This originally intended equivalent has never held and now the number of cash to the tael varies with the value of the copper and the supply of and demand for copper cash. The cash is worth approximately one-tenth of an American cent.

The copper cash is the plebean coin of China and on account of the poverty of the great mass of the people is practically the only coin which they ever use. To show to what extent the copper cash comes into use in Chinese life, the average laboring man gets 200 cash for a day's work; a skilled artisan gets 300 cash per day.

As to the cost of living among the peasant and working class, a pound of rice costs about 40 cash; a pound of sweet potatoes about fifteen cash; a pound of fish about 100 cash; vegetables enough for the family about 50 cash; and cakes and sweetmeats from one to five cash each.

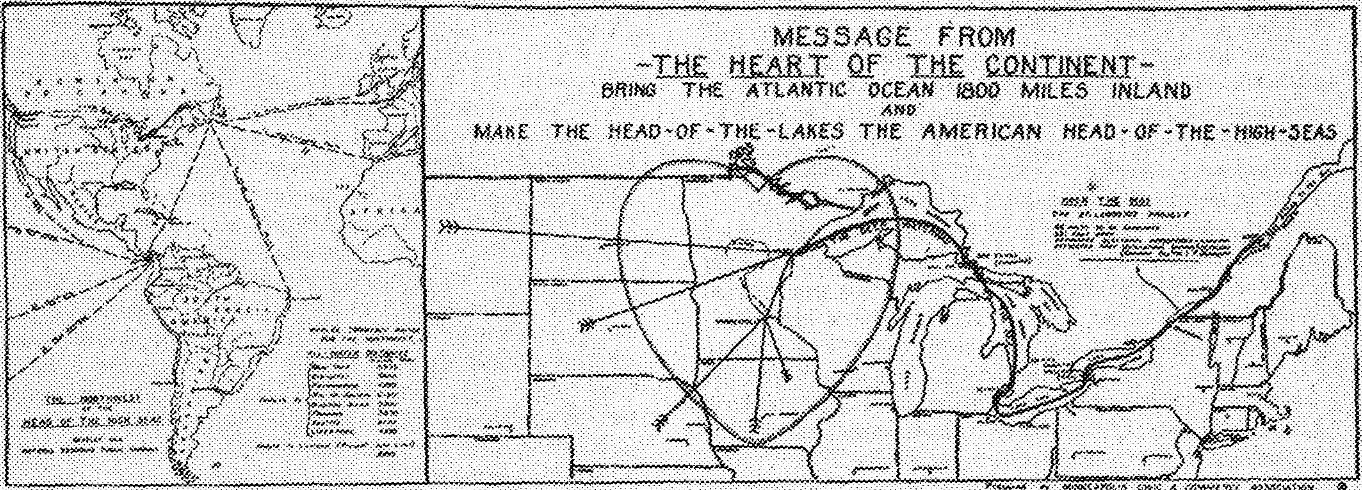
In addition to the complexities arising from the use of the metal currency described above, there are those introduced by the use of the bank notes issued both by the foreign and native banks.

Even with the lare foreign banks, the notes are at a discount outside of the port of issue. As an example, notes issued by the Shanghai branches of these banks are at a discount in Peking, Tientsin and Hankow.

In the case of the Bank of China (Chinese) all of the branches are not jointly liable for the issue of Bank of China notes. Each branch is liable only for its particular issue. Thus notes of some of the weaker branches are at a discount of as much as forty per cent.

Then in Manchuria there is a large circulation of Japanese yen, Mexican dollar notes, several different issues of what are known as small coin notes, and in the north a great variety of Russian Rouble notes, ranging from the Romanoff to the Bolshevik issues. The relative values of these various currencies are constantly fluctuating, so business on a credit basis s almost like a gambling game.

In this simple description of the most common forms of currency in use in China, it is hoped that the fact has been clearly brought out that the foreign business interests operating in China are confronted with complex and fluctuating exchange problems from the time of the sale of merchandise for copper to the Chinese consumer, the transfer into the terms of silver currency of the locality in which the sale is made, the conversion of this into the silver of the large treaty parts, which is then used to purchase gold exchange for the transfer of funds to the foreign country.



By A. H. Douglas

Minnesota and the Northwest states adjacent, have an enormous transportation asset in the Great Lakes, which constitutes immeasurably the most important inland water highway for commerce in the world. The great Northwest, the Great Lakes region, and the wonderful and fertile Mississippi Valley desire, and must have full economic freedom. They are entitled to the best highway to the markets of the nation and of the world, for their rich and growing products of the farm, factory and mine. When the approach to the entrance of New York Harbor, from the inland country is clogged and blockaded beyond all possible relief, it becomes of utmost importance that a coast-wise road by way of the St. Lawrence be constructed into the Great Lakes,—this matchless harbor with its unrestricted door to the world.

Let us relieve the railroads of billions of dollars of expenditure to take care of peak loads with mounting deficits the rest of the year, and make it possible by improving the St. Lawrence River to utilize this American "Mediterranean."

Commerce on the Great Lakes has developed to such an extent that during the year 1916, over one hundred million dollars of cargoes passed the Detroit River, and during the same year nearly ninety-two million tons of freight passed the Soo locks to and from Lake Superior. In the following year, with a lesser tonnage of freight, the value of the cargoes carried amounted to nearly 1 1/5 billion dollars. These figures are somewhat bewildering, but it may assist in interpreting them to know that the traffic passed the Soo locks is several times th ecombined traffic passing through the Panama and Suez Canals.

The handicap of the present waterway is that it is substantially land-locked and has no adequate outlet to the high seas. At the present time, shipments by vessel leaving Duluth may tranship to barges at Buffalo and reach New York Harbor by canal. Or the same vessels may tranship to 2000 ton vessels passing from Lake Erie through the Welland Canal to Lake Ontario, through the St. Lawrence Canals to Montreal, and thence through the tidal river and the Gulf of St. Lawrence to the Atlantic Ocean. A lake steamer, however, carrying 5000 tons is limited in its eastward trip to the lower parts of Lake Erie. The foreign commerce has never had an adequate opportunity to develop by reason of heavy freight charges after reaching the eastern limit of the deep waterways of the Great Lakes.

At the present time, the Canadians are buildin the great Welland Canal with locks large enough for ocean vessels of 30 foot draft and channel depths of 24 feet throughout its full length. On the completion of this waterway, deep draft navigation will be practicable to below Ogdensberg, 70 miles down the St. Lawrence River. At this point begin the Rapids of the St. Lawrence River, which descend about 220 feet in the 105 miles to Montreal. From here on, the Great St. Lawrence River stretches in a stately waterway more than 500 miles toward the Gulf of St. Lawrence and the Atlantic Ocean.

This great international project now being investigated, calls for a deep waterway adequate for ocean vessels to pass in and out of the Great Lakes unhampered. For the upper 35 miles of this waterway, the St. Lawrence River is the boundary stream between the United States and Canada. The lower part of the river, however, departs into the Canadian territory. Between Ogdensberg and Montreal, the great volume and constant flow of the St. Lawrence River, and the descent in the rapids, make available water power to the extent of upwards of four million electrical horse power. It is believed by some who are active in promoting this waterway development, that water power will finance the project.

The enormous extent of the benefits and general development of the Northwest which will result from this waterway is difficult to estimate, and is complicated with the less tangible benefits arising from the general economic good for the nation. It is very certain that flour and wheat may be shipped to Liverpool without breaking bulk much cheaper than it is now shipped by lake, rail and ocean through the port of New York. It is very certain that the imports consumed by the Northwest can come in direct much cheaper without being forced into the congestion of New York Harbor. It is very certain, also, that upon the completion of this project, the flags of all nations will touch at the ports of the Great Lakes with incalculable benefits to the entire nation.

The opening of this new route would be an enormous stimulus to foreign trade. With the development of our merchant marine nothing could be of greater value to the nation than adding this strip of coast line to our shores. Incidentally, the rolling stock of Northwest railroads would be kept in this territory, increasing the turnover and facilitating the movement of grain, which is now greatly enhanced by the general congestion at the eastern terminal. Prompt liquidation of grain credits would result and the money be made available for other commercial uses to the general benefit of all.

Only in a spirit of co-operation for the development of our entire nation in all its commercial possibilities, can lie our real American commercial supremacy over the other nations of the world. The nation, as a whole, and the great Northwest, in particular, should not be forced to sacrifice development for any existing port, state, or terminal. Viewed from every angle of national welfare, this international project should be carried to completion without any undue delay. These waters and their powers belong to these two friendly nations and should be utilized to their fullest extent. The benefits therefrom will be immeasurable. When the great Northwest and the other Great Lakes States comprising more than one-half of the Union, plead at the bar of national economic justice and demand the means for better distribution of the products of their farms, factories and mines, it should be the concern of the entire nation to unite in the promotion of this great St. Lawrence waterway.

IMPRESSIONS OF THE EAST

By HARRY J. KORSLUND, Arch., '20

In writing this article I will not attempt to describe the things I saw on the trip, but will confine myself to general impressions, especially impressions of the Eastern Universities. I wish I had been asked to write a review of the plays I saw in Chicago and New York, for then, I am sure, I could tell of things that would have an appeal for every student engineer and architect.

But since this is not the case, perhaps it is well in starting to briefly state the purpose of the trip and the places visited. Mr. A. Moorman, bank-builder of St. Paul, presented the traveling scholarship to enable the winning student each year to make a three weeks' visit of the largest Eastern cities for the purpose of studying modern architecture from concrete examples (engineers! don't take this too literally), and still more, I presume, to broaden the student's viewpoint. My itinerary included a three-day stay at Chicago, one day at Detroit, five at Boston, six at New York, three at Philadelphia, and three at Washington, D. C.

During my stay at each place I made it a point to wander around amid the crowd keeping my mind open to impressions both of the buildings and of the people, for one cannot truly study architecture without studying the people and the way they live. Some days I would walk for miles and miles visiting the noteworthy buildings which I would pass, and always watching the crowds. In fact, it was a common occurrence for me to walk so far in one day that on returning to the hotel I would find my socks were spats.

On the first visit to New York and the Eastern cities one cannot grasp the vastness and complexity of the modern business system, and the architectural and engineering monuments it has caused to be created. When we consider that Woolworth Building alone houses over thirteen thousand people, or twice the number of students attending the University, we can get some idea of the modern office building. Were this building laid flat, it would, with its floors beneath the ground and its tower, extend approximately the length of three Minneapolis blocks. And this structure was not created as an experiment, or to satisfy the whim of an eccentric; but it was built to fill a need of the day, and has been properly called the "Cathedral of Commerce."

One thing that especially impressed me was the wonderful manner in which traffic is taken care of. Three distinct systems, namely; the elevated, the surface lines, and the subways, combine to take care of the millions of people that work down town and live miles away from their place of business. One can take a subway in New York and be carried to the other end of Brooklyn in less time than he sometimes must wait for the "Como-Harriet" at the Parthenon corner.

I had a splendid opportunity to visit the great Universities of the country, and I availed myself of that opportunity to the best of my ability. While in Boston I spent several days out at Harvard and Massachusetts Institute of Technology, Columbia in New York, and the University of Pennsylvania at Philadelphia.

In general I do not think these schools have any marked advantage over "Minnesota" in their course of study, and for several reasons I am heartily glad that I took my undergraduate work at the "U. of M." But I did find that the average student in architecture and engineering was several years older than the average student of our college, and that he had a far more serious attitude toward his work.

For one thing most of these schools require a preliminary training of from two to four years in academic work, like the pre-legal or pre-medic course at Minnesota. The faculty maintains that the student should have such preliminary training for several reasons.

As Professor Boring, head of the architectural school at Columbia puts it, the students who thus start their course are two years older than if they registered directly from high school. This alone is a tremendous advantage to the department, for the men are so much more capable of performing their work. Then too, this preliminary training goes to make a finer quality in the men themselves which in turn is reflected in their work.

During these two years of liberal arts work the student can clean up his first year mathematics, rhetoric, language, etc., and get a good training in descriptive geometry and mechanical drawing, so that when he enters upon his technical course, he can really "hit the ball" and hit it hard. During those two years he has had an ample opportunity to acquaint himself with the social side of his University life and to become connected with the various student activities, both of which are essential to his training. Then when he has established himself in his University life, and has worked some of the excess pep out of his system, he is more than willing to buckle down to his more serious professional work.

But to me the far greatest argument for this general training is that it broadens a man and makes him more appreciative of the affairs about him. A man cannot afford to limit himself to a technical education alone, for this would make him an automaton, while his profession requires that he be an all-around man.

This fact was forcibly driven home to me while I was visiting the architectural school at Harvard. Through Mr. Loye and Mr. Kleinschmidt, two former Minnesota students, I met a great number of the men in the department and enjoyed several meals with them in the old "Memorial Hall," and I will always cherish memories of the good times we had at their tables.

These men were what I would call all-around fellows. They were serious and hard workers in their studies, but they were men that could entertain and carry on a conversation on most any subject, be it politics, literature, or football. Their training showed. They were courteous, congenial and polished without making one feel he was associating with "high-brows." They were far from being effeminate; in fact, one could not help but feel he was associating with real men. Human nature is pretty much the same the world over and despite their culture they could tell us as pointed a story or raise as much cain as anyone. Still they would never lose their air of refinement and well breeding.

Another thing I noticed was the attitude of the students toward the instructors. They look upon their professors as advisors rather than taskmasters. They have gotten over the high school idea that some "prof" was continually trying to "ride their necks" and I believe this was due to the fact that they met their instructors on an equal footing as man to man.

One thing that my trip taught me was, that a sympathetic study of human nature, and an appreciation of what is occurring in the world outside of your own restricted field, is of greater importance than a thorough technical knowledge.

OUR BAND

As a potent factor in promoting real "Minnesota" spirit, the University Band can well be accorded a place of the first order. As a musical organization in itself, it is deserving of high praise. Many here at the University do not realize what a complete organization it really is and with what care it is being conducted by Bandmaster M. M. Jalma. We are indeed fortunate in having Mr. Jalma at the head of it. His ability as an organizer and able leader was put to a severe test when he was given the task of organizing a band in the old First Minnesota Field Artillery, which became the One Hundred Fifty First U. S. Field Artillery. Mr. Jalma conducted this band throughout the eighteen months that it spent across the water doing its bit in the World War by a service of approximately ten months at the battle front. To keep men musically fit under conditions at the front was no easy matter, and yet the One Hundred Fifty First band was known as one of the leading bands in the American Expeditionary Force. The building up and maintaining of such a band is proof enough of ability.

The University Band is made up of two bands, a concert band and an R. O. T. C. band. The concert band consists of fifty-five pieces, only ten of these men are required to drill and are playing in the band as an alternative for drill; the other forty-five volunteer their services. Each man is carefully selected by examination for the particular position that he holds, and personal advice and attention is given by Mr. Jalma to each man individually.

The R. O. T. C. band consists of fifty men taken from the Freshman and Sophomore classes, which are required to take military drill. This band is conducted on the same basis as the concert band and as the members develop to the proper stage of efficiency they are placed in the concert band.

On Wednesday, January 5th, the band played at the State Capitol for the inauguration of the new governor, J. A. O. Preus. Real Minnesota "Pep" was very much in evidence during this concert.

During the latter part of February a trip in the southern part of the state is planned, and during Easter vacation a similar trip in the northern part of the state.

Whenever "Our Band" is listed for a concert, you may be sure of something worth your time in listening. It is not a mere collection of instruments but a musical organization in the true sense of the word.

An atom is a little thing,
As small as small can be,
'Tis smaller than a needle's point,
'Tis smaller than a flea.
I never saw one in my life,
But when I went to school,
I was told it would take two of them
To make a molecule.

AMERICAN DYESTUFFS

By DR. W. H. HUNTER

A few days ago, the press stated that Congress was about to repeal all war-time legislation. No announcement made since the armistice has been more important to American chemists. It is stated on excellent authority, that in German ports, several years' supply of dyestuffs lie packed, ready for export to certain firms in the United States, whose names are already on the boxes. Further, these dyes are to be sold at such rates, owing to the low value of the mark, that no American dyestuff maker can hope to compete in the open market, for the business of the great users of dyestuffs. The obvious result will be that the users of dyestuffs will stock up with these German dyes, the importers will fill their storehouses with low-priced wares, and the makers of American dyestuffs will be obliged to close their enormous plants, turn away their chemists and other help, and charge off to profit and loss the millions of dollars invested when the country called for relief from the shortage of dyes.

The imaginary "man in the street" undoubtedly would be very favorably impressed by the prospect. "Good German dyes again! Lower prices for all the many articles which are dyed! Fine!!"

Let us examine these notions. First, are German dyes better than American dyes? This is one of those questions which cannot be answered by yes or no, like the famous question "Have you stopped beating your wife, yet?" Dye for dye, American dyes are exactly as good as German dyes.

By the phrase "dye for dye," is meant that when the same organic substance is made in both countries, the merican chemist can make it just as well as the German chemist. A given molecule is the same, whether made by an American or a German factory.

Yet it must be admitted at once that a great deal of trouble resulted when we started to make dyes in this country in quantity. This can be traced to three main causes. First, all the American makers of dyes were not skilled organic chemists, and they did not all have skilled chemists in their employ. Further, the workmen and foremen had to be trained to the new kind of work. So, many a batch of dye was off in shade, and should not have been sold, but so great was the demand for dyes, that many manufacturers did not have the nerve to turn a batch into the sewer, but put it on the market. Naturally, these were chiefly men with small plants, who were in it just for the time of easy money.

Second, all dyes of the same color, even of the same shade, are not the same substance. The pressure on the American manufacturer of dyes was very great indeed, and he had to make dyes as fast as he could. Now there are certain dyes which can be made very readily, such as azo dyes, and other dyes of entirely different character, such as indigo, which are much more difficult to make, taking more skill, more time, and more equipment. Naturally, the American firms turned first to the dyes which were easy to make, while their research laboratories busied themselves with the problem of making the more difficult dyes. So the easier dyes, which were sometimes poorer, too, appeared on the market first. It does not always follow that the easier dye will be the poorer, as that depends much upon the use to which it is to be put, but that question leads too far afield.

The third cause of dissatisfaction was a most interesting one. During the dye shortage, many rejected lots of foreign dyes, were brought out again and sold as American dyes! Nuf said.

So much for early troubles. The real question is whether or not we are now making good dyes, and whether or not we can make all the different dyes we need. The answer is a decided affirmative. One concern in this country is credited with a capacity of a million pounds of indigo a month, but it is not an official report. At any rate, they are making an enormous amount of it, and its quality is at least as good as that of the German makers, if not better.

Then how about costs? Should we be content to pay high prices for our manufactured articles?

Again the answer must come in sections. First, the cost of the dye used is a very small fraction of the total cost of an article. On a pair of shoes, there may be a cent's worth of black dye. On a bathing suit testimony given before a Congressional Committee showed that the dyestuffs used would cost from 2½ to 20 cents, according to the color. We need not suppose that the cost of a suit will e changed by the introduction of German dyes, for it is a question whether any man carries fifty cents worth of dyestuff on his person!

Second, and more important by far, even if the cost of dyestuffs entered into our living expense far more than it does, it is folly to suppose that the German dyestuff makers will keep costs down, once they have driven the American manufacturers off the market. The present rate of exchange gives them a mighty weapon now—but later, what will happen? The answer is clear to anyone who tries to make use of the low rate of exchange to buy German books cheaply.

The irritating thing is that some of the people who urged the American chemist to the utmost to supply them with dyes, should now be willing to buy German dyestuffs. For there are real reasons why we must have a dyestuff industry. First, for economic independence. American chemists can make dyes, they are making dyes, and they are good dyes. If they are given time enough, they will be making all the different dyes that are needed. Why should we again become dependent on any other country for our dyes?

Second, and most important, for national defence. Any student who has taken a course in organic chemistry knows that the substances which are used to make dyes can also be used to make explosives, to make poison gases, to make healing medicines, etc., etc. We must always have available in this country, plants, chemists, and workmen skilled in the varous processes used in dyestuff making. for the same processes, in different orders, and on different substances, bring about the formation of these very various kinds of substances.

For instance, one of the so-called "crudes" obtained from coal tar is toluene. On nitration, toluene is converted into ortho and para nitrotoluenes, or into trinitrotoluene, at the will of the chemist. The trinitrotiluene is better known as T. N. T., the powerful explosive, while the simpler ortho or para nitrotoluenes are convertible into dyestuffs, or into medicinal substances.

On the other hand, the toluene can be sulphonated and, after a couple of other steps, there results saccharine, the sugar substitute.

Again, toluene is easily converted into poison gas. Now, all of these various uses of toluene, resulting in so many different products, of which only a few are mentioned here, all of these uses depend on the same kind of chemical knowledge, the same kinds of industrial apparatus, and on workmen with the same training, just as the bridge builder, using the same materials and the same men, can build any desired type of bridge.

The United States cannot afford to lose the experienced chemists and workmen who are now making dyes, by having them change to other work.

England has already safeguarded her dyestuff industry, by passing laws which operate to prevent the entry of German dyes for a long enough period to allow the industry to become established. France has done the same. All the American chemist and the American manufacturer asks is the same thing: protection until he is prepared, as one chemist puts it, to go into Germany and put American dyestuffs on the German market!

The machinery for doing this is at hand. It was started, but was also stopped! The Longworth Bill, designed to prevent the entry of German dyestuffs, passed the House at the last session of Congress, but was held up in the Senate. If it is passed before all war-time legislation is repealed, well and good. If it is not—if time is allowed for vast stores of German dyes to be "dumped" in this country, it might as well never be passed.

PRACTICAL SMOKE PREVENTION

By E. H. Cotton, B. S., '19.

Smoke, which is chimney gases that contain small particles of unburned carbon, is due to a lack of hot air at the point where the volatile gases should be burned, the result being that these gases are only partly burned and the carbon is set free. A smoky stack then really represents money shooting into the air. The waste of fuel is not the only loss caused by smoky chimneys. If the depreciation in value of residence property near factories, the cost of painting and repainting of houses and stores, and the constant scrubbing and washing to remove soot could be expressed in actual money the total amount would probably be enormous. With the knowledge that smoke can be prevented most all of the larger cities have ordinances which prohibits the emission of dense smoke from any smokestack.

The fundamental condition of perfect combustion of soft coal is that every particle of the gas distilled from the coal be brought in contact with a sufficient supply of very hot air to burn it. By the use of mechanical stokers the gases may be distilled uniformly, because when properly designed and operated stokers feed both the coal and the air at a regular rate. If proper provisions, such as a fire-brick combustion chamber, are made for mixing the gases with hot air stokers will burn high volatile coal without smoke.

The question of a stoker installation should be carefully considered. The added efficiency and capacity, and the smokelessness must be balanced against the added first cost, the increased depreciation, and maintenance cost. A stoker installation in most cases will be found profitable in the larger plants, but generally in smaller plants some other method of obtaining smokeless combustion must be found. If the boiler has not a fire-brick chamber of sufficient length to burn the smoke with hand firing, and it is not practicable to install a mechanical stoker the kind of coal used must be changed. The use of coal low in volatile combustible matter prevents smoke, but in most cases when using this kind of fuel the cost of operating small boiler plants is almost doubled.

Coke, being a smokeless fuel, is available for use in boilers which are not adapted to the smokeless combustion of soft coal, but its use for this purpose is quite limited on account of its cost. Coke breeze, which is coke screenings, can be obtained in some localities at a very low cost. A sample of this coke breeze was recently tested and found to contain 84 per cent fixed carbon and 10 per cent ash. By mixing coke breeze with a cheap coal high in volatile combustible matter it was found that a cheap smokeless fuel was obtained. The mixture of coke breeze and coal made a very hot fire, and by giving the boilers plenty of draft the volatile matter in the coal was entirely burned. The amount of volatile matter per pound of fuel used was decreased, depending on the proportion of coke breeze and coal. This proportion depends on the volatile matter of coal with which the coke breeze is mixed. It was found that it is not advisable to use more coke breeze than is necessary to burn the smoke in high pressure boilers, because of the difficulty of obtaining sufficient draft to keep up the steam pressure. In low pressure boilers a 50 per cent mixture of coke breeze and a high volatile coal was found to be very successful without increasing the labor of the firemen.

The horizontal fire tube boiler is still much in use in smaller heating plants of 50 to 150 H. P. With Illinois coals carrying 30 to 40 per cent of volatile matter there is no better method of producing dense black smoke than in a fire tube boiler with hand firing. A mixture of coke breeze and Illinois washed nut coal was used in a 150 H. P. fire tube boiler, hand fired, and found to entirely eliminate the smoke. The method of alternate firing, which consists in firing fresh fuel, first on one-half of the bed of the furnace, and then on the other half alternately at equal intervals of time was used. After each firing the volatile gases that arose from it came in contact with the current of hot gas, carrying an excess of air from the other side of the bed which burned all the smoke.

A mixture of coke breeze and high volatile coal not only eliminated the smoke, but also decreased the cost per ton of fuel used.

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EDITORIAL

Now that we can't climb onto the "water wagon," let us jump on the "Sunday Blue Laws."

Carlos W. del Plaine, formerly Civil Editor, has been appointed Editor-in-Chief of the Techno-Log Staff.

Due to a heavy program of studies, Lyle A. Dills has been forced to resign his position as News Editor, and LeRoy A. Grettum, E.E. '23, has been appointed to fill the vacancy.

Other additions to the staff are: John M. Newman, Assistant Circulation Manager; N. R. Moore, Assistant Business Manager, and Miss Betty J. Sullivan, Chemical Editor.

Unavoidable difficulties are responsible for the late appearance of the Techno-Log this month.

"Mark Hopkins on one end of a log and a student on the other," was James A. Garfield's definition of a college. It was merely an expression of the admiration and gratitude felt by many men for the great teacher, Mark Hopkins. It voices a recognition of the fact that teachers and students are, after all, the great essentials of any institution of learning. Buildings, equipment, catalogs, and executive machinery make a brave appearance, but, alone, they can never make a school. Only the mature scientist, prepared for research, is ready to be left to his own devises in even the best of laboratories. The average undergraduate needs more than books and machinery, more than instruments and assignments; he needs the inspiration of contact with living, thinking men. When this is forgotten, the profession of teaching degenerates into poorly paid hack-work, and the man into a "prof."

The poorest of faculties almost always has one, and the best have many men upon whose fairness, interest, and co-operation the student can rely. Such a man is never tempted by his autocratic power to become a tyrant. He never vents upon a whole class his irritation with a single student. He never forgets that the students whom he instructs are human beings with average sincerity of spirit and seriousness of purpose. On the other hand, he does real teaching. He is not content to make assignments and give quizzes. He is able to anticipate the difficulties of a class, and has the patience to answer questions as long as uncertainties remain. His classes are places of real instruction, not of guessing what the "prof" intended; and his office is a mecca for worried or troubled students.

A big university is always open to the accusation of soul-lessness, but there are instructors in the College of Engineering whose relations with students, whose success in teaching, as shown by the work their classes do, and whose power to influence young men are a sufficient answer to any such criticism. Happy the student who finds such a faculty man, and who finds him early.

If it were possible to assimilate all human accomplishments from the beginning of time into one vast column, placing each one in its proper place with respect to time, and then focus a motion picture camera on the procession as it passed in review, a film could be made, which, if projected on a screen before the eyes of the world, would feature the hero of the universe, "Engineering and Science."

It would be very difficult for us to appreciate such a stupendous spectacle if our impression of most motion picture productions of the present day were not changed. We believe, and rightly so, that most of these productions are the fruits of highly creative imaginations of individuals who have little sense of perspective of things humanly probable. To change this belief then, we must be convinced that a screen production is reasonably "True to life," we might say.

To be convinced then of the trueness of our "World film," let us use our own imagination and follow the experiences of a male inhabitant of the planet Mars who has dropped onto this earth of ours.

He has landed at the base of the Woolworth building in New York City and is still somewhat unconscious as a result of his impact with the peculiar, hard, and smooth surface upon which he sits gazing upward to the massive structure, towering to the clouds almost, beside him. As he gazed in wonderment an awning was lowered above him, shutting off his view. He got upon his feet and walked to the curbing to step off, but a queer contrivance on two wheels made him step back. When the bicycle had passed he made another attempt, but another contrivance similar to the first came directly at him with greater speed and a series of explosions. He jumped to the middle of the street and sliped on something smooth and shiny and before he was able to get to his feet again a huge yellow monster bore down upon him and with the clanging of a bell ringing in his ears he was hurled aside into the path of yet another monster that came upon him smoothly and quietly and hurled him into the air above. He landed on a long bridge through the bottom of which he could see many people and funny forms passing. He looked but a minute, when with a rush and a roar, an elevated train dragged him along and released him over a large hole below, through which he fell. On opening his eyes he saw nothing, all was dark as night. Suddenly an intense light pierced the darkness and he was blinded by its glare, not alone blinded, however, but terrified at this new, strange apparition. He staggered to gain his balance and just as he was about to fall, the Subway Express hit him and he knew no more. He awoke on a platform that again dazzled him with its myriad of lights strung about. He rushed up the open stairway to the street above, where, on remembering the scene of his first fright, he dashed madly along until he came to the Bay. Plunging himself into its waters he thought of safety at last, but his feeling of security was of short duration. He came to the surface just as a large ocean liner brushed him along its sleek sides. He dove under the surface to escape the new peril and beheld an odd shaped sea monster coming his way. Swimming with every ounce of energy in him he was unable to get out of its path in time and was caught and carried to the surface once more. Believing it to be his end, he stretched himself upon the deck of the submarine and prepared for the worst, when suddenly a great whirring and commotion in the air aroused him. He sat up, and believing the great pair of wings as belonging to some super-bird of the air, he clung to it in the hope that it might carry him back to his home. The great bird ascended into the air with him.

From a peculiarly shaped instrument, strange voices were audible to him which seemed to emanate from the space beyond. The wireless telephone was too much for his very much shaken nerves, and he jumped from the hydroplane and landed on a passing balloon, which carried him up and out of our sight forever, in the direction of Mars.

Thus, by this flight of our own imagination, we are given a true view of Engineering and Science in the Universe, and we can appreciate more comprehensively the extent to which all material things of this earth are co-ordinated in our "World film" by Engineering and Science, to produce a common end, namely, service to mankind.

ATTENDANCE RULES

COLLEGE OF ENGINEERING

1. The following rules shall apply to all students registered in this College.

2. All matters regarding class attendance shall be dealt with on the principle that each student is expected to perform the entire work of the course to the best of his ability.

3. Neglect of work, as indicated by irregularity in attendance or low scholarship, is sufficient reason for exclusion from class with a mark of failure in the course.

4. Leaves of absence and excuses for absences will be accepted only when approved by the Dean of the College or his duly authorized representative. All absences not so excused will be regarded as unexcused. However, the official leaves of absence granted to University organizations by the Dean of Student Affairs and excuses given by the University Health Service for absences on account of illness will be accepted as having the approval of the Dean of the College.

5. Application to the Dean for leave of absence should be made prior to a contemplated absence, and for an excuse, immediately upon returning from an unforeseen absence. Certificates from physicians or others may be presented in support of applications.

6. The excuse card obtained from the Dean must be promptly shown by the student to each of his instructors in the classes missed in order that the recorded absences may be marked as excused. Failure to present excuses may result in exclusion from class.

7. Serious tardiness may be regarded as an absence and the student may be refused admission to the class for that particular period. This applies to laboratory, field work, and drawing, as well as to recitations and lectures.

8. Students shall be held responsible for all work missed through absence, whether excused or not. The instructor may require that this work be made up in such manner and at such time as he prescribes.

9. Absences in the two days immediately before or after any holiday or vacation shall be given a weight double that of absences at other times.

10. Any student whose unexcused absences in a course in one quarter become equal to the number of credits for the course in that quarter shall be dropped from the course with a mark of failure.

11. No student whose aggregate absences in one quarter for any reason whatever exceed 40 per cent of the total class periods in the quarter shall be considered a candidate for a credit in the course, except by permission of the Faculty with the approval of the head of the department.

ENGINEERS IN AERO CLUB

At the first meeting, for this school year, of the University of Minnesota Aero Club, two engineers were honored by the 'fliers' by being elected to office. Carlos del Plaine was elected president and Robert Murray vice-president. C. del Plaine and R. Murray both served in the Royal Air Force during the war. "Del" served in Belgium, France and Egypt, and was decorated with the British Military Medal. "Bob" served in France and Belgium, and was decorated with the Distinguished Conduct and Military Medals.

There are, at present, five engineers in the Aero Club. They are Carlos del Plaine, Robert Murray, Stanley Hahn, M. L. Boxell, and Kenneth Godwin. To qualify for membership to the club, a man must show record of experience as an aviator. "Del" illustrated his ability before the crowds on 'Homecoming Day.'

The purpose of the Aero Club is to study and promote aeronautics, as well as to keep a permanent record of each 'flier's' service.

Prohibitionist: "After a long darkness, we now see the light."

The Other Party: "Aye, verily, the 'moonshine.'"

"Dear Editor:—Should a stenographer kiss her boss?"

No, that would be a stenographical error.

Q. Who made the first nitride?

A. Paul Revere.

Friend: "Well, did you get any noteworthy marks last quarter?"

Stude.: "Sure, I got two As and a C."

Friend: "What were they in?"

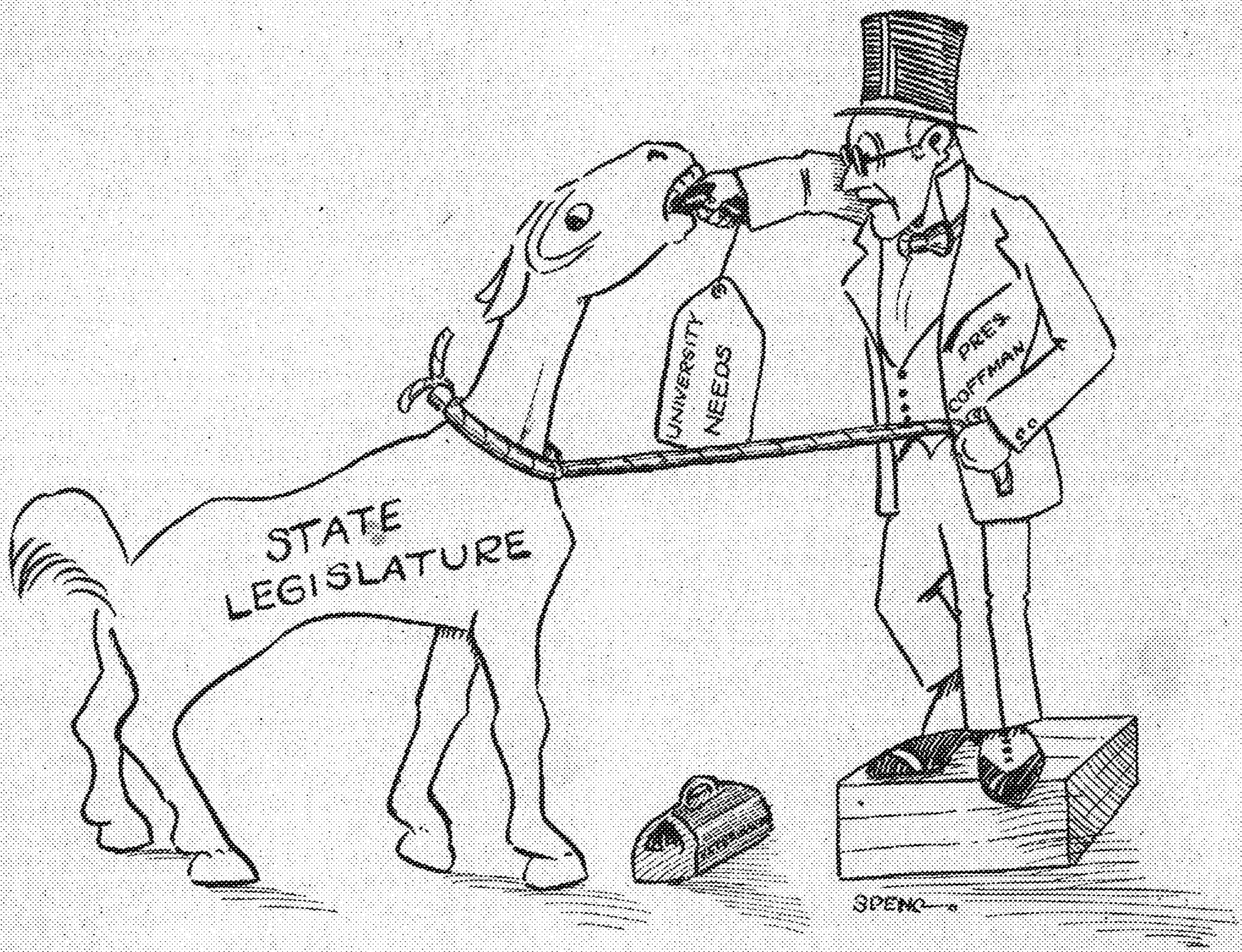
Stude.: "Laundry."

Friend: "How come, in laundry?"

Stude.: "That's my laundry mark, A. A. C."

"Give for one year the number of tons of coal shipped out of the United States."

"1492—None."—Ex.



WILL HE EVER SWALLOW IT?

Engineer in Accounting.

First Student: "To which account shall I charge postage expense?"

Engineer: "Charge all postage to Delivery Equipment Account."

It may be interesting to ask how a motor with a WOODEN armature would run. H. R. Rosendahl thinks it would be very economical.

Qwrty: "How are you getting along with Georgiana?"

Upsdf: "I love her still."

Qyrty: "Oh, she has a still, has she?"—Tiger.

Professor Ryan informed the Senior Electricals that those intending to take Transmission would have to have a "Still," and now those that cannot take it are working up intimate acquaintances.

COLLEGE NEWS

The Student Branch of the A. I. E. E. held its second meeting of the year Dec. 20 and, in spite of the fact that the finals were in progress, a nice turn-out was obtained.

The meeting was called to order by Pres. B. C. Maine and in order to make the meeting as short as possible all business was dispensed with. The program was opened with a cornet solo by Roy Palmer, accompanied by Geo. Wessale.

Major Ingles, of our own military department, was the speaker of the evening and gave a very interesting talk on the part played by the Signal Corps in the late war. He told of the rapid growth of the small Signal Corps in 1916 to the large and well-trained corps of men specialized in various professions and trades and of the difficulties those men had to work under and the importance of the Signal Corps to the other units.

Professor Shepardson gave a short talk on "Registration Law of Engineers and Architects," which is being prepared to be presented to the legislature by the Engineers of Minnesota.

The December meeting of the Minnesota Section of the A. I. E. E. was held on Tuesday evening, Dec. 21, at the Engineering auditorium.

Mr. Geo. H. Herrold, managing director and engineer of the St. Paul Planning Board, gave a talk on the "Minnesota Joint Engineering Board," outlining the functions of this board and what it has done for the Engineers of Minnesota.

Mr. W. C. Armstrong, chief engineer of the St. Paul Union Depot Co., spoke on the "Registration Law for Architects, Engineers and Surveyors," and also on "The Minnesota Federation of Architectural and Engineering Societies." He emphasized the fact that the Engineers of Minnesota needed this registration law as a protection of the profession and the public, and that it would place the profession on a higher plane.

Chairman J. D. Marshall brought up the question of nominating a Minnesota man as candidate for vice-president of the National Chapter of the A. I. E. E. and it was voted to do so.

We expect to have an article on the "Registration Law and the Minnesota Joint Engineering Board," in the near future.

Alex Luce thinks it does not make much difference whether you use figures for a square piston when you have a round cylinder. He spent five hours trying to fit the square piston into a round cylinder in a thermodynamics problem.

Mr. Raymon Bowers of the Department of Architecture was recently appointed by the Minnesota chapter of the Cosmopolitan Club to be General Manager of the International Revue, which will be given by the Club on April 15th.

Mr. C. H. Dow, instructor in Railway Surveying, has resigned to go to the South Dakota State Highway Commission. He is stationed at present in Pierre, S. D.

Dean Ora M. Leland went to Champaign, Ill., during the Christmas holidays, to inspect the Engineering equipment of the University of Illinois. From there he went to Chicago to attend a meeting of the Alumni Association, before which he gave an address.

In the December 9th issue of the Engineering News Record, Vol. 85, No. 24, there is an article by Prof. J. I. Parcel and George A. Maney, entitled "Secondary Stresses in Kenova Bridge Measured."

The enrollment in the College of Engineering for this quarter is as follows: Freshmen, 319; Sophomores, 317; Juniors, 155; Seniors, 115; Post Senior, 7; Unclassed, 9; making a total of 922.

There are three new instructors added to the faculty of the College of Engineering, Mr. Clifford Franks, Mr. L. T. Boone and Mr. J. H. Kuhlman.

Mr. Boone, alias "Daniel," obtained his degree of B.S. in 1910 and his C.E. in 1912 from the University of Wisconsin. He then spent five and a half years with the joint engineering staff of the Tax and Railroad Commission of Wisconsin. He then served as Instructor in Railway Engineering for two years in the University of Wisconsin. From there he went to the firm of Sloan, Huddle, Feustel and Freeman, consulting engineers of Chicago, and with whom he stayed for nine months. For the following seventeen months he was Structural Engineer on the Concrete Ship Section of the U. S. A. Shipping Board. For over a year since then he was Assistant Construction Engineer for the American Chain Co., in York, Pa. He has come here to take the place of Mr. Dow, who recently resigned from the Engineering faculty.

Mr. Clifford Franks has come to be the Class Assistant to Prof. Bass and Prof. Parcel. He is a '16 graduate from the University of Iowa, is a Tau Beta Pi, and a member of the A. A. E.

Mr. Kuhlman is instructor in Electrical Engineering and comes to us from Iowa State College.

Mr. Q. W. Hershey of the Westinghouse Electric Manufacturing Co. gave a very interesting illustrated talk on "Electrification of Railroads" before the Student Branch of the A. I. E. E. at their January meeting, held January 7 in the Engineering Auditorium. Mr. Hershey is delivering the most powerful locomotive in the world to the Milwaukee R. R. and had the locomotive on exhibit at the Milwaukee station. This locomotive is a 4200 H.P. 3000 volt D.C. passenger locomotive fitted with six 750 volt series motors arranged in pairs, and equipped with Automatic Forced Ventilation, Westinghouse System Regenerative Braking, Westinghouse Electro-pneumatic Control, and Westinghouse Type 14-EL Air Brake.

In comparing the Electric locomotive with the Steam, Mr. Hershey brought out the facts that the Electric increases the track capacity very greatly, which is of very great importance at present; also that heavier trains, making better time and running on better schedule, due to the fact that the Electric is not laid up for repairs and has proven to run as much as from 25 to 50 times as far as the Steam without operating trouble.

Another important feature of the Electric is the great saving of fuel, due to the fact that the power is generated outside of the locomotive in case of the Electric and because of the greater efficiency of stationary plant over the Steam locomotive, a saving of from 25 to 60 per cent of fuel is obtained. One of the largest losses of the Steam locomotive are "stand-by" losses, which are eliminated by the Electric. Regenerative Braking is also a source of fuel saving, as has been shown on the electrified part of the Milwaukee R. R., the locomotives pumping back into the line from 11 to 13 per cent of the power used in going down grades.

Philip C. Carlson was a victim of the hiccoughs for four days starting the first of the year. We wonder where he spent New Year's Eve.

Charles Ellsworth, '20, attended the A. I. E. E. meeting January 7. He is employed as lighting and starter man in a garage on Lyndale and Lake.

On December 16th Commencement exercises were held in the Armory, when President Lotus D. Coffman presented diplomas to 92 students. The commencement address was delivered by Dean Charles P. Everson, of the School of Medicine, University of Indiana.

The following Engineering students were among those who received their degrees: Nathan Harris, of the Civils; George L. Brown and Edmund Hanrahan, of the Generals.

THE UNIVERSITY RADIO STATION

H. C. FORBES, CHIEF OPERATOR.

The radio station of the university, under the direction of Mr. C. M. Jansky, Jr., is rapidly rounding into shape as one of the leading amateur and experiment stations in the Northwest.

The present equipment insures communication with similar stations up to a distance of several hundred miles. Reception is possible from practically all the commercial stations in the United States and from ships on the Great Lakes, off the Atlantic coast and in the Gulf of Mexico. High-powered stations in all parts of the United States are heard up to one hundred feet distant from the "loud-speaker" phone, and the high-power stations in Germany, Panama and Hawaii have been heard.

At present two transmitting sets are used in addition to the radio phone. One is a 1 Kw. Clapp-Eastham rotary quenched spark set, which is used for general communication, and the other a small Signal Corps (SCR 74) spark-coil outfit which is used for local work about the Twin Cities in order to minimize interference with other local stations.

The radio phone is a SCR 67 equipment, using two Western Electric vacuum tubes. Its range is well adapted to local work, and it is hoped that some exceptional distances may be covered with it this winter.

Two receiving sets are also used, one for receiving the higher powered, long-wave stations, and the other for reception from amateur and commercial stations having wave-lengths up to six hundred meters. The long-wave set was constructed out of equipment from the laboratory, using the "honeycomb" coils and a Western Electric VT-1 detector tube. Two SCR 72 amplifiers of two stages each, may be used when desired, all stations then being received on the "loud-speaker" phone. The short-wave receiver is also a Signal Corps instrument (SCR-54-A), using a VT-1 as a detector, and a SCR 72 amplifier. A variometer and variable condenser have been added to make the set regenerative.

Within the next month, an additional spark transmitter will be installed, one set then to be used on about a seven hundred meter-wave for long distance transmission, and the new one on about two hundred and fifty meters for general communication. This arrangement will insure a transmitting range of over one thousand miles for the station. An undamped-wave transmitter and a high-power radio phone will also be installed in the near future.

Two aerials are available for the equipment, the smaller one, 100 feet high and 150 feet long, is used for short-wave work, and the other, 100 feet high and 400 feet long, is used for long-wave reception.

The station has been granted a government experimental license, with call letters 9XI. This license allows the use of almost any power or wave length desired, a privilege which only a very few stations enjoy. A staff of operators has been picked from the junior and senior electrical engineering classes, most of them having government commercial licenses. They maintain "watches" every evening except Sunday, and are individually responsible for the operation of the station on the nights on which they are on duty.

The station has undertaken several functions, and numerous investigations will be carried on during the winter. Weather reports are broadcasted from the station every noon at twelve-thirty, and are received at many points throughout the state. Play by play, reports of the home football games have been broadcasted by radio, and were reported received from many points.

On election night, returns were received from two stations simultaneously, and were telephoned to the Campus Club, beating the wire returns by more than an hour, in some cases.

The apparatus is also used for the instruction of the students in the advanced R. O. T. C. Signal Corps course, and for the senior class in radio communication.

WESTINGHOUSE BUILDS GIANT TRANSFORMER.

Four of the largest transformers in the world, each of which has a capacity 35 per cent greater than the largest single-phase transformer heretofore constructed, were recently designed, built and tested at the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company and shipped to Colfax, Pa., on the Allegheny river, where all four will be installed in the new plant of the Duquesne Light Company.

Each of the transformer tanks has a diameter of nearly 10 feet and is approximately 16 feet high. With the bushings in place the total height is over 22 feet, measured from the wheels of the truck upon which the tank stands to the tip of the bushings. Each transformer weighs 63 tons when filled with oil. Over 18 tons of special high grade oil is required for each transformer.

The four transformers required some 14 miles of copper wire for the windings and 82 tons of the finest quality sheet steel obtainable for the magnetic circuit. Almost two miles of seamless copper tubing are required in the cooling systems of the four units.

The transformers at the Colfax station will be arranged in one bank of three with one spare for use on occasions of necessity. The transformers will step up the output of a three-element 70,000 kva. steam turbine, from the generating voltage of 11,500 volts to a transmission voltage of 66,000 volts. Provision is made so that when this generating station reaches its ultimate capacity the transmission voltage may be increased to 132,000 volts. This will be necessary owing to the great amount of power which will be generated at this station.

ALUMNI NOTES.

W. L. Kinsell, E.E., '00, sends us the best of New Year's greetings from Muskegon, together with some encouragement and praise.

L. F. McKenzie insists that one of the best ways of keeping in touch with the Engineering College and the Alma Mater is to take the Techno-Log, and he backs his words by a subscription.

Martin Cornelius, E.E., '06, is with the Westinghouse Co. at East Pittsburgh and is directing the design of propulsion equipment for war ships, the battleship Tennessee in particular.

J. M. Levin is located at Long Island City with the New York and Queens Electric Light and Power Company.

We recently received a letter from Victor H. Carlson, E. E., '20, alias "Vic," who is with the Chili Exploration Co. in Chili, South America. It is the only place he knows of where men are glad to be laid off. Everett Knowles, E.E., '20, and Carlson left the U. S. last June and by this time letters from home look like million dollar checks. Their address is: ℅ Chili Exploration Co., Chile, S. A. Via Antofagasta.

A number of the old Alumni attended the last meeting of the A. I. E. E., among whom were R. M. Peterson, '20, C. H. Reeve, '19, Hugo Schlenk, '20, and Ray Lockwood, '20. The last named gentleman showed considerable interest at the beginning of the meeting when the proposed "License Law" was brought up for discussion. He registered keen disappointment, however, when he found that this law did not refer to marriage licenses.

HURRAH! The Seniors are going to have a dance. At a class meeting held Tuesday noon it was proposed to have a Senior dance. A committee composed of Roy Palmer, L. Sverdrup, Peter Rueter, Roy Papenthien and R. Damberg was appointed to carry out the plans.

P. I. Peterson, E.E., '21, who is employed by the Cutler-Hammer Company of Milwaukee, has recently been appointed to a responsible position with that company. Congratulations "Pip."

Harold S. Langland, who graduated in '19, and Miss Helen Stanley, who is also a graduate of Minnesota, were married recently. They will make their home in San Francisco.

Mr. C. H. Reeve E. E. '19 formerly with the Northwestern Telephone Co., of Duluth has entered the employ of the American Telephone and Telegraph Co., and is now located at Minneapolis.

Mr. Geo. R. Jones E.E. '15, with two associates, recently bought out the Minneapolis Electric Equipment Co.

Mr. P. Edelman E. E. '16 has been located in New York city where he has brought out a number of inventions.

Mr. Donald Loye E. E. '16 who is with the American Telephone and Telegraph Co., of New York city was recently married. Congratulations Don, tell us about it.

Mr. F. H. Irwin E. E. '16 is connected with the Pierson Wilcox Co., Minneapolis.

Mr. Clayton Reasoner M. E. '20 is back for his post senior year. He has been with the Western Electric Co., during the summer.

In the February issue 1920 of the "Journal of the American Institute of Electrical Engineers" we find two articles written by Minnesota men. "The Measurement of Projectile Velocities" by P. E. Klopstig E. E.'11 and A. L. Loomis, and "Standard Graphic Symbols" by E. J. Cheny, E. E. '04.

H. S. Langland E. E. '19, O. C. Lee E. E. '19 and A. P. Peterson E. E. '19 recently of the Electric Machinery Co., of Minneapolis, have accepted positions as instructors in the drawing and mathematics department of the Engineering College.

Mr. E. C. Melvy E. E. '17 is located at 17 Parkrow, New York city, with the Overseas Importing Company.

Knox A. Powell, B. S. '20, of Moore, Pa., is trying his best to absorb the knowledge of turbines and condensers as a sponge absorbs water. He is with the Westinghouse Electric & Manufacturing Company.

L. F. McKenzie, B. S. '20 is overseeing the construction of high voltage distribution lines for the Triumph Electric Co., at Stephens, Minn.

Tom Granfield, E. E. '14, is moving to Omaha, there to continue his work with the Northwestern Telephone Co.

Ed Holm, B. S. '20, is with the C. M. and St. P. railroad here in Minneapolis.

The product of the Minnesota College of Chemistry goes to Brunswick, Ga., where A. H. Reu, '19 is employed by the Hercules Powder Co., in their naval-stores plant. This field of work, Mr. Reu informs us, has been practically untouched by technical men, especially the turpentine and rosin industries and therefore offers great opportunities.

Among the old engineers who called on us during Home Coming Week, were E. Teberg, B. S. '17, H. E. Berndt, B. S. '20, F. A. Dever, B. S. '20 and C. C. Hanke, B. S. '20. No doubt many of the alumni forgot us this year and perhaps many more did not know that we were in existence, but we hope that next year the Techno-Log will be in a position to greet all the old graduates as they return for the Home-Coming festivities.

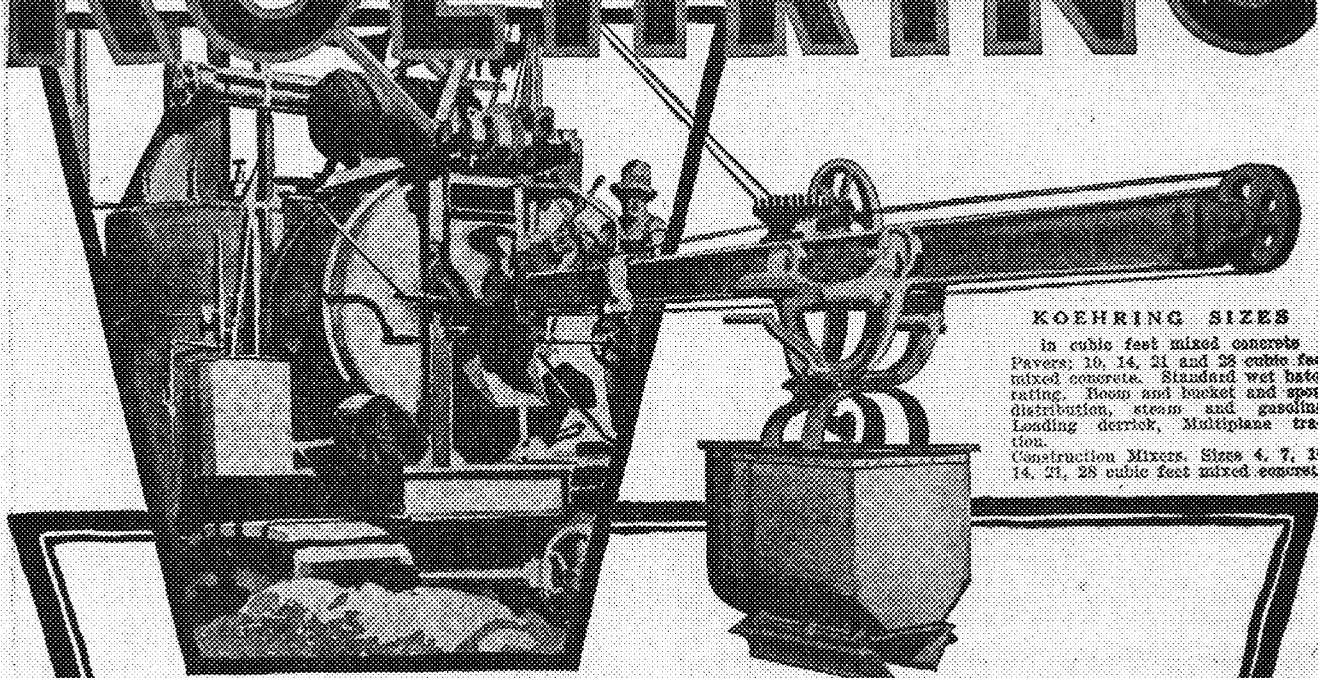
Captain R. L. Gotzenburger, E. E. '13-'14 visited the U last fall on his way to the Frankfurt Arsenal at Philadelphia, where he is now stationed.

Mr. E. W. Christianson E. E. '19 who has been in the employ of the Northwestern Telephone Co., of Duluth has been promoted and transferred.

At the first A. I. E. E. meeting of the year, held November 12, fifty electrical engineers were present. An interesting program was presented which marked the first gathering a success. The feature of the meeting was that only students took part in entertainment.

After a short business meeting, Baisl C. Maine presented Samuel A. Berg, who talked on "Human Electrons." R. W. Liddle was the next speaker and enumerated his summer experiences in central station work in a South Dakota town. Ray W. Sweet was introduced as "An Old Salt" on "Deep Sea Stuff," which was a reminder of the part the navy men, especially wireless operators, played in the world war.

KOEHRING



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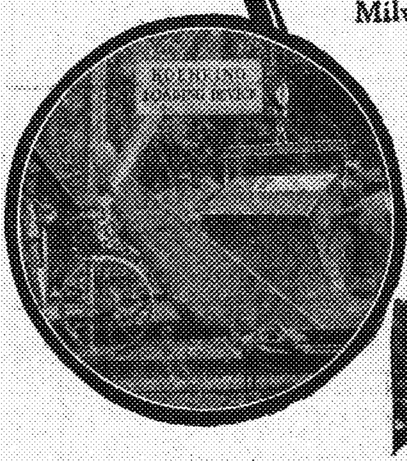

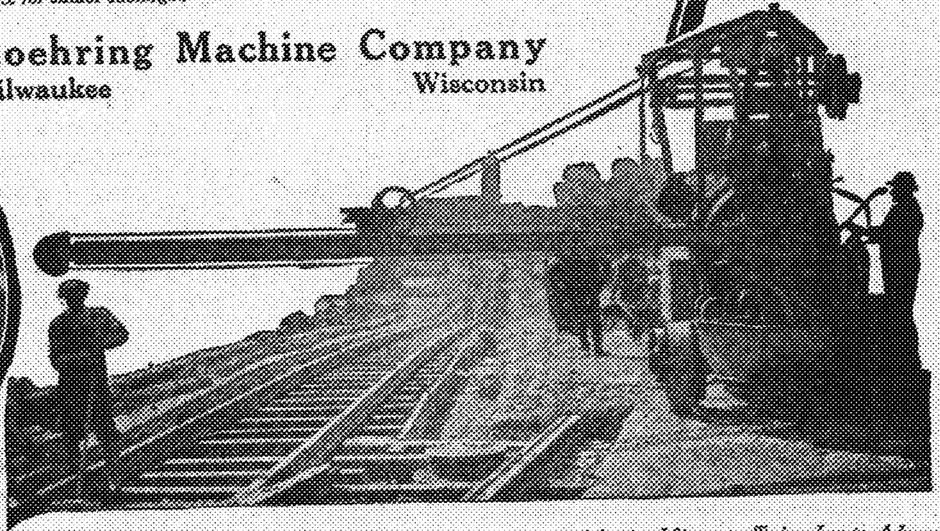

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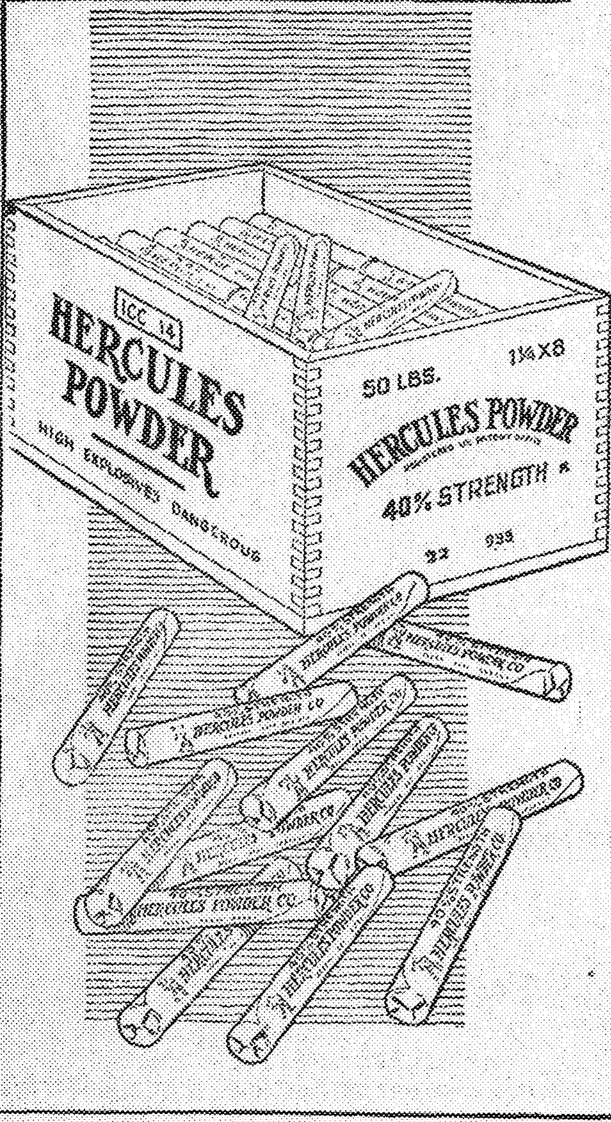

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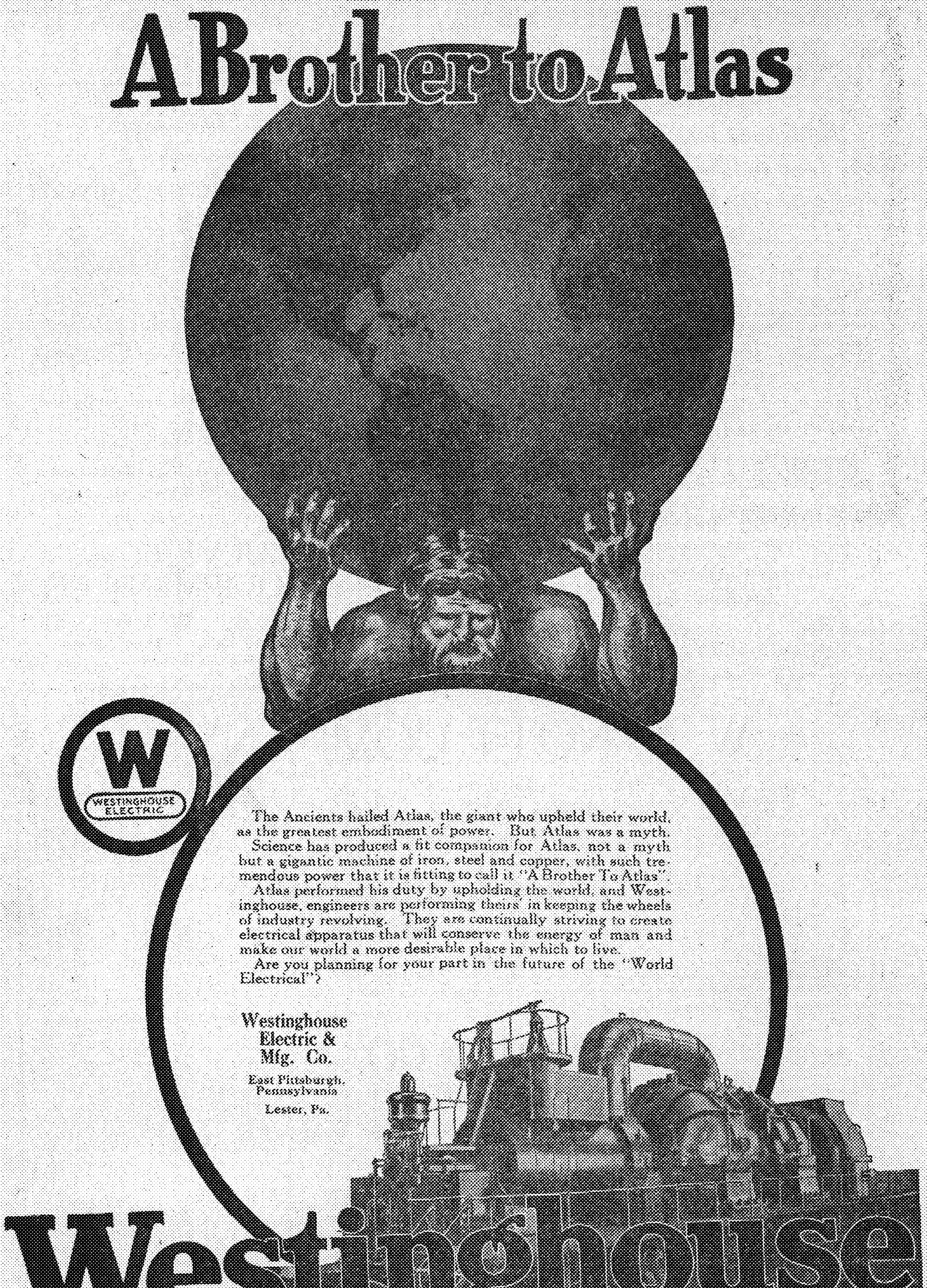
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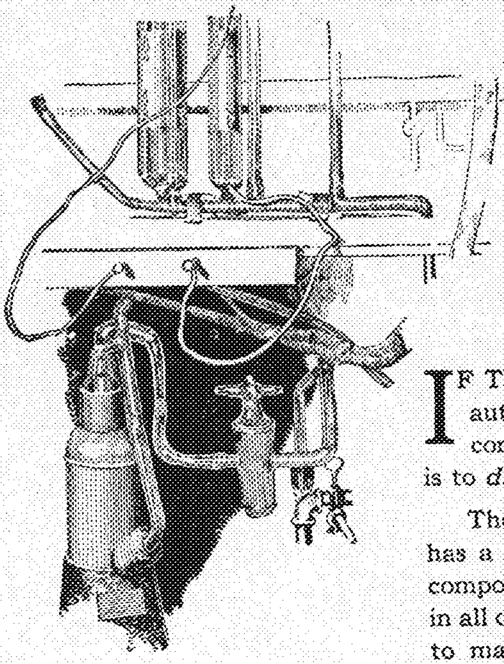

What Is Vacuum?

IF THE traffic policeman did not hold up his hand and control the automobiles and wagons and people there would be collisions, confusion, and but little progress in any direction. His business is to *direct*.

The physicist who tries to obtain a vacuum that is nearly perfect has a problem somewhat like that of the traffic policeman. Air is composed of molecules — billions and billions of them flying about in all directions and often colliding. The physicist's pump is designed to make the molecules travel in one direction — out through the exhaust. The molecules are much too small to be seen even with a microscope, but the pump jogs them along and at least starts them in the right direction.

A perfect vacuum would be one in which there is not a single free molecule.

For over forty years scientists have been trying to pump and jog and herd more molecules out of vessels. There are still in the best vacuum obtainable more molecules per cubic centimeter than there are people in the world, in other words, about two billion. Whenever a new jogging device is invented, it becomes possible to eject a few million more molecules.

The Research Laboratories of the General Electric Company have spent years in trying to drive more and more molecules of air from containers. The chief purpose has been to study the effects obtained, as, for example, the boiling away of metals in a vacuum.

This investigation of high vacua had unexpected results. It became possible to make better X-ray tubes — better because the X-rays could be controlled; to make the electron tubes now so essential in long-range wireless communication more efficient and trustworthy; and to develop an entirely new type of incandescent lamp, one which is filled with a gas and which gives more light than any of the older lamps.

No one can foretell what will be the outcome of research in pure science. New knowledge, new ideas inevitably are gained. And sooner or later this new knowledge, these new ideas find a practical application. For this reason the primary purpose of the Research Laboratories of the General Electric Company is the broadening of human knowledge.

General Electric Company

General Office Schenectady, N.Y.

MINNESOTA TECHNO-LOG

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IN THIS ISSUE

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by the students of
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CONTENTS

MINNESOTA TECHNO-LOG

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SOCIETIES

University of Minnesota Branch of American Institute of Electrical Engineers.—Pres., Basil Maine; Secy., Ludwig Larson; Treas., A. Wilson.

University of Minnesota Branch of American Association of Mechanical Engineers.—Pres., Joachin; Vice-Pres., Lloyd Elmer; Secy., Olmstead; Treas., Roy Aure.

American Association of Engineers.—Pres., J. H. Werdenhoff; Vice-Pres., Lyle A. Dills; Secy. and Treas., Geo. Christlow.

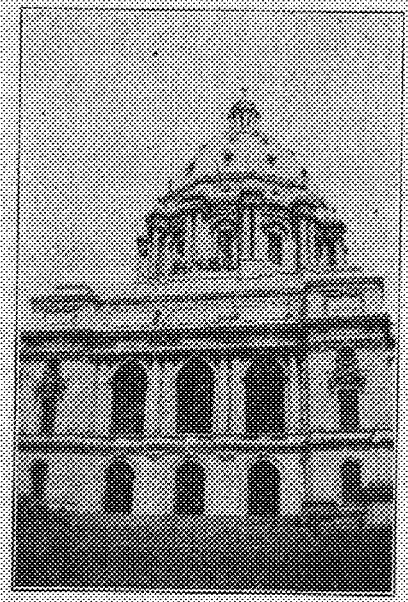
Architectural Society.—Pres., Edward Larson; Vice-Pres., A. R. Melander; Secy., R. Damberg; Treas., M. L. Anderson.

University of Minnesota Society of Civil Engineers.—Pres., J. H. Werdenhoff; Vice-Pres., Robt. Muessel; Secy., Victor Wood; Treas., W. D. Weis.

The Minnesota Capital

By RUFUS E. FRITZ, A. '24

One of the most beautiful buildings in the world, the Minnesota Capitol, stands within ten miles of this campus. Its completion in 1905 marked the beginning of a new era of public building construction thoughout the United States. The plans of this edifice were drawn and executed under the direction of Mr. Cass Gilbert, who is one of the world's most eminent architects.



Minnesota State Capitol

That the Capitol represents the materialization of what were considered at one time to be the dreams of an impractical man, is true. The discouraging views held by some critics at the time when Mr. Gilbert undertook the construction of the Woolworth building are but a repetition of what took place in Minnesota twenty-five years ago.

The Capitol is located in a very advantageous position. It stands on the brow of a high hill and overlooks the Mississippi River Valley. The dome rises to a height of 235 feet, and can be seen long before one enters the city proper. The surrounding grounds are being enlarged and beautified rapidly, while suitable approaches are being planned which, when completed, will connect the Capitol with other handsome structures throughout the city.

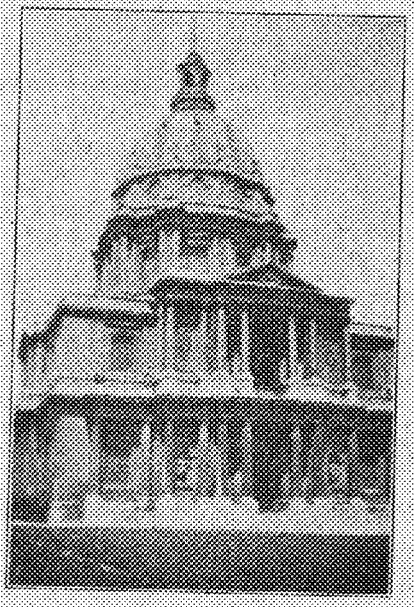
The exterior of the Capitol below the three upper floors is of Minnesota granite. The balance of the super-structure, including the dome, is of white Georgia marble. Tennessee and Georgia marbles are the only two which will withstand the rigors of the northern climate. As the result of many tests, white Georgia marble was finally chosen for the work, owing to its low degree of porosity and its superiority for cutting.

The exterior is a blending of Roman and Grecian architecture: the arches, balustrades, and dome are Roman, but the columns, pilasters, lintels, and window treatment are Grecian. No portion of the building is suggestive of the petty, individual design of the Gothic art, but, on the contrary, its magnificent splendor typifies all that which is strong and just. It seems that the structure rises out of the ground to claim for Athens, Sparta, and Rome the glory which was once theirs.

The six figures on the cornice above the facade entrance personify the various stages through which the State has passed since the day of the Pioneer. The cutting and carving is the accomplishment of Italian masters, and the golden horses which stand on a ledge near the base of the dome show the touch of pure art.

The dome of the Minnesota Capitol is surpassed in beauty and skill of stone construction by no other. St. Peter's in Rome, Le Pantheon in Paris, St. Paul's in London, and St. John's in New York are the only domes of stone and timber construction or entire stone construction and of such size that would permit them to be compared with the dome of the Capitol at St. Paul. One famous dome is that of the National Capitol at Washington. This, however, is of steel and iron construction, whence comes the proverb, "It expands like a lily." Furthermore, the Minnesota State Capitol has not only one dome, but it has three: first, there is the outer cupola of pure marble, and below this is the middle dom which is built of masonry and whose top rests thirty feet beneath the inside of the outer dome. Below the middle cupola is the third, or innermost dome which carries the decoration and mural paintings. From this inner dome is suspended a chandelier containing 23,000 pieces of cut glass.

The exterior impresses one with the sacrifice which the citizens of the State have made in order to erect this monument, but the interior sur-



Napoleon's Tomb—Paris
Known as Les Invalides. Built by Louis XIV.

passes the exterior in splendor; the finish is more delicate, and the stone of finer texture, of all hardnesses, of all colors, and from all parts of the world.

There is but one interior in the world which can in any way compare with this one, and it is that of the Hotel des Invalides, where rest the remains of Napoleon. The difference between the two is the difference between the unlimited extravagance of a haughty autocracy, and the level-headed expenditures of a democracy.

The main entrance opens directly upon the rotunda. From this part of the building one gets an excellent view of the interior of the dome. The vastness of the interior really gives one a feeling of the insignificance of one's own person.

In the arcade, which encircles the rotunda, stand four bronze cases containing the remnants of what were at one time the flags of the most famous regiments which took part in our more recent wars. On the ground floor, directly below the rotunda, is the ghost's chamber. This room gives out a weird echo at the slightest sound, causing one to beat a hasty retreat. The ceiling of this chamber is finished in Mexican tile which, in the shaded light, has a peculiar streaked appearance.

In the east wing is the million dollar staircase that leads up to the Supreme Court on the second floor. On the first and second floors may be seen marbles from all parts of the world: Verde Antique from Vermont, Botticino from Italy, Belgium Black, Lepanto from Spain, Breche Violets and Pave, Sylvan Green, and Grand Antiques. These are worked out into panels, columns, wainscots, borders and inlays.

The Chamber of the House of Representatives is finished in mahogany and white Vermont marble. The walls are tinted in light gray and gold. The Senate Chamber is finished in Breche Violet, one of Italy's most exquisite marbles. The walls are decorated in mauve and gold. The interior of this chamber, although not so stately as that of the Supreme Court, leaves an impression on the mind which is not easily forgotten.

The Governor's Room is very artistic in its appointments. It contains rich tapestries, rugs, oil paintings and furniture of heavy design. One of the paintings is a life-like representation of the glorious battlefield of Gettysburg. The remaining paintings are the masterpieces of master painters: Blashfield's Battle of Corinth is elegant in its portrayal of human emotion under shell fire.

There are several minor details about this structure which are of considerable interest. Perhaps the most prominent of these is the winding stairway which conducts one through a labyrinth of passages and landings to the innermost dome and thence to the top of the outer dome, where one may get a view of the surrounding hills and valleys.

It is indeed a pity that so little is known of such a grand edifice. People travel to foreign lands to visit places of interest, when with practically no expense they could view with pride a truly remarkable monument to the industry and thrift of a commonwealth.

Materials of Construction for Chemical Industries

By DR. C. A. MANN,
Prof. Industrial Chemistry.

The student working in the Chemistry laboratory is given apparatus consisting of glass-ware, porcelain-ware, platinum, and in some cases nickel and iron. With this type of material he is able to perform his experiments without fear of the action of chemicals on these materials and without therefore contaminating his products. Because of their resistance to chemical reaction these materials would be of great value in chemical processes on the larger scale, but because of certain properties their use is limited in the industries.

The materials of construction used in chemical plants may be roughly divided into six classes, namely:

1. Wood;
2. Ceramics;
3. Metals;
4. Alloys;
5. A combination of second and fourth types;
6. Miscellaneous.

In discussing these materials of construction it is to be kept in mind that they are not to be used for supporting or general structural purposes, but that they are to be used in direct contact with the chemicals that enter into chemical processes. Some of the properties required of such materials are, that they can be made into suitable shapes, easily machined, resistant to the action of chemicals, either of high or low heat conductivity, that they be strong so that they may resist shock, and that they are easily available and cheap.

Cypress wood is the kind of wood that is commonly used by chemical plants for making vats and tanks. These are used for the precipitation of paint pigments for coupling of organic materials, for manufacture of dye stuffs, for soap vats, in the paper industry, particularly in connection with beating engines, in the tanning industries, and in the extraction of natural dye-stuffs from dye woods and the extraction of tannic acid from hemlock. In the latter industry the wood is used for making pipes for transporting this tannic acid because of its corrosive action on nearly all of the common metals. The cheapness of wood and the ease with which it can be shaped into various equipments is a desirable feature. The only method of applying heat is through submerged steam pipes.

Under the head of ceramics we may class such materials as glass, porcelain, chemical stone-ware, some natural stones, and fused silica. All of these materials are very resistant to acids of different concentrations except hydrofluoric and are not acted on by most neutral solutions and will withstand some of the weaker alkalis. This makes these materials useful structural substances. The properties, however, limit their general use on a large scale. They are all very fragile and, therefore, cannot withstand shock. The range of temperature that can be applied is usually quite limited. It is almost impossible to make equipment of large sizes of them which could be used for production of chemicals on the ton basis. The greatest value of glass-ware is for the manufacture of bottles and carboys used in the transportation of strong and high purity acids. A limited amount of glass is used for flasks and condensers in making chemically pure acids. In the nitric acid industries glass tubes are in constant use for the transportation of this acid to various parts of the plant.

Hardly any porcelain is used for the larger chemical equipment except as a coating over metals. Its high cost has always limited its more general use. Chemical stone-ware or vitrified or glazed clay is the most extensively used ceramic material. Although it is quite fragile it can be shaped into various forms of a thickness that will stand considerable shock. This type of material is used for the manufacture of vats, absorption towers and the filling material of these towers as well as for stills and coiled condensers. Certain manufacturers make acid pumps with this kind of material. It will not stand sudden changes of temperature but because it can be ground and polished it can be made and fitted into very complicated shapes. Up to a few years ago most of this type of equipment was imported but it is now available through the General Ceramic Company and also through the Maurice A. Knight Company.

Fused silica-ware, known as Vitriosil, has a limited but important application in the chemical industry. The greatest use is in connection with the concentration of sulphuric acid where silica dishes are placed in cascade over direct heat. Fused silica-ware is exceedingly fragile, very resistant to the action of acids and expensive, but will stand sudden changes of heat better than any other ceramic material. It has been used to a slight extent for crucibles and small stills in general laboratories.

A few metals are used in the construction of chemical equipment. These are in their order of importance: lead, copper, platinum, silver, aluminum, and gold. Because of their high heat conductivity and the resistance of specific chemicals, these materials have been found of considerable importance in the manufacture of chemicals on a large scale. The greatest use for lead is in connection with the chamber method of making sulphuric acid where the entire plant except for the suiphur burner consists of lead sheet and lead piping. It is also used in connection with transportation of various liquids in chemical plants. Lead is resistant to both sulphuric and hydrochloric acid of limited strength. Sulphuric acid of 95% strength may be boiled in lead without serious effect, but lead will only withstand cold hydrochloric acid.

At the present time the market offers a material called chemical lead, which contains a small fraction of percent of calcium and also an antimonial lead which gives the lead greater stiffness. The lack of this stiffness limits the general use of lead for structural purposes, but it is used for lining other equipment which supports the lead sheet.

Copper is resistant to cold sulphuric, hydrochloric, and acetic acids. But it is more because of its high heat conductivity that copper is used in chemical equipment. The greatest use of this material is in connection with stills, condensers, and fractionating columns used in the recovery of organic solvents which do not have any action on the copper. It is also used in connection with the turpentine industry and volatile oil industry, and when distillation can be carried on out of contact with air it is used for the distillation of acetic acid, which only acts on copper in the presence of oxygen.

Platinum, because of its great resistance to the action of acids, would be a satisfactory structural material, but its use is limited because of its high cost. Practically the only uses at the present time are for sulphuric acid stills and for electrodes in the manufacture of certain chemicals by the electrolytic method.

One of the few uses of silver is in connection with condenser tubes in the acetic acid manufacture. Gold might be used similarly, but because of its high cost it is used only in connection with very small types of apparatus. Although aluminum is attacked by strong acids it may be used in connection with the nitro-celulose industries where nitrations are carried out by mixed acids consisting of strong sulphuric and nitric acids. This mixture has very little action on aluminum and the aluminum is therefore used in the form of forks to lift the nitro-celulose out of the acid. It is also used in connection with condensers for acetic acid. Alkalis react with it very rapidly and therefore this structural material must be kept out of contact with these materials.

Under the head of alloys might be included cast-iron and steel which are alloys of iron and carbon; duriron, tantiron ,corrossiron, ironic; manganese steel, chrome steel, brass, bronze, monel metal, and mecco metal. Of these alloys the cast-iron is the most important. It can be cast in various shapes, easily machined, and has a high compressive strength. It is resistant to strong sulphuric acid, mixed acid, and to alkalis, both cold and boiling. Because of its low tensile strength it must be cast into heavy shapes, which is a disadvantage. It will withstand comparatively rapid changes of temperature and also shocks.

Steel has similar chemical properties to cast-iron, but it is not so easily machined. The fact that it has high tensile strength gives it the advantage that chemical machinery can be built very much lighter than it can with cast-iron. Steel is used on a large scale for shipping strong sulphuric acid, both in the shape of tank cars and as bilge barrels. It is also used very extensively for structural purposes around the plant.

Duriron, tantiron, corrossiron, and ironic are low carbon steels containing between 15 and 20% of Silicon. These alloys are very resistant to acids, both cold and hot, and to alkalis of moderate strength. They can be cast, but they are so hard that it is impossible to machine them and all fittings must be ground. They are very brittle and therefore apparatus must be built in heavy sizes. A few chemical properties of these materials are here given:

U. S. BUREAU OF STANDARDS DEPRECIATION TESTS ON DURIRON

Corrosive	Solution, % by wt.	Four months at 15 -20 C. loss in mgs. per sq. cm.	% loss
Sulphuric Acid	95%	.118	.007
Sulphuric Acid	25%	.272	.016
Sulphuric Acid	10%	.398	.025
Nitric Acid	70%	.105	.006
Nitric Acid	25%	.123	.007
Nitric Acid	10%	no loss	no loss
Hydrochloric Acid	25%	46.992	2.862
Hydrochloric Acid	5%	18.9	1.162
Acetic Acid	99%	.105	.006
Ammonium Chloride	27%	.568	.026

Both manganese and chrome steel have a limited use in chemical machinery as wearing surfaces in connection with crushing, grinding, and pulverizing equipment. It is because of the toughness and hardness of these steels that they can be used for the purposes named.

In many cases brass may replace copper, particularly in connection with distilling apparatus where organic solvents are used. It is stiffer than copper and therefore can be built in lighter weights. The alloy of copper and tin, known as bronze, further alloyed with phosphorus to make phosphorus bronze is a material which resists the acids very well. A common use for phosphorus bronze is the manufacture of acid pumps and also the manufacture of very resistant wire screen.

Monel metal is a name applied to an alloy consisting primarily of copper and nickel with a small amount of iron. This material is produced directly from an ore that contains the constituents in the proper ratio. Up to the present time it has a limited use in the chemical industry, but the properties shown below would indicate that it could be used for apparatus in connection with many chemical processes. The high cost of this alloy has probably limited its use, although a certain amount of difficulty has been experienced in casting it without creating severe strains. It can be easily machined, brazed and soldered.

This alloy is resistant to some acids, to superheated steam and to all atmospheric conditions. It is not acted on by sea water. Immersed in 50% sulphuric acid for a period of fifty-six days, it showed no loss in weight. In the form of chips it was boiled in this same acid and after forty-eight hours lost only 0.5% in weight.

Another new alloy which has just appeared on the market is mecco metal, whose properties are as follows:

RATES OF CORROSION
(Inches Penetration Per Month)

$\%H_2SO_4$	Meco Metal at 38 C. or 86 F	Meco Metal at 45 C. or 133 F.
		0.000385
1	0.000155	0.000281
20	0.000134	0.000161
50	0.000035	0.002910
100	0.001865	
%HCl	at 25 C. or 77 F.	at 60 C. or 140 F.
2	0.000205	0.001535
20	0.001400	0.030400

Some of its properties would indicate that this material could be used very extensively in the chemical industries. At the present time it is used largely for the manufacture of acid pumps.

Combinations of the ceramic materials with alloys are coming into prominence. Both the Pfaudler and Elyria Companies are manufacturing equipment of this type. The Pfaudler Company coats a stell or cast-iron with a glass coating. Usually a low melting or lead glass is used in the form of a boro silicate. One requirement of this type of equipment is that a glass coat must adhere to and practically fuse into the metal when applied, and that both the coat and the metal must be the same co-efficient of expansion. Under no circumstances can a direct fire be applied because it would crack off the glass coat. With equipment of this type we have the chemical advantage of the glass and the structural advantage of the covered metal.

In a similar way porcelain and other metallic oxides in the form of enamels are used to coat the surfaces of metals and particularly of alloys as iron and steel. The equipment is built in the shape of vats or tanks and in some instances still have been made of these materials. Its greatest use is in connection with the manufacture of high grade chemicals and particularly medicinal or pharmaceutical products, although it has been used in connection with the manufacture of milk products as well.

Of the miscellaneous structural materials rubber has gained great importance. It is made in the shape of pipes and pipe fittings for the transportation of corrosive liquids. Such materials as asphalt and paint, lacquers and varnishes, have been used for lining either wooden or steel tanks to make them acid proof. Concrete is being used more extensively for permanent storage tanks for the more or less neutral unactive chemicals.

In this paper only a limited number and then only the more important materials of construction have been considered. Many other alloys have appeared on the market for stuctural purposes, whose chemical properties have not yet been determined. No doubt, some of these will be used for the manufacture of chemical equipment. In some instances no suitable material has been found to concentrate certain chemicals. As an example, zinc chloride always reacts with the material with which it comes in contact, therefore, not only wearing away the equipment but seriously contaminating the zinc chloride.

A discussion of the materials of construction for chemical plants is of primary interest to industrial chemists and chemical engineers, but other engineers who are at one time or another required to erect chemical plants or design equipment for them can make use of the limited information concerning some of the properties and uses of these materials of construction.

"Papa, where is Atoms?"

"I don't know, my boy. Do you mean Athens?"

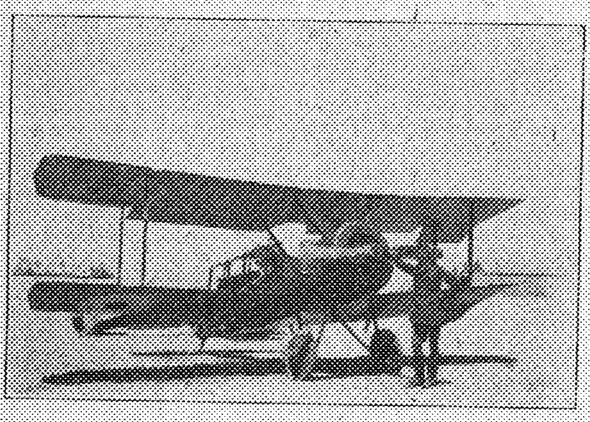
"No, Atoms. The place where everything is blown to."—VooDoo.

The Nile Delta from the Air

By CARLOS W. DEL PLAINE

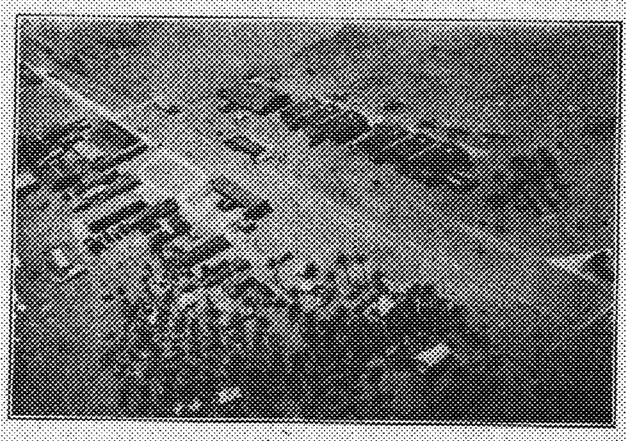
During my training as a pilot, I was attached to a scout squadron whose aerodromes were on a peninsula about thirteen miles from Alexandria, Egypt. The whole peninsula was cut off from the mainland by a high, triple barbed-wire fence which, on one side was patrolled by English soldiers and on the other by mounted Sudanese guards. The Englishmen were there to prevent the exit or entry of any person without a military pass; the Sudanese were supposed to keep any evil-intentioned persons out of the Sultana's palace grounds that lay just outside the enclosure. Within the barriers were two large aerodromes, an immense aircraft factory, and the dilapidated village of Aboukir. The huge hangars, machine-testing plants, wireless station, and living quarters were grouped in an oasis of sparse bunches of date-palms. The aircraft factory lay between the aerodrome and the village. The landing ground was a large, flat area of sand, fairly smooth and about half a mile square, bordered on one side by a plantation of palm trees. On the other side were the partly excavated ruins of Canopus, gaping wounds in the sides of the low, gray hills. Through the center was a first-class military road that ran parallel to the single track of the Egyptian State Railway.

One evening, in looking over the bulletin board which hung in the mess room, I noticed that I was posted to fly on reconnaissance at five o'clock the next morning.



A Sopwith "Pup"

In the cool darkness of the early morning I walked down the deserted road to the hangars where the aeroplanes were housed. Already the mechanics had rolled out my machine on the tarmac, and were filling the tanks with petrol and oil. Like a huge bird it stood there, its wings showing ghostly white as they stretched on each side of the fuselage. Not a breath of wind stirred the folds of the little sausage balloon that hung high on a mast above the hangars. The branches of the palms hung down in a strange silence. From beyond the grove came the ceaseless lapping of the waves on the sea-beach. I stepped into the seat of the machine and strapped myself in. "Switch on," called the mechanic; then he deftly revolved the propeller blades and started the engine. Gradually increasing the petrol feed, I tested the engine at various speeds. The machine surged against the blocks that were placed in front of the under-carriage wheels. The sand flew backward with terrific velocity. When the engine seemed to be working smoothly, the blocks were jerked away, and the aeroplane sped from the hangars. With a steadily increasing roar, the machine rolled along the ground; then, responding to a slight pull on the control column, it left the ground easily and imperceptibly. What a glorious thrill it is to feel the tremendous power of such a machine, and to sense a mastery over the air! The rush of the cool air is almost intoxicating and one laughs aloud from sheer joy as the machine climbs steadily upward.



Aboukir Monaska, Egypt

That morning the sky was clear. A band of orange light stretched along the horizon far out on the Mediterranian, a token of the approaching sunrise. As I rose in huge, sweeping circles I could look down on the sleeping camp below. The buildings were almost lost under the spider-like tufts of the palm trees. One wisp of smoke from the officer's mess wavered but slightly from its thin straight line, reminding me of an old picture of Abel's sacrifice. In the East the sun rises quickly past the horizon, and all at once it is day. I watched carefully that I might not miss it. Just as the altimeter registered two thousand feet, I saw the sun, a red, boiling disk, appear as if released by a catapult from somewhere below the skyline. The camp still lay in the blue shadows between the sand hills, but across the bay stretched a broad pathway of sunlight that tinged the sails of the fishing boats with a blood-red dye. Little ripples stirred the placid bay as the first breeze came in from the seas. Like the star in the Turkish flag, a small, rocky island lay in the center of the crescent-shaped bay—an island that recalled Nelson's Battle of the Nile. What changes that island has seen! The downfall of the fascinating Cleopatra, and the burial of her temples by the sand; the fight for supremacy between the French and the English; and now the flight of aeroplanes that swooped above the shaky fortress of Aboukir.

Turning away from the blinding glare of the sun, I climbed up and up until the reading was six thousand feet. Then, following the coast line, I pointed the machine in the direction of Alexandria.

Along the shore stretched a grey strip of sand, a border for the wide fields of the Nile delta. Occasionally it was broken up by clumps of trees that surrounded a flat-topped house, and sometimes by small groves of banana trees that proved the fruitfulness of irrigation. The delta plain had the appearance of a huge patch-work quilt in which Nile-green patches were predominant. Narrow brown roads stretched along between the patches; wide canals in parallel bands of silver fed the thread-like irrigation ditches that gleamed in the sunshine. White, dusty highways wound in and out among the sandhills that could be distinguished by their shadows. On these roads crawled dark specks followed by clouds of dust. These were motor-trucks on their way to the Divisional ration dump. What appeared to be a brown centipede was a column of infantry on its morning route march. A dark streak stretched diagonally across the face of the land, sweeping in smooth curves through and around native villages, and losing itself in the heart of Alexandria. This was the railway from Rosetta.

Dropping down to a lower level above the harbor of Alexandria, I circled around in order to count the ships that lay at anchor. When the engine was shut off, I could hear plainly the rattle of chains, the warning screech of speedy motor boats, the chanting of natives as they unloaded the steamers. Long piers nearly enclosed the harbor, which teemed with water craft of all sorts. Funnels and masts of torpedoed vessels arose from the water in both the inner and outer harbors. Away from the water stretched the ancient city in irregular terraces of ugly, flat roofs. In the searching rays of the morning sun the dirty-white city lay torpid, as if half awake and not wholly recovered from an all-night debauchery. From the center of the city long avenues stretched eastward toward Ramleh. A large lake extended to the west. The Mahmoudjeh Canal lay along one edge of the city, packed from bank to bank in many places by feluccas and dahabeyahs, whose spars pointed upwards like the bare trees of a burned forest. On the outskirts of Alexandria lay green gardens, cool and restful to the eye after the dazzling sullenness of the acres of flat roofs. Only around the military camps did there seem to be any activity. The one-horse carriages stood still in the Square of Mohammed Ali.

I left the city behind me and climbed rapidly to a higher altitude, then flew homeward. Below me, in a queer mixture of grey, green and brown, the landscape sped past like a reel in a cinematograph. When I came above the landing ground, I shut off the engine and spun downward for several thousand feet. In those few moments it seemed as if the earth were spinning around with me for an axis. Water, sand, palm trees, and camps chased each other around in a circle that darted rapidly toward me, but stopped as the aeroplane came out of the spin into a glide. Now I could distinctly see men rushing to and fro, like ants whose nest has been disturbed. Aeroplanes were lined up outside the hangars, huge flies ever ready to leave the ground. The rubbish heaps in the village were swarming with ragged boys, goats and dogs. Women spread flat cakes of dung on the roofs to dry for fuel. A native, leading a shambling camel, sauntered across an open strip of sand. I zoomed down at him and watched with wicked satisfaction the alacrity with which the man scurried out of the way. Then a long glide in to the tarmac, and the machine came to rest.

Copenhagen

"Hello, miss," said Copenhagen, when he came into the Book Store to scatter sweeping compound the other morning.

"How do you do, Mr. Copenhagen," replied the obliging young lady who hands out triangles and plotting paper. "It's been a nice day, hasn't it?" and she smoothed the surface layer of her right ear muff.

"Aye say so, and now Aye ban feeling so good sence the Dane come home again and tangs bane getting started. Aye tell you, Miss, this hare college engineering got to have somebody home to tend to it. Ain't you tank so? Maybe?"

"Why, yes, I guess we're all glad to see Dean Leland back."

"Aye tell you, Miss, Aye bane tanking good deal 'bout this College Engineering. Seven jear Aye bane yanitor hare. Aye sane lots boys come, and lots boys go. But this jear Aye sane more boys go and not come back. Lots them bane good boys, and Aye bane tanking why not make engineer out them.

"Jesterday Aye bane looking again at dose letter pasted up out there by boy's names. Aye ain't never sane so many boys got F and E by his names. Aye sane once in paper where Perfesser Van Wagging says Engineers got most smart boys what bane on this Juniversity. Now Aye bane wondering how other colleges stay on campus at all when engineers can't only yust get E and F. You tank, Miss, all smart boys going now to be lawyers, maybe?

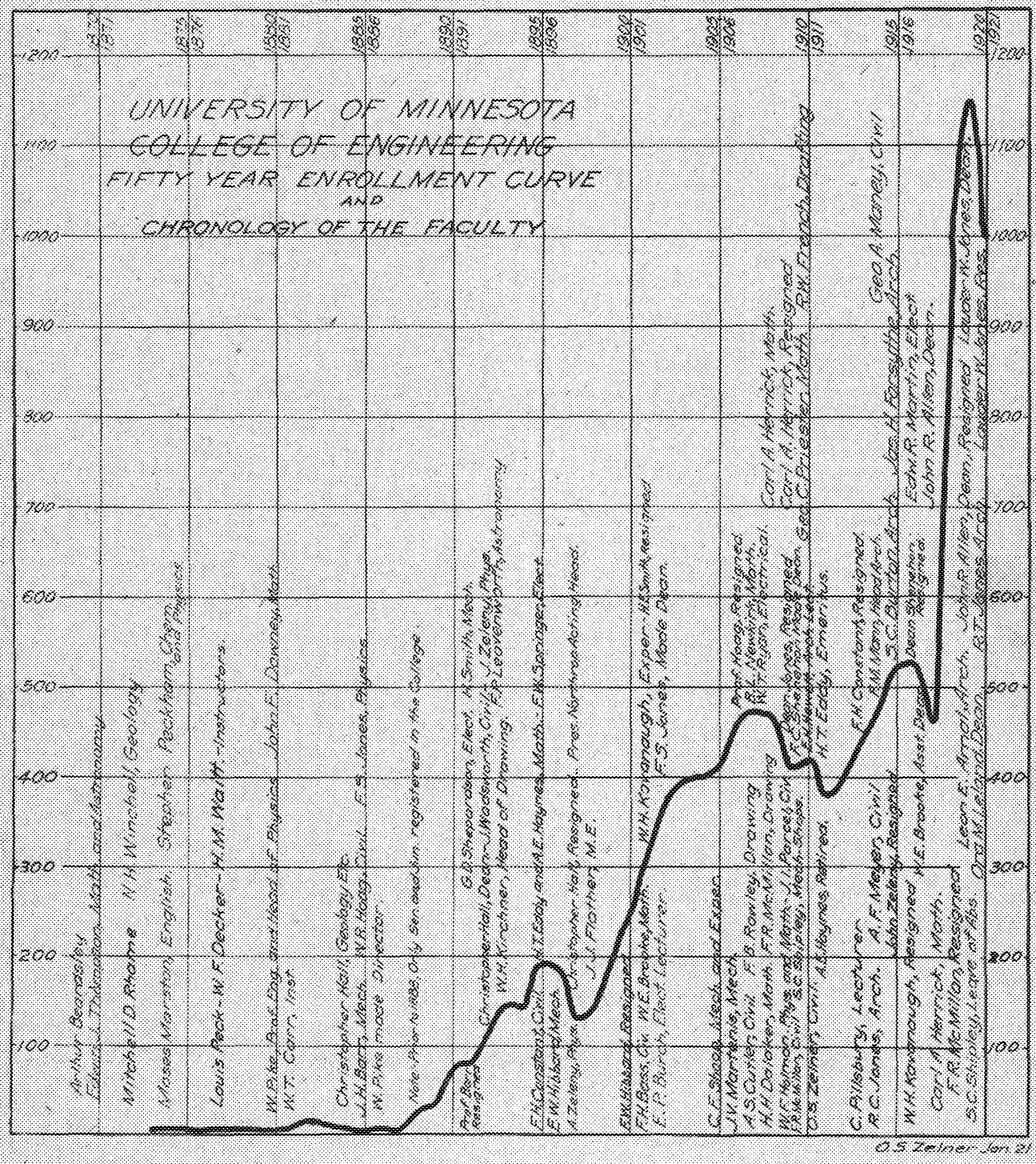
"You tank, Miss, it bane that perfessers forget how to learn the boys, maybe? Aye bane tanking, if we got smartest boys in this Juniversity, and they can't learn them nothing, who you goin' to tank bane to blame? Maybe the perfessers found out so much bout figgers and how to build tangs theyain't got time to teach all to boys in four years. Aye tell you, Miss, Aye used to sane lots A's and B's on dose little lists, and some folks looking happy. Now Aye yust sane them letter Aye said, and some dese fellers certainly learn to swear when they was in the army—or some place else.

"Aye bane tanking what Aye do wit my boy Ole. Aye jused to tank Aye make engineer out him. But Ole he bane only yust good boy; he ain't no venius. He can't learn no more dan his teachers can teach boys. Aye tank Aye make Ole learn doctoring. Ain't you tank so, Miss? Maybe? He ain't no yenius, Ole ain't.

"There goes that bell, Miss. Aye got to go see what the Dane want now. Good-bye."

Steady Employers.

Smith—"Who are you working for now?"
Jones—"Same people—wife and five children."
—The Passing Show.


UNIVERSITY OF MINNESOTA
COLLEGE OF ENGINEERING
FIFTY YEAR ENROLLMENT CURVE
AND
CHRONOLOGY OF THE FACULTY
O.S. Zelner Jan. 21

Ground Telegraphy

By MAJOR H. C. INGLES,
Signal Corps, U. S. A.

Editor's Note

Major H. C. I. attended the University of Nebraska as a student in the Electrical Engineering College 1906-1909.

Graduated from the United States Military Academy at West Point, N. Y., with the class of 1914.

Transferred to the Signal Corps of the Army in April, 1917.

Served as Senior Instructor in the 1st, 2nd, 3rd and 4th Signal Corps Officer's Training Camps during the war. Prepared the schedules of instruction for all the Signal Corps Officer's Training Camps.

Graduated from the Signal Corps School at Fort Leavenworth, Kansas, in 1920.

Instructor in the Signal Corps R. O. T. C. Camp at Camp Vail, N. J. last summer.

Assigned to the University of Minnesota in charge of the Signal Corps Unit of the R. O. T. C. in October, 1920.

Ground telegraphy is a means of electrical communication which requires no wire connection between the sending and receiving stations, but which differs in several material respects from radio telegraphy. The transmitting apparatus for ground telegraphy, like radio, depends upon an alternating current for its operation, but one of very much lower frequency. The frequency of the alternating current for the ground telegraph is well within the audible range, rarely being over 1700 cycles per second. This, of course, removes the necessity for a detector in the receiving apparatus. A second radical difference lies in the medium which transmits the signals. The ground telegraph does not depend upon the more or less imperfectly understood electro-magnetic wave for its transmission, but upon th econductivity of the earth. Its operation depends upon the fallacy of a statement which sometimes appeared in our older text books to the effect that electricity always takes the path of least resistance. As a matter of fact, electricity in completing its circuit, takes all the paths available and the division of the current over the different paths in inverse proportion to their resistance does not alter this fact.

As an illustrative experiment to demonstrate the extremely simple principle involved, let us take a blanket, dip it in water, wring it as dry as possible and spread it on a flat surface. Now let us take some source of alternating current, such as a buzzer using an induction coil, and set up our apparatus as shown in figure No. 1. Whenever the key, K, is closed, alternating current will flow between the two points A and B and it will take all of the indefinite number of paths offered by the moist blanket. It should be noted that this is a straight conduction proposition, the same, in principle, as we would have if we connected A and B with a metallic conductor. The current is, of course, a great deal smaller than it would be with a metallic circuit because of the high resistance of the paths. If we did not moisten the blanket, the resistance would be so high we would get no appreciable current.

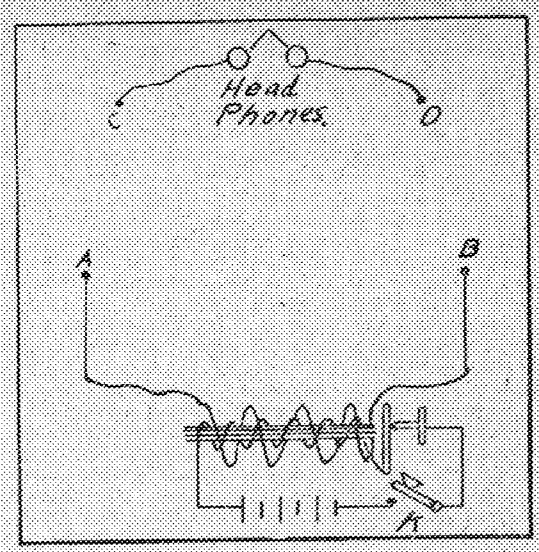


Fig. 1

Let us go a step farther and add to our apparatus a 200 ohm telephone receiver with leads a couple of feet long and each carrying a brass or copper tack at the end. Now, if we stick the tacks into the blanket, as shown at the top of Figure 1, and again press the key, we can hear the signal in the telephone receiver. This is what has occurred. We have now supplied a path part of the way between A and B which has less resistance than the damp blanket has. Part of the current will continue to travel over the paths supplied by the blanket, but a portion of it will take the path through the telephone receiver. The receiver, therefore, reproduces the signals made with the key and buzzer.

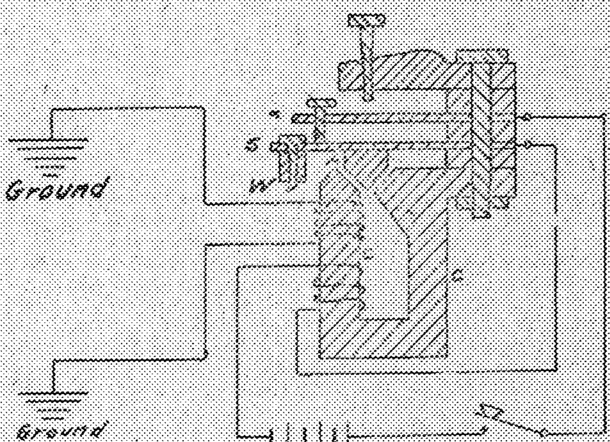


Fig. 2

This simple experiment illustrates the principles involved, but for practical operation as a method of transmitting signals, refinements of the apparatus are necessary. If a buzzer is used as a transmitting instrument, it must be capable of furnishing a high voltage alternating current of 500 cycles per second or over. It should also have some means of varying the frequency. During the World War, the Signal Corps in the American and French armies used a so-called power buzzer, a cross-section of which is shown in Figure 2. The contact spring, S, is very stiff and the armature, A, and transformer core, C, are so designed as to furnish a magnetic circuit with very small air gaps. This insures a rapid interruption of the primary circuit and consequently a fairly high frequency alternating current in the secondary. This frequency is controlled by mechanically damping the contact spring, S, with tuning weights, W. In this way it can be varied from about 650 cycles per second with a two-ounce weight to about 1700 cycles per second with no weight. A small A.C. generator furnishing about 500 cycles per second has been successfully used to furnish transmitting current.

The terminals of the secondary winding of the transformer are grounded to two good grounds about two hundred yards apart. Our transmitting station is then installed and ready for operation. The terminals of our receiving station are then grounded at whatever distance desired from our transmitting station, with about the same distance between grounds. The base line connecting the two receiving grounds should be approximately parallel to that of the transmitting grounds.

With the grounds of the transmitting apparatus several hundred yards apart, it is evident that the current flowing over any one of the infinite number of paths furnished by the earth is very small. The amount of current that we are able to get through our telephone receivers, when we get a few hundred yards away from our transmitting station, with the simple apparatus described above, is wholly inadequate for their operation. It is necessary to amplify these minute currents which are picked up in the receiving leads several thousand times before they will operate even a very sensitive telephone receiver.

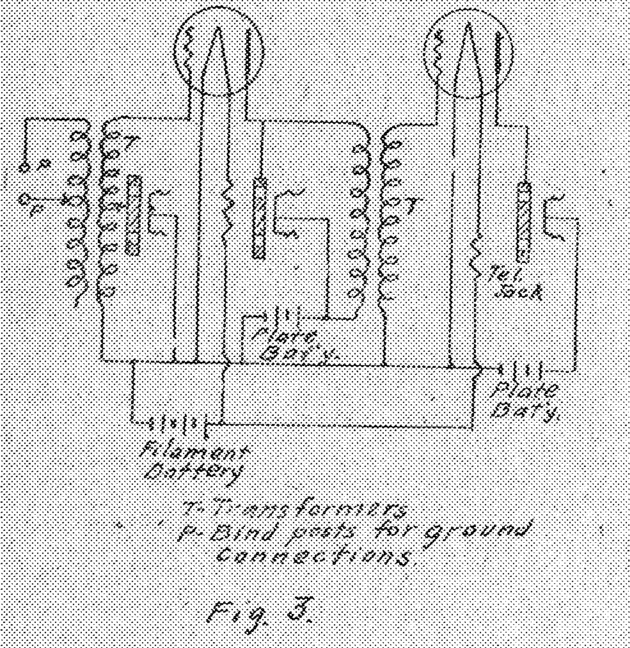


Fig. 3.

An amplifier such as the one shown schematically in Figure 3, has been used with considerable success for this purpose. It is no t practicable to attempt more than a three stage amplification as the minute ground currents always present in the earth are picked up and amplified as well as the desired signals. With more than three stage amplification, this results in so much noise in the telephone receivers that the desired signal cannot be distinguished. Even with three stage amplification, it requires considerable practice before one is able to distinguish the desired signals. The type of amplifier illustrated permits the use of less than three stage amplification when the signals are strong enough to permit of it.

Geological formations have a great influence upon the transmitting range. Very damp earth, a swamp for example, practically nullifies the operation of the instruments. It renders the conductivity of the earth too good and there is not enough divergence of the paths of the current in flowing from one ground to the other.

Its maximum sending range is not over three miles and it is subject to a mass of interference. The only distinguishing characteristic a station can have, aside from its conventional call letters, is the tone of its signals. This can be controlled to a certain extent by the vibrator on the transmitting buzzer. However, the ground telegraph is useful in determining the conductivity of different soils and in testing the efficacy of different types of grounds. It has possibilities for future development which commend it for further study to electrical engineers.

The small son of a well-known electrical engineer is more familiar with the appliances of modern civilization than with the small things of nature, and when visiting in the country, unhesitatingly picked up a hornet, more closely to inspect its mechanism. When his father hurried out to discover the cause of the commotion which immediately broke the peace of the summer day, the little lad was ruefully sucking a thumb, while tears streamed down his face.

"Why, what is the trouble, son?" was asked.

"It was that bug," he managed to explain between sobs. "I think his wiring is defective. I touched him and he wasn't insulated at all."—Philadelphia Public Ledger.

Little Mary.

One day little Mary had been very naughty and her mother said to her:

Mary, you must go upstairs and pray for forgiveness for your sins."

When the little girl came down after some time, her mother asked: "Did you tell God all about it?"

"No," replied the child, "but I told Mrs. God, and I guess it's all over heaven by this time."—Virginia Reel.

Circumstantial Evidence.

Willie and Jack were two youngsters pugilistically inclined.

"Aw," said Willie, "you're afraid to fight; that's all it is."

"Naw, I'm not," protested Jack, "but if I fight, my ma'll find it out and lick me."

"How'll she find it out, eh?"

"She'll see the doctor going to your house."—Minneapolis Tribune.

MINNESOTA TECHNO-LOG

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EDITORIAL

The College of Engineering of the University of Minnesota affords a legitimate field for a student-faculty publication such as the **Techno-Log.** This is the theory which was responsible for the founding of the magazine and for its continued appearance. Within the college itself there are nearly a thousand students, pursuing five different courses, and taught by a large and constantly varying faculty. These men have much in common to share with one another, and much that is peculiar to each group or to various individuals in these different sections, but of value to all. Scattered over the face of the earth in every zone are the alumni of the college. They are enjoying new and strange experiences, carrying on research work, and making discoveries of their own. Each of them needs some reliable way of keeping in touch with his college and its progress, and each has much to contribute to those who are still undergraduates. It is as a college publication, serving a need of the college, and useful as a means of communication and information for engineers, that the **Techno-Log** has a claim upon the loyalty and support of Minnesota engineers. We do not believe that there is need for us to compete with the **Engineering News-Record** or with **Engineering and Contracting.** The field of the exclusively technical magazine is being acceptably filled by national publications. For the present, at least, or until a demand brings about another policy, the **Techno-Log** will occupy itself not solely with matters technical but with questions of general interest to our readers as well. As an expression of all that is best for the interests of Minnesota engineers, the magazine bespeaks the hearty co-operation of undergraduates and the patience and generous support of the alumni, both of which are necessary if the **Techno-Log** is to be in the fullest sense the mouth-piece of the College of Engineering.

St. Pat at Home

The tradition of St. Patrick's Day as Engineer's Day at Minnesota is firmly established. Year by year the celebration has grown in size and cleverness, and there is every reason to expect this year's committee to surpass the past. In one regard, however, the afternoon's open house needs a complete overhauling and general improvement. To speak quite frankly, in former years there has been a distinct tendency to advertise the engineers as hosts to the University, and then to flunk out in the observance of hospitality. Visitors who ventured over last year unaccompanied by members of the Engineering College found no one to welcome them, and no one to explain the apparatus in the Experimental building, which is all Greek to the average uninitiated layman. He was left free to wander about unhailed and ungreeted and to take his departure in the same way unless he succeeded in attaching himself to the party of personal friends whom some engineer was personally conducting. No faculty man was anywhere in evidence; a group of co-eds, connected with the College of Engineering at most prospectively, poured tea as well as could be expected. The whole effect was most chilly for the indiscreet outsider who had ventured to take the widely published invitations seriously.

By all means keep the dance for engineers and their personal guests; let that be our own little affair. But when we ask the University to our house, let's be at home, and forget the "Wish I'd been introduced, so I could speak" attitude. If every fellow gives one hour of time to active duty as host, the whole will be entirely changed. Let every piece of apparatus be plainly marked with its name and purpose, and let two or three men be stationed by each to explain it to all comers. Let provision be made for actual demonstration. And on that day at least, let faculty and students co-operate. Why not ask half a dozen faculty women to pour the tea and help to extend a real welcome to people who have a right to expect it? As hostesses they have amply shown most of us what they can do.

All together, all cheerful, all ready with a welcome hand, and the day will be in reality what it has been in name, the Engineers "At-Home."

Create, Develop, Direct

Many men think themselves worth salaries of twenty-five thousand dollars a year, but men really worth it are hard to find. Recent surveys reveal an increasing demand for men who can get results. Such men have no difficulty in obtaining salaries of twenty-five thousand dollars or more. The posers and the theorizers, who are able to make little headway in getting results, do not last long.

A large agency in New York reports that the search for real men, men who can produce results, is on in all parts of the country, and local agencies are asked to search every field for high-priced men. Hundreds of industrial corporations, looking for heads, are willing to pay twenty-five thousand dollar salaries, if the right men are found. The "production engineers," who have largely succeeded the "efficiency experts," are today getting large pay. One master of mechanical processes is drawing sixty-seven thousand dollars a year, twelve thousand of which is fixed salary and the remainder is based on output. The size of the entire sum he obtains proves that he is earning it.

In transportation circles, the high salaried man is eagerly sought. A railroad man who can enlist capital, direct traffic, and above all develop new sources of income and surround himself with men of brains and ability, can draw a salary that approaches the hundred thousand dollar mark.

These higher rewards have to be earned. The ability must be of the creative order. The man must open new opportunities or in some way add to the sum of human wealth and happiness.

It is for such minds as these that the great rewards are waiting. Create, develop, direct, economize, are the words of today.—Mpls. Journal.

Hockey at Minnesota

By "MAPLE"

A recent movement on the part of some one or two students of this University has for its object the resurrection of hockey at Minnesota. These men also seek for hockey the recognition that is accorded this sport by the Canadian universities and the large educational institutions of the east, viz: that it be made a major sport.

That Minnesota has ample resources from which to draw material to do her credit in this field is quite obvious from the recent games and practices on the Armory rink—if the present polygon of congealed H_2O may be so dignified. That climatic conditions are very favorable is also conspicuously evident upon the face of any thermometer from December to March.

While the writer has no definite knowledge of the status of hockey at other universities in the middle west, it is safe to assume that Minnesota's endeavors in this connection will be closely watched and, in the event of success, these institutions will be quick to follow her lead. An interscholastic hockey league would be the logical outcome with, in passing, Minnesota capable of making an uncomminly strong bid for top honors.

Last year the University of Toronto developed a hockey team that was beaten for the world's amateur championship honors by a very small margin. Yale, Harvard and Princeton and other important eastern colleges have been keenly contesting hockey laurels for the past several years and their teams have acquitted themselves very creditably against the best from the north. They are using every means possible to open up one more avenue over which more successes and fame may come their way.

There are in this, and every other institution of its kind, many men who excel in but one line of sport. If this be football, track or basketball ample scope is provided them to develop this skill and to bring distinction upon themselves and their alma mater. No such encouragement is given to a hockey player here and this is by no means fair to the individual or the University.

A fast and well-trained hockey team is as capable of providing an hour's exciting entertainment as is the best football team that ever pushed itself away from a training table. Intercollegiate hockey matches in the north and east draw bumper houses and as much excitement prevails during the winter on this account as obtains in the fall over football. Such would very soon be the condition here. From a financial point of view there is nothing to fear. This city, and for that matter, this state, is noted for its keen zest for winter sports of every description.

Last winter there was inaugurated on this campus an inter-college hockey league. The games were played according to a well drawn up schedule, the Engineers winning first place. The writer had occasion to officiate in an unimportant capacity at several of these games and saw plainly that with adequate facilities Minnesota may easily hope to develop a hockey team worthy of her high ranking in athletics. What is needed first of all is a rink large enough to meet the requirements of the game and offering suitable accommodations for spectators. At comparatively little expense the present sheet of ice at the Armory could be greatly improved in these two particulars.

Whether from a lack of publicity, poor accommodations or inconvenient hours, or a strong combination of these three, the games last winter had but a handful of spectators. But the success of the game here as a major sport must not be measured by past experiences, in view of the almost total absence of organized support and encouragement. With a fair amount of that which has so largely contributed toward the successes which have attended Minnesota's football and basketball teams, she may avail herself of another branch of athletics which will carry her name still higher on the roll of clean collegiate sport.

Loaded.

Business Manager: "Here's a blank form."

Editor: "What for?"

Bus. Mgr.: "Sort of business questionnaire. The boss wants you to tell what you do around the office."

Editor: "Give me six blanks."

Reason Enough.

"Why did you strike the telegraph operator?" asked the magistrate of the man who was summoned for assault.

"Well, sir, I gives him a telegram to send to my gal, and he starts readin' it. So, of course, I ups and gives him one."—London Tit-Bits.

Poor Old Henpeck.

"The time will come," thundered the suffragette orator, "when woman will get a man's wages!"

"Yes," sadly muttered a man on the rear seat, "next Saturday night."—Ex.

Preacher vs. Doctor.

Willie had swallowed a penny, and his mother was in a state of alarm.

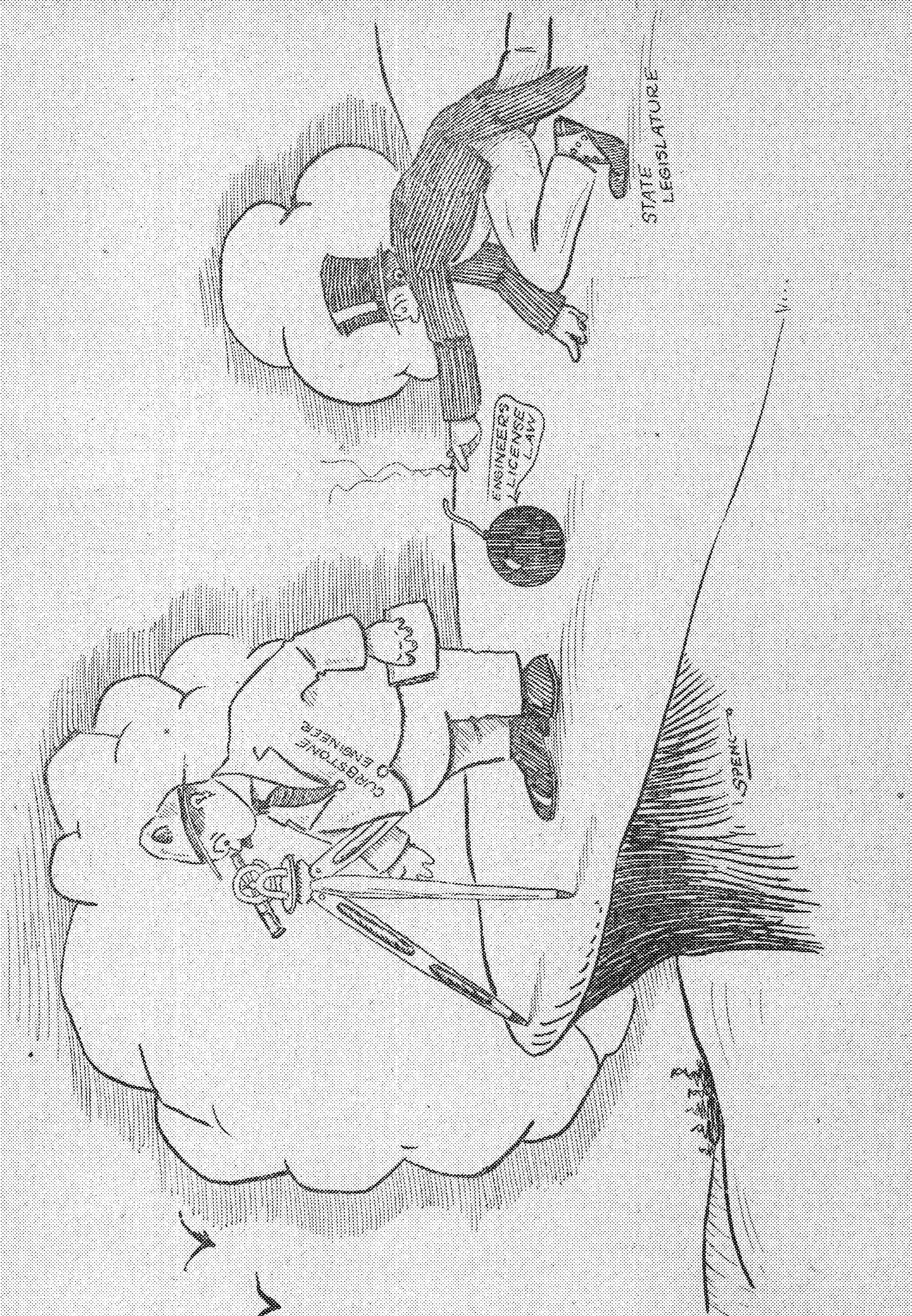
"Helen," she called to her sister in the next room, "send for a doctor; Willie has swallowed a penny!"

The terrified and frightened boy looked up imploringly.

"No mamma," he interposed, "send for the minister."

"The minister?" asked the mother, incredulously. "Why the minister?"

"Because papa says he can get money out of anybody."—Kyote.


STATE LEGISLATURE
ENGINEER'S LICENSE LAW
CURBSTONE ENGINEER
SPENC

COLLEGE NEWS

Practice for the annual inter-class basketball games will soon be started by the Freshmen and Sophomores. The present Sophomores were the all university Freshmen champions last year, but prospects for a winning team again are none too bright. Varner and Bergsland are ineligible, being on the varsity squad, and one of the other men has not returned.

The first dance given by the class of '23 was a decided financial success; the treasurer's report, presented at the last class meeting, showed a balance of forty dollars. Plans for a second dance have been postponed to the third quarter because it would interfere with St. Patrick's Day arrangements.

If the College of Engineering can produce two more men like Kearney and Enke, Minnesota will win the conference basketball championship hands down. The way those two knights of St. Pat break up the opposition's plays and handle their players is a sight for sore eyes. "Bearcat" is all over the floor at once, and living up to his nickname every minute of the game. Opposing players might just as well run into the side of the armory as to try to get Enke off his feet. The Engineers have plenty of reasons for feeling good at every game, win or lose; it's an honor to be classmates of such men.

The A. A. E. (student branch) held a meeting in the main auditorium on January 13. The meeting was called to order by Pres. Werdenhoff. The question of consolidating with the A. E. S. was brought up and the motion in favor of such action was carried. Following the business meeting a three-reel movie, "The Story of Coal," was shown, and refreshments were served.

Arthur Beckel, Chem., '19, who has been with the Du Pont company, has come back to Minnesota this quarter to do research work in organic chemistry.

Maurice Chernus, of the Senior Civils, recently took a leading part in a play given at North High school entitled "When Do We Eat." He made such a hit that he is seriously thinking of following the theatrical profession.

E. P. Harding, associate professor of Technological Chemistry, has been granted a leave of absence until next fall. Dr. Harding has left for the oil fields of Oklahoma, where he will do field work in petroleum technology. Dr. C. A. Mann has taken Prof. Harding's classes, and I. W. Geiger succeeds him as head of the Students' Work Committee of the School of Chemistry.

A near accident occurred in the halls of the M.E. building during the week of January 17-22, when the Banker's Short course was being held. An upper classman, hurrying down the hall to the Junior drawing room with a bottle of ink in one hand and three books in the other stopped so short in front of an open door that only heaven's good luck kept the ink and books where they belonged.

What did he see? One of the bankers sitting in the front row of chairs smoking a big cigar, absolutely regardless of the rules and regulations.

Jay Carpenter was investigating some of the exhibits in Professor Shepardson's museum in the basement of the Electrical building and got his thumb mixed up with the working mechanism of one of the machines, which makes it very inconvenient for him to collect fares. Guides should be provided for sight-seers to prevent accidents and save the thumbs of investigating students.

LeRoy Grettum, president of the Sophomore Engineers, was one of the three men chosen to represent the Sophomores in the annual all University Freshman-Sophomore debate. The debate will be held sometime in April. The prize of $100 will be awarded to the winning team.

Leif Sverdrup, of the Senior Civils, is in charge of arrangements for the Cosmopolitan dance, to be held in the ball room of the Minnesota Union on February 26th.

Under the auspices of Phi Lambda Epsilon, honorary scientific fraternity, Prof. F. H. McDougall gave an interesting lecture Friday evening, January 21st, on "Modern Views on the Structure of the Atom."

The following men have been elected to the electrical honorary fraternity: Hugo Wahlquist, Henry Forbes, Martin Wichman, Abner Wilson, Elmer Mangney, Glenn Ransom.

The A. I. E. E. student branch will hold a meeting in M. E. auditorium, Monday evening, February 14th, after which refreshments will be served. Mr. C. M. Jansky will give a lecture and demonstration of the radio-telephone. "High Frequency Phenomena" is the title of the subject to be given by E. C. Manderfeld and George Wessale. This will be a rare treat, as very few opportunities are offered in the United States to become acquainted with the wireless telephone. A concert will be received by wireless telephone.

The following men have been elected to the honorary engineering fraternity, Tau Beta Pi: Civils, R. E. Bergford, C. D. Jensen, E. A. Dehn, H. W. Carpenter, A. N. Johnson; Electricals, H. W. Wahlquist, L. C. Larsen, Geo. Wessale, S. A. Berg, E. F. Johnson, Basil Maine, H. W. Petersen, R. J. Heidelberger; Architects, O. Thorshov; and Chemists, R. H. Swart, R. M. Lee; Miners, V. W. Ganrud, F. B. Wenger, H. F. Davies.

The first of a series of three popular art lectures, and illustrated with slides, will be given by S. Chatwood Burton, assistant professor of architecture of the University of Minnesota, February 7, at 4:30 p. m., in the auditorium of the main engineering building at the University. The two other lectures will be given on the first Mondays in March and April. Professor Burton, a painter and sculptor, received his training at the Royal

College of Arts in London and at the Academies Julien and Colarossi in Paris.

Kenneth Klassy, formerly of the Class of '21, is now in his Senior year at Harvard Engineering College, Cambridge, Mass. He is studying electrical engineering and is greatly taken up with his work; so much so that he is planning to attend another year. He is greatly satisfied with the course offered and praises highly the faculty of that institution. The faculty there are in many cases identical with those of M. I. T. Klassy has a brother, Merrill, here who is a Sophomore in S. L. & A., but is taking a few courses in engineering.

The U faculty gave a dance in Minn. Ball Room on January 22. "Doc" Holman, professors Bass and Parcel, of the Engineering College, were among those attending.

R. E. Falkenberger, E., '23, is leaving school this month. He plans to enter the real estate business with his father in Texas.

A small but peppy crowd attended the A. E. S. mixer Friday evening, January 28, in the main auditorium. The four speakers of the evening were Howard Jacobsen, representing the bookstore, C. W. del Plaine of the Techno-Log staff, Ed. Mikesh, the Junior chairman of St. Patrick's Day arrangements, and Prof. O. S. Zelner. George Lindsey, president of the association, introduced the speakers and opened the general discussion which followed the talk by Prof. Zelner.

"Jake" got all roiled up over the criticism of the prices being charged for various articles in the bookstore, and did not hesitate to explain things in plain English. However, he pointed out that the object of the store is not to cut the prices but to sell only standard articles of the best quality obtainable at the regular retail price. The bookstore is in sound financial condition at present, and the problems remaining to be solved are problems of operation on an efficient basis rather than problems of existence.

The next speaker was Carlos del Plaine, editor-in-chief of the **Techno-Log**, who presented a very clear-cut picture of the conditions under which the magazine is operating, and made a comparison of our publication with the magazines of other technical schools. "The **Techno-Log** welcomes criticism of any nature," said del Plaine, "because it shows that the students are interested."

Ed. Mikesh, Junior chairman of the St. Patrick's Day committee, gave out the first advance dope on the plans under way for the big day. He took the prescribed engineer's attitude when making a speech in the auditorium (sitting on top of the desk on the platform, with his legs dangling over the edge), and outlined the program for the day as it is now planned. The parade will take place about 12:00 noon, and will last an hour. The reviewing stand will be located on the main campus, in order to properly impress the academics. In the afternoon the knighting ceremony will take place, when all the Seniors kiss the blarney stone in the experimental building, followed by the Green Tea in the auditorium. The crowning event of the day will be the ball in the armory at night, to which the whole university is invited.

Prof. Zelner closed the program of speeches with one of the most sincere and sensible talks on relations between student and faculty that has been delivered in a long time. He opened his talk with a story which aroused attention at once, and then proceeded to give his views on the subject with a frankness that was refreshing after hearing what faculty members say in most of the speeches on this topic. He pointed out that the attitude of the man who considers the prof. who mixes with his students an easy mark for grade hunters is an insult to the judgment of the instructor, and has very little foundation in fact. Although personal invitations to the faculty were sent out, Prof. Zelner and an instructor from the School of Chemistry were the only members of the faculty present.

At the close of Prof. Zelner's talk, Lindsey threw the remainder of the time open for general discussion from the floor on the problem of getting acquainted with instructors, which brought out many expressions of opinion from the students present. The general concensus of opinion was that the initiative in this matter ought to come from the faculty, during the first two years at least. The meeting then adjourned, after which refreshments in the form of coffee, cookies and cup-cakes was served.

Henry Kendall, president of the American Institute of Architecture, and Mr. Robert Kohn, director of the A. I. A., spoke Monday afternoon, January 31, in the Architectural studio. Mr. Kohn spoke on the subject of the relations between architects and the government. Mr. Kendall outlined the ethical principles by which architects should be guided.

Mr. Kohn and Mr. Kendall were entertained by the Minnesota Chapter of the A. I. A. Monday night.

Long Hours.

First Stude: I spent nine hours on my Calculus last night.

Second Stude: How so?

First Stude: I put it under the mattress and slept on it.

Some students are always behind in their studies so that they may pursue them.

Prof. Bass, reading specifications: "All valves shall be opened by turning to the left."

Jimmie W., C.E., '21: "Isn't that rather ambiguous? Shouldn't it state what side of the valve you would have to stand on?

A Doctor's Problem.

Young Miss in a Doctor's Office: "Where can I be vaccinated where it won't show?"—Literary Digest.

In Chemistry.

"What is Calcium Filtrate?"

"The calcium salt of Filtric Acid."

Alumni News

George Paulsen, '17, is now connected with the Steenberg Construction Co., St. Paul, as the Architectural member of the firm. Everything seems to be going fine for George, who says that contracting isn't so bad, even to including wedding contracts to one of which he affixed his signature in August of last year.

Speaking of weddings, Bunny (Donald) Buckhout, '17, is also contemplating the leap. In fact, invitations have been received announcing the coming event. Bunny has been in the employ of a large architectural firm in Toledo, Ohio, for the past two years, and will make that place his home.

Myron Dassett is spending a year in study abroad, and will doubtless enter L'Ecole des Beaux Arts, Paris, early in the spring. He has been occupied during the last three months in and about Rheims, where he has been measuring and drawing up portions of the Cathedral.

Mr. Dassett was at Minnesota in 1914-15-16, but entered Columbia following the war, and received his degree in Architecture there.

George Fraser, '18, is attending Cornell this year majoring in Architectural Design and working for an M. A. degree from that institution. Others studying in the East are: Ed. Loye and F. A. Kleinschmidt, '20, at Harvard, and Shu Min Lin (Shimmie) at Columbia.

George Prudden, '17, is in Detroit, Mich., connected with the Aero Plane Manufacturing Co., and reports that he will be in the designing end of the game. He says that, tho foreign to Architecture, he feels that he has found his life work and so far is more than interested in it.

David Dineen, '19, is back at the Department of Architecture this quarter taking up a little advanced design. He is back with the usual good speed, and we may expect some good work from him.

Stewart Wright, '19, is still with the C. H. Johnston office in St. Paul. We understand that Stew's interest is pretty well settled in the Saintly City and that nuptial tidings may be expected from that quarter at any time.

Harry Korslund, '20, has been with the firm of Germain & Jensen of Duluth since the first of the year. He says that he likes the place very much and finds that Duluth weather, with its fur-lined underwear, isn't so bad as might be expected.

A. D. Beel is now with the research bureau of the Aluminum Company of America. Dr. F. C. Fray, Chem., '05, is in charge of the bureau. Other alumni who are with the same firm are J. D. Edwards and C. F. Taylor, Chem., '13.

We have recently received a communication from J. O. Morris, M.E., '88. He is living in Chicago and is engaged in Mechanical Engineering work, specializing in automatic machines, tools, and synchronizing movements. Mr. Morris has also been engaged in Bible Class work at the Great Lakes Naval Training Station for the past three years.

G. T. Peterson, M.E., '08, formerly with the A. T. & S. F. railroad, is now directing the apprentices of Duluth & Iron Range railroad at Two Harbors, Minn.

Donald L. Johnson, Chem., is showing them down in Missouri that Minnesota turns out good chemists. He is with the Standard Oil Co., at Sugar Creek.

J. G. Morrissey, B.S., '18, is now with the United States Pressed Steel Car Co., of Pittsburgh.

T. F. Talbot and Russel Ross, E.E., '18, are with the General Electric Co. at Schenectady, New York.

Theodore Sanders, jr., B.S., '19, is connected with the St. Paul association in the capacity of Industrial Secretary.

Ed. Sherwood, B.S., '20, is at present field engineer for the New England Fuel Oil Co. He is now engaged in locating a pipe line through the jungle 65 miles outside Tampico, Mexico.

On January 25th, O. M. Leland, Dean of the Colleges of Engineering, Architecture and Chemistry, was the guest of honor at a banquet held at the Hotel Radisson by the Engineering Alumni Association of Minnesota, co-operating with the entire Engineering Fraternity of the state.

Mr. W. H. Hoyt, '90, of Duluth, chief engineer of the Duluth, Messaba & Northern railroad, acted in the capacity of toastmaster. In his introductory speech, Mr. Hoyt most heartily commended the work of the **Techno-Log**, the official magazine of the College of Engineering and Architecture, and expressed the desire that the Alumni give it their whole-hearted support, not only financially but by the contribution of articles of interest to the engineer.

The address of welcome was given by Mr. M. Toltz of St. Paul. Mr. Toltz stated that it was his opinion that in Minnesota we should have an engineer on the Board of Regents, and that in view of the prominence of the College of Engineering in public affairs such action was no more than justified.

Following Mr. Toltz, Pres. L. D. Coffman, of the University of Minnesota, spoke on "A Crisis in the Promotion of Scientific Work." He urged the co operation of the manufacturers and engineers of the state with the staff of the University for the promotion of scientific research, resulting in the progress of industrial lines throughout the country. In the establishment of an institute of technology in Minnesota, he said it would be absolutely necessary to have the backing of those engaged in business and commerce.

"I should like to see 25 to 50 engineers ask 25 manufacturers to sit in with the mand discuss the establishment of an institute of technical research for the solution of special problems," said Pres. Coffman.

He furthermore suggested that in view of the fact that Minnesota will spend $60,000,000 on the improvement of her road system, that $1,000,000 be set aside for the establishment of a department of highway research.

Dean O. M. Leland, in his reply, spoke on the "Education of an Engineer." He pleaded for a broader outlook on the part of the engineering graduates to prevent them from becoming "bread and butter engineers," and stressed the fact that the Engineering Fraternity is depending upon the alumni of the Engineering College for the reputation of the school.

A. M. Burch, '96, recently returned from China, spoke on "China and the Chinese as Seen by the Engineer."

The banquet was attended by one hundred and twenty-five alumni, members of the Engineering Fraternity and faculty of the University of Minnesota, virtually every part of the state being represented. It was considered by all as a success in establishment of a closer relationship between the University and the alumni and Engineering Fraternity of Minnesota.

J. C. Robbers is now employed by the Minnesota State Highway Department as assistant construction engineer. Mr. Robbers left school at the outbreak of war in 1917, and served with the Second Engineers overseas. An interesting article by Mr. Robbers on Highway Construction appeared in the December 1st issue of **Engineering & Contracting.** Other Minnesota men with the Highway Department are R. J. Wolfangle, '17, Clarence Lillie, '17, D. J. Bleifuss, '20, and C. Hanson, '20.

F. W. Hooslef, '17, of the M. S. Radiator Co., Detroit, visited the University while in the city during the holidays.

Oscar Rosenthal, B.S., '18, is in Tampico, Tamaulipas, Mexico, working as resident engineer for the Aguilla Petroleum Co. He finds construction in that country in a pioneer state and says that there is a good opportunity for engineers.

A. P. Hustad and J. C. Hustad, Chem., '15, have formed the A. P. Hustad company, consulting engineers, with offices in the Andrus building, Minneapolis.

Capt. Walter Luplow, B.S., '17, together with Mrs. Luplow, have sailed for Germany, where Capt. Luplow is assigned to the American forces. Previous to this he was connected with the Infantry school, Camp Benning, Ga.

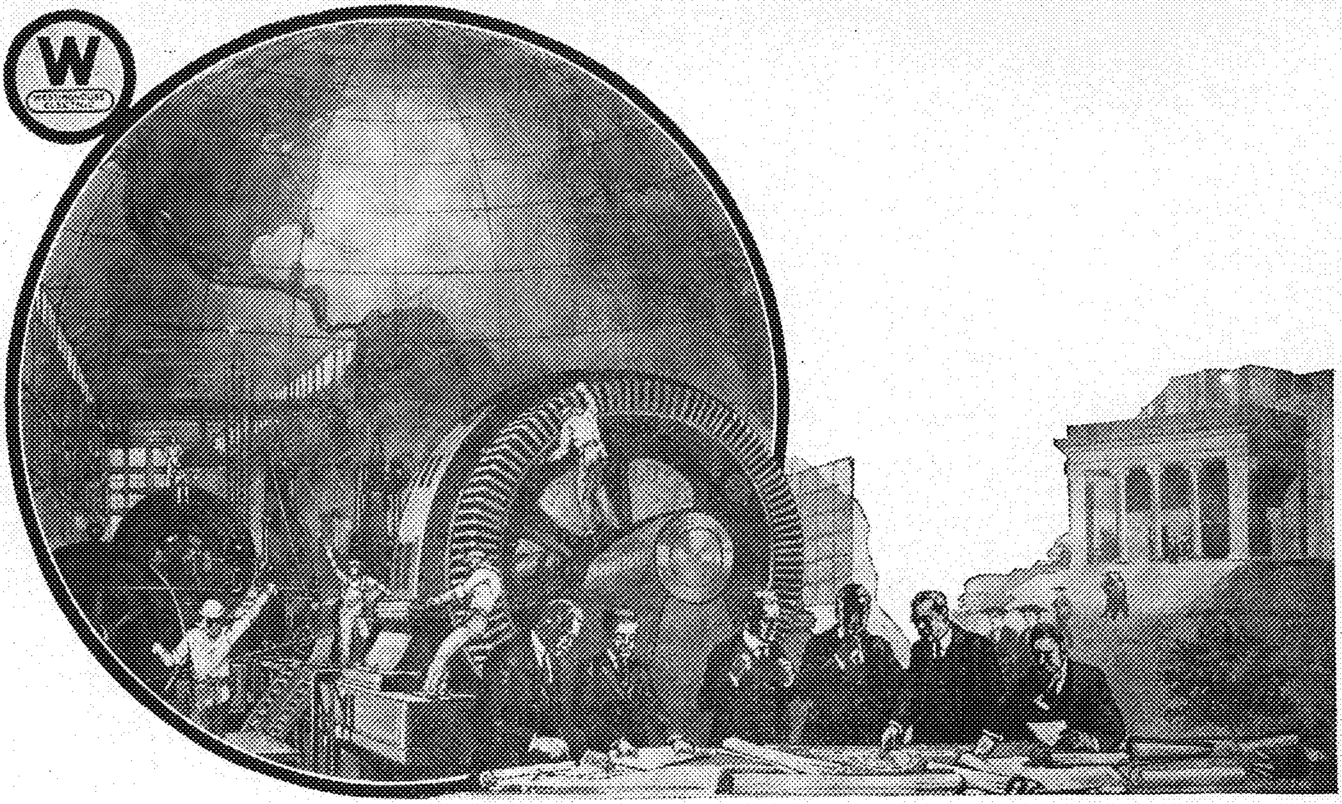
R. C. Nelson, ex., '16, is assistant engineer with the New York Central R. R. in their federal valuation department. Added to this, he holds down an official position on the staff of the Cleveland School of Technology.

David E. Berg, '12, has written a book entitled "Picking Your Prof, or Getting Through College." He is a brother of Sam, senior electric. Sam says that there is some good advice in it.

Ralph Westberg, E.E., '20, was renewing old acquaintances on the campus January 20. He is in the employ of the Canadian Westinghouse Co. in the shops on the testing of equipment of the Queenstown hydro-electric plant. In February he is going on the road doing construction and installation work. His address is 40 Ashley street, Hamilton, Ontario, Canada.

It was overheard that Gates Hunt, in the employ of Cutler-Hammer Co., Milwaukee, expects to be transferred to New York. He is taking up sales work. We imagine "Giddeon" "busted" up to old "Cut," and told him he wanted to see the bright lights.

Sigurd Eliassen, B.S., '18, writes from China, where he is engaged by the Commission for the improvement of the river system of Chih Li. Eliassen is struggling with the surveying end of the investigation of the flood problem in the Chih Li Province. He has promised the **Techno-Log** an interesting article in the near future, and sends his best wishes to all the students and faculty that he knew when he was here at the College of Engineering.



Applying Theory

Westinghouse, putting theory into practice, has employed the ablest technical graduates of the engineering schools of the country.

Annually over two hundred picked electrical and mechanical engineers are trained. Before their analytical minds the field of electrical practice is systematically passed in review until the work which they can elevate into achievement is discovered.

In this way the directing personnel of Westinghouse is built — trained engineering thinkers put where they can achieve the greatest results. Bulletins descriptive of the various lines of work and the way young engineering graduates obtain positions with the company will be gladly furnished.

Westinghouse Electric & Manufacturing Company

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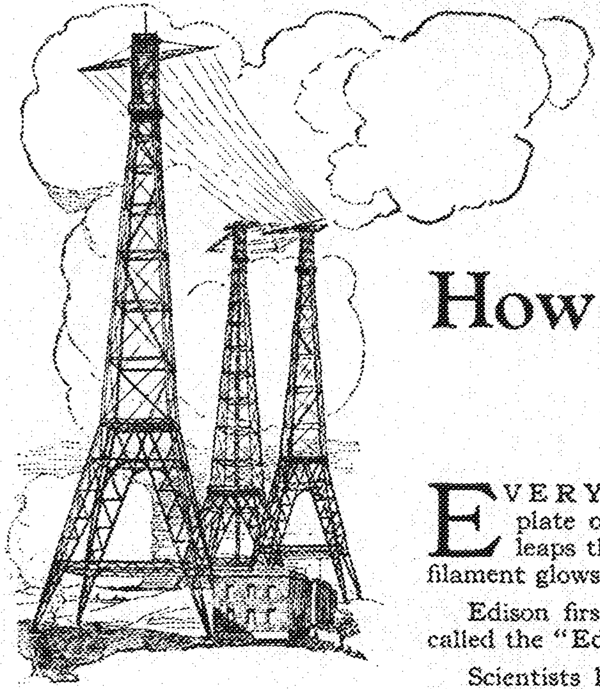

How is a Wireless Message Received?

EVERY incandescent lamp has a filament. Mount a metal plate on a wire in the lamp near the filament. A current leaps the space between the filament and the plate when the filament glows.

Edison first observed this phenomenon in 1883. Hence it was called the "Edison effect."

Scientists long studied the "effect" but they coud not explain it satisfactorily. Now, after years of experimenting with Crookes tubes, X-ray tubes and radium, it is known that the current that leaps across is a stream of "electrons"— exceedingly minute particles negatively charged with electricity.

These electrons play an important part in wireless communication. When a wire grid is interposed between the filament and the plate and charged positively, the plate is aided in drawing electrons across; but when the grid is charged negatively it drives back the electrons. A very small charge applied to the grid, as small as that received from a feeble wireless wave, is enough to vary the electron stream.

So the grid in the tube enables a faint wireless impulse to control the very much greater amount of energy in the flow of electrons, and so radio signals too weak to be perceived by other means become perceptible by the effects that they produce. Just as the movement of a throttle controls a great locomotive in motion, so a wireless wave, by means of the grid, affects the powerful electron stream.

All this followed from studying the mysterious "Edison effect"— a purely scientific discovery.

No one can foresee what results will follow from research in pure science. Sooner or later the world must benefit practically from the discovery of new facts.

For this reason the Research Laboratories of the General Electric Company are concerned as much with investigations in pure science as they are with the improvement of industrial processes and products. They, too, have studied the "Edison effect" scientifically. The result has been a new form of electron tube, known as the "pliotron", a type of X-ray tube free from the vagaries of the old tube; and the "kenetron", which is called by electrical engineers a "rectifier" because it has the property of changing an alternating into a direct current.

All these improvements followed because the Research Laboratories try to discover the "how" of things. Pure science always justifies itself.

General Electric Company
General Office Schenectady, N.Y.

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MINNESOTA TECHNO-LOG

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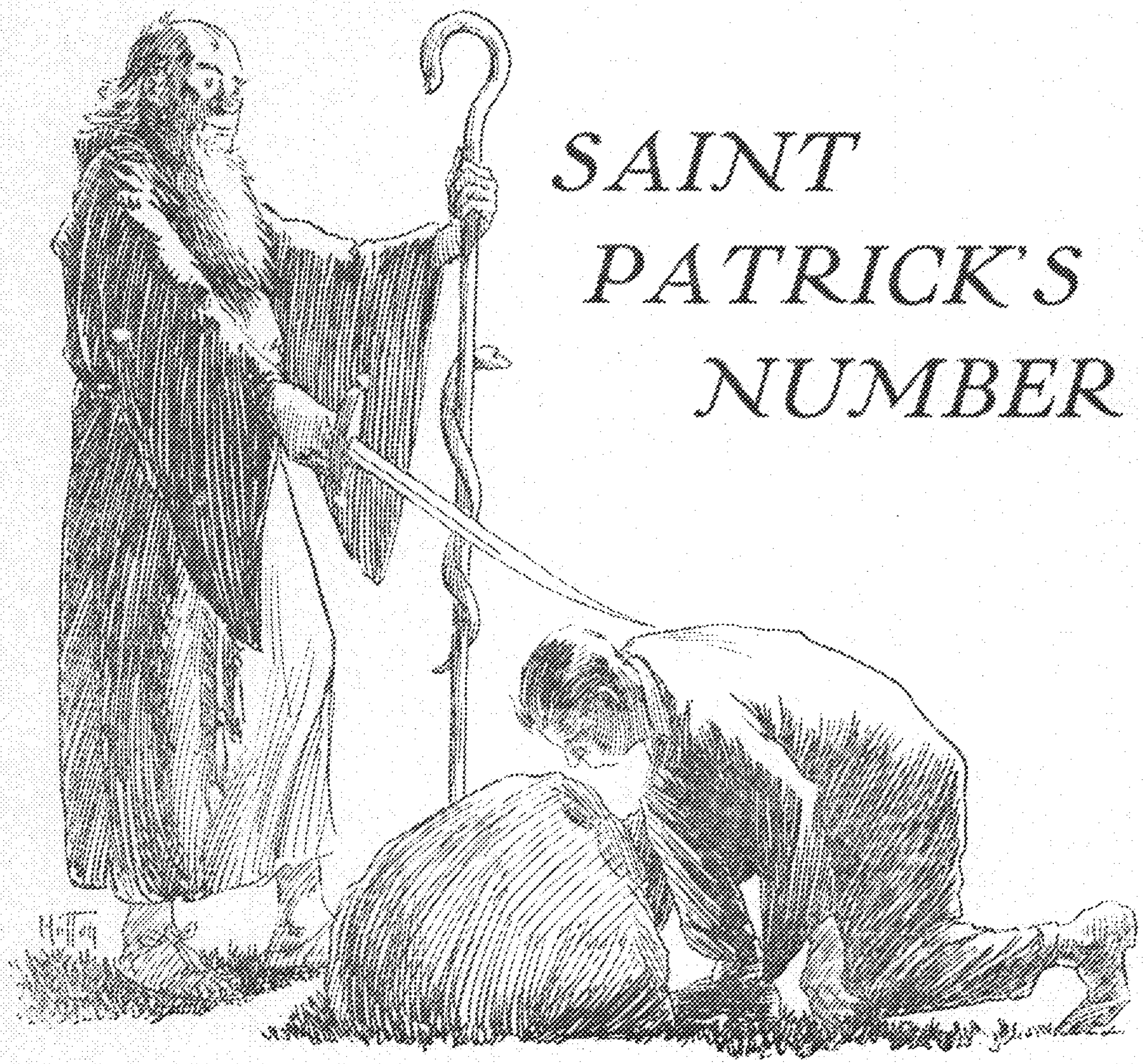
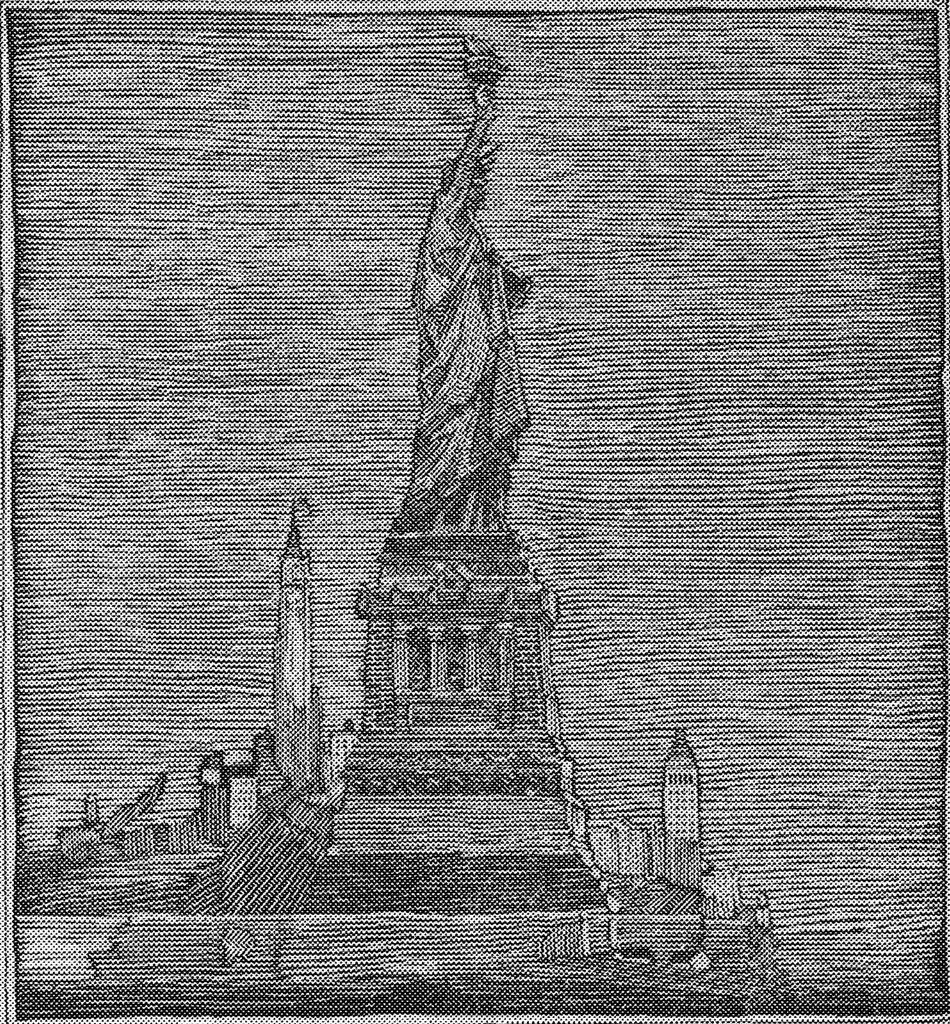
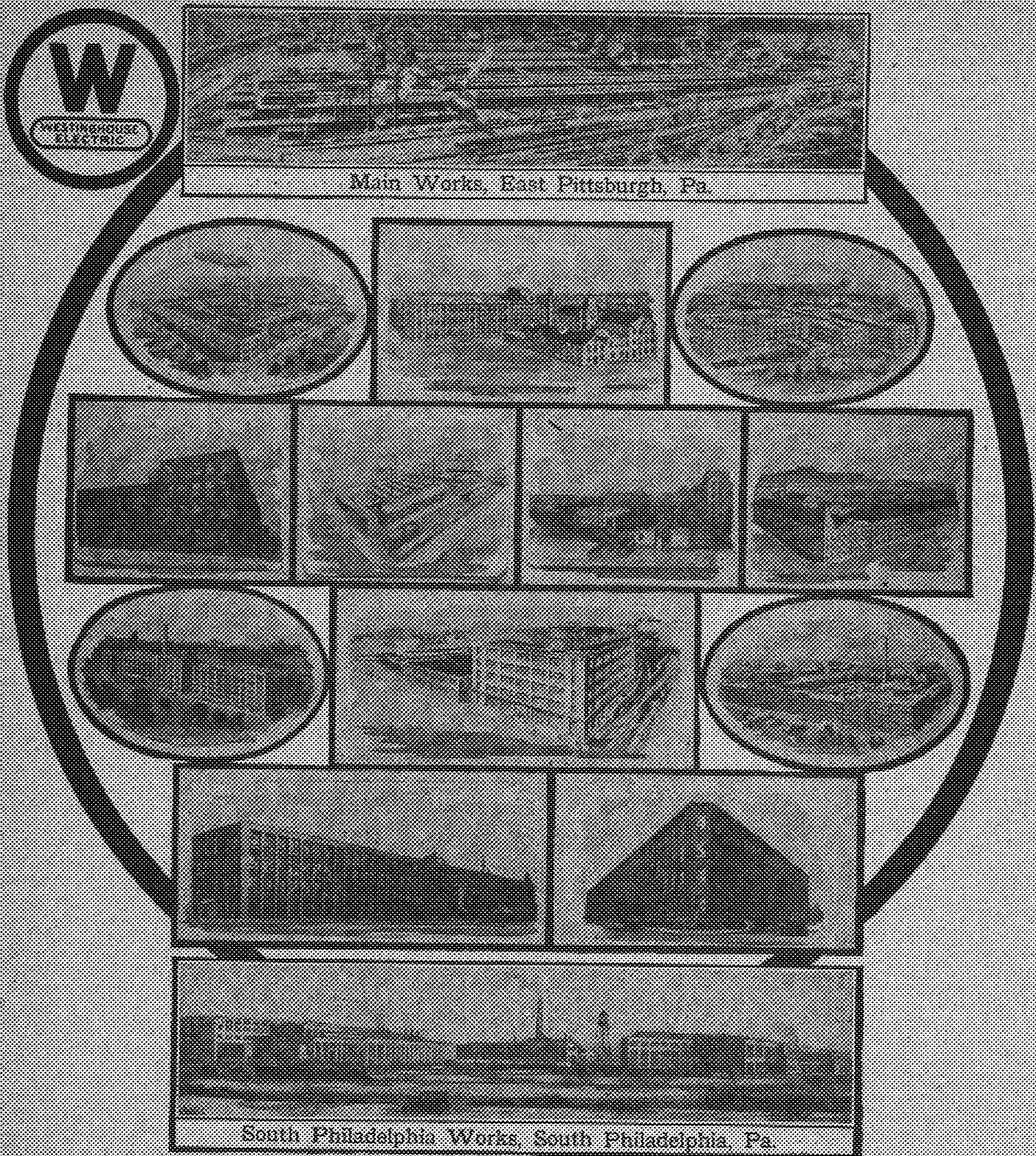


SAINT PATRICK'S NUMBER





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In every type of power plant, stokers for the boilers; motors for pumping; in the engine room, turbines, condensers, and generators. From power house to consumer, transformers, converters, switchboards, and line material.

In the industrial fields, besides generating apparatus, electrical motors of every kind, control apparatus, lighting and special devices. In transportation, motors, controllers, and switching devices; automotive and marine equipment.

In the home, electrical washing and ironing machines, irons, fans, toasters, percolators, stoves, ranges, vacuum sweepers, lamps, curling irons—all this for the farm as well.

The design, manufacture, and sale of these products are fields of great opportunity for engineers.

Westinghouse stands ready to assist young men in attaining their ambitions in engineering.

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The Fine Arts School in Paris

By LEON ARNAL

BIOGRAPHY.

Professor Leon Arnal, instructor in advanced architectural design in this college, since choosing architecture as a profession, has had his career marked by successes and honors in rapid recurrence. His biography is a story of the achievement of a man who lives and loves his chosen profession—art.

Professor Arnal was born in a little village in the mountains of southern France. At the age of seven he went to Marseilles where he entered school, graduating from high school there at the age of fifteen. At the time his father favored engineering for his son's lifework, and Leon was reluctant to pursue this course for some reason rather vaguely felt. When he was writing to his parents for permission to enroll in the Fine Arts School, for a year's training, his reasons began to clear themselves. His experience there was so successful that the doubts of his parents soon vanished as to Leon's career.

Professor Arnal says of the four years he spent in the Marseilles Art School as, "Four wonderful years full of enthusiasm spent in studying every subject related to architecture—painting, sculpture, decoration, sketching, mathematics, and the like."

At the end of this course, he was the winner in a competition, for a three year scholarship to the Ecole des Beaux Arts in Paris, and so he went to the big city for the first time. On the first attempt he passed the competition for entrance, being among the forty-five which are admitted twice a year. He joined one of the three ateliers in the school and became a pupil of M. Louis Bernier, a leading architect who designed the world-famous "Opera Comique" in Paris.

At the age of twenty-five Professor Arnal was in a position to do his final thesis, having completed the required work for the "Diplome." He had also served a full year in the French army. The students are allowed to stay in the school until they are thirty, so Professor Arnal did not present his thesis. He continued to study and take part in large competitions including the Grande Prix de Rome, in addition to doing work in an architect's office.

At thirty Professor Arnal presented the thesis and was graduated with the second highest number of credits in a class of fifteen hundred students. During his school career he won several prize competitions, in addition to over a score of medals and mentions.

After finishing school, he returned to Marseilles with an idea of going into practise for himself. Here he won a large public competition, but the erection of the building was postponed indefinitely. Soon after he met Professor Paul Cret, from the University of Pennsylvania, who offered him a position on the architectural faculty at that institution. Professor Arnal accepted and three months later was teaching in the United States, not knowing a single word of English at that time! He taught at Pennsylvania for three years.

When France declared war, Professor Arnal was in France on a vacation. He enlisted and a month later was at the front, with the British army, as officer interpreter. Four years later he was discharged, possessor of the British Military Cross.

In September, 1919, he returned to the United States and resumed his career as instructor, but this time at the University of Minnesota. The architectural students find that he is occasionally caustic in his criticisms but very likable; an untiring worker, but fond of a good time; an extremely conscientious instructor, anxious to help those who work; and a master of his art in every phase.

Minnesota will indeed be fortunate if she is able to keep such a man on her faculty for many years to come.

The Fine Arts school was founded at the time of the Revolution, in 1795. The purpose of the school is to teach painting, sculpture, engraving, and architecture. It is situated quite close to the "Quartier Latin" on the Left Riverside District (Rive gauche). With the exception of "Ateliers," the several buildings which compose the school contain a large collection of paintings, drawings, and plaster casts, making the whole a sort of museum.

On this ground there once stood an old monastery, of which only the chapel remains. The plan of the school is rather a complicated one, due to the fact that it was extended piece by piece during the nineteenth century according to the needs of a body of students which increased continually. But this gave the different architects in charge of the buildings opportunity to connect these buildings by means of courts, corridors, and porticoes, treated with such a delightful and unconventional spirit that one thanks Fate for things being so.

First, we enter the school through a monumental gateway leading to the main court of Honor. On the right-hand side there is the chapel. We enter it through the remains of a facade of a French Renaissance Chateau, destroyed during the Revolutionary period. These remains were rebuilt against the wall. The latter has been turned into a **Musee de la Renaissance** with copies of the paintings and casts of sculpture by Italian masters. In this room there is a full-sized copy of Michael Angelo's "Last Judgment." Further on is a large lobby giving access to other parts of the school as well as to two studios for painters. It is in this lobby that the students gather to await the results of competitive judgments. The left-hand side of the Court of Honor is a blank wall artistically decorated with pilasters and entablature. On the center of the court we see a free-standing marble column with a graceful bronze figure on the top. At the far end of the court there is a large piece of sculpture in the shape of a triumphal arch, the only fragment left of the Chateau de Gaillon (Renaissance period), which was burned during the Revolution.

From either side of this monument a second court leads to the main building of the School, built from 1820 to 1838. This vast building contains in three stories large collections of full-size casts from the antique, paintings, and a library of 20,000 books on art. There is also an amphitheater used for official ceremonies, such as commencements.

On the left-hand side of this second court there is a building which accommodates in four or five stories, rooms for 500 students when they work in preliminary sketches—called **"les Loges."** On the right we have a glimpse into a garden with magnificent tall trees.

Coming back to the main lobby, we take a corridor leading to an inner court built in the shape of a Pompeiian Atrium, with columns, arcades and mural paintings. A frieze from the Panathenies runs along the walls whose vivid Pompeiian colors give the whole thing an unusual brightness. The court is designed as a little formal garden with grass plots and flower beds. In the center a fountain furnishes a gentle display of water into a basin where birds love to bathe. A mulberry tree in a corner nearly covers the court with its leaves and shadow, leaving only room for straight and bright sunbeams. This is the **"Cour du Murier."** I know of no more peaceful place than this court, with its atmosphere which reminds one of the beauty of antiquity.

Further on there is a lobby leading to a large room, the "Melpomine," where student's works are exhibited and judged. This big room is a part of a rather new building fronting the river Seine, designed especially for exhibition purposes. It contains several halls, vestibules, and monumental staircases.

This last lobby leads into another court, where we see three studios for sculptors. Further on we pass the administrative quarters and gnally reach the architects' and painters' "ateliers." These ateliers are around a court which at one time was the Court of Honor of a delightful 18th century residence. The building is two stories high and students work in what were once refined drawing rooms and boudoirs.

But before we get into one of these ateliers let me tell you what a student has to do before he is allowed the privilege of being a member of the atelier. No one is a regular student until he has complied with numerous requirements, through competition. Competition is the rule, one may say, the corner-stone, of the Fine Arts School. Most of the students come from the Provinces, though they can acquire the degree of "Architecte Diplome par le Gouvernment" in a few schools scattered over the territory, though a process very similar to that of the Beaux Arts Institute in New York.

The first competition to enter the school is a rather difficult one and requires a good training in the subjects covered. The average time spent on these preliminary studies may be reckoned from two to four years. The following are called for at the first competition:—

An architectural esquisse in 12 hours.

A free-hand drawing from cast in 9 hours.

Clay modelling from cast in 9 hours.

Points are given to each test. TThe sum of these points must reach a certain level before the competitor is admitted to further tests. Those who fail are eliminated until the next time. Approximately half of the competitors are "out" after this first experience. Those more successful are tried by further tests:—

A perspective with casting shadows, 12 hours.

A study in cutting stone and shadows, 8 hours.

A descriptive and casting shadows, 8 hours.

Problems in algebra, trigonometry, and geometry.

Oral quizzes in history of art, and general history.

All these students who pass up to the last test have a certain number of points according to their merit. The first 45 are the winners, and 15 foreigners are also "taken in," if they have earned as many points as the last Frenchman. There are about 500 students at each sitting, and there are two sittings a year. The winners are "Students of the Fine Arts School" and start their studies as members of the second class. It takes them about two years to get through this class successfully, spending one whole year studying calculus, perspective, descriptive construction; and another year is required to get two mentions on analytic problems, and four mentions in design.

Then they pass on to the first class or Grade I. There they study only design, but have to comply with a mention in free-hand drawing, one in clay modelling, and one in building law. When a student is through this class he is ready for the final thesis, the subject to be chosen by himself, and developed as far as possible, including the working drawings. This last competition is judged by a special jury which delivers the degree of "Architecte Diplome par le Gouvernment."

As has been already said, every kind of work is a competition in itself, judged by a jury of leading architects, most of them being patrons of ateliers. They give awards, mentions, and medals, according to merit. (Medals are worth several mentions.) A great many money prizes are offered for competitions by people who are interested in the school. The highest award given in the school is the Grand Prix de Rome, which is a scholarship given by the French Government to the ablest student in order that he may spend four years in Rome to study art.

There are two kinds of ateliers—inside and outside. There are only three ateliers in the school and about a dozen outside the school, the only difference being that in the school education is free, and in outside ateliers students have to pay a small fee to their patrons.

The interior policy of the atelier is presided over by a "Massier," who is a student elected by his class mates to rule the atelier with the help of a council of four or fice students. The "Massier" is the spokesman of his comrades when necessity arises; he handles the finances and buys the equipment not furnished by the school. Each "Massier" of the ateliers, from Architecture, painting, sculpture, and engraving sections, belong "ipso facto" to a group called the "Grande Massier," who represents the whole school, and with the help of a council very often deal with general questions of great importance.

We see in an atelier, boys, sometimes 15 years old, rubbing shoulders every day with men nearly 30 years of age. The young men are called "nouveaux;" the others, "anciens." The first must serve a certain period as "help" for the "anciens," going out on errands, stretching canvasses, or bringing water. A "nouveaux" can scarcely find time to work for himself sometimes for a year. But this is a tradition, and the traditions of the school have endured for nearly a century and a half. So well are they rooted that "fagging" is a very important matter, which persists in spite of everything, although there has been a decrease in that kind of thing in the last ten years. It is easy to understand what happens very often when a "nouveaux" first enters an atelier. If not aware, he will object and revolt. Then there is trouble for the poor fellow until he thinks it wiser to end the misery by yielding. He gives in, he is tamed. After that life becomes brighter for him. He understands jokes, can work quietly, and in his turn becomes a "terrible ancien" frightening the newcomer by his hard looks, roars, and demands for supplies.

Among the traditions and customs of the school there are several well established, and dear to the heart of any student. First, there is the day when results from the very first hard competition are posted on the bulletin board in the main lobby. Just think what must be the state of mind of a young fellow who went through a competition lasting a month, on the very day that he is to learn whether he gets in or not. Imagine his feeling if he finds that he went through successfully the whole process of elimination, and now will be among the forty-five. All the competitors are there in the lobby in the court of honor,—thos who hope as well as those who have already been eliminated. All are very eager, all anxious, shouting, giggling, noisy, rushing through the gates, stopping traffic in the streets, and at last, when they know, they have a snake-like parade through the Latin Quarter, putting everything in disorder. No, really, one can't forget the day he became a student of the Fine Arts School in Paris. The first goal is won, the first peak reached. It is a great day.

Then there is the "Rougerin's parade." "Rougerin" is the name of a two-weeks' prize competition in the first class. The day the problem is due, it is a custom that each atelier builds a framework on top of a small push-cart. The framework is stretched over with cloth or paper in such a way that it would remind one of the subject of the program. When the problem is handed in at twilight all these carts are illuminated inside and out and gathered in the court of honor and are started through the streets in a parade, preceded by a band. About 1,500 students follow the push carts with the wildest shouts and songs ever heard. This continues until everybody reaches the space in front of the Pantheon, where an enormous bon-fire is built with the "monuments" as fuel. The police are pretty busy in these days in the "Quartier Latin."

Now with the third custom we reach the culmination of the Beaux-Arts traditions. This is the "Bal des Quat 'Z' Arts," meaning the "Dance of the Four Arts." All students of all the schools participate in the festivities, which require about a month of preparation in the atelier. A large hall is rented in any part of Paris and for one night the guests will live the life of the antique—say of Babylon, Memphis, or Athens, according to the case. Each atelier has to build a portion of the room, a stage setting where its members gather. This piece of work is generally a very large one, an elaborated thing designed to be in keeping with the period required. The best settings or "loges" are given prizes by a jury. All of the work, which includes building the stage, putting up the setting, fixing up lights, and several other devices, must be done in one day. Everything is brought ready to be erected. A gigantic Pharaoh, temples, pyramids, columns, shoulder against each other.

I feel quite unable to depict for you the night that follows. It is indescribable; it is so gorgeous, so "Thousand-and-one-night"-like that words fail me. From the beginning to the end there is such an orgy of colors (for none is admitted unless costumed), an orgy of scents, of sounds, music, dances, stunts, in a hazy light, with hundreds of people whirling, dancing frantically, running, jumping, swaying, singing! One can hardly realize whether he dreams or is awake.

And at last, at dawn, when the sun rises over the sleeping Paris, harassed, but still with glimmering eyes, there is the return to the school, made by means of the most picturesque parade an early arising Parisian could ever meet in his life. Some walk or dance, others pile up in automobiles or cabs. At last the whole procession arrives in the court of honor—at Home. After a lot of stunts in the open, the parade breaks up. But for the whole day you can meet in the outskirts of Paris some Athenian or Pharaoh in quest of lost Propylae or pyramids.

Before I leave thi ssubject I wish to say a few words about a nice tradition we had in my days in the atelier Bernier. Each year the whole atelier went out into the country for two or three days and took a trip to the Chateau de la Loire or Normandy or Bourgovne. These trips were delightful in early summer, full of profit from the scholastic point of view and they proved to be an admirable way for developing comradeship between ourselves.

All these reminiscenses confirm me of what I always felt when in school—that the atelier is for a student his whole life. The atelier is the place where he works his ambitions, wherein he finds pleasure an d relaxation when needed. There he spends all his time. A student of the Fine Arts School does not mingle much with the other students in the Latin Quarter. For him nothing is above being an Architect, a sculptor, or a painter. He lives with art, and this, at least in his eyes, give him superiority over the others, especially in a country where art has always existed as the pinnacle of all professions. Even our students do not mingle much with the students of the other ateliers. One should remember that every problem is a competition, not only between the members of the same atelier, but with the other ateliers. So each atelier desires to get the best out of judgments in order to justify the motto of each student,—"My atelier is the best atelier." Success for the atelier means pride for each student and, of course, fame for the Patron. These patrons are, as a rule, men of rare achievement; they are respected and loved by the student. A student spends several years in the school, and the influence of the atelier patron in the course of those years is a very strong one. These professors have a very high notion of their educational duties. I wish that I had enough space to tell you what has been said abroad and in this country a few months ago when the architectural world lost Jean Louis Pascal, architect and patron of generations of French and American students in Paris.

Most of the students, as has already been said, come from the provinces, where they have been studying for the preliminary competition in local schools. When in Paris they live mostly alone, the atelier being their whole life. There is no campus life, nor any fraternities with their horde of social attractions that one finds in the American universities. The student lives in boarding house or hotel, or with a private family. He has a great deal of independence, he directs his own life and his faculties for the best. Most of the time he works in the downtown architects' offices and earns his living through his school years, acquiring thus a good deal of practical experience in architecture.

There is practically no co-education in the Department of Architecture. The other departments have about 50% of girls. In my days there was only one girl architect student. She was an American and went through her courses successfully and is now practicing architecture in some city of the United States.

As a whole, the student spirit at the school is wonderful. It is the spirit of youth,—it is the spirit of art. They firmly believe in it. They are brought up to like it, to love it. They receive a higher education through the medium of their patrons, who inherit from their predecessors the tradition of loving art, loving architecture, loving the profession. How could one fail to love art in a land where the master-pieces of a thousand years form the environment. One may fear that this wonderful past is a burden hard to carry, detrimental to new ideas. But, none the less, the school is progressive, instructive, and keeps well ahead with new world conditions and problems.

The Beaux Arts School proved to be a most efficient body during the World war. It served greatly on account of its standards. The losses sustained by the school were greater than that of any other governmental school except the military ones. Architectural students and alumni under 45 fell by thousands. The Roll of Honor in the lobby of the School tells the story to the passerby —to the "nouveaux." It shows the latter what their duties are, what they have to do in order to replenish the brilliant group of young fellows nearly swept out. It shows them what "anciens" did for the love of their country—which means the defense and the love of their art.

This resume is written in loving memory of Georges Mauxion, alumnus of the Atelier Bernier, Professor in design at Cornell University, who was killed in action in November, 1917, at Champagne.

No Need to Hurry.

At the San Quentin prison in California a base ball game was being played by the white prisoners and the black prisoners. The game was very close, but in the last inning the whites loaded the bases, and the pitcher for the blacks—who was serving a thirty-year sentence—began to show signs of nervousness. Noticing the black pitcher's tendency to hurry the delivery of the ball, a black prisoner in the bleachers yelled:

"Take yo' time, black boy, take yo' time! You got plenty ob time—you got thirty years yet!"

Old Way Would Do.

Pullman porter (to aged man as train pulls into depot)—"Brush you off, sir?"

Aged Man—"No, I'll get off the usual way."—C. M. & St. P. R. R. Employees Magazine.

Copenhagen

"Hello, Miss," said Copenhagen, setting down the can of sweeping compound the other morning and reaching for the Morning Tribune.

"Good morning, Mr. Copenhagen," said the young lady in the book store, putting up one hand to see if her collar was securely pinned behind. "You're pretty busy these days, aren't you?"

"Aye bane some busy, Miss, all right, you bet. But Aye ain't bane so busy yet as this here Eddie Mikesh for the last couple weeks. Aye wonder, Miss, could you tell me 'bout this har Maister Sant Patrick? Aye ask Perfessor Priester onct, an' hay said, 'Yimminy, Copen, you bane staying 'round har all these jears and ain't bane knowing how he bane good Enyineer and saying, "Give me liberty or give me deat." And Enyineers bane saying that evry seventeent March since. You spose that bane so, Miss, and why he wanted so deat?"

"I don't know, Mr. Copenhagen," said the young lady, running an inquiring finger under her hair-net. "If I were you, I'd ask Howard Jacobson. I think his ideas are so much clearer than Mr. Priester's, don't you? And he expresses himself so much better, you know. But what makes you ask about this Patrick, whatever you call him?"

"Aye yust guess you bane fresh 'round hare or you ain't asking that, Miss. Aye seen sax Patrickson parades, and Aye tell you, we all get up at twelve o'clock night if that's when Perfessor Priester going to start out on his parade. You yust ought to sane him, Miss. Hay puts on old hat pretty bad knocked up on edges, coat wit some kind of pin-cushions on the shoulders, nice lots gold buttons, faded white pants, boots, and awful sw-word by his side. Aye tell you he look yust lake a reglar Yeneral, so kind of cross and proud like.

"And back in the parade, you got no idea how cute Clarency Olson and Kenny Godwin is goin' to look wit them little green shawls sliddin' down off one shoulder and hangin' on to their chimney-pipe hats wit bot hands when they go past the jung ladies. But Aye don't know how the golosh section back in the parade is goin' to get on wit out Kenny.

"But, Aye tell you, Miss, the day ain't what it jused to be. Last jear the whole ting bane pretty ladylike to suit some us old guys. Even them mediciners ain't got pep to start a damn ting. And, Miss, you never seen how them yuniors last jear yust put the Kissing Stone in the vault instead going out and planting it like all good enyeneers jused to do. Aye sane wan jear, Miss, when yuniors bad all kinds time finding out where it bane buried. Onct Aye sane 'em have to dig up Mississippi river getting it. Aye guess that bane better place for Kissing Stone than in old vault wit Dane's flunk books and extry quiz paper. Aye guess last jear they bane fraid they get feet wet or maybe not get back to yunior room soon nuff for friendly little game noolah. They bane nice fellers, Miss, but they got kind of indoor ideas bout Enyineering game.

"Anyhow, Miss, you want yump your yob along wit everybody and see Perfessor Priester gettin' results makin' Andy Miller kneel down nice on bot knees in his best pants, and havin' Laurry Hayward kiss the stone, and him wit no more practice than he's had. It's some sight, Miss, and yer friends'll all be there, and havin' a cup of green tea wit the faculty and dancin' a bit to the yazz music like they always have.

"It's one day in the jear, Miss, Aye'm proud to be an Enyineer, and you will be too, Miss, when you see them big fellers gettin' down so rispectful to Perfesser Priester, and him in his old hat and yumper."

"Well, Mr. Copenhagen, it certainly sounds interesting, and I think I'll have to try to get off to go. Do you suppose it would take a special meeting of the A. E. S. to close the book store for the afternoon?"

"Aye bet you, Miss, you yust ask nobody and go, Aye tank that good way. There goes that bell, Miss. Excuse me, I got to go see what the Dane want now. Goodbye."

The Success Family

The father of Success is
Work.
The mother of Success is
Ambition.
The oldest son is
Common Sense.
Some of the other boys are
Perseverance,
Honesty,
Thoroughness,
Foresight,
Enthusiasm,
Co-operation.
The oldest daughter is
Character.
Some of her sisters are
Cheerfulness,
Loyalty,
Courtesy,
Care,
Economy,
Sincerity,
Harmony.
The baby is
Opportunity.

Get acquainted with the "old man" and you will be able to get along pretty well with all the rest of the family.

Mr. Never Work was loitering in the village grocery store.

Proprietor: "I understand that you are moving away from our town, so I have decided to cancel the bill you owe me and let you begin anew with a fresh start."

Mr. Never Work remained silent and looked at the proprietor as if worried.

Proprietor: "What's the matter?"

Never Work: "Don't you generally give a fellow a cigar when he settles up his account?"

With the Chile Exploration Company in South America

Editor's Note:—This article is made up from letters received from Everett Knowles by his parents and also a letter from Victor H. Carlson by the Techno-Log. Mr. Knowles and Mr. Carlson graduated from the Electrical Department in June, 1920. They sailed from New York June 30 and arrived at Antofagasta, Chile, South America, July 17. The Company paid all their expenses but deducts a portion of the monthly salary until they have been with the Company eighteen months. The expense money is then credited to them. It takes five weeks for a letter from Minneapolis and the postage is five cents.

After a very pleasant voyage of seventeen days we arrived at Antofagasta. We were met by a company motor boat and the companies agent took care of our baggage by "greasing" the official palms in abiding by the custom regulations. We spent one day in Antofagasta, a city of about forty thousand inhabitants and one of the most flourishing and important cities in Chili. Its streets are paved and its "plaza" or park of tropical flowers and trees, which is characteristic of every city, gives it a very pleasant appearance. Antofagasta affords very poor hotel accommodations, which is true of all the cities on the western coast of South America. The hotels are small, dirty, wood and stucco structures built with "patios" or courts in the center. All the rooms face the "patio" and afford no privacy, as most of the rooms have no locks, and those that do are very flimsy, to say the least. The nights are cool, but none of the houses or hotels have any means of heating them and the natives think you odd for mentioning such a thing.

One would suppose that here in the tropics many fruits would be served at the meals, but just the opposite is true, the main food is meat and a great deal of it is served with as many as five different kinds served in courses one after another at one meal with very little or no fruit.

The mines and reduction plant of the company are situated at Chuquicamata, on the west slope of the Andes mountains, about one hundred and fifty miles northeast of Antofagasta. We started from Chuquicamata on the Company's narrow gauged railroad and after a ten hours' ride thru a desert, with nothing but great sand hills to look at, we arrived at Calama, a small agricultural town which owes its existence to the over-flowing of the river Loa. From here we travelled the remaining distance of twelve miles by automobile. The road winds over a pampas on a two thousand foot rise from Calama to Chuquicamata, taking an hour to travel the distance. Chuquicamata looked very large at a distance, with all its lights aglow and the plant running full force. The sun was just setting as we arrived and the air was so clear that the stars shown in myriads and I received my first view of the Andes with their snow-capped peaks, which were turned various colors by the setting sun, making a very beautiful scene.

Chuquicamata is situated in a barren desert with no vegetation of any kind, but it is not a level plain of hot, burning sand and a scorching sun. It really is the sea bottom which has been raised by volcanic action and now forms the foot-hills of the Andes at an altitude of ninety-two hundred feet.The surrounding territory is composed of hills of rock and sand, perfectly barren, due to the mineral content and the lack of rainfall. Chuquicamata is in a section of these hills where there are large deposits of copper sulphate; in fact, some of the hills are composed of nothing but that chemical. Here the largest plant of its kind in the world is located.

The company houses are modern with every convenience, including electric radiators. The family houses are of several different types, but all are one story structures. The rooms for the single men are equipped with home conveniences; sheets, blankets and pillows are supplied, but we have to furnish our own towels.

The first night I was assigned to a room in what is known as the staff quarters, a sort of dormitory. The married couples of our party were taken to the guest house. Single men club together and are given the use of a large house which has one large main room with the other rooms opening to it. They contract with a cook who supplies the meals, keeps house and does the laundry for all at a specified sum per man. My companion obtained a place for me in one of these houses, called mess houses, and nearly all of the men are electrical workers, ten in number. Living expenses will, I fancy, amount to about sixty dollars per month.

Living conditions are very good, especially in the mess houses. Our Chinese servants always have hot water on tap and everything done up right, so that all we have to do is heed the dinner bell. Meals served in the private families are better in some ways, for they can select their food and we have to eat what the Chinks select, which is mostly meat and not enough variety of food. They generally serve what food they can get away with; but I have no fault to find, as we get very good meals, including fancy desserts, such as bread pudding and hard sauce.

The weather is wonderful. The sun shines every day and a cool breeze is continually blowing. If we had a rain it would shut down the plant. Earthquakes occur quite often, for we are only about one hundred and sixty miles from an extinct volcano, but there is no cause for alarm for they have had them for years and they are not much different from the vibrations of a coal truck rumbling past and is not as bad as the vibration from a blast at the mines in which thousands of pounds of explosives are set off at a time. The only nuisance in my estimation is the white dust in the streets, which prevents one from keeping his shoes clean, and the very dry atmosphere and, now and then, a sand storm, which generally comes at mid-day.

The climate has not affected me in the least but I do notice a shortness in breath on exertion such as climbing some of the foot-hills, which are extremely high and steep.

The sun is very bright and the sand reflects the light very well, so that colored glasses come in very handy. It is hard to get any photographs because of the lack of contrast.

Social life here is varied and includes everything from horse racing and gambling of all kinds to dancing, formal and informal. Booze is on tap at all times. Horse racing is held every Sunday on the public race track and a great deal of betting goes on. A dress suit and an open purse provide access to the higher strata of society. The Company has a large club for the employees, equipped with a swimming pool, and at which entertainments are held. The club initiation fee is ten dollars and monthly dues of two dollars. At the dances held at the club one is expected to buy liquor for the ladies and, believe me, they can drink it. Champagne is their favorite and that costs forty-five pesos a bottle, or nine dollars in U. S. money, an expense I have left out of my list. On my birthday I bought the mess a bottle of whiskey costing nearly four iron men. I have been out to dinner a number of times and have thoroly enjoyed myself.

It is going to take some time to pick up the language, for I do not come in contact with the natives and the language they speak is rather hard to get on to after a course in pure Spanish. I am going to join the Company's Spanish class and hope to approach the native tongue or speech, which they call "roto," meaning ragged. It is derived from the fact that the poor natives go around in rags mostly. The natives are the most dishonest lot you ever saw and will steal from under your nose if they get the chance. Robberies of all kinds take place in spite of the "carabaneros" or state police. It is a dangerous community in many respects. There is continual fighting among the natives, who employ the most murderous looking knives I have ever seen. They are very brutal in many ways and get into fights at work.

I started to work in the largest sub-station of the plant, which receives power from their station at Tocopila. There has been very little new work going on because of the inability to obtain material from the States and also because of the trouble between Chile on the one side and Peru and Bolivia on the other. These countries were on the verge of war in July. Carlson and myself are now working on some new work of wiring and testing an installation, of oil-switches and transformers with bus-bar work, which supplies the different parts of the plant with power. Working hours are from seven to eleven A. M. and from twelve forty-five to four forty-five P. M., an eight hour day. We work Sundays when necessary.

Money is used very little down here, as the Company conducts a credit system by which all debts are taken out of one's salary and all you get at the end of the month, unless you want cash, is a credit statement. You can draw Chilean currency at the current rate of exchange.

Some Cow!

A Long Island animal was advertised for sale by her owner: "For Sale—Cow that gives five quarts of milk a day, also two grindstones, one set of harness, and a hay rake."

Delegates' Report of the National Convention of the Guard of St. Patrick.

Many of the Minnesota Engineers have been looking forward for the past year to the convention of the Guard of St. Patrick, and have taken a great deal of pride in the fact that they were charter members of this national organization.

The sentiment seemed to be, however, that this national organization was not fulfilling all its possibilities. The delegates left on Wednesday night, February 9th, for Ames, with the instructions that this feature in some way should be remedied.

After registering at Engineering Hall and being assigned quarters, the delegates were escorted to the convention floor in the Transportation Building. It was apparent that the mechanical arrangements of the convention had been well taken care of. Over the president's chair was the shamrock and slide rule as an emblem of the Engineers. Freshman, sophomore and Junior banners were displayed prominently and other decorative features were attractively arranged. Tables bearing the names of the different states were furnished with blotters and pads, pen and ink, and the whole aspect was one which looked like business.

At ten-thirty our first session was called to order by Vice-President Crilly, at which Dean Marston, Iowa State College, delivered an address of welcome. The substance of this talk seemed to be an urgent request for one national engineering collegiate society. Professor Paine, one of the originators of the national movement, next sounded the key-note of the convention and asked that the following points receive consideration: 1. A standard certificate of knighthood. 2. A seal. 3. A ritual or ceremony of knighting. 4. General policy. 5. General committee on publicity.

Upon motion the minutes of the previous convention were accepted and placed on file. The report of President G. W. Fowler, who was not able to be present, was next read, in which the idea of a broadening activity was evident. After the reports of the vice-president, secretary and treasurer a recess for lunch was allowed.

The afternoon business session convened at one-thirty, credentials were presented and the following schools represented: University of Missouri, Mississippi School of Mines, Iowa State College, University of Oklahoma, University of Minnesota, University of Arkansas, and University of Tennessee. Delegations were also present from the University of Iowa and the University of Colorado. Chapters not sending delegations were University of Mississippi and Washington University. The balance of the afternoon was spent in reports of the various colleges, first as to their organization, and second as to their methods of celebration. Many interesting things were found in both of these fields. Perhaps the outstanding feature in the field of organization was that of a central purchasing committee which issued orders and controlled all expenditure of funds. There were also some novel plans of organization, including time-keepers for all work done on celebrations, safety experts, etc. However, it would not seem practical to apply many of these suggestions to the activities of such a large enrollment as we have at Minnesota.

In the discussion of celebrations it seems that most of the schools now celebrating St. Patrick's day were putting a great deal of effort on open house. That is, each laboratory was open during certain hours for public inspection. Various stunts were in operation and the whole program very entertaining.

One other feature that seemed common was that of a Queen. This dignitary was elected from among the girls attending the University and considerable ceremony and honor was attached to her election. The election was made in a variety of ways, some giving votes proportionate to the number of hours spent in work on the activities of the day, others equal voting power by all engineers, etc. The result of the election was usually disclosed by her appearance during the dance, such as jumping through a shamrock.

After these reports the following committees were appointed: 1. On amendments to the constitution. 2. Design of seal and certificate. 3. Consideration of the badge. These committees were instructed to report the following morning. Recess was declared at 4:30.

Friday A. M. was largely spent in committee meetings. The reports were made in the afternoon but rejected because they did not fit in with a national plan.

The Friday session ended with a feeling of more or less discouragement among the delegates. It seemed as though not a great deal was being accomplished.

Saturday morning, however, found a new spirit, and after very little deliberation a new committee was appointed on Constitution Amendments. Its report and proposed amendments were accepted unanimously and a new feeling of co-operation was in evidence, one which is so typical of Engineering students. We forgot our own selfish desires in the good we could accomplish for the organization.

The constitution as presented and adopted by the convention is printed here for your inspection; you will notice it requires two-thirds of the chapters to ratify the action of the convention.

Mr. William Crilly was elected President of the new association and it was voted to hold the next convention at Rolla, Mo.

The convention adjourned at 2:00 o'clock P. M., Saturday, February 12, 1921.

A very enjoyable time was spent with the Ames chapter and the delegates were entertained in a splendid manner. It was not all work indeed, for Thursday evening a banquet was held and a delightful time enjoyed by the delegates as guests of the Senior Engineers. Friday evening the entertainment committee had secured partners for the delegates and all stepped out to an Engineers Dance. After an interesting trip through the Shops and Laboratories on Saturday afternoon, the various delegates parted for their trains.

A great deal of credit should be given to the Ames chapter for their competent arrangement of details and entertainment.

Respectfully submitted,
Harry E. Brown,
Howard C. Jacobson.

Constitution

ARTICLE I—NAME AND OBJECT

1. The name of this organization shall be the Association of Collegiate Engineers, the local chapters assuming such names as they desire.

2. The object shall be to promote national unity and brotherhood among engineering students through exchange of ideas and customs.

ARTICLE II—MEMBERSHIP

1. Membership shall consist of (a) active and (b) honorary members. Active members shall be students in the engineering course of the subscribing colleges and shall be classed as follows:

1. Knights (or Ladies) of the order.
2. Guards of the order.

(b) Honorary members shall be elected by the local chapter or their representatives.

ARTICLE III—CEREMONIAL

1. There shall be at each college where this constitution is adopted a day set apart as a holiday and to be known as Engineers' Day.

2. The date to be set by each chapter and as near as possible to such date as the convention may determine each year.

3. There shall be some fit knighting ceremony conducted on Engineers' Day.

ARTICLE IV—OFFICERS

1. The National Officers shall be; President, Vice President and Secretary-Treasurer, who shall constitute the Executive Commitee.

2. The President shall be elected at each convention from among the Senior delegates, and he shall hold office until a successor is elected.

3. The Vice President shall be a Junior elected within one month after the convention, by the college at which the following convention shall be held.

Should the Vice President leave college the local chapter shall elect his successor.

4. The Secretary-Treasurer shall be elected from the Engineering students or Faculty of the University of Missouri by the local chapter and shall hold office until his successor is duly elected.

The Secretary-Treasurer shall have charge of all funds of the association and shall make a complete report at each convention. He shall have charge of the history and records and shall be required to distribute them to all other chapters.

5. A special secretary shall be elected by the members of the colleges at which the convention is held, to make minutes of the proceedings of the convention, and shall turn these minutes over to the Secretary-Treasurer for copying and distribution.

6. A report of all conventions shall be distributed to each chapter.

ARTICLE V—CONVENTIONS

1. A convention shall be held each year, the place of each convention to be decided at its preceding convention; the date to be decided by the college at which the convention is to be held.

2. A quorum shall consist of representatives of a majority of the chapters.

3. A special convention may be called by a petition from two-thirds of the chapters.

ARTICLE VI—CHARTER MEMBERS

1. Charter members of this organization shall be:

University of Missouri.
Missouri School of Mines.
Iowa State College.
University of Oklahoma.
University of Minnesota.
University of Arkansas.
University of Tennessee.
Oklahoma Agricultural and Mechanical College.
Washington University.

ARTICLE VII—ACTIVITIES

1. The activities of the organization shall be (1) to celebrate a common holiday thereby forming a bond of brotherhood. (2) to promote student government and afford and exchange of ideas and experience. (3) to promote student publications and assist in their standardization. (4) to promote student enterprises such as the co-operative purchase of books and supplies, etc. (5) to promote athletics, dramatics, debate, oratory or any other student activities which tend to broaden the scope of the engineer and shall be approved by the convention.

ARTICLE VIII—ORGANIZATION OF LOCAL CHAPTERS

1. The recognized governing body of the engineering students at each school shall constitute the local chapter.

2. It shall include in its scope all activities as herein provided.

3. The local organization shall include the customary officers and a representative council with at least one faculty member chosen by the council.

ARTICLE IX—AMENDMENTS

1. This constitution may be amended at any convention by a vote of a two-thirds majority of the Chapters represented subject to ratification by a vote of two-thirds of the chapter of the organization.

2. All votes shall be in within sixty days from date of notice.

3. All amendments shall take effect immediately upon ratification.

By-Laws.

ARTICLE I—MEMBERSHIP

1. A Knight or a Lady shall be any member of the Association of Collegiate Engineers who has been duly knighted. Any member who is in his or her senior year, who has taken part in all activities of the organization while in college and who has paid all required dues is eligible to become a Knight or a Lady of the order.

2. A Guard shall be any member who has not been knighted.

3. Any engineering student in any college subscribing to this constitution may be a member.

ARTICLE II—FEES AND DUES

1. The national dues may be assessed annually by the convention.

2. Each chapter shall levy its own dues for its own expenses.

ARTICLE III—INSIGNIA

1. The official badge shall be a shamrock traversed by a three quarter inch slide rule, bearing the inscription "Engineer's" in block letters. The shamrock shall be emerald green enamel with a highly polished gold border. The slide rule shall be of highly polished gold with black enamel letters.

2. The seal shall be not under one and three quarters in diameter and shall consist of the following: The embossed badge of the order, surrounded by the words at top "Association of Collegiate Engineers," at bottom, "Founded in 1903."

3. The colors shall be emerald green and white.

4. The badge shall be worn only by duly dubbed knights or ladies of the order.

5. Any special or additional badge or emblem shall require the approval of the Convention or of the Executive Committee.

ARTICLE IV—HEADQUARTERS

1. The National Headquarters shall be at the University of Missouri, at which place shall be kept the records and history of the organization, copies of which shall be distributed to each chapter.

ARTICLE V—CHAPTERS

1. Upon petition from any recognized Engineering College new chapters may be formed by a two-thirds vote of the chapters present at any convention.

2. Each chapter shall have power to make its own constitution and by-laws, provided they do not conflict with the National Constitution and By-Laws.

3. Any chapter may be eliminated from the organization by unanimous vote of all other chapters.

ARTICLE VI—DELEGATES

1. Each chapter may be represented in a convention by two undergraduate delegates; and all chapters represented shall be equal in voting power.

2. One delegate shall be elected by each chapter each year, after the first year, from the Junior class to serve two years.

3. In case any delegation cannot attend the convention

3. In case any delegate cannot attend the convention elected for one year to fill his place.

4. Any chapter may elect any faculty member, or graduate Knight as an additional delegate or as a delegate to take the place of a regular student delegate. Such delegate may be elected to serve any length of time the Chapter chooses.

5. The traveling expenses of each delegate and national officer, which shall include round trip railroad fare from his chapter to the place of convention, and sleeping car fare, shall be met by uniform per capita tax upon each member of the Association of Collegiate Engineers, and shall be levied as follows:

Each chapter, except the chapter with which the convention meets, shall inform the National Secretary-Treasurer of the exact amount of railroad and sleeping car fares to the place of convention; and also the number of active members in the chapter. This information shall be furnished at the request of the National Secretary-Treasurer within two weeks from the date of his notice.

The National Secretary-Treasurer shall then inform each chapter, except the chapter with which the convention meets, of the amount of its assessment, which amount shall be paid to the National Secretary-Treasurer within two weeks from the date of his notice.

ARTICLE VII—REPORT OF ELECTIONS

1. Election of delegates governing officers and heads of activities of the chapter shall be reported in prescribed form within ten days to the National Secretary-Treasurer.

ARTICLE VIII—STANDING COMMITTEES

1. The standing committees of the organization shall be appointed by the President as follows: (1) Engineers' Day, (2) Student Government, (3) Publication, (4) Publicity, (5) Book Store, (6) Historian.

ARTICLE IX—AMENDMENTS

1. These by-laws may be amended at any convention by a majority vote of the chapters represented.

ARTICLE X—MISCELLANEOUS

1. In all questions involving parliamentary procedure Robert's Rules of Order shall be the governing authority.

Arrangements for St. Pat's Day

The first meeting of the committee on arrangements for the St. Patrick's Day celebration took place Friday noon, February 11, in room 136, M. E. The meeting was in charge of Ed. Mikesh, general chairman of all committees, who started things off by asking Dean Leland to present his ideas and express his sentiments on the affair. The dean promised all the support and co-operation he could give us to make the day the biggest ever. "I am heartily in sympathy with the idea of making the whole day a holiday," he said, "and I am sure the faculty of the college will do the right thing." The only suggestion the dean had to offer about the nature of the festivities was that it should be made more of a visitor's and alumni day than heretofore.

Following the dean's talk, Ed. Mikesh announced the names of the men on the various committees. Following is a complete list of the men on the general committees; in addition to these there are section leaders among the freshmen whose names have not yet been announced.

Parade committee: Chet Bros, chairman; civils, W. K. Cook, Loring Slade; mechanicals, A. R. Kleinschmidt; architects, Don Graf; chemists, LeRoy Wyman; electricals, P. H. Williams; sophomores, Sam Sutherland; Irving Marshman, Ed. Olson, Roy Olson. Dave Goode is in charge of the arrangements for trucks, and Ralph Hilgedick is responsible for the reviewing stand.

Dance committee: Glenn Westigard, chairman; Don Capstick, C. L. Swanson, John Magnuson, R. D. Spencer, Ed. Erickson, John Morrison, Stephen Darling, Howard Bakken.

Entertainment committee: Harry Brown, chairman; Ernest Nordstrom, R. L. Katter, C. K. Katter, Leo Buhr, Hibbard Hill, John Downie, H. C. Fiske, N. Cassel, Marlow Bergstrom, Mackenzie, Paul Koob.

Green Tea committee: Frank Moorman, chairman; G. M. Moga, R. Hennessey. The following girls from the Architectural department will manage the tea: Miss Gardner, chairman; Misses Dickey, Grace, Mullen, Metcalf, Knutson, Breullard, Little, Crost, Nixon, Knox, Harwood, Anklebdandt.

Publicity committee: George Bailey, chairman; George Foltz, Rudolph Kuhlman, Ellsworth Johnson, LeRoy Grettum.

Button committee: Lawrence Pinska, chairman; Clayton Westigard, Roy Palmer, Seymour Cray.

Purchasing committee: Bill Forsell, chairman; Lloyd Olmstead, Lloyd Mitchell, Dick Bosshart.

Arthur Kuram and Bill Forsell are the two vice-chairmen, acting as secretary and treasurer respectively.

The tentative program for the day which was outlined at this time was as follows:

9:30-11:30—All buildings open for inspection, with students not taking part in the parade on hand to show visitors around.

12:00-1:00—Parade, with reviewing stand on main campus.

1:15-1:30—Light lunch for visitors served in the experimental and main engineering buildings.

3:30-6:00—Green Tea and dansant in the auditorium.

9:00-12:00—Grand Ball in the armory.

The various committees have started work in their respective duties already, and every effort is being made to make the affair the biggest ever. Special efforts to bring out the alumni in large numbers are under way; the committee wants to give the whole university and its friends a chance to look us over.

The publicity committee plans to edit a "Green" issue of the **Minnesota Daily** for St. Patrick's day. Any who desire copies of that interesting sheet should apply to them early.

Mew—Mew.

The cat that nightly haunts my gate,
How heartily I hate her!
Some night she'll come and mew till late,
And then I'll mew-ti-later.
—Cartoons Magazine.

The Army Habit.

Lady Shopper—Pajamas, size thirty-six.

Ex-Supply Sergeant (in reverie)—Where's yer old ones? Gotta turn 'em in; gotta see yer old ones.—The Red Diamond.

Engineer—Why do you say that Arthur is an optimist?

Economics—Well, he is always willing to go out on a date with a jane who has been characterized as "not very good looking, but an awful nice girl."—Pitt Panther.

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EDITORIAL

We are very sorry to announce the resignation of O. F. Beeman, our Business Manager. Mr. Beeman was one of the founders of the Techno-Log and his efforts have aided greatly in placing it on the path of success. We feel a great loss in his leaving, but due to his foresight in selecting an able assistant in Mr. N. R. Moore to succeed him, the office of Business Manager will be well taken care of.

Mr. Paul Koob, C.E. '22, has been added to the staff as Civil Editor.

St. Pat's Day

The College of Engineering, alone among the colleges of the University of Minnesota, has a well developed body of traditions. With our St. Patrick's Day celebration a feature of the University year looked forward to by the whole student body, we have no need to join in the general wail concerning Minnesota's poverty of tradition. Like many other customs made sacred by their hoary antiquity, its origin is lost in an ancient period when its activities were first struggling for recognition, but no graduate for many years back fails to remember with holy joy the sound of the band and the sight of the side-walks lined with spectators as Professor Priester, followed by the Guard, swung into motion. Year by year, certain observances have become dearer and dearer to the hearts of students, and more leniently looked upon by faculty men, until at present the celebration has no more whole-hearted supporters than some of the professors who have been here long enough to understand its spirit. Certainly the time has come for hearty and active co-operation to show the rest of the University that students and faculty have worked together to present a fair picture of the Engineers. Professors in charge of certain courses can give invaluable service in advising the students as to the planning of experiments for public demonstration, and choosing work for display. Indeed, the faculty, no less than the students, are hosts, and ought to assist in the general entertaining, not limiting themselves, as did the rhetoric staff last year, to a "small and early" of their own. A goodly showing of faculty men and their wives, if the latter could be persuaded to assist at the tea tables and elsewhere, would certainly add much to the general tone of the day. Traditions are things that build a united alumni body as well as a devoted student morale, and in this case tradition favors a bigger and a better St. Pat's every year.

Standardized Note Books

"Some like it hot; some like it cold;
Some like it in the pot nine days old."

This was originally said of pease porridge, whatever that is, but at the present time it applies very well to the state of affairs in note taking in the College of Engineering. Some professors demand full, formal, and neatly prepared notes; others never trouble to show students how to take valuable notes in their fields. Some read note-books carefully and comment on work in detail; others judge, apparently, by the bulk of the paper used after the famous manner of Wouter Van Twiller who weighed the account books of rival litigants and administered justice accordingly. The result of this is that some students are preparing, day by day, sets of notes that will be invaluable for years to come, but others have only scattered jottings, mostly on the backs of convenient envelopes. As a matter of fact, the multiplicity and variety of note-books required are enough to discourage an ordinary student from attempting to keep notes. How much better it would be if one note-book, well bound and indexed were sufficient, and if every student were trained in the making of notes that would always be of use to him. Let the departments of the college compromise their differences, agree on a reasonable, useful size of book, demand that some required freshman course put a reasonable emphasis upon training the student in note-taking, and then Minnesota students will come to regard notes as useful and valuable instead of a tiresome bother.

At a special noon meeting of the '24 Club on Tuesday, February 9th, Prof. Zelner made a strong plea for the establishment of the university dormitories and athletic field on the forty acre Hunter tract near the Ag campus, as a means of solving the housing problem with which the University is confronted, and also relieving the Athletic Association of uncertainty as to the best location of the new stadium which will be necessary in the near future. Large diagrams and plans of the proposed arrangements of athletic fields and dormitories were presented for the inspection of the members of the club and the faculty men present. Since then the club has inspected the place in force, under the guidance of Prof. Zelner and a party of surveyors.

Harry Brown, halfback on the football team and junior general, was elected junior delegate to the guard of St. Patrick convention, which met this year at Ames, Iowa, to discuss plans for the celebrations on the 17th of March. Brown received 107 votes and R. H. Hennessey, his nearest competitor, received 67. Howard Jacobson, who was last year's junior delegate, accompanied Brown as senior representative.

Not Versed in Ethnology.

"Earnest," said the teacher of geography, "tell what you know about the Mongolian race."

"I wasn't there," explained Earnest hastily. "I went to the ball game."—Ex.

Report on Inspection Trip of Chemical Engineers, September, 1920.

By A. N. PARRETT

Each year the Chemical Engineering Department conducts an inspection trip to the most important chemical plants in and around Chicago. The following is a brief report of the trip by one of the students, the trip in question being made September 7th to 17th, 1920, under the supervision of Dr. C. A. Mann.

Reports on Some of the Individual Plants Visited.

SHERWIN-WILLIAMS CO.

The plant of the Sherwin-Williams Co., situated in South Chicago, is but one of many operated by this large concern. It is a large and modern plant devoted chiefly to the manufacture of white lead, dyes, intermediates, acetic acid, lithophone, varnishes, and insecticides. White lead was being manufactured by the Old Dutch Process. Casting machines were efficiently and rapidly casting lead buckles from electrolytic lead. After cooling, these buckles were placed in earthenware jars together with a small amount of 30% acetic acid and buried in layers in huge bins by covering each layer with spent tan bark. Here they are left for three months, during which time the spent tan bark ferments, generating carbon dioxide. The carbon dioxide and acetic acid already present react with the thin lead buckles, slowly corroding them, forming, according to the well-known reaction, basic lead carbonate or "white lead." The corroded buckles are then ground, bits of metallic lead removed, the fine particles of white lead floated off and settled in tanks. Then the white lead is further ground in chasers and then mixed with linseed oil while still saturated with water. By a remarkable physical process, the oil displaces the water, causing it to rise to the surface. The white lead is then ready to be placed in pails and kegs for shipment to all parts of the world.

The lithophone section of the plant was the newest portion of the entire plant. Here barium sulphide is caused to react with zinc sulphate in such a way that barium sulphate and zinc sulphide are precipitated together in colloidal condition. After heating to redness several times and plunging into cold water, the lithophone is finely ground and used as a paint body.

A number of dyes and intermediates were also being manufactured, such as sulfur colors, magenta, para-nitroaniline red, etc. Paris Green and Bordeaux Mixture were also being made in large quantities.

GRASSELLI CHEMICAL CO.

Another large plant situated in the South Chicago industrial section was that of the Grasselli Chemical company, manufacturing inorganic acids and roasting zinc sulphide ore or Sphalerite. The sulfuric acid was manufactured by the "chamber process." The chambers were of recent construction and of modern fire-proof design. The huge lead walls were supported by steel framework and the building was lined inside with an asbestos preparation. A dirt floor and steel corridors and stairways combined to make the building housing the chamber the most elaborately fire-proof structure I have ever seen. Three distinct types of sulfur dioxide furnaces were installed. One variety was a row of large rotary pyrites burners, which, by the way, were not in present operation. Large rotary sulfur burners were operating, however, furnishing most of the sulfur dioxide, by burning Louisiana sulfur. The third variety was the Hirschoff burners which roast zinc sulphide ores to form zinc oxide, the gases passing off containing considerable sulfur dioxide.

Nitric acid was being produced by the Valentiner Process in modified form. One of the chemists reported that they were successfully making zinc sulphate from nitre cake by using zinc hydroxide. This seemed to offer great possibilities, for nitre cake or impure sodium sulphate left from the treatment of Chilean saltpeter with sulfuric acid has had very little use.

ILLINOIS STEEL CO.

This steel plant was situated south of Chicago on the shore of Lake Michigan. Ore boats from Duluth were unloading, making huge mountains of red iron ore in close proximity to the blast furnaces. The molten iron from the blast furnaces was taken directly to the open hearth furnaces, bessemers, or cast in pigs to be used for other purposes.

An interesting part of the plant was a large building in which were installed a series of large bore, long stroke gas engines for the utilization of the blast furnace gas. Around 80,000 H.P. was being generated by these engines alone. An idea of the size of the plant may be gleaned from the fact that the plant operated 88 of their own locomotives, just to transport iron and steel from one part of the plant to another. The open hearth furnaces were in operation, although the bessemers were cold and silent, as were the electric furnaces for steel.

The large rolling mills were in operation, but to describe them and their manifold operations would furnish the details for a lengthy article.

UNIVERSAL PORTLAND CEMENT CO.

Lime, alumina, and silica are the principal ingredients of Portland cement. The large Buffington plant of the Universal Portland Cement Co. uses these materials in the form of sand, clay and limestone. These materials contain also, MgO, Na_2O, K_2O, and Fe_2O_3. The materials are mixed in proper portions after being reduced in size to 92% 100 mesh in long tube mills filled with steel balls, and are then calcined in long rotary furnaces, powdered coal being used as the source of heat. The material becomes semi-fused and issues forth as clinker which is dumped outside the building in large piles and left to age for two or three months. The process of aging improves the cement, so that when finally ground as needed, it is fresh and in first-class condition. The clinker is easily ground in ball mills to 95% 200 mesh, and is usually placed on the market in bags or barrels.

STANDARD OIL CO.

Petroleum is found in Kansas, Oklahoma and Texas. The Standard Oil Co. of Indiana, however, prefers to distill these various oils at their Indiana plant south of Chicago on the shore of

Lake Michigan. They have accomplished a marvelous engineering feat in building a pipe line reaching from the above mentioned mid-continental fields to this suburb of Chicago, simply because it is cheaper to pipe the oil up to the great middle-west market than it is to ship the distilled products. The distillation of petroleum as practiced at this plant is a combination of fractional distillation and the famous "cracking" process. By this combination comparatively large amounts of gasoline are obtained. Large horizontal retorts, heated by coal fire, are used for the distillation and at the end of each distillation must be cleared of a heavy tary coke by men who actually enter the hot retorts thru small doors at the end and shovel out the coke. The products of the plant are gasoline, kerosene, light oils, cylinder oils, liquid paraffin, solid paraffin. Liquid paraffin is sold under the name of "Stanolax" and is used for medicinal purposes.

CORN PRODUCTS REFINING CO.

The home of the famous "Argo" products is situated near Chicego in a suburb called Argo. Here King Corn is changed into various forms to meet the needs of man. Starch, glucose, corn sirups, animal feeds, and dextrose are obtained from just plain ordinary yellow corn. First of all the corn is soaked with a warm solution of sulfurous acid (our old friend sulfur dioxide dissolved in water). This softens the kernels of corn. Then they are mashed up and the germs are mechanically separated from the rest of the kernel. Next the shell of the kernel is screened off and the dextrines and starch pass over long wooden troughs, where the starch settles and is later dried. The germs are pressed to obtain a corn oil which is put on the market as a salad or cooking oil under the name of "Mazola." The shells or glutin portions are dried and sold as feed, while the dextrines are hydrolyzed to obtain glucose or corn sirup. The concentration of these sirups is done in huge triple effect evaporators.

ILLINOIS ZINC CO.

Across the street from the Western Clock Co. at LaSalle, Ill., is the plant of the Illinois Zinc Co. at Peru, Ill. Sphalerite zinc ore is roasted and the sulfur dioxide is used to make sulfuric acid. Hirschoff furnaces are used for this purpose as at the Grasselli Chemical Co. The sulfuric acid plant is about 20 years old and hence is not nearly as modern as that of the Grasselli Chemical Co. The chambers are housed in a wooden building, but by an efficient sprinkling system the fire hazard has been cut down until the company which installed the sprinklers, we were told, guaranteed that a fire could be built anywhere in the plant and would be put out in five minutes. The zinc oxide obtained from the Hirschoff furnaces is smelted and cast into ingots or rolled into zinc plates. The smelting of the zinc is carried on in small open door furnaces placed in banks and heated by producer gas. A number of hours is required for this prupose.

A large number of zinc plates were being pierced with holes. Upon asking the reason for this we were told that in order to ship these plates abroad tariff free, they had to be pierced in order to escape the tariff on zinc plates.

COLLEGE NEWS

We are glad to say that Maurice Chernus of the Senior Civils has fully recovered from the effects of the operation that he underwent recently, and that he is able to take up his studies again.

The most interesting meeting so far this year of the Student Branch of the A. I. E. E. was held Monday evening, February 21, in the main Engineering Auditorium. A large number attended and enjoyed the spectacular and interesting demonstration of High Frequency put on by E. C. Manderfeld and Geo. Wessale. They performed such experimentsas lighting an electric lamp by passing the current through the body of Mr. Wessale, lighting torches, and lighting up a set of Geisler tubes.

Mr. Jansky, of the Electrical Department, gave a very interesting and educational talk and demonstration of the radio telephone. Mr. Jansky gave a brief history of the development and also explained the operation of the radio telephone and predicted a new and large field for the Electrical Engineer, namely the Radio or Communication Engineer. A victrola concert which was given at the radio room was heard by means of the radio telephone.

Mr. Jansky also announced and gave a demonstration of the latest development in radio, the Radio Eye, by which the operator can see who he is talking to. It has caused a great deal of comment and many of the geniuses of the Electricals are attempting to solve this unbelievable mystery of how it is done.

Mr. P. Raymond Wilson announced the coming Electrical PEP-FEST and MIXER to be held on March 11 at the main Engineering Auditorium to work up a lot of PEP for St. Pat's Day and the Electrical Show.

Glen Ransom announced the inspection trips, under auspices of the A. I. E. E., to the East Side River Station of the Northern States Power Co., The Street Railway Generating Station, The Coon Creek generating station and the National Mazda Lamp Works.

Mr. Ray R. Sweet was elected chairman of the Electrical Show and he appointed P. Raymond Wilson and E. C. Manderfeld to act on the executive committee.

The Seniors held their annual Ball Saturday evening, February 19, at the Union Ball Room. The ball room was all decorated up and carnival hats and balloons were distributed among the dancers. "Doc" and Mrs. Holman and Prof. and Mrs. Maney were chaperones.

On February 25th, Col. C. H. Boyden, of the Portland Cement Association, gave a lecture to the students who were interested in the use of concrete on "Cold Weather Concreting." He used lantern slides to illustrate his lecture.

An Engineer's Bible class has been formed, which will meet once during each week in the Engineering building for lunch and short talks by members and the leader, Rev. Norman B. Henderson, pastor of Olivet Baptist church.

LeRoy Grettum, sophomore Electrical, was a member of the sophomore debating team which defeated the freshmen in the annual contest for the Frank H. Peavey prize of $100. The sophomores secured a unanimous decision from the judges, who were Prof. Blakey and Prof. Hansen, of the Economics Department, and Prof. Kirk, of the School of Chemistry. Grettum spoke third the main speeches and also in the rebuttal.

The sophomores upheld the negative of the question, "Resolved, that the movement for the open shop should receive the support of public opinion." The Engineers turned out in remarkable force, considering the nature of the occasion; there were fully half a dozen in the audience. Their presence was greatly appreciated by that one Engineer debater alone in the of the Academics.

Cyril Jensen, besides being elected to Tau Beta Pi, was chosen captain of the University track team to take the place of Frank Kelly, who is recovering from an operation for appendicitis. Cy is a Senior Civil, and has been active in athletics throughout his college career. Last year he was hurdler and high-jumper on the University team, and this year in addition to these two events he is also broad-jumping. He is one of the most consistent point-getters on the team, and can always be depended on to place. In the indoor meet with Shattuck, Cy was second high man in individual scoring, with 14½ points. He took first in the broad jump, tied for second in the high jump, second in the 30-yard high hurdles, third in the 30-yard low hurdles, and was first runner on the half mile track team.

The Engineers are not well enough represented on the track team by far, considering the amount of material we have. Minnesota needs track men now as she never needed them before, and it's up to us to produce some men for the track squad who will do the same thing there as Enke and Kearney are doing on the basketball team. At present there are only half a dozen Engineers going out for the team. Clarence Varner, sophomore, is a promising distance man; Sidney Acker, also a sophomore, has shown speed in the middle distances, and Loren Dawson, former Central high star and track captain, is training for the dashes. Dudley Kean, freshman miner, is going good in the high jump.

Since the return of Kelly to school, and the results of the Shattuck meet, track prospects have brightened up considerably. They are none too rosy yet; but with an early spring, which will allow outdoor practice to begin as soon as possible, Minnesota ought to upset the ambitions of Conference leaders.

The freshman basketball team played its first practice game at Seven Corners, losing a hard fought battle by a 29-12 score. Their opponents were a rough bunch; it was dangerous to play too hard for fear the game would end in a free for all. We hope that they're not discouraged, however; the inter-class games are not of that nature. The sophomores have started practicing this week, under the coaching of Clarence Varner. Teams looking for practice games will confer a favor by communicating with the news editor through the Techno-Log office or dropping a note in box 378.

The Engineers showed up well in the ski meet with Wisconsin, three of the five men on the team being from St. Patrick's favorite school. Dudley Kean, freshman miner, Richard Goodridge, sophomore civil, and Lief Sverdrup, senior civil, made 142, 125 and 92 points respectively. They were up against stiff competition. Besides the fact that four of the Wisconsin men were also Engineers, they had received their training in the sport in Norway and were all experts. The two longest jumps were made by Hesselberg and Norberg of Wisconsin; Hesselberg cleared 70 feet in spite of the bad weather and poor condition of the slide. The meet took place at the municipal slide in Glenwood park.

Lief Sverdrup, captain of the Minnesota team, had hard luck in the meet with Wisconsin, but he redeemed himself the next day, when he got fourth place in the municipal championship meet with a jump of 74 feet, beating out Strom of Wisconsin. The whole team made a fine showing, and if given support and the opportunity to practice which they deserve, Minnesota skiers would rank with the best in this part of the country.

On February 23rd, Prof. George Maney took his class in reinforced concrete over to St. Paul to attend the convention of the Minnesota Concrete Products Association.

On February 28th, the Engineering student body was addressed by Edward S. Carman, president of the A. S. M. E. His subject was "The Responsibilities of the Engineer as a Leader."

Alumni News

L. C. Tomlinson, E.E. '04, is an instructor in the Electrical Department of the Industrial Division of the Carnegie Institute of Technology at Pittsburgh, Pa.

During the holidays, H. A. Tallmadge, E.E. '17, was a visitor at the University. Mr. Tallmadge is now completing an electric transmission line between Crookston and Stephens, Minn.

At the building show last month several alumni were in evidence with their respective displays. George Paulson, '17, was on the floor most of the week for his firm, the Paul Steenberg Construction Company of St. Paul, explaining the use of double concrete wall construction for all kinds of building. J. J. Liebenberg, '16, and S. Kaplan, '18, of that firm were also present. Liebenberg, Kaplan and Martin had a booth of their own with a fine display of colonial house sketches.

On January 27th, Harry Gay Fortune, '19, was united in marriage to Miss Madeline Jesinore, of Kentucky. The event took place at the First Church of Christ, of this city, and was attended by a few friends and relatives. Mr. and Mrs. Fortune left Minneapolis the night of the wedding for Toledo, where they will make their home.

E. J. Teberg, '20, recently became president and manager of the Pembina, North Dakota, Light and Power Co. During the war Mr. Teberg rose to the rank of captain in the Engineering Corps of the U. S. army.

The Architectural Department was well represented at the building show, having a carefully chosen display on exhibition in the balcony. The work is said to have brought forth much comment from the public as well as being a Mecca in itself for alumni visiting the show.

Thomas D. Lane, Ex. '22, is now attending a law school in Lawrence, Kansas. His address is, care of Acacia Fraternity House.

Duane Taylor, E.E. '17, writes from Annapolis, where he is now doing graduate work in Engineering at the Naval Academy. Duane says he is highly pleased with his work there. His address is 204 Prince George street, Annapolis Md.

Jeff Hamilton, '19, received sixth honor in the Le Bruhn competition, the first honor being rewarded by a six months' traveling scholarship abroad. He is now contemplating entering the race for the annual Paris Prize and we take this opportunity to wish him the very best of good fortune, hoping that his name will grace the head of the list.

Mighty Poor Average.

Mrs. Bussy—"What is your husband's average income?"

Mrs. Hank—"Oh, about midnight."—Kyote.

After four years with the City National Bank at Copenhagen, Denmark, M. O. Nelson, a former student of the College of Engineering, is spending three months in New York City. Nelson traveled extensively in Europe before coming to America, visiting France, Italy, and Switzerland. After the completion of some special work in New York, Mr. Nelson will return to Denmark to rejoin his wife and three children.

Max Pfaender, '17, landscape architect, announces the opening of an office at Yankton, S. Dak. Mr. Pfaender furnishes landscape plans and specifications for the improvement of all classes of public and private grounds, and acts as consulting landscape architect for those communities that do not employ a permanent superintendent. For nine years Mr. Pfaender with with the U. S. department of agriculture on experiment stations in Nebraska and North Dakota. He has traveled extensively throughout the United States and Canada studying parks, civic improvements, and landscape architecture.

DAYLIGHT ILLUMINATION.

The angle of refraction being equal to the angle of incident, it is a simple matter to determine the correct angles to use in manufacturing glass which will give good illumination. But for proper industrial plant illumination, there is more to be considered than mere deflection of light. The direct beam of light must be eliminated in order to prevent sun glare, which is objectionable on account of its causing heavy shadows and strong contrasts which decrease the efficiency of employees and necessitate the use of shades which in turn reduce the light to such an extent that daylight illumination any distance from the light source is not sufficient. Therefore, in order to produce a glass which when used in the windows of industrial plants will produce as near to ideal illumination as possible, we must first eliminate the direct rays of the sun by deflecting the light to the ceiling and side walls which re-deflect it back to a distance 25 to 50 feet from the window throughout the entire working area. To accomplish this we have scientifically designed a type of glass which is named "Factrolite."

Factrolite consists of 30 ribs to the inch, running at right angles, forming 900 pyramidical prisms or 3,600 light deflecting surfaces which completely disintegrate the direct beam of light from the sun. Furthermore, the depressions in the surface of Factrolite are so slight that the accumulation of dirt and dust is minimized and can be perfectly cleaned with an ordinary dry scrubbing brush. Incidentally, the cleaning of windows is most important for keeping up production and increasing the efficiency of any industrial plant and should be given more consideration in plant management.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.

220 Fifth Avenue,

St. Louis. New York. Chicago.

No. 1

Victor Engquist, Charles Ellsworth, Clarence Price and R. M. Peterson, all members of the class of '20, attended the A. I. E. E. meeting at the Northwestern Bell Telephone Co. building January 31st. Mr. Engquist, upon being asked what he was doing, said he was out picking currents from the gas mains left there by the street railway. Victor is in the employ of the St. Paul Gas company.

George Fraser, '19, won the first prize at Cornell University for a poster to advertise the Cornell masque "Martini." Fraser also won a second prize in a contest conducted by the Beaux Arts Institute of New York on the best solution of a problem in architectural design.

J. E. Ohrbeck, Ex. '20, is now working as a draftsman with the William Bros Boiler and Mfg. company of this city. His home address is 1818 Kenwood Parkway, Minneapolis.

The Minnesota Engineer is found in Mississippi, where H. A. Kroeze, '19, is employed as State Sanitary Engineer. Kroeze makes his home in Jackson, Miss.

E. M. Love and F. A. Kleinschmidt, '20, who are now taking graduate work at Harvard, received the two highest awards amongst the Harvard men in a recent competition on one of the problems in which the Massachusetts Institute of Technology and the Architectural Club of Boston participated.

H. V. (Vic) Kruse, C.E. '13, is now engaged in mining engineering at Clemenceau, Arizona.

The alumni of the Architectural Department are hereby given advanced notice of the annual Architects' Jubilee, which will be staged at the Engineering College April 21st. The pageant will have a Roman setting this year, and the party will follow the Greenwich Village idea. All contemplating attending should start planning their costumes now, remembering that a riot of color is the thing desired and that no one will be admitted unless costumed to the full spirit of the evening.

John Hoag, who started with the class of '20 and joined the Royal Flying Corps at the beginning of the war, is now in the insurance business at 202 Andrus building, Minneapolis.

H. N. Anderson, '20, is with the Worthington Pump Works and is at present in Boston. He writes that he was all over New York City and explains his experiences and his idea of New York by saying "Oh, Baby, that is the life."

Jake Czock, '20, who is with the Worthington Pump Works and is located at Cambridge, Mass., has invested in a dress suit and is a regular devil among the women.

F. W. Jordan, E.E. '18, has been elected to the board of directors of the Westinghouse Club of Pittsburgh.

A. H. Porter, Chem. '08, has resigned his position with the New Prague Flouring Mill Co., of New Prague, Minn., and is now associated with Harry E. White, flour broker, with offices at 68 Broad street, New York City.

A new faculty member, R. Skagerberg, instructing in drawing and descriptive geometry, is a graduate of the class of '15. He served in the U. S. A. air force during the war as a pilot.

Ray Lockwood, B.S., '20, is the American Telegraph and Telephone Co. here in Minneapolis.

From Duluth comes the news that H. E. Bernt, B.S., '20, is doing construction work on the new steel plant of the Steel Corporation.

F. A. Dever, B.S., '20, is in charge of yards and bridges with the Duluth, Messaba & Northern railroad.

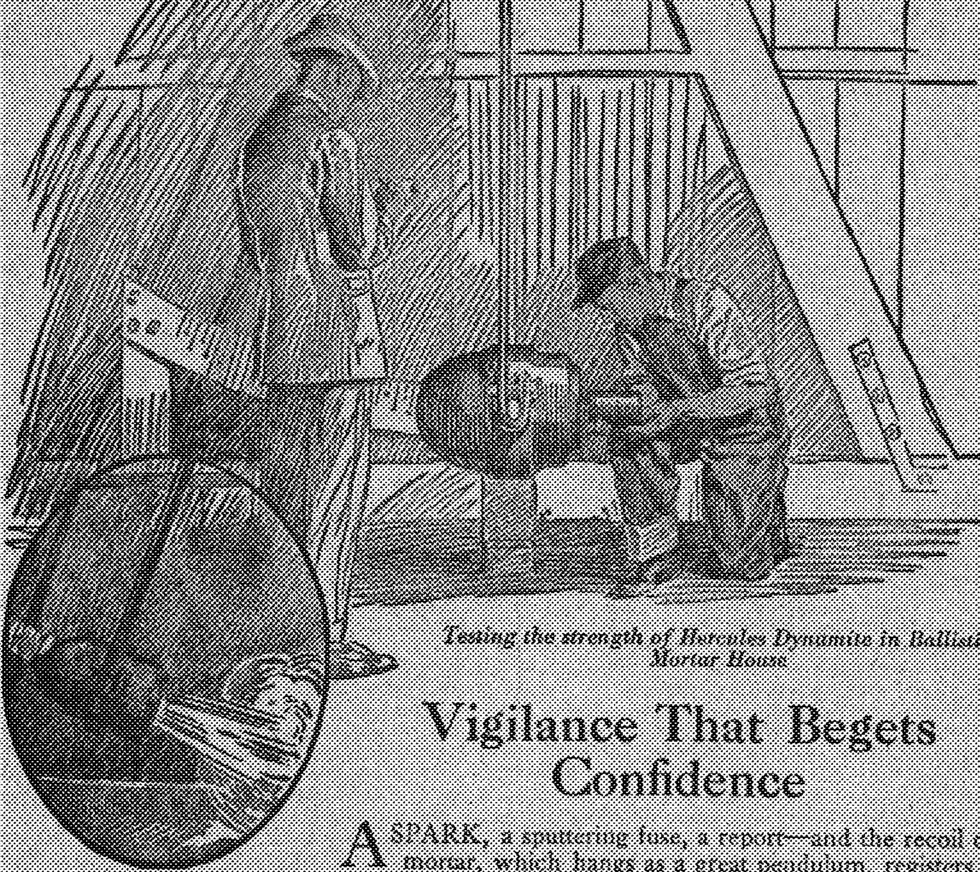
Carl C. Hanke is in Chicago designing for the Sanitary Department of that city.

Down at Raleigh, N. C., J. O. Halverson, Chem., '06, is telling southern farmers how they can best grow tobacco and cotton. He is with the Department of Agriculture in charge of work in nutrition.

At the thirteenth annual convention of the "Society of Engineers" of North Dakota, held February 10th and 11th at Bismarck, E. M. Grimes, C.E. '00, spoke on the "National Department of Public Works." Mr. Grimes is supervisor of bridges and buildings for the N. P. Railway, Fargo, N. Dak.

Several graduates of 1920 are back at school this year engaged in research work preparatory to writing their theses. W. F. Joachim is conducting a series of motor oil tests on tractor motors. Ed. J. Hayes is studying the heat insulating qualities of various wall boards and other building materials. G. L. Tuve is experimenting on oil burning torches and furnaces. E. B. Curry is working on the design of an oil burning steam power plant. L. Murill is performing chemical tests on oils used by W. F. Joachim, while C. M. Reasoner is interested in testing the effect of design, capacity, and various paints on steam and hot water radiation.

Lieut. R. C. Blessley, a member of the class of '18, was recently married to Miss Mabel Jackson of Oak Park, Chicago. The happy couple are now spending their honeymoon in Minneapolis. Lieut. Blessley will return shortly to Panama, where he will be stationed with U. S. Air Service at France Field. During the war Lieut. Blessley served overseas on both English and American fronts. He has a number of German planes to his credit and, during the course of his fighting, was brought down himself badly wounded.



Testing the strength of Hercules Dynamite in Ballistic Mortar House

Vigilance That Begets Confidence

A SPARK, a sputtering fuse, a report—and the recoil of a mortar, which hangs as a great pendulum, registers the energy stored in Hercules Dynamite. This simple but accurate test is only one of many which are employed by the Hercules Powder Co. to maintain the unfailing high and uniform quality of Hercules Explosives.

Before it is finally accepted as ready for commercial use a Hercules Explosive, no matter what its nature, must pass almost as many examinations as a boy about to graduate from high school. It is due to this unflagging vigilance on the part of the men who make them that the products of the Hercules Powder Co. occupy the enviable position they do in the fields of sport and industry.

Among hunters and trap shooters, miners and quarrymen, engineers and contractors, Hercules Explosives enjoy a firmly established reputation for unusually high and uniform quality. This is the reason why they are called upon to perform so much of the work which can only be carried on efficiently and economically by the use of explosives.

HERCULES

Explosives Chemicals Naval Stores

HERCULES POWDER CO.

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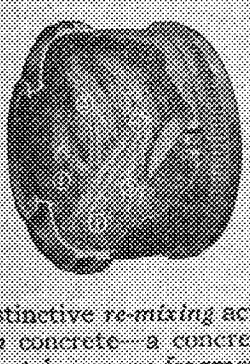

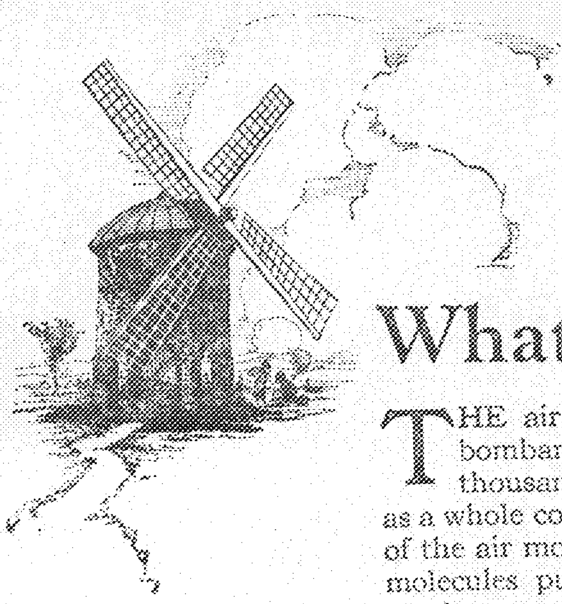

What Is Air Pressure?

THE air is composed of molecules. They constantly bombard you from all sides. A thousand taps by a thousand knuckles will close a barn door. The taps as a whole constitute a push. So the constant bombardment of the air molecules constitutes a push. At sea-level the air molecules push against every square inch of you with a total pressure of nearly fifteen pounds.

Pressure, then, is merely a matter of bombarding molecules.

When you boil water you make its molecules fly off. The water molecules collide with the air molecules. It takes a higher temperature to boil water at sea-level than on Pike's Peak. Why? Because there are more bombarding molecules at sea-level—more pressure.

Take away all the air pressure and you have a perfect vacuum. A perfect vacuum has never been created. In the best vacuum obtainable there are still over two billion molecules of air per cubic centimeter, or about as many as there are people on the whole earth.

Heat a substance in a vacuum and you may discover properties not revealed under ordinary pressure. A new field for scientific exploration is opened.

Into this field the Research Laboratories of the General Electric Company have penetrated. Thus one of the chemists in the Research Laboratories studied the disintegration of heated metals in highly exhausted bulbs. What happened to the glowing filament of a lamp, for example? The glass blackened. But why? He discovered that the metal distilled in the vacuum depositing on the glass.

This was research in pure science — research in what may be called the chemistry and physics of high vacua. It was undertaken to answer a question. It ended in the discovery of a method of filling lamp bulbs with an inert gas under pressure so that the filament would not evaporate so readily. Thus the efficient gas-filled lamp of today grew out of a purely scientific inquiry.

So, unforeseen, practical benefits often result when research is broadly applied.

General Electric
General Office Company Schenectady, N.Y.

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MINNESOTA TECHNO-LOG

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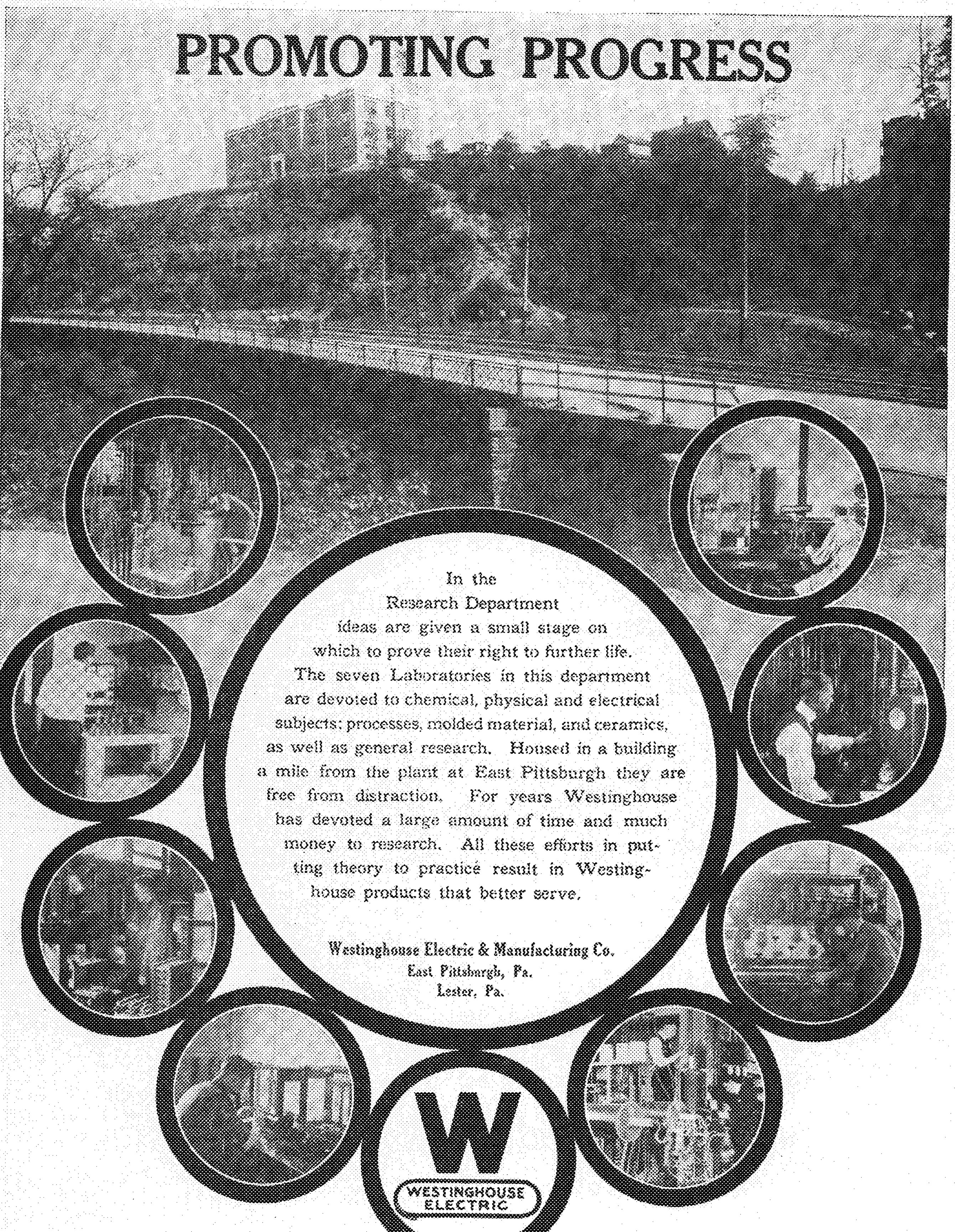

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SOCIETIES

University of Minnesota Branch of American Institute of Electrical Engineers.—Pres., Basil Maine; Secy., Ludwig Larson; Treas., A. Wilson.

University of Minnesota Branch of American Association of Mechanical Engineers.—Pres., Joachin; Vice-Pres., Lloyd Elmer; Secy., Olmstead; Treas., Roy Aure.

American Association of Engineers.—Pres., J. H. Werdenhoff; Vice-Pres., Lyle A. Dills; Secy. and Treas., Geo. Christlow.

Architectural Society.—Pres., Edward Larson; Vice-Pres., A. R. Melander; Secy., R. Damberg; Treas., M. L. Anderson.

University of Minnesota Society of Civil Engineers.—Pres., J. H. Werdenhoff; Vice-Pres., Robt. Muessel; Secy., Victor Wood; Treas., W. D. Weis.

Flood Problems in the Province of Chih Li in North China

By SIGURD ELIASSEN, B.Sc. '18

In the autumn of 1917 Tientsin, the chief port and trade center of North China was inundated for a period of more than one month. The flood did not come absolutely unaware on the inhabitants as reports of serious floods on tributaries to the Hai Ho, the main outlet for all the rivers flowing across the Chih Li plain, had reached the city more than a week before.

The Hai Ho runs through Tientsin. It is formed by five river systems having their point of confluence at the city or just above it. From Tientsin to the sea the Hai Ho has a length of thirty miles. It is regulated for navigation on this stretch.

Some days before the flood water reached the city it could be watched from the tops of high buildings creeping slowly nearer, and for this reason people refused to believe that the flood would be serious and stayed in their houses until the water drove them out. It was then generally too late to save any property as no boats were available and the material damage became very great. Where the writer lives at present the water stood two feet above the living and dining room floors and about six feet above the general level of the ground. As far as Tientsin is concerned much of this damage could have been averted by a little forethought and some smart dyke building and dyke repairs when the first report of simultaneous floods on tributaries to the Hai Ho reached the city. After the city had been flooded dyke repairs were effected and the water was pumped out after one month's inundation. To add to the difficulty a great number of refugees from the surrounding district gradually came into town trying to find food and shelter, and these had to be taken care of as well as it could be done. The port was closed for general communication with the outer world for more than a month, as wash-outs on railroads and difficult harbor conditions made approach to the city impossible except for small shallow-draft sailing boats. The total damage has been estimated, for Tientsin alone, to be from 15 to 20 million dollars without counting the damaging effect to trade, and for the whole province of Chih Li to more than 100 million dollars, as most of the autumn crops were lost. Five million people were rendered destitute.

At the time of the catastrophe most people were led to believe that it was the Yellow River that had again changed its course and sought its old bed to the north; but to the initiated it was known that Tientsin periodically, before foreigners settled in China, had been subject to floods when some or all of the tributaries to the Hai Ho were in flood at the same time.

To understand the situation it is necessary to describe briefly the general geological and hydraulic features of the province of Chih Li, and the prevailing meteorological conditions.

The Province of Chih Li. (Approximately 124,500 square miles.)

Chih Li province may be divided into the plain and the mountainous area, the plain occupying 1/3 of the whole province. The plain is a part of the great alluvial plain of North China, built up by deposits from its many rivers, mainly the Huang Ho or Yellow River assisted by the many rivers of the Chih Li province flowing across it in the northern part. A branch of the plain may be said to extend through the Huai River basin flanking the Grand Canal on both sides extending as far as the Yangtse Kiang River. The Shantung mountains to the east stand up like islands in the ocean from this plain.

The plain is bordered on the west and north by mountain ranges of the immense Tibetian, Turkestan and Mongolian plateaus. The dividing line between the plain and the mountain range is very distinct, as the mountains rise very abruptly; it runs in a practically north-east and south-west line from Peking to the Yellow River. At the Yellow River, the mountains recede towards the west and come eastward again south of the river. Still farther to the south a spur of low, irregular mountain ranges extend from the main ranges in an easterly direction and form the divide between the plain and the Yangtse Kiang valley.

Just north of Peking on latitude 40° and longitude 116° 30' the mountain ranges swing towards the east and reach the coast at Shan Hai Kuan, a town about 100 miles to the north-east of Tientsin.

The mountains to the west of the plain are very rugged and reach average heights of 4,000 to 6,000 feet, with occasional peaks up to 9,500 feet in the Hu Tuo Ho and Sang Kan Ho drainage areas.

The mountains are almost barren everywhere, the soil-cover is scanty above the loess deposits and only the less precipitous hills may have a scattered, low bush growth and tuft grass covering the rock formation.

It is said that the mountains 150 to 200 years ago were heavily forested and that the ruthless deforestation that has taken place since then is the real cause of the present numerous floods in the plains below. The popular belief that forests have a retarding effect on flood run-off has been discussed frequently amongst engineers and foresters, nearly all of them agree to this. A smaller number of engineers, however, amongst whom are the most noted hydraulic engineers living, have arrived at the conclusion that as a rule the forests neither add nor subtract from the magnitude of destructive flood flow. It seems to the writer that the latter view is the correct one as regards the situation in Chih Li. It may be perfectly correct that the hills were forested 150 to 200 years ago, but evidently the flood problem during the forested period was relatively just as much a problem to the natives as it is today, the only difference being that the flood problem is affecting more territory and more people today than previously. The plain, steadily advancing in to the Gulf of Pei Chi Li, becomes populated, and with the increase of trade the economic side of the problem becomes more serious for every decade.

To come back to the physical description of the mountain areas:—

The rock formation of the mountains is chiefly composed of limestone with granite and sandstone occurring irregularly. The soil covering the valley is loess, which, according to Richthofen, is wind deposited silt probably from the desert of Gobi. In many places the loess formation is of immense thickness and reaches depths of more than 1,500 feet in the valleys of the province of Shan Hsi to the west of Chih Li. On account of the steep mountain slopes the farmers have terraced the slopes both to prevent wash-outs and to store up in the soil as much as possible of the rainfall which occurs very irregularly, in torrential downpours during July and August and is almost negligible the rest of the year. From December to April there is often no precipitation. The terraced condition of the soil has, of course, a modifying influence on the run off in many districts. In others the percentage of cultivated land is so small and the percentage of barren, precipitous hills so large that flood run-off is a very considerable percentage of the rainfall.

Loess is a remarkable material. It is very porous, but the interstices are so fine that the water percolates only slowly through it. It is similar to clay in that the capillary action is great, but slow, and that run-off over it is severe. Water pools after rain will be standing for days in open bare fields or in irrigation ditches where the soil is more compact. However, when the loess becomes saturated with water it dissolves like sugar, and commences to flow, forming a thick yellow soup. It is this fact that causes the Chih Li and the Huang Ho rivers to be so heavily silt-laden when they are in flood. It is probable that loess formerly did cover the mountain sides to a far greater extent than it does at present; but that the torrential summer rains have washed great quantities of it down into the valleys where it has been terraced to prevent the downward motion.

Loess will stand vertically when cut, and in the loess regions it is very common to see the roads cut deep down into the soil through action of wheels, wind and water, the sides standing perpendicular some times up to 100 feet on both sides of the road. A liquid stream of loess will, when the rain ceases, gradually stiffen and present a surface somewhat similar to gypsum. The farmers use the loess almost solely for building their houses. They wet it almost to saturation, form it into bricks, sunbake it and build their walls from these mud bricks. A severe prolonged rainshower, however, has a disastrous effect on their buildings and they usually take great care in having the mat or straw covered roof extend well outside the wall, thus protecting the mud bricks. A plaster of mud and straw is also a common protection for the bricks. In many places dwellings are simply made by digging caves into the loess walls, a primitive but practical solution of the housing problem for the poor man.

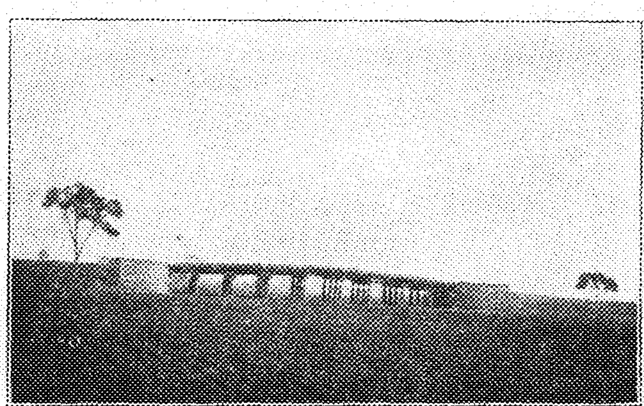
Hydraulic Features.

Glancing at a map of the province of Chih Li there are seemingly a great number of river courses crossing it on their way to the gulf of Pei Chi Li. This is somewhat misleading as a number of the courses shown are "dead" or abandoned courses, many of which become water carriers during flood periods.

Some of the numerous tributaries shown are normally dry due to the lack of precipitation during the winter. The low water flow of the main streams is only a few hundred c.f.s. During the summer time, however, when the rainy season occurs, all of the streams swell suddenly to an extraordinary extent, and since they come down from the mountains on a very steep slope and through valleys where the soil is the easily eroded loess they are heavily silt-laden. This burden is dropped when the velocity decrease.

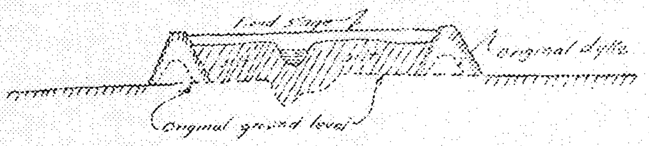
The Chinese have been forced to dyke in the rivers from where they debouch upon the plain, due mainly to the fact that floods occur during mid-summer at a time when the second crop is well advanced.

As far back as history can take us it has been a continual fight between man and nature, nature trying to build up the plain evenly, with the rivers flowing in well defined, stable channels, man interfering with his dyke building, with the result that the river beds are now unstable from where they leave the mountains to where they enter the gulf of Pei Chi Li. It is said that dyke building commenced at the time of Yu, about 4,000 years ago, though it may easily be that dykes existed long before that time. Emperor Yu is considered to have been China's most eminent hydraulic engineer, and it took him ten years to bring the dyke system of north China into shape. The result of dyke building has been that all the rivers now practically flow on ridges and that shallow valleys exist between the dykes of one river and the dykes of a neighboring river. This condition is constantly being aggravated by the steady, strong northeast winds, blowing during the winter, which carry away immense quantities of the tilled, dry, loose soil, the valleys thus gradually being excavated. The process is slow, but steady.



A Typical Dead River

Within the dykes, the river has naturally tried to do what it would have done if it had been left alone, namely, to build up its low water bed and its flood plain. (See sketch.) In the course of time the flood channel diminishes in capacity and the dykes must be built higher and higher to accommodate the floods. Dyke breaks when they occur become very disastrous and more and more difficult to repair. In one way it is fortunate that the Chih Li rivers have such a small low water flow and it is possible in most cases to force the river back into its old channel after the flood has subsided. Of course the hydraulic conditions are becoming worse after every flood, but as every square foot of the plain is cultivated and the population something like 300 persons per square kilometer (800 persons per square mile) it is easy to understand that the flood problem is difficult in the extreme. Technically it is not impossible to



Cross Section of a dyked river in the plain.

work out a remedy, but the economic conditions are adverse to any radical solution. As it is, the plain is being built out rapidly on a very flat slope into the Gulf of Pei Chi Li and it may be that the people will be forced, in the course of another 1,500 to 2,000 years, to a policy of immense settling basins situated well back into the plain in order to build up the gradient of the streams and make the beds stable.

Below is given a list of the hydraulic features of the main rivers in the province which have a bearing on the flood problem of the Chih Li plain. In collecting the data the drainage areas have been calculated to a point where the rivers commence to be dyked in, the reason for this is that it is questionable whether during low stages seepage water does enter a river after it has been dyked in. Available stream measurements tend to show that on some of the rivers there is an increase in flow on their way across the plain, while on others the measurements show a distinct loss. During flood the conveyance loss on all the rivers is very great.

The topographical features of the water-sheds above the plain are somewhat similar. The geological compositions vary slightly and is best reflected in the amount and nature of the silt that is brought down by the rivers. Loess is the predominant feature of the silt, though it is mixed with varying quantities of fine sand. Thus the water-shed of the Pei Yun Ho produces a more sandy silt than the rest, while that of the Yung Ting Ho seems to have the most extensive loess formation.

The maximum flow is still a matter of conjecture on all the rivers. The figures contained in the list have been calculated from the 1917 flood levels obtained by the Chih Li River Commission surveyors. The figures are naturally only approximate, since the surveyors have had to rely on information given them by farmers and villagers a year or more after the flood. In many cases the 1917 flood heights were not the maximum in the memory of living men.

(Continued in the May issue)

TABLE SHOWING MAIN HYDRAULIC FEATURES

of

THE FITE PRINCIPAL RIVERS

of

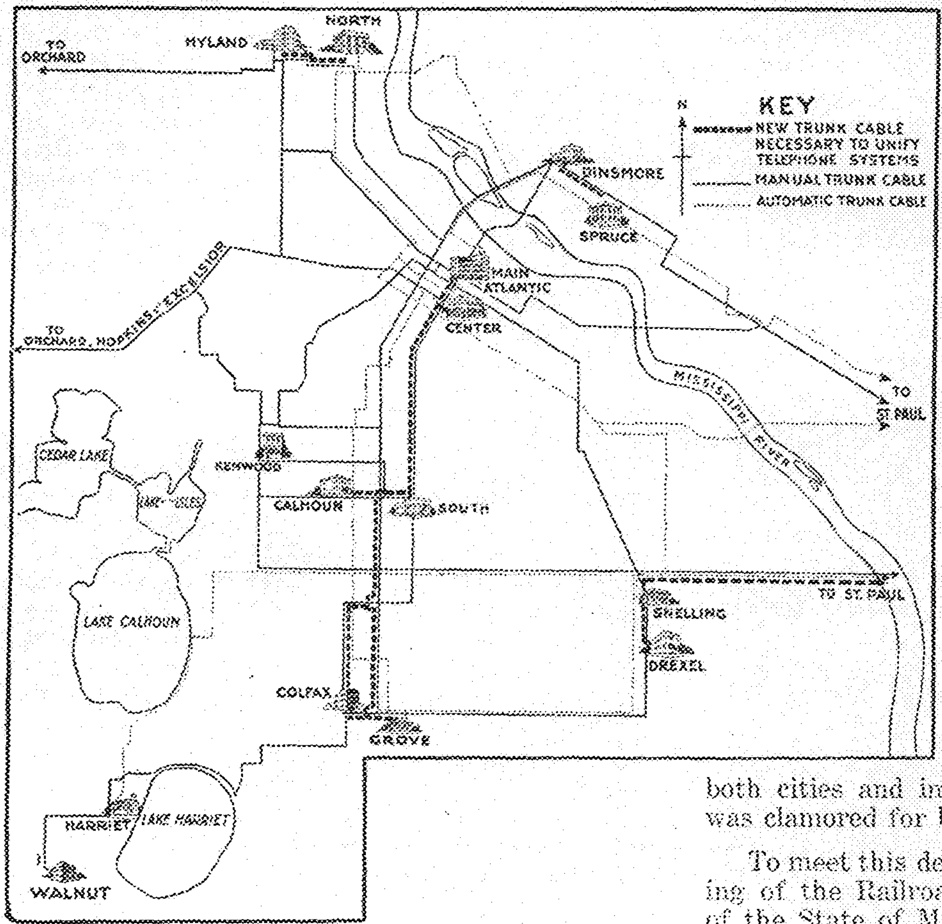
THE CHIHLI PROVINCE

River System		Approximate Drainage Are's	Runoff in c. f. s.		Flood Runoff c. f. s. (per sq. miles)	Silt Content Parts per million by weight	
Principle	Tributaries	(square miles)	Maximum Flood	Normal Low stage		Normally	During Freshet Season
Grand Canal or Nan Yun Ho and its continuation the Wei Ho	Tan Ho Chi Shui Ho } An Yang Ho } Chang Ho	15,200 above Linching 5,500 5,700	30,000-35,000 at Linching not yet determined	800-1,000 not yet determined	2-2.3	700-800	8,000-10,000 at Linching
Tzu Ya Ho	Fu Yang Ho Hu Tuo Ho	6,100 9,150	not yet determined 375,000 (1917)	800-900 100-200 600-800	? 41.0	? 500-1,500	? 20,000-25,000
Ta Ching Ho	Chu Ma Ho Fu Ho Tang Ho Sha Ho Mu Tao Kou	12,000 above Hsien Chen 3,700 1,700 2,100 1,300 900	not yet determined	600-800 below Hsien Chen		250-300	12,000-15,000
Yung Ting Ho	Sang Kan Ho Sang Yang Ho	20,500 above Lukuochiao 10,150 8,200	250,000 (1893)	600-800 ? ?	12.2 ? ?	1,000-1,500 ? ?	150,000-250,000 ? ?
Pei Yun Ho	Chao Pai Ho	7,780	85,000 (1917)	600-800	10.9	100-200	40,000-60,000

Consolidation of Automatic and Manual Telephone Service in Minneapolis

By WM. WEIBLER

Division Equipment Engineer of Northwestern Bell Telephone Co., Minneapolis



The automatic office names had to be changed because of letters used in calling.

Calhoun to Dykewater
Center to Geneva
Grove to Locust
North to Cherry
Snelling to Dupont
Spruce to Gladstone
Harriet was discontinued

Today the city of Minneapolis is experiencing what just a short time ago existed in the minds of telephone people as a beautiful thing in theory, but a near impossibility in practice, the physical connection of a machine switching telephone system with a manual telephone plant.

The cause for a consolidation of two kinds of telephone systems of the magnitude of the Minneapolis consolidation was brought about by the existence of two distinct and separate telephone companies in the city, the Tri-State Telephone & Telegraph company and the Northwestern Bell Telephone company. The Tri-State Telephone & Telegraph company had seven central offices all working on an automatic basis and serving 25,000 stations, while the Northwestern Bell Telephone company had ten central offices all working on a manual basis and serving 68,000 stations. These two systems covered practically the same territory and by referring to "cut," which is a map of the city of Minneapolis with all the telephone offices located thereon, you can see how closely the offices to serve the different parts of the town are situated.

On July 1, 1918, the property of the Tri-State Telephone & Telegraph company in Minneapolis was sold to the Northwestern Bell Telephone company and the property of the Northwestern Bell Telephone company in St. Paul to the Tri-State company. This eliminated competitive service in both cities and immediately consolidated service was clamored for by the public.

To meet this demand and also to follow the ruling of the Railroad and Warehouse Commission of the State of Minnesota, under whose supervision all telephone companies in the state operate, we established a branch of the Engineering department to handle only matters dealing with the consolidation.

The problems which confronted us were so numerous and complex that day after day was consumed in conferences between members of the American Telephone & Telegraph company and our own members from the Commercial, Traffic, Plant and Engineering departments before a plan of action was decided upon.

The first thing to be done was to determine the number of duplicate stations and the district in which they were located. This was done by making a card index of all duplicate stations taken from the listings in the two telephone directories. From these cards information was prepared showing the number of probable stations to be connected to each central office of both systems after the consolidation. Then from traffic figures from the systems extending over a long period of time, estimates were made to determine the calling load in the different central offices.

It was apparent that in order to combine the two systems, it would be necessary to convert one of the systems to the same type of equipment as the other, or devise a method whereby the manual and automatic equipments could be averaged so they would work together without interference.

Several plans were considered and the ones receiving the greatest amount of consideration were the following:

On calls from the automatic system to the manual:

1. The automatic subscriber would be required to dial a certain code number which would connect him to a manual switchboard where the call would be handled the same as any ordinary manual call.

2. The automatic subscriber would dial the automatic office, the number would be flashed to full number and with a storing system at the the manual board on what is called a call indicator.

3. This system is the same as No. 2 with the exceptions that the storing device is located in the manual office and is directly connected to what is known as the call indicator position. This is the system which was finally worked out as it kept all of the call indicators equipment together, which facilitates the location of trouble, also the latter system as well as No. 2 made it possible to have the automatic subscriber dial the number wanted and not have to pass the number to an operator.

On calls from the manual system to the automatic.

1. The manual subscriber makes his call as usual but the manual operator completes the call by dialing directly into the nearest automatic office using all six digits, namely, the first two letters of the office name and the four numerals.

2. The same as No. 1 except that the trunks would be provided to each automatic office and the operator would be required to dial only the four numerals. As the latter method lessens the time required for the operator to complete the call it was adopted.

One of the peculiarities of an automatic switchboard is that the mechanical switching apparatus is based on the same division of units as the decimal system. For example, automatic central office equipment, having connected with it any number of stations up to 999, may be operated, and any number called, by three turns of the dialing device on the subscriber's set. An automatic system having connected to it any number of telephones from 100,000 to 999,999, requires six operations of the dial to make a connection between two telephones.

With the adoption of the "call indicator" plan of operation, it was at once apparent that six turns of the dial were necessary in making calls in Minneapolis, not only to prepare for the time when Minneapolis had over 100,000 automatic and manual subscribers, but to provide for the calls to St. Paul with its 54,000 automatic and manual stations.

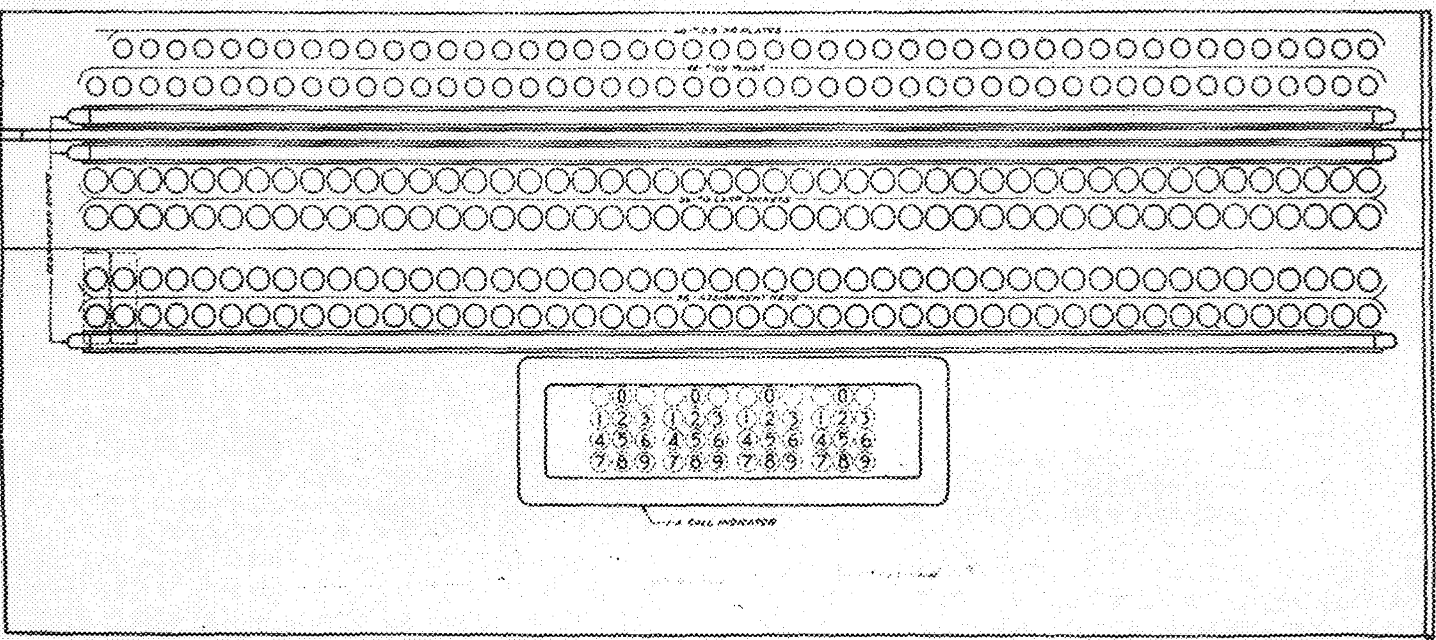
Automatic telephones in Minneapolis before the consolidation were designated by numbers having five figures—as "62 391." Six operations of the automatic dial meant that each automatic telephone number would have to consist of six digits as "345 721."

From a traffic as well as the subscriber's standpoint six figure numbers were not feasible. After making a series of tests, it was found that telephone numbers, both automatic and manual, consisting of a name and four digits were much easier to remember and generally more satisfactory.

A name and four digits for all telephone numbers in Minneapolis resulted, the name to be that of the central office to which the telephone was connected. Then by placing both letters and numerals on the automatic dial, so that by operating it twice on a basis of letters and four times on a basis of numbers, six operations of the dial would be made. In all cases it was arranged to make the letters to be used in dialing, the first two letters of the name of the central office to which the called telephone was connected.

For example, if an automatic subscriber wished to communicate with Kenwood 7431 and he dialed K-E-7-4-3-1, it would be the same as if he had dialed 5-3-7-4-3-1, because the "K" occupies the same position on the dial as "5" and the "E" as "3."

This meant the selection of new names for some of the central offices. Manual telephone numbers already had a name corresponding to the



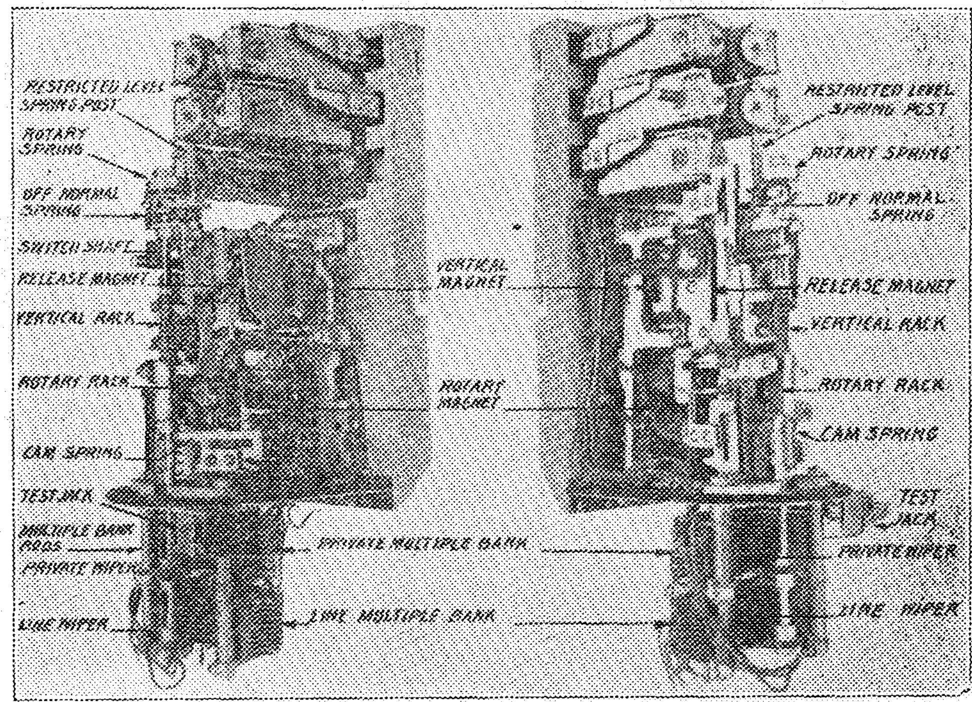
central office to which they were connected. To make them all consist of a name and four figures, all manual numbers consisting of a name and one figure were eliminated. This meant the abandonment of ten multiple jacks at each manual central office. All manual telephone numbers between 10 and 99, connected with each central office, were prefixed with two ciphers. For example, "South 28" became "South 0028." All manual numbers between 100 and 999 were prefixed with one cipher. For example, "Colfax 805" was changed to "Colfax 0805."

After the fundamental plans had been adopted as stated, the necessary refinements of the circuits and the amount of equipment required in each of the offices had to be worked out.

In working up the call indicator system, such problems as this arose:

How many registering circuits will be required to take care of 48 call indicator trunks, which is the number of trunks on one operator's position? As there was no precedent to follow and the cost of equipment was high per circuit, this question could not be settled by a mere chance guess. After a considerable number of conferences with Engineers of the American Telephone and Telegraph company, the Automatic Telephone company, the Western Electric company and of our own Engineers, it was finally decided that eight circuits per position would be ample. Our experience to date has proven our decision to be correct, as only in extreme cases do we require more. In order to guard against calls going astray, however, due to all registering circuits being in use, the call indicator circuit is so arranged that a lamp associated with the trunk which missed a registering circuit will flash until this trunk is connected to a supervising operator who determines the number called and completes the call.

Another important question which came up was: When should the "ring-back" induction be placed on the trunk? (This "ring-back" induction is the purr that is heard after a call is made to notify the calling subscriber that the party called is being rung.) Should it be placed in the line as soon as the call indicator circuit is ready for completing the call or should it wait until the call is actually completed? There are good arguments on both sides of this question and not until after carefully considering all of them was it decided to wait until the connection is actually completed. We accept this decision because in case a subscriber heard the ringing inductions and thot his party was being rung it might be found that the line is busy and he would then receive the busy back-tone which would probably confuse him and render both tones ineffective. The argument for placing the "ring-back" induction on the line as soon as the last number of the call is made is that on all straight automatic calls this is what happens and a great many people, especially those accustomed to using the automatic telephone, are used to this almost instantaneous ring and will hang up and start the call again because they would think something wrong with the call.



Side Views of a Selector Switch With Cover Removed

As there is a charge of ten cents for calls between Minneapolis and St. Paul, some method had to be found to intercept all automatic calls of this type. A circuit was designed to take care of this interception. This circuit not only had to intercept the call but also determine for the intercepting operator whether the telephone from which the call came was entitled to make this sort of a call as a large number of business places have free telephones which are restricted to local calls only.

There are hundreds of details just like the above examples which had to be worked out in each individual case on which volumes could be written.

While the engineering forces of the telephone company were working out some of the problems relative to consolidation, the United States Government had taken over all telephone properties in the United States and their operation was be ing regulated by the government telephone operating board.

Despite the fact that engineering plans had been made soon after the purchase of the Tri-State property in Minneapolis and the material and equipment needed to effect the consolidation had been determined, permission to order it could not be obtained from the government until May, 1919.

About the first material received which would permit work to start on the consolidation was the new dial number plates for automatic stations. The new plates show both numbers and letters. The old dial plates showed only figures, one for each pull on the dialing device. With the exception of the figures "1" and "0" each pull on the dials now has one figure and three letters, which are arranged on the plates as follows:

	ABC	DEF	GHI	JKL	MNO	PRS	TUV	WXY	
1	2	3	4	5	6	7	8	9	0

A crew of approximately twenty men was required to handle the work of installing the new dial plates. A definite route was laid out for each man to follow each day and approximately 275 plates were changed daily by this crew. This work was completed December 1.

In order to establish intercommunicating tie lines between the seven automatic and ten manual offices, considerable underground construction had to be done. A large amount of new trunk cable also had to be installed. All this work has been completed and nearly all the necessary splicing has been finished.

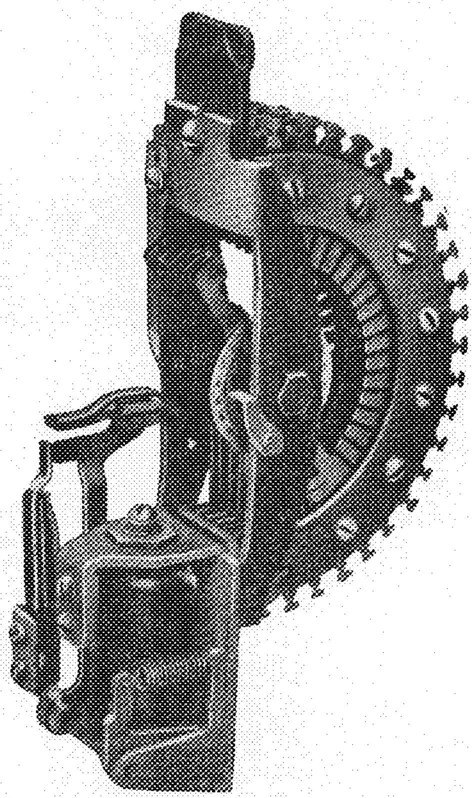
A Machine Switching Desk Set

In conclusion I will explain how the two systems are now working together.

Calls under the consolidated plan from manual-to-manual stations will be handled as before. Calls from automatic-to-automatic stations will likewise be made as at present except, as mentioned before, the first two letters of the central office name and four numerals will be dialed.

But if a manual subscriber desires to talk to an automatic user, he will pass his call to an "A" operator as on a manual-to-manual call. "A" positions will be equipped with dials. The "A" operator will establish a connection with the desired automatic central office over a trunk line, and then dial the four digits of the number called and the connection will be established.

In order to dial the number the operator will first connect the dial on her position to the cord circuit she is using by throwing the dial (locking) key associated with that cord circuit. She will



A Rotary Line Switch

then dial the number in the usual way, restoring the dial key when through. To guard against a key remaining thrown, a special tone is provided which warns the operator as soon as the called party takes off his receiver, that a dial key is thrown and should be restored.

In case a called automatic station is found busy, a busy tone will be automatically placed on the connection which will be audible to the calling manual subscriber. It is expected that manual subscribers will soon learn the meaning of this busy tone.

To equip the "A" positions so that calls from manual to automatic telephones can be dialed, 7293 cord circuits had to be arranged in addition to placing the automatic dials. It has also been necessary to remodel the present ringing keys on the "A" boards.

Now let us suppose that a call is made by an automatic subscriber for a manual telephone. Here is where the cornerstone of the consolidation plan, the "call indicator," comes in.

The automatic subscriber will dial the first two letters of the central office name associated with the telephone number of the subscriber wanted. Let us assume that he is calling "Main 4073." He operates the dial as follows: M-A-4-0-7-3.

The call indicator will be installed on certain positions on the "B" boards of the various manual central offices. Each of these call indicators is made up of forty small lamps under a plate of numbers arranged thus:

As the subscriber dials the letter "M" and then "A" he is automatically connected with a trunk to the "B" board of the Main central office, where an operator is on duty at one of the call indicator positions. If he dialed "K" and then "E" he would be automatically connected with a trunk to the "B" board of the Kenwood central office, or "C" and "O" to the Colfax office.

A rotary line switch then automatically connects the selected trunk with any vacant call-indicator register, of which there are eight for each call indicator "B" position. As the subscriber dials 4-0-7-3 the register records this number and as the last numeral is recorded an assignment lamp associated with the trunk obtained lights up.

The operator then presses an assignment key associated with the trunk on which the assignment lamp is lighted, and the number will then appear on the lamps of the call indicator before the operator. When the connection is completed by the operator plugging into the 4073 jack in the "Main" multiple the number displayed on the call indicator disappears, after which another number can be made to appear by depressing another assignment key.

If, upon test, the called line is busy, the calling plug will be inserted into a "busy back" jack as in manual-to-manual practice.

The mechanism selects an idle trunk for each call. The line switches pick up for each trunk a register which is not busy, and the number dialed by each subscriber is recorded on the register he obtains. The operator presses the assignment key associated with each lamp in the order they light up. The registered number is displayed on the call indicator and cleared as the calling plug is inserted in the jack of the line wanted.

The following was found on a freshman chemistry quiz:

Q. What is the function of MnO_2 in the preparation of oxygen?

A. It acts as a paralytic agent.

The Minnesota Union

By SHELDON S. HIBBARD, E. '23

The Minnesota Union was evolved from the realization of the need of a men's club on the campus.

Several years ago the men of the University felt the desirability of having some building on the campus where the men of Minnesota could go during their spare hours. Accordingly, they got together and pledged sufficient funds to begin the operation of the old Chemistry building, which was donated to their purpose by the Board of Regents. (The legislature appropriated $17,000 for the purpose of remodelling this building.)

In the fall of 1914 the Minnesota Union first opened its doors to the men of the University. The purpose, as stated in the constitution of the Minnesota Union, was: To promote the best interests and welfare of the University of Minnesota and comradeship among its members, and to maintain a suitable club house for such purpose.

At that time the building was still in a crude state; but each succeeding year its equipment has been added to and improved. The work of remodelling has progressed since the beginning, until now, although its capacity is severely taxed, the Minnesota Union is fulfilling its obligations to a high degree of efficiency. It ranks among the first of similar University club houses in the country.

Upon its organization the government of the Minnesota Union, subject to the Board of Regents, was vested in a Board of Governors. The Board of Governors is constituted as follows: two members of the University faculty, one member of the General Alumni association (not a regent, officer, or member of the faculty), one upperclassman from each college, and one additional upperclassman from each college having more than one thousand men students enrolled.

The Board of Governors employs a manager, who has charge of the administration of the Union, excepting the cafeteria, which has its own manager.

Membership of the Minnesota Union consists of all men students enrolled in the University. The annual dues of members are seventy cents per quarter, payable at the time of registration.

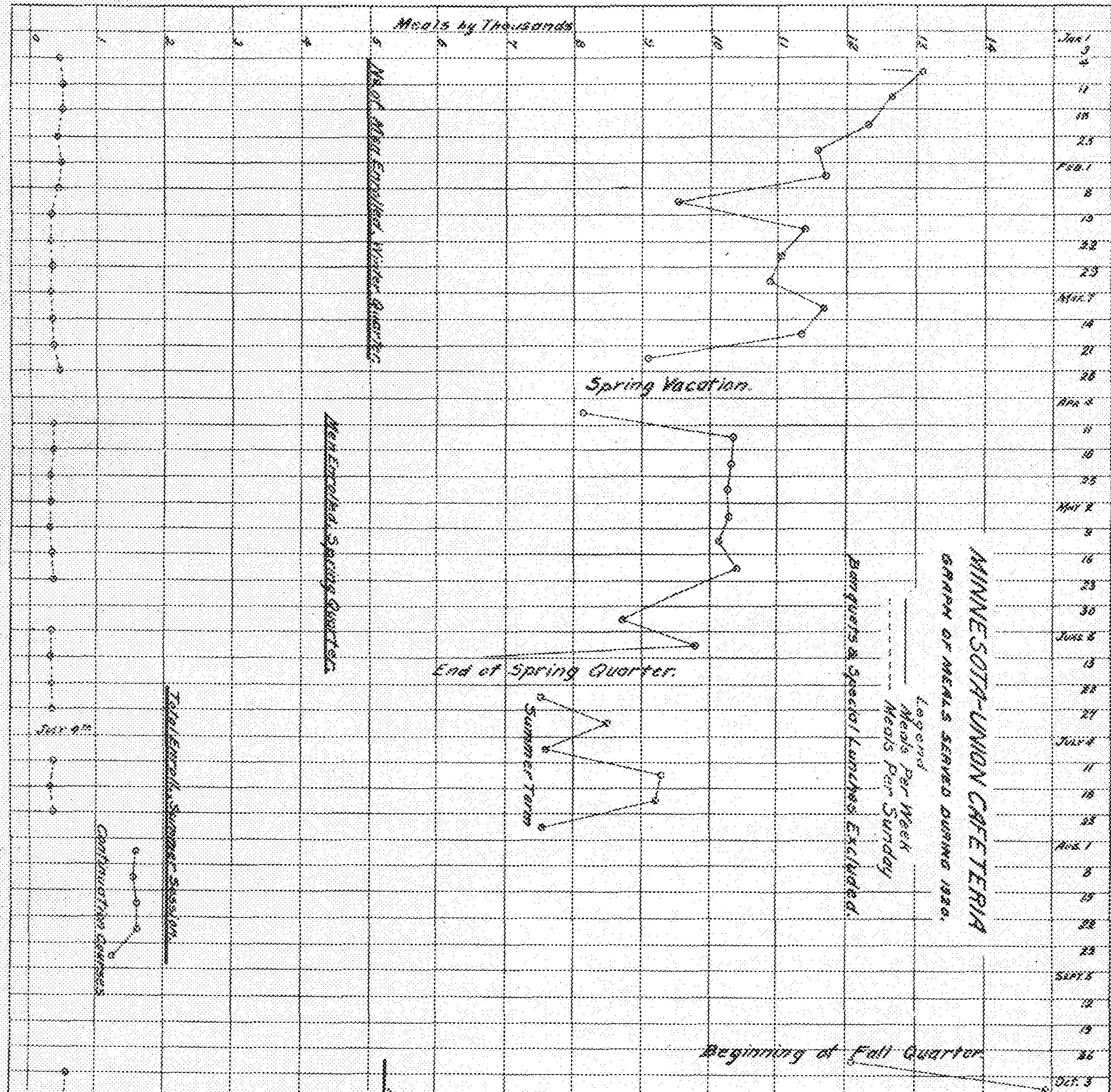
The Minnesota Union at present has a number of reading and lounging rooms, two pool and billiard rooms, one finely furnished ball room, a reception room, two cafeterias, several private dining rooms, a little theatre ,and a barber shop. The Union is also the home of the University Y. M. C. A. and of the Housing Bureau.

During the school year a number of student mixers, banquets and dances are held at the Union.

Perhaps the most interesting feature about the Minnesota Union is its large cafeteria on the ground floor. Three meals a day on week days and dinner on Sunday are served on the cafeteria plan, reducing the usual waste of time, labor and money to a minimum. To relieve the heavy noon-hour traffic another smaller cafeteria is operated on the third floor.

At the present time an average of about two thousand meals per day are served at the Union at an average cost of 18 cents for breakfast, 32 cents for dinner, and 22 cents for supper.

The accompanying graph gives some interesting data on the magnitude of business done by the two cafeterias during the year 1920.


MINNESOTA-UNION CAFETERIA
GRAPH OF MEALS SERVED DURING 1920.
Legend
Meals Per Week
Meals Per Sunday
Banquets & Special Lunches Excluded.
Meals by Thousands
Spring Vacation.
End of Spring Quarter.
Summer Term
Beginning of Fall Quarter
End of Fall Quarter

MINNESOTA TECHNO-LOG

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EDITORIAL

Charles T. Skarolid, E. '23, has been added to the staff of the Techno-Log as assistant advertising manager, and Everett J. McCubrey, E. '21, as assistant news editor.

Cosmopolitanism

On another page in this issue will be found an article on "Flood Control in China," by Sigurd Eliassen. Three years ago Eliassen was one of our best known seniors; today he is living in China, working for the Chinese government, taking a hand in shaping the destiny of that great country. The last issue of the Techno-Log carried an account of the Chilean experiences of Victor Carlson and Everett Knowles. Among the colleges of the University, the College of Engineering has always had a large percentage of foreign students in its enrollment, and almost without exception these men have proven brilliant students. As a result of association with these students from other countries, and of the fact that many of our men look forward to the practice of their profession in some foreign country, Engineers have always been particularly interested in the Cosmopolitan Club, the local chapter of the world organization of Corda Fratres. Sigurd Eliassen, Cirilio Romero, Shu-Ming Lin and Leif Sverdrup have been among the most prominent members of this organization.

Attention has been directed recently to the International Revue, which is the annual celebration staged in the Armory by the members of the Cosmopolitan Club. There is probably no other time and place where one can see gathered together on this campus so many nationalities in their respective characteristic costumes. The international character of the program is indicative of the range of nationalities in the Club. Any engineering student will find much of interest in the program, and an opportunity to meet Cosmopolitans in the dance which closes the evening.

Engineering Education

In medicine, in law, in dentistry, and in agriculture the educational tendency of the last ten years has been to increase continually the requirements for cultural background and preparation before a student is permitted to take up technical training and while he is engaged in his professional courses. Not so long ago a boy just out of high school was regarded as ready to begin his medical course. Now he must have a pre-medic cultural training of two to four years. In a less degree this is true of the other professions mentioned.

In engineering, on the contrary, the last ten years have shown no progress whatever in this matter. A green country lad just out of a small-town high school is still presumed to have practically enough of culture, of civic consciousness, of altruistic vision to go out as a leader of men and a planner of the great modern projects which make life liveable for all. A three-hour course in rhetoric for a single year is assumed to be all the training in literature, in expression, and in general culture that he needs.

To be a farmer, a student must take nine hours of freshman rhetoric, five hours of public speaking, and five hours of argumentation. Besides this, the College of Agriculture offers advanced courses which are so effectively urged upon the students in various lines that advanced public speaking, for example, is offered to a good sized class twice a year. In the College of Engineering, a single one-quarter course, Rhetoric 31, is offered just once a year. In 1921, thirty-five Engineering students elected this, and twelve entered classes in public speaking. The facts speak for themselves. In contrast with medics, dents, laws, and farmers, the Engineering students of the University of Minnesota are being educated, not to lead in constructive citizenship, but to become draftsmen and compass butchers on a salary under orders from somebody who knows how to buy their labor cheap and sell it to his own advantage.

Communications

Editor Techno-Log:

After considerable study and thought I have adopted for my own notes the standard letter-size paper, 8½"x11". The reasons for this step are numerous, but some of the most important are: the almost universal use of this sized paper in business offices; the ease with which letters and other matter may be utilized in the notes, including typewritten and blue printed material without folding. This size is suitable for calculations, sketches and tabulations, as well as for many small drawings, and can be filed easily in vertical filing cabinets. Forms for special notes and sketches are frequently printed to save time in the field or office and since these are frequently printed on the standard letter sheet they can be placed in the note books without trouble.

In order to avoid difficulty with the variety of punchings needed to fit covers made by various manufacturers, I would advise a spring-back binder, of which several good ones can be had.

L. T. BOONE,
Dept. Civil Engrg.

My dear Mr. del Plaine:

I was very much interested in the editorial on note taking which appeared in the March edition of Techno-Log. I heartily agree with you that students do not take notes intelligently and, therefore, that it would be desirable to have some instruction upon note taking as a part of one of the freshman courses. I do not feel that all students should take notes in the same manner, nor that the same student should necessarily take notes with the same degree of thoroughness in all classes, but there are certain principles common to all good note taking. How extensive the note taking should be must depend somewhat upon the individual taking them and the nature of the subject matter presented in the course. It is not desirable to my mind that notes should be voluminous. The object of a University course is to teach students to think, rather than to accumulate facts. Proper note taking should, therefore, be stimulating and not the mere amassing of information. I should like to comment favorably upon the discussion of such subjects in Techno-Log.

Very truly yours,
J. WARREN STEHMAN,
Asst. Professor Economics.

Editor of the Techno-Log:

Kindly allow me to express my appreciation and admiration for the way in which the Engineering students acted as hosts to the entire University on St. Patrick's Day. No one who visited the Engineering buildings on March 17th could dispute the fact that the students were demonstrating most efficiently. This was nowhere more noticeable than in the shops, where volunteer workers kept the machinery in operation from early morning until late afternoon.

Several hundred visitors were entertained, all of whom were impressed with the value of such practical work. It was with difficulty that the Legislators were gotten through the various departments, for they all wanted to stay longer to see what was going on.

The paper weights and other souvenirs which were being made in the shops were highly prized by the visitors and will be kept as interesting mementos of Engineers' Day.

J. J. FLATHER,
Head Dept. Mech. Engrg.

Following are the names of the men who graduated at the end of the second quarter:

Civils,—James Werdenhoff, William Mackintosh, W. D. Weis, Edwin L. Hanson, R. R. Simmons, Carl S. Johnson, Alfred N. Johnson, Cyril Jensen, B. C. Henry, C. W. del Plaine, E. R. Dehn, H. W. Carpenter, Fred Enke, Leif J. Sverdrup, Harold Barber.

Generals,—John Noble, Lyle Dills.

Architects,—Carl Gewalt.

Mechanicals,—H. H. Von Rohr, George Lewis.

Another Ground Hog Day

Friday, April 22nd, will be Ground Hog Day for the Architects. The Gopher Architects will come out of their holes in the morning to celebrate their Annual Jubilee and during the entire day will entertain at open house for the entire university.

There will be an exhibition on the third and fourth floors of the Main Engineering Building of the work done by the Freshmen, Sophomores, Juniors and Seniors. In the afternoon a tea dansant will be held in the Studio on the fourth floor of the Engineering building, and everybody is cordially invited.

The big event, which will wind up the Jubilee festivities is the Costume Ball. Perhaps there is nothing that can add so much gayety and frivolity to a party as a gay array of costumes. No one will be allowed to enter the auditorium of the Main Engineering building on that evening without a costume. It is the committee's desire to have this year's ball set a precedent for coming Jubilees.

The feature of the Ball will be a one-act Roman playlet, "A Rubbing Study," explaining why Nero burned Rome. The setting of the play is in one of the gorgeous rooms of the Baths of Caracalla and the playlet promises to depict the life of our present Roman architects during that day.

Don't forget the day,—Friday, April 22nd,—third and fourth floors of the Main Engineering building. We extend a most cordial welcome to all. Tickets for the big Costume Ball can be obtained from any of the Architects at a later date.

One of the most recently organized groups on the campus is the Northrop Club. To quote from its constitution, it is "....an organization....to promote good fellowship among all persons of Congregational affiliation or preference at the University of Minnesota." Practically every college is represented in its membership by both faculty and student body. The organization was named in honor of Dr. Cyrus Northrop, President Emeritus of the University, one of the most prominent Congregationalists in the Northwest.

A successful campaign for members was culminated February 23rd when the first annual banquet was held at Shevlin Hall. This was the first large open meeting of the club and was thoroughly enjoyed. The program was especially fine. The chief speaker was the "patron saint," Prexy Northrop. He gave a clear outline of the history of Congregationalism from its beginning at the little church at Scrooby, England, through the landing of the Pilgrims, the development in this country up to the present day.

Dr. H. P. Dewey, of the Plymouth Congregational church, spoke on the "Student and His Church," pointing out the relation and obligation of the student and the church. He laid emphasis on the present need at Minnesota for adequate recognition and provision for chapel service. Dr. Dewey has had a wide experience at Williams and at Yale, where daily chapel is a vital part of undergraduate life.

Russell H. Stafford, '12, chaplain of the club, the other speaker on the program, gave the "History of the Northrop Club," outlining the aims and purposes of the group.

Prof. Charles P. Sigerfoos, the toastmaster, handled the program in his usual pleasing manner. The Northrop Quartet, made up of Engineers, sang a couple of songs during the evening. The organization of the club and the general arrangements of the banquet were engineered by men from the Engineering College. John Clark was largely responsible for the membership drive. Harold Crooker, of the School of Chemistry, is treasurer and Carl Glidden, of the Engineering College, is president.

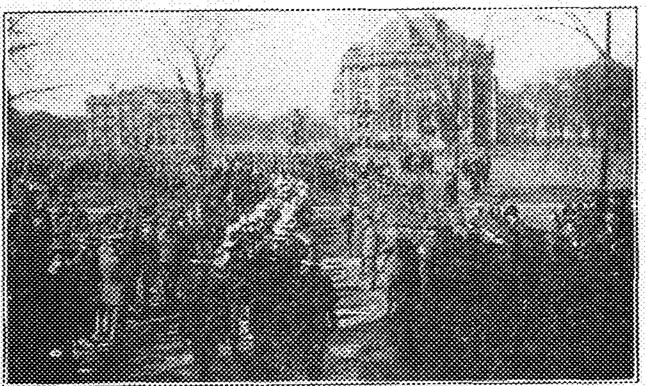
Engineers' Day

By LEROY GRETTUM

Undoubtedly awed by the magnitude of the occasion and the pointed threats of St. Patrick himself, the gods who control the weather came through on the 17th of March with a real day; there was a slight breeze at times, but it was more than made up for by the sunshine and we needed something to cool us off anyway in the breathing spaces between events.

In spite of the fact that the special convocation in honor of our visiting legislature took most of the underclassmen away from their work on the floats just when they were most needed, the parade went off in regular Engineer fashion. Neither too long nor too short, with enough funny stunts to make it live and enough seriousness to make it worth while, it set a high mark in our record of achievements.

Led by an exhibit of new sport model cars obtained through the efforts of the parade committee and the courtesy of over-town motor dealers, the van-guard appeared, coming past the Chemistry building at five minutes to one. Headed by the University Band, next came the postgraduates and seniors, marching in full costume of green capes and high green hats with the regulation clay pipes in their mouths. The seniors were led by their class president, Leslie Halliday.



Engineers on Way to Convocation

The rest of the parade consisted of the floats and stunts put on by the members of the three under classes. The junior Electricals had an especially good float showing electricity as the foundation of modern civilization, and the chemists had some apparatus mounted on a truck which gave forth sweet perfume and attracted the attention of every bystander in a half mile radius. The sophomores, contrary to previous years, clearly had the edge on the freshmen, both in the number and originality of their stunts. One of the mechanical sections had a painless dentistry establishment set up on a truck for the purpose of extracting appropriations from the state legislature. Section three of the electricals had a complete wireless outfit on their truck with the latest jazz at their command, and another section bore the remains of a certain well-known department in an honest-to-goodness coffin. We never saw a rooster before who could produce an egg, but one was present there; two assistants, with the aid of a wrench and screw-driver, extracted more than a dozen during the course of the parade. It was built after a model of Mr. Ford's famous synthetic cow.

The individual stunts were more numerous than ever, and raised continuous laughs from the onlookers. Some hard-boiled ladies from the track were present in full war-paint, an extremely realistic monkey and organ-grinder did a rushing business in pennies, and some pretty husky looking babies were wheeled along in bulging carriages.

St. Patrick himself was present in all his glory, in the person of Mr. Kuhlman of the Electrical department. Owing to illness, Prof. Priester, who has always filled this role in past years, was unable to take the part; but Mr. Kuhlman made a very satisfactory patron saint.

Shortly after the parade was over, the knighting ceremony took place in the experimental building. Our distinguished visitors, Speaker of the House W. I. Nolan and Lieut.- Gov. Louis L. Collins, and also Dean Leland, were made honorary members of the Guard of St. Patrick, each of them kneeling to kiss the Blarney Stone and receiving their certificate of membership from Harry Brown, chairman of the entertainment committee. The seniors were then formally received into the order as privates in the army of St. Patrick, after which everybody adjourned in a body to the Green Tea.

The famous and traditional Green Tea was a decided success; the faculty showed up almost to a man and brought their families along; the alumni turned out in full force for the occasion, and scores of students from other colleges accepted our invitation to visit us in our own building. The orchestra kept the dancers busy from four till six. The exhibits of drawings arranged along the halls attracted much attention from outside visitors.

The crowning event of the day was the Grand Ball in the armory in the evening. For the first time this year the place was really decorated so it looked presentable, and the lighting effects were splendid. The floor was crowded, but both wings were thrown open and there was room enough for all the Engineers who wanted to come. The whole College turned out in force at this event, and every one seemed to have a good time.

The whole celebration was a decided success from every standpoint, and the impression we created was one of hospitality and good feelings toward the whole campus. Succeeding classes will not find it difficult to obtain a full holiday for the occasion on our account.

College News

The Northwestern Bell Telephone company of Minneapolis was host to the Minnesota Chapter of the A. I. E. E. at their new telephone building on Third avenue south near Fifth street, Monday evening, January 31.

A "regular feed" was served in the company's cafeteria after which a short business meeting was held. Mr. J. D. Marshall, chairman of the chapter, announced the nomination of Mr. F. W. Springer, of the Electrical Department of the College of Engineering, as candidate for vice-president for this district of the National Chapter. Mr. Fred Dustin made an appeal to the members to support Mr. Springer and place a Minnesota man in the position.

The first speaker of the evening, Mr. G. F. McDermot of the Commercial Department of the Northwestern Bell Telephone Co., gave a brief history of the growth of the company from 59 telephones in 1879 to 96,000 in 1920. He spoke of the difference in service of the telephone business and that of other types of business and emphasized the fact that because of the more personal service of each individual customer and because unlike any other business the "over-head" expense increased as the amount of business increased, it was imperative to have a regulated monopoly to give the service required by the public.

Mr. C. B. Spring, General Equipment Engineer of the Northwestern Bell Telephone Co., gave an illustrated talk on the new Automatic equipment, explaining the working of the mechanism and the operator.

An inspection trip through both the manual and automatic exchanges was taken with a guide who explained the operations.

A large number of Student Members attended. We nearly forgot to mention that two of the "Bell Boys" were called upon to answer questions.

In the April issue of the "Professional Engineer," there appeared an article entitled "Every-engineer," which was contributed by Prof. Frederick Bass, head of our department of Civil Engineering.

The student branch of the A. I. E. E. held a meeting February 21 in the Engineering auditorium at which Mr. R. Frair of the Northwestern Bell Telephone company gave an illustrated lecture on the development of aerial and underground telephone systems, and the new high frequency systems by which many messages can be sent over the same lines at the same time. The life of Thomas A. Edison was shown in a three reel movie, after which ice cream and cake were served.

The meeting was presided over by Basil C. Maine, president, who stated the purposes and object of the A. I. E. E. for the benefit of visitors. "This society is not merely a technical and professional organization," said Maine, "but has for one of its main objects the fostering of any worthwhile campus activity."

The Andrew Quartet, under the direction of Prof. O. S. Zelner, who is also a member of the quartet, will sing groups of negro folk-songs at the Cosmopolitan Revue held in the Armory on the evening of April 15th.

If plans now on foot mature, the $650 debt which the Band incurred last fall during its trip with the football team will be fully cleared up through the efforts of the Engineers. Michael Jalma, leader of the band, asked that the Engineers aid them in removing this debt; some of the upperclassmen got busy at once, and the result is a championship boxing match staged under the auspices of the Engineering College which will be held in the Armory on Saturday evening, April 16.

In addition to making the necessary arrangements, we have promised to sell 400 tickets at $1 each, not only among ourselves but all over the campus. To make the match a success and at the same time give boxing a boost into the position which it rightfully deserves, the support of the whole university is necessary, and when these tickets appear it's up to us to get out and do some hustling. Complete details concerning the night's entertainment will be announced in the Daily shortly before it takes place.

Irving H. Marshman, sophomore Electrical, has been in the hospital during vacation with a severe attack of inflammatory rheumatism.

Leif J. Sverdrup, B.Sc. '21, left April 27th for an extended visit to his home in Norway. He plans, however, to return to this country in the summer to take up engineering work.

The students and faculty of the Electrical department held their first Electrical Pep-fest and Mixer Friday evening, February 11, in the main auditorium. The whole department turned out for the occasion; all the faculty except three members were present, and over a hundred students representing every class made their appearance. The program opened with several selections by the Ampere Quartet, composed of E. F. Johnson, Basil C. Maine, M. Tuve and Rene Braden. This was followed by a reading of "The Cremation of Sam McGee" by C. G. Eubank. Martin Wichman, managing editor of the Techno-Log, made an appeal for active support from the students and the faculty of the whole college, stating that it was by no means perfect, but that with proper encouragement and financial support it would play a vital part in the life of the Engineering College. "Pinky" Williams and I. H. Marshman, chairmen of the junior and sophomore sections for the parade, gave out some advance dope on the nature of the Electrical stunts.

The surprise of the evening was a stunt procured by Alex Hammerstrom, who secured the Y. M. orchestra composed of eight stringed instruments and a saxophone, which proceeded to liven things up at once with the peppiest music heard around here for a long time. Besides putting on group selections, individual members of the orchestra presented special features on the piano, banjo, ukelele and guitar. All the musicians were from the Central Y. M. C. A.

A championship wrestling match between Sam Berg, senior Electrical, and S. M. Packard, freshman miner, was staged under the direction of Frank Gilman, wrestling coach. The match went ten minutes without a fall. This was followed by a battle royal between L. C. Little and Wm. Russell, with Prof. Shepardson acting as referee to the satisfaction of the entire audience.

Clarence Teal got away with some awful stuff with the aid of a pair of hosiery models from a downtown store and another sophomore with as much nerve as he had. J. M. Downie demonstrated some black-face comedy that made a hit, although we didn't think the faculty would dare laugh in public at one or two of his stories, after what happened to the Foolscap last year.

Alumni News

THE EDITOR WISHES TO ENCOURAGE BOTH ALUMNI AND STUDENTS TO CONTRIBUTE ARTICLES OF INTEREST FOR THIS COLUMN. ALL ALUMNI NEWS SHOULD BE ADDRESSED TO THE ALUMNI EDITOR OF THE TECHNO-LOG.

The Republic Creosote company of Indianapolis is keeping two of our chemists busy: William Higbury, Chem. '14, and R. Darwin May, Chem. '15, M.S. '16.

George A. Hult, E.E. '16, has lately become assistant manager of the Northern States Power company at Sioux Falls, South Dakota.

F. W. Hvoslef, '17, was elected secretary of the Detroit Chapter of the Minnesota Alumni association at its recent organization. Hvoslef tells us that they havea live bunch of Minnesota people in Michigan, with Engineers predominating.

Frank Heck, Chem. '19, is engaged in physiological chemistry for the Mayo Foundation at Rochester.

R. H. Olson, E.E. '19, was seen about the campus early this month. Mr. Olson is a member of the Olson-Pearson company of Chicago and is engaged in electrical engineering.

W. C. Beckjord, E.E. '09, is employed on valuation work for the Grand Rapids Gas Light company. His address is 89 Benton St. S.E., Grand Rapids, Michigan.

Robert P. Ahearn, Ex. '23, is now established in the McKnight Building, Minneapolis, and is conducting an advertising service. After leaving school last year, Mr. Ahearn went to Chicago, where he worked for some time on the Tribune. Later he became interested in house organ work and at present is turning out such publications for several Northwest concerns.

LeRoy Fordingdon, Ex. '22, is now working for the St. Paul Daily News as a reporter.

Mr. R. V. Wright, E.E. '98, addressed the A. S. M. E. at their meeting, held March 12. He spoke on what transportation has done to develop the country, and outlined the present engineering problems encountered by railroads, the greatest of which was the human element. His advice to students of engineering was to read their technical papers to enable them to keep up with the times. Mr. Wright is the managing editor of the "Railway Age."

O. F. Beeman, Ex. '21, former business manager of the Techno-Log, is now doing architectural work with a firm in Duluth.

G. A. Bachmann, Ex. '23, is teaching school at his home in Willow River, Minn.

F. W. Jordan, E.E. '19, a member of the Varsity football team in 1916-17, has been elected a member of the board of directors of the Westinghouse Club. In 1919, Mr .Jordan entered the employ of the Westinghouse Electric and Manufacturing company of East Pittsburgh as a graduate student, after two years' service in the United States Navy. Mr. Jordan is identified with the General Engineering department of the Westinghouse company.

Alexander Lagaard, E.E. '13, is now practicing as a patent attorney and electrical engineer. Alex is associated with H. C. Fisher under the firm name of Fisher & Lagaard, with offices at 509-519 Commerce Bldg., St. Paul.

It has come to our knowledge that C. A. Dow, '13, is to be married this June to Miss Uzerle Elizabeth Morrison, daughter of Mr. and Mrs. J. W. Morrison.

Herbert J. Kessel, Chem. '19, is now with Montgomery Ward & Co. at their St. Paul branch. His home address is 1984 Marshall Ave., St. Paul.

Arthur B. Freun, C.E. '08, has filed his candidacy for nomination for alderman of the Fourth ward of Minneapolis. Mr. Freun is president and treasurer of the Freun Cereal company. He is supported in his political efforts by a committee of influential residents who favor putting young business men in the council. Mr. Freun's address is 57 Oliver avenue north.

Several alumni and men well known at College of Engineering took prominent parts at the twenty-sixth annual convention of the Minnesota Surveyors' and Engineers' society, held February 21, 22 and 23 in St. Paul. R. W. Acton, C.E. '05, of Duluth, president of the society, addressed the first meeting. F. C. Shenehon, former dean of the Engineering College and at present a Minneapolis consulting engineer, spoke at the banquet meeting, his subject being, "Putting the Shore Line of Minnesota on the Coast Line of the Seven Seas." Dean Leland also addressed the banquet meeting on the subject, "Engineers and the University." The following men were present and presided at various sectional meetings: Mr. E. W. Kibby, instructor at the College of Engineering; C. L. Motl, C.E. '10, district highway engineer of Brainard, Minn., and F. W. McKellip, C.E. '98, city engineer, Faribault, Minn.

L. E. Curtiss, '09, is employed by the Great Northern R. R. as a bridge engineer. Mr. Curtiss is also a member of a valuation committee representing all railroads of the Northwest.

THE DISADVANTAGE OF POOR LIGHTING.

As thousands of our industrial plants are operating to-day with poor lighting and in some cases with extremely bad facilities, it would seem that the importance of the subject of lighting has not been given the serious consideration by those responsible for such conditions.

Poor lighting is one of the most serious handicaps under which a manufacturing establishment can operate. First of all, poor lighting is the cause of a large number of accidents in industrial plants; and it is singular that accident reports do not yet properly classify the hazards of poor lighting, which in many cases is the primary cause of an accident attributed to what is really a secondary cause. Safety engineers and other officials who make accident reports should always consider the condition of the lighting when working up a report of accident causes, for it plays an important part in a great many casualties and is apt to be overlooked. All accidents due to poor lighting are accidents of neglect, and are preventable. The poor lighting accident hazard is clearly chargeable to management and not men. It is a difficult matter to make such progress with Safety First in a plant which has neglected to provide one of the fundamental requirements of accident prevention—good lighting.

Probably no one single factor connected with the equipment of a plant so directly affects the efficiency and inefficiency as the quality and quantity of the lighting. The curtailment of production of all working under the disadvantage of poor lighting represents a big loss each day; the poorer the lighting the less able is the working force to function efficiently. Quality and quantity both suffer, representing a preventable loss wholly removable by improving the lighting.

Under poor lighting condition, we cannot expect and rarely do we find an orderly, clean factory. Darkened places encourage careless habits and workers are often led to deposit discarded articles or material which should be deposited elsewhere. The eyesight of those who attempt to use their eyes continually in insufficient light, below nature's demands, is often affected. Too much light, such as is furnished by bright, unprotected lights, is as harmful as too little illumination; both are fundamentally wrong. Nature's own illuminant, daylight, is unequalled for our requirements of lighting.

The eye is best suited to daylight in the proper quantity. Sun glare should be avoided, and in the darkened hours proper artificial illumination provided. Daylight should be utilized to the fullest extent. It is supplied free in abundant quantity for our use. Modern invention has supplied a means whereby the interior of buildings can be lighted by daylight, and all the advantages secured which is furnished by good lighting at the smallest cost.

Industrial buildings should have as much wall space as possible devoted to windows fitted with Factrolite Glass, which insures the maximum amount of daylight and which prevents the direct rays of the sun from passing through as it properly diffuses the light.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

St. Louis. New York. Chicago.

No. 2.

C. L. Methven, C.E. '11, has been appointed district highway engineer by the Minnesota State Highway department. Mr. Methven was formerly county engineer for Dakota county. His home is at Hastings, Minn.

Philip F. Didrikson, Ex. '20, is employed by the U. S. Steel Corporation, Bethlehem, Pa., as a student engineer.

M. H. Dunnigan, Chem. '15, is at Moose Jaw, Canada, with the Western Oil Refining company.

The Techno-Log wishes to extend its sympathies to Mr. and Mrs. Charles Chamberlain of St. Charles, Minn., in the bereavement of their daughter Doris, who died last month. Members of the class of 1918 will remember their son, Lieut. Herbert Chamberlain, who was drowned in Virginia while attempting to rescue a comrade.

Mr. F. C. Lang, C.E. '08, gave an illustrated lecture before a meeting of the Iowa County Commissioners and Highway Engineers at Ames, March 24. The subject of his lecture, "Effect of Shale Pebbles in Concrete and Removal of Shale from Gravel," was the result of some extensive research work carried on during the past year and is of considerable interest in highway construction. Mr. Lang is a member of the University faculty and also Engineer of Tests and Inspections for the State Highway department.

David Grimes, '19, was at the U as advance agent for the A. T. &T. Co. He is in the research department of that company and is located at New York City. He is married and tells us that two can live cheaper than one, and for those who doubt it he has figures to show. He made us believe it, as he showed us a picture of a home he has built.

Norman Kingsley, of athletic fame, was present at the last meeting of the A. I. E. E. He is now with the Northwestern Bell Telephone company and is in charge of sub-station installation work in Minneapolis.

The Canadian Engineer for November 25th, 1920, has an exhaustive article by Mr. B. F. Groat, consulting engineer, (Minnesota, 1901), on the "Ice Diversion Works of the St. Lawrence River Power Company." Mr. Groat is a recognized authority upon the theory of this subject and the article presented by him in the issue referred to is his first detailed description of the design and construction of those works and their operation during the past two winters.

This is almost as hard as what was found on a Freshman Chemistry quiz the other day.

Question: Distinguish between physical and chemical reactions and give examples.

Answer: The burning of wood is a chemical reaction, so is the rusting of iron; in fact, just about all reactions occurring in chemistry are chemical reactions.

Jokes

Stanley Corl to the stockroom clerk in quantitative lab: "Give me a suction flask, please."

Stockroom Clerk: "Can't do it, they're both out."

A Stickler.

Pupil: What keeps us from falling off the earth when we are upside down?

Prof.: The law of gravity.

Pupil: How did the people stay on before that law was passed?

Heard in the Business College.

Why does labor turn over?

Because Mexico has four revolutions a year.

Help! Police!

Jack—"Did you hear of the daring hold-up in my back yard?"

Jim—"No. What happened?"

Jack—"Two clothes-pins held up a shirt."—Scoville Bulletin.

Shake Before Taking!

Tommy (to Aviator)—"What is the most deadly poison known?"

Aviator—"Aviation poison."

Tommy—"How much does it take to kill a person?"

Aviator—"One drop."—Kyote.

Three Famous Explorers.

K Col. Roosevelt—the River of Doubt.

Gen. Pershing—the River of Kraut.

Gov. Edwards of New Jersey—the River of Drought.—Ex.

Hootch.

Hot—They say Bossus works far into the night in the Chem lab.

Dog—And then staggers up to his room.—Colgate Banter.

The Boy's Hope.

"I hear your father is ill."

"Yes, quite ill."

"Contagious disease?"

"I hope not; the doctor says it's over-work."—Carnegie Puppet.

Coming Off.

Forsythe—Stumbled into the dressing-rooms at the Joyous Theatre by mistake last night.

Skinker—What was going on?

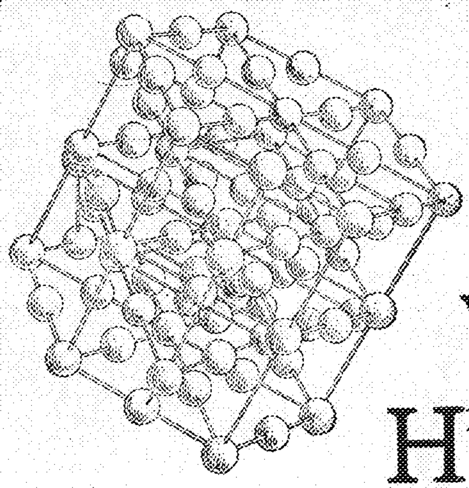
Forsythe—Nothing to speak of.—Washington Dirge.

Couldn't Be Worse.

Undertaker—Jones is in a pretty bad "hole."

Customer—Why! What's the matter?

Undertaker (cheerfully)—well, we buried him yesterday.—Princeton Tiger.



Who Was Moseley?

HE was a young Oxford man, only twenty-seven when he was killed at Gallipoli. Up to his time, man had never seen the inside of an atom. . He turned the X-rays on matter—not figuratively but literally—and made them disclose the skeleton of an atom just as certainly as a surgeon makes them reveal the positions of the bones of the body. Moseley proved that all atoms are built up of the same kind of matter. He saw, too, just why an atom of copper is different from an atom of gold.

Atoms are built up of electrons. Each atom consists of a nucleus, a kind of sun, with a certain number of electrons grouped about it, like planets. Moseley actually counted the number of electrons of all the metals from aluminum to gold.

When you discover what gold is made of or a new fact about electricity, you open up new possibilities for the use of gold or electricity. For that reason the Research Laboratories of the General Electric Company are as much concerned with the "how" of things—atoms and electrons, for instance—as they are with mere applications of the electric current.

Hence Moseley's work has been continued in the Research Laboratories, with the result that more has been learned about matter. How does water freeze? What is lead? Why are lead, iron, gold and tungsten malleable? Such questions can be answered more definitely now than ten years ago. And because they can be answered it is possible to make more rapid progress in illumination, in X-ray photography, in wireless telegraphy, and in electrical engineering as a whole.

There would have been no coal-tar industry without the vast amount of research conducted in organic chemistry, and no electro-chemical industry without such work as Sir Humphrey Davey's purely scientific study of an electric current's effect on caustic potash and caustic soda. Sooner or later research in pure science always enriches the world with discoveries that can be practically applied. For these reasons the Research Laboratories of the General Electric Company devote so much time to the study of purely scientific problems.

General Electric Company

General Office Schenectady, N.Y.

MINNESOTA TECHNO-LOG

Vol. 1 May 1921 No. 7

Contents

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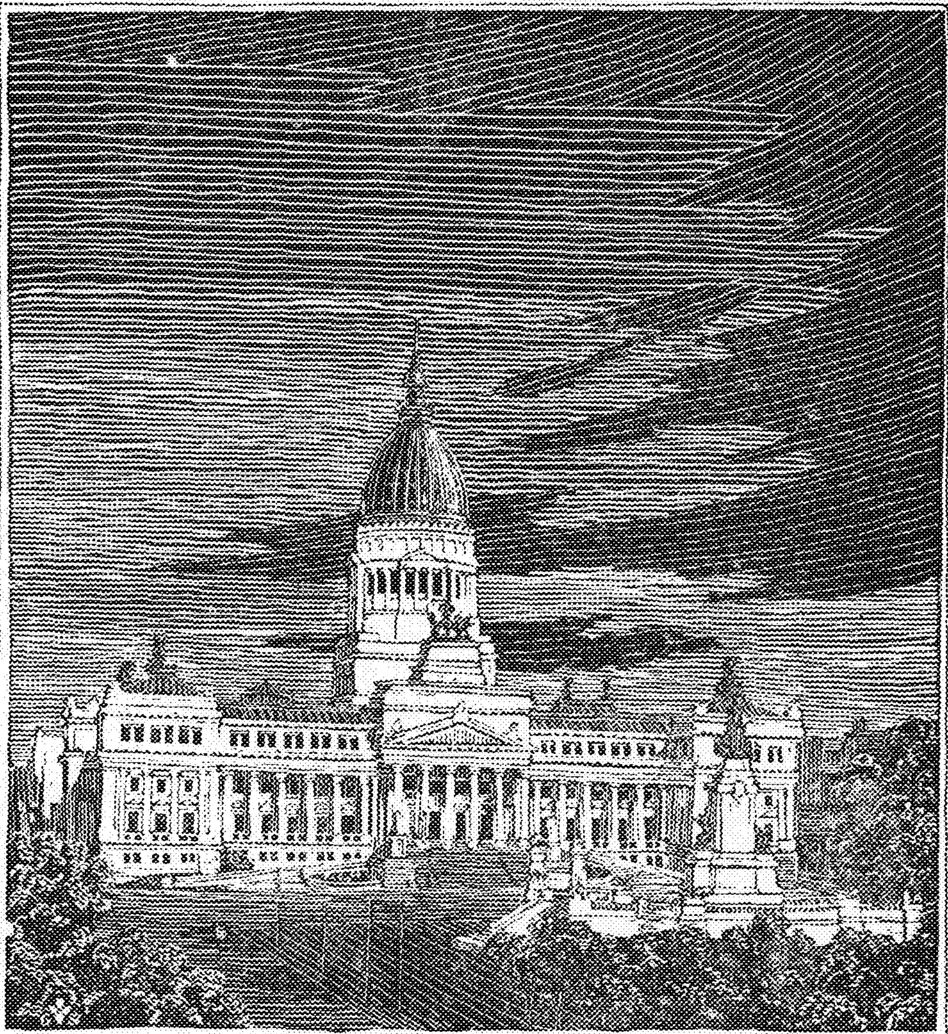

BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS.

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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St. Louis. New York. Chicago.

No. 3.

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Critical Speed

By J. H. ROWEN

Professorial Lecturer, Mechanical Engineering

This article is put forth as the solution of a problem that occasionally comes before mechanical engineers, and which problem causes considerable trouble to most engineers, as few have ever had a good, concise and logical method brought to their attention. In writing the article it has been assumed that the reader is acquainted with the general principles underlying the usual graphic methods involved in developing bending moment and deflection diagrams. Furthermore, in order to avoid making the article too long, no attempt has been made to prove logically the methods used.

To obtain the critical speed for a shaft, mathematical formulae may be used where the shaft diameter between bearings is a fixed quantity, or, in other words, where the cross-section of the shaft, between bearings, is constant throughout the length, and when we know the various loads.

When, however, as generally exists in high speed machinery, the cross-section of the shaft varies at different parts of its length, the problem is very different and no mathematical formula can be used, and, as a result, some graphical solution of the problem is necessary, and though several methods may be proposed, yet the following is as nearly correct and trustworthy as any. If properly carried out, it will always give answers with a very small and negligible probable error. In the opinion of the writer, it can be depended on as correct within ¼ to ½ per cent.

The problem really consists in being able to determine actually the deflection that the shaft will have when loaded under various loads. When determining the critical speed the loads that effect the conditions are the centrifugal forces caused by the actual weight of parts of the shaft or of definite pressures thereon when these weights and pressures are not evenly balanced about the geometrical axis.

However truly a shaft, such as a turbine rotor, may be machined, even though it may be considered as perfectly machined, so that it is geometrically true about its axis, yet in service this same shaft or rotor will deflect more or less. The greater the deflection being, and the greater the speed of rotor being, the greater will be the centrifugal force tending to generate deflection in the shaft or rotor.

The critical speed of a shaft or rotor is that speed at which the centrifugal forces set up by reason of the deflection are just sufficient to overcome the resisting power of the material, which resisting power tends to straighten the shaft or rotor and thus remove deflection. This critical speed may be defined as that speed at which the centrifugal forces set up are just sufficient to maintain any deflection that may have been put into the shaft or rotor.

Critical speed from another point of view may be considered as the determination of that number of vibrations that the shaft or rotor would make, if considered as a piano wire strung between supports, when struck with a hammer. In other words, in a shaft having a critical speed of 3,840 revolutions, were it possible to start this shaft in vibration it would vibrate in unison with the note of a piano, were the note of the piano making 3,840 vibrations a minute or 64 per second, and if the starting of this shaft in vibration were possible, in the presence of a piano it would be noted that the string which would vibrate 64 times a second, that is, the note "C," two octaves below middle "C" on a piano tuned to concert pitch, would vibrate in sympathy. From a scientific standpoint, therefore, determination of critical speed is the determination of what note a shaft would make if subject to vibration.

Until recent years critical speed was a subject for the consideration of only theorists and it was considered as an academic problem rather than as an engineering problem, but since the days of steam turbines, when high velocity became common, critical speed has become an engineering problem, and in many cases we are operating turbines at revolutions many more than the critical speed of the shaft itself. This is done by using what is called a flexible shaft, and it is perfectly safe to use this shaft at a higher number of develop that high speed without remaining at the revolutions than a critical speed, provided that we critical speed any great length of time. In other words we speed the machine up and pass through the critical speed as fast as we possibly can. If we run a shaft at its critical speed any length of time, the amplitude of vibration would become greater and greater at each revolution and it would only be a question of time when the deflection became so great that the shaft would break. At the critical speed an impulse tending toward the deflection would be applied synchronously with each revolution and the amplitude of vibration would become greater and greater with each revolution in the same way that if a piano wire or a violin string could be picked at the instant of greatest amplitude of each vibration it would cause the amplitude to increase to such an extent that the string would ultimately break.

In engineering, the rotor shaft is of a design that it does not lend itself to mathematical investigation, and the problem that has confronted the engineer is to consider the shaft in two different ways. First, the shaft must be considered as a beam between two supports, and we must analyze the shaft so as to simplify the section, leaving in the section only that part of the original section which tends to prevent deflection; in Fig. I is shown such a simplified half-section; AB is the center line or axis and the shape of the section is shown by the broken lines BCDE——UVW with hollow section from X to Y and from Z to a. Remaining parts of the actual shaft or rotor must be considered as not resisting deflection, but as merely being weights or loads on the shaft itself. Secondly, the shaft or rotor must be considered as having a certain amount of weight, which weight will act as loads tending to cause deflection and therefore centrifugal force when the shaft is rotated. It therefore becomes necessary to calculate the weight of each part of the shaft and to estimate the location where these weights become effective on the shaft so far as distance from the point of supports or bearings is concerned; and, in this estimate of weights it is necessary to consider not only the weight of the shaft which resists deflection, but in addition, all appendages such as blades, shroud rings, overhangs to the shaft itself and which are of such a nature that though they do not resist deflection, they still are weights tending toward centrifugal force.

In our problem these weights have been assumed to appear Wa, Wb, Wc,————Wn.

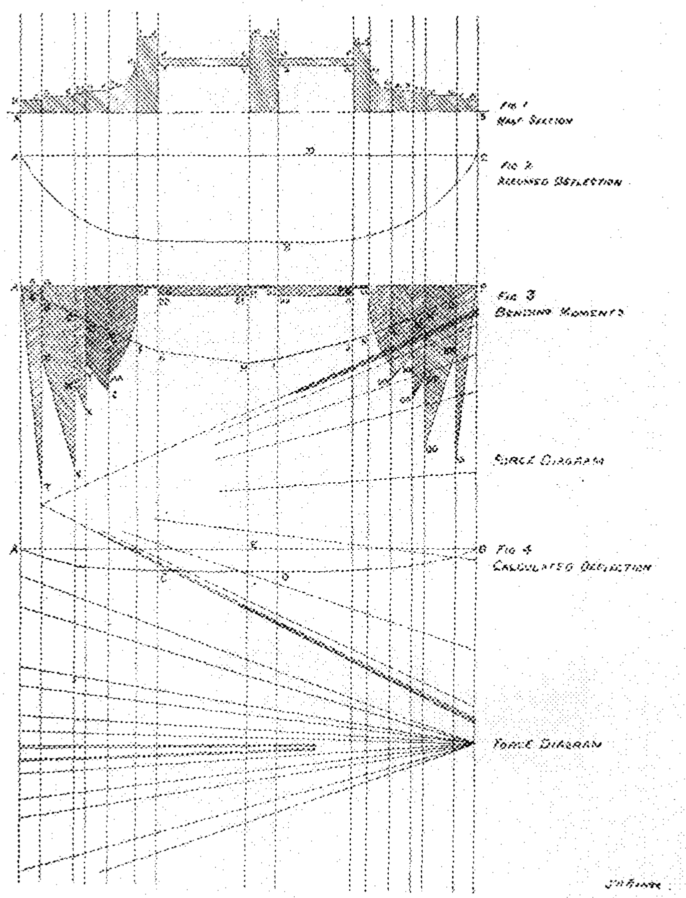
The method pursued in this graph is to assume the shaft actually deflected into a reasonable deflection curve and then calculate how many revolutions is necessary in order to maintain the shaft in this deflection. In the choice of this assumed or estimated deflection curve, in order to get good results we should know the characteristic curve into which the shaft or rotor of this type would deflect.. If we have this characteristic curve it is easy to assume another of a similar nature, but if we have not this characteristic curve it would be well to do the problem twice. First, by assumption of any deflection curve and work it to a conclusion and the characteristic deflection curve will result. We should then take the characteristic curve as developed (or a similar curve) for the assumed curve and go through the process once again for a corrected answer. If our assumed curve would not be very different from our developed characteristic curve, it is possible to assume a characteristic graph that would have a summation of bending moments that would equal the bending moments had the deflection been assumed as similar to the characteristic curve. This would obviate the necessity of going over the work a second time. Assuming that we had a characteristic curve, I have assumed a deflection curve as shown by A, B, C, in Fig. 2. This assumed curve should be drawn on our graph so that the length AC equals the length AB on our scale drawing of the shaft section which resists deflection as shown in Fig. 1, and it is usually drawn immediately underneath Fig. 1 so that ordinates may be drawn from the point of application of the loads or weights.

The ordinates from the base line ABC (Fig. 2) to the deflection curve ABC are measured at every point at which there is an application of load; thus, in this case, where the weights Wa or 69 pounds is applied the ordinate is made .365.

If we conceive this shaft to be rotated in bearings at the points A and B, and the shaft is deflected according to the assumed curve, it would become evident that each one of these weights or loads will act on the shaft, not as an ordinary load, but will generate a centrifugal force due to the rotation; the radius of rotation being the amount of deflection at that point. In the case of weight Wa, the radius is .365. In this method we assume that some certain revolutions, such as 4,000 will cause this deflection. This is not correct, but our method will be to determine what factor by which 4,000 must be multiplied in order to obtain the deflection originally assumed. For each one of the weights, therefore, Wa, Wb————wn for the various radii of rotation we determine the centrifugal force that is caused by the rotation at the assumed number of 4,000 revolutions. Such a centrifugal force due to weight Wa rotated 4,000 per minute at a radius of .365 will be 11,451 pounds.

Centrifugal force always acts radially. This centrifugal force may be considered as dead loads acting on the shaft at the same point as the weights Wa, Wb, etc., acted.

The next operation in the graph is to determine the resulting bending moments in the shaft at every point of its length, having so many loads, acting at different points on the shaft the graphic



method for this is generally most convenient, although the mathematical method could be used for the purpose. No explanation of the graphic method for developing this bending moment diagram will be given, it being considered that the method is familiar to all that would be interested in critical speed. The bending moments diagram is shown according to some scale in Fig. 3 by the line ABC————OP.

The method so far outlined in this graph is one in very common use by designers; but the next step is the only unusual one in the whole graph, and that is the method whereby we make allowances for the fact that the cross section of the shaft or rotor varies throughout its length.

DATA RECORD

LOCATION FIG 1	DIAM. (INS)	$\frac{I_s}{I}$	LENGTH	AREAS = Σ B.M.	LOCATION FIG 1	WG'TS W_a-W_n	CENT. FORCE $k = 4544$	DEFLECTION ORDINATES: ASSUMED	DEFLECTION ORDINATES: CALCULATED
B-C	6	19.3	4.75	.276	D	69	262 k	.365	
D-E	7 3/4	6.95	7.47	.552	F	75	52.5 k	.70	.747
F-G	9	3.84	2.8	.182	H	81	630 k	.775	.828
H-H_1	10	2.5	5.09	.274	H_2	206	181 k	.875	.936
H_2-H_3	16½-10½	2.07	6.0	.144	I	1453	1370 k	.945	1.0
I-J	35	.0169	5.5	.004	K	2047	2020 k	.985	1.035
K-L	$^{+25}_{-22}$	.16	21.25	.14	M	2042	2042 k	1.0	1.08
M-N	35	.0169	6.5	.004	O	1850	1850 k	1.0	1.08
O-P	$^{+25}_{-22}$	.16	17.5	.093	Q	852	840 k	.995	.99
Q-R	31 3/4	.025	3.5	.002	S_3	792	750 k	.945	.945
S_3-S_2	15¼-10½	2.07	4.75	.12	S_1	201	172 k	.855	.9
S_1-S	10	2.5	5.14	.264	T	81	58 k	.715	.81
T-U	9	3.84	2.8	.164	T_1	75	46 k	.615	.702
T_1-U_1	7 3/4	6.95	7.44	.496	V	69	18.3 k	.265	
V-W	6	19.3	4.75	.272					

ASSUMPTIONS

FIG 2

REVOLUTIONS FOR CENT. FORCE = 4000

STANDARD SECTION — $\overline{DIAM}^4 = 25000$

SCALES

(a) 1" = 20"

(b) 1" = 2000 k = 908800 lbs

(c) 1" = .8 SQ. INS.

(d) P.D. = 5.04"

(e) P.D. = 5.275"

DEFLECTION $\frac{a^3\,b\,c\,d\,e}{EI} = 4.5" = 1"$ ON DIAGRAM

$$\text{CRITICAL SPEED} = 4000\sqrt{\frac{\text{MEAN ASSUMED DEFLECTION}}{\text{MEAN CALCULATED DEFLECTION}}}$$

$$= 4000\sqrt{\frac{1}{1.067}} = 3870 \text{ REVOLUTIONS}$$

J. H. Rowen

Our knowledge of deflection causes us to believe and to know that deflection in shaft varies inversely as the moments of inertia (about the diameter) of a cross section of a shaft and that this moment of inertia varies directly as the fourth power of the diameter, if the shaft is solid; or as the fourth power of the outside diameter less the fourth power of the inside diameter, if the shaft is hollow. The deflection in the shaft of constant cross-section varies directly as the bending moments, inversely as the moments of inertia, and in the problem before us we have a shaft in which the various parts of the length have different moments of inertia.

In order to determine the deflection, therefore, it is possible for us to incorporate in our graph a fictitious shaft of constant cross-section wherein the moments of inertia will remain constant throughout the length, and which shaft will have the same deflection in all parts of its length that our original or rotor shaft would have; and from our previous statement it will be seen that in order to do it we must multiply the bending moments that we actually have in our original shaft or rotor by a ratio existing between the moments of inertia of the cross section of our assumed shaft to the moments of inertia of our actual shaft or rotor at the various points of its length.

For this problem I have assumed a standard solid shaft of uniform cross section wherein the fourth power of the diameter equals 25,000. The moments of inertia for such a shaft (about a diameter) will equal 25,000÷64, and it will be seen that for that section of our real shaft between B and C the moments of inertia of our assumed shaft is 19.3 as great as the moment of inertia of our real shaft. The bending moments between these limits B and C as developed and shown on Fig. 3 are given by ordinates measured from AQ down to the line AB, such as RS. In order to make the assumed shaft deflect the same amount as our real shaft between the points B and C, we must multiply the bending moments between B and C (Fig. 1) by 19.3. This is done graphically by laying off QT=19.3 times as long as BQ and connecting AT. This method is then followed for all points on the bending moments diagram AB——OP and an irregular bending moment diagram A, T ,U, V, W, X, Y, Z, AA, BB,——RR, SSP. An examination of this figure will show that there will be comparatively little deflection between I and R (Fig. 1), these points being the limits of blade attachment. This is typical of turbine rotors and most designers assume this part of the assumed deflection curve to be a straight line; which assumption, though not strictly, is nearly correct.

This diagram shows the bending moments that must be developed in our fictitious or assumed shaft in order that the deflection shall be the same as the deflection in our actual shaft or rotor. By ordinary graphic methods Fig. 4 has been constructed to show what actual deflection would take place in the assumed shaft, and ordinates from the line AB to the curve AC, AB as measured are shown on the graph.

It will be noted that our developed deflections are slightly in excess of our assumed deflection, and had our assumed deflection curve (Fig. 2) been chosen absolutely correct as to shape, the ratio between the final determined deflection and the assumed deflection would be constant at all points. It will be noted, however, in this case that this ratio varies from about 1.08 to 1.05 with an average of 1.067. This is very close and much closer than usually found in actual work, but assuming that the ratio is 1.067 our problem becomes that of calculating the actual number of revolutions that represent the critical speed. Starting, therefore, with the idea that we assumed a deflection of 1" with revolutions of 4,000 and that we determined that the actual deflection under these conditions was 1.067 we can easily determine the revolutions that would have caused the deflection to be calculated correct to the assumed deflection.

It will be remembered in figuring our centrifugal force that the square of the revolutions was a factor in determination of the centrifugal force. It is, therefore, evident that in order to determine the critical speed our 4,000 revolutions must be divided by the square root of 1.067. This will give, in this case, a critical speed of 3,870.

In construction of this graph, like any other graphical method, great care must be used in remembering that wherever a drawing is made to scale, that scale becomes a factor in some way in our measured result of the graph. Thus, in measuring our deflection at the point E, the actual deflection cannot be measured as the length EF, but must be considered as EF multiplied by some scale, which scale depends on the various scales made use of in the graph.

It will be noted that in this method there has been used two force diagrams in which a certain polar distance was made use of. These polar distances are vital. The scale for length as used in Fig. 1 is made use of three different times, and in each one of our two force diagrams we have a certain scale for laying off the force. The deflection is also inversely as the moments of inertia, and it is also the inversely as the modulus of elasticity of the material itself. The scale for deflection can, therefore, be considered as equal to $\frac{a^3 b c d e}{E \, Is}$ where a is equal to the scale per length; b is the scale for force in the first force diagram used; c is the scale for force in the second force diagram; d is the polar distance in the first force diagram; e is the polar distance in the second force diagram; E is the modulus of elasticity for the material for which the shaft is made, and Is is the moment of inertia of the cross section of our assumed shaft.

All the necessary work pertaining to this graph is included and shown together with Fig. 1, 2, 3 and 4 on the attached graph and data sheet.

SUMMARY OF OUTLINE IN GRAPH

First—Lay off the length scale (Fig. 1) and section of that part of shaft which reduced deflection.

Second—Assume a deflection curve based on characteristic curve of this type of shaft or rotor.

Third—Estimate weights of the shaft and the appendages and apply these weights at different parts of the length of the shaft (these weights must include absolutely all rotating weights).

Fourth—Calculate centrifugal force due to all rotating weights rotating at an estimated speed, at radii corresponding to the ordinates of our assumed deflection curve. Construct bending moments diagram using centrifugal force as the loads.

Fifth—Assume some fictitious shaft of constant cross-section to which to compare our bending moments diagram.

Sixth—Reconstruct the bending moment diagram so as to apply to the fictitious shaft in order to give the same deflection in the fictitious shaft as the real bending moment will develop in the actual shaft. See Fig. 3.

Seventh—Construct Fig. 4, which is a deflection curve, by means of a force diagram, in which areas in our modified bending moment diagram of Fig. 3 are used as forces.

Eighth—Combine the scale of our various curves and develop the scale on which the deflection curve in Fig. 4 is drawn.

Ninth—Measure various ordinates in Fig. 4 and apply the scale for deflection at different points. Determine the ratio between the deflections in Fig. 4 with corresponding ordinates in the assumed curve, Fig. 2, and decide on amount of ratio between ordinates. If these ratios vary considerably at different parts of the length of the shaft, a new assumed deflection curve similar to the one developed in Fig. 4 should be taken and the work from second step to eight step repeated before the ratio is accepted and before step ten is done.

Tenth—Determine critical speed by multiplying the assumed revolutions (used in developing centrifugal force) by the square root of the ratio between ordinates of the assumed curve and ordinates of the developed deflection curve.

Didn't Care to Mention His Name.

A colored woman presented herself the other day in an equal suffrage state at the place of registration to qualify for the casting of her vote upon the school question at the next election.

"With what political party do you affiliate?" inquired the clerk of the unaccustomed applicant, using thep roscribed formula.

The dusky "lady" blushed, all coyness and confusion. "Is I 'bleeged to answer that there question?"

"Certainly, the law requires it."

"Then," retreating in dismay, "I don't believe I'll vote, 'case I'd hate to have to mention the party's name. He's one of the nicest gentl'mums in town."—Ladies' Home Journal.

Trying to Please One.

Angry Diner—Waiter, you are not fit to serve a pig!

Waiter—I am doing my best, sir.

Flood Problems in the Provience of Chih Li in North China

(Continued from the April Issue)

By SIGURD ELIASSEN, B.Sc. '18

The Yung Ting Ho Problem.

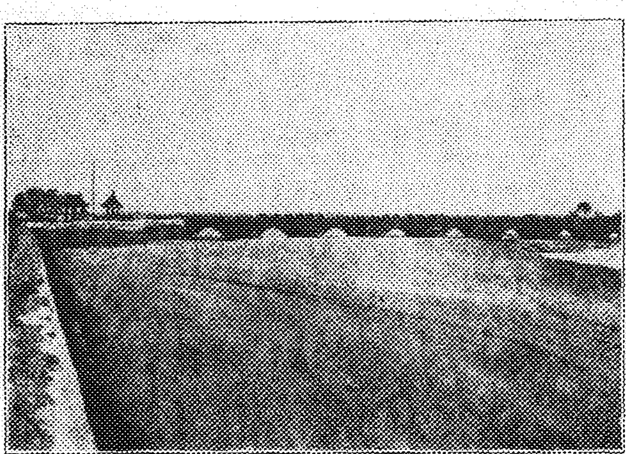
The most menacing river of the province is the Yung Ting Ho or the Hun Ho. Curiously enough, the name Yung Ting Ho means the permanently fixed river. This is the official name given it by an emperor who thought he forever had conquered its flood evil after he had confined it between what he considered strong dykes. The people living in the neighborhood of the river have pertinently named it the Hun Ho or the unmanageable river, which is more nearly the truth. Nearly every summer it breaks its dykes at one place or another and floods large areas to the north and the south of it.

Many of the tributaries of the Yung Ting Ho have their origin in the mountains in the province of Shansi, the neighboring province to the west of Chih Li. The river is first called Yung Ting Ho after the confluence of two important tributaries, the San Kan Ho and the Sang Yang Ho.

The Sang Kan Ho, which is the most important of the two, has its origin amongst the Wu Tai Shan ranges in Shansi. The mountains are here barren and very rugged, reaching heights of more than 9,000 feet. The valleys are covered with the easily erodible loess. During the intense summer rainfall the water in the swollen rivers becomes extremely silt laden, a silt content of as much as 25 per cent by weight of solid matter not being unusual. It is liquid mud that is flowing down into the plain.

The Yung Ting Ho leaves the hills 20 miles to the west of Peking and reaches the plain at Lu Kuo Chiao, a small town situated on its bank 15 miles from Peking. Here it is spanned by two bridges, a modern steel railway bridge and a famous old masonry bridge known amongst foreigners as the Marco Polo bridge. Whether Marco Polo, the Venetian traveller who visited China in the sixteenth century, had anything to do with the building of this bridge or not is not known. It is an eleven arch structure of imposing solidness. The arches are half buried in silt. From borings it has been found that the bridge rests on a stone floor foundation extending right across the river bed. Each opening has an area of 930 square feet, making a total of 10,230 square feet for the eleven openings. Half of the opening is ordinarily covered by silt. During freshets, however, it seems reasonable to expect that the silt is completely scoured out, leaving a clear opening for the flood water. Assuming a velocity of 15 feet per second through the opening gives a discharge of slightly more than 100,000 c.f.s. The 1917 flood went over the bridge. From the cross-sectional area and slope of the river below the bridge, the maximum discharge during the 1917 flood has been estimated to more than 250,000 c.f.s. From these estimates and from the fact that the 1917 flood overtopped the bridge, it is clear that the designer greatly underestimated the flood flow. That the structure has withstood the onslaught of more severe flood than that of 1917 speaks, on the other hand, highly of the ability of the early Chinese bridge engineers.

From the Marco Polo bridge the Yung Ting Ho is dyked in until it enters the Pei Yun Ho a few miles above Tientsin. It has the steepest descent through the plain of any of the rivers of the province and the resulting high velocity accounts for the many dyke breaks that have taken place. For some distance below the Marco Polo bridge the dykes are only a mile to a mile and a half apart. 45 miles below the Lu Quo Chiao bridge they gradually commence to diverge in order to enclose a large territory commonly known as the Hun Ho "delta." The delta is nearly 50 miles long and 30 miles wide. At places on the southern side of the delta there are not less than three dykes, one outside the other, protecting the country farther to the south. Within the dykes of the delta the river meanders at will. The delta has, in fact, been a huge settling basin. Its role is now fulfilled as the whole territory is silted up almost flush with the five meter high dykes. The present problem



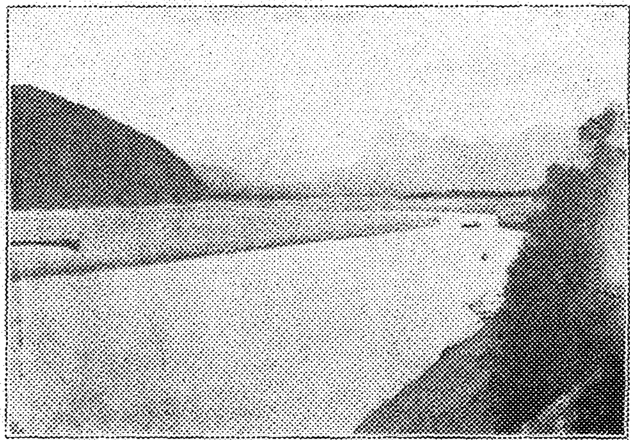
Marco Polo Bridge at Lu Kou Chiao

is to find a new course to sea and perhaps a new settling basin for this unruly waterway.

The farmers living within the delta have had to build their houses higher and higher almost every year. The method they follow to do this is to remove the roof, add another few bricks onto the wall, and then replace the roof. It is amusing often to see doors and window sills below the surface of the ground level. Wood-work is costly and is the last thing that is renewed.

Beside the Hun Ho "delta" settling basin the Chinese have, in their attempt to regulate the river, made use of the "by pass" method, using the Ta Ching Ho as the "by pass." They have excavated one connecting defluent between the river at Lu Kuo Chiao and Ta Ching Ho and another at Chin Men Cha, 30 miles below Lu Kuo Chiao, also leading to Ta Ching Ho. The reason for this has probably been that the Ta Ching Ho and the Yung Ting Ho very seldom are in flood at the same time. Control works in the form of masonry weirs regulate the discharge into the effluent. The effluents are now badly silted up and almost useless.

The problem of regulating the flood flow of Yung Ting Ho has received a good deal of attention from foreigners, as it is claimed that the river is detrimental to the navigation on the Hai Ho. The Hai Ho has, since 1912, been regulated for navigation. A board consisting of foreigners and Chinese with foreign engineers in charge of the works is looking after its maintenance and improvement. It is a semi-official institution. Since the Yung Ting Ho discharges its water into the Pei Yun Ho only a few miles above Tientsin, and the Pei Yun Ho joins the Hai Ho at Tientsin, it is



Yung Ting Ho
Where It Leaves the Mountains at Men Tou Kou
Tu Men Lou Weir

argued by the Hai Ho Conservancy officials that every summer when there is a serious freshet on and the Yung Ting Ho makes a new bed for itself through the silt deposits in the delta, there is a tremendous amount of silt being brought down into the Hai Ho, most of which is being deposited at the mouth of the Hai Ho, blocking every effort to keep the channel through the bar deep enough for vessels drawing more than 10-12 feet. A new outlet for the Yung Ting Ho is therefore being planned. So many interests are involved in such a scheme, however, that it undoubtedly will be a long time before anything is done.

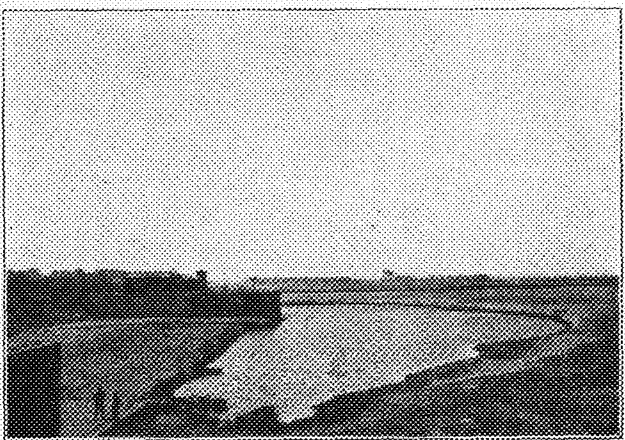
The Pei Yun Ho Problem.

The Pei Yun Ho or Northern Transportation River is a continuation of the Grand Canal from Tientsin to Tungchow, the "sea port of Peking." As already mentioned, the Pei Yun Ho flows into the Hai Ho at Tientsin. In 1913 the Pei Yun Ho forced its way across a 5-miles wide strip of ground into a neighboring river, the Chien Kan Ho. All the water finds its way to sea via this river at present, leaving the bed of the old river between Tungchow and Tientsin nearly dry.

A difficulty in describing the rivers in the province of Chihli is that they change their names so frequently, there being no one name that can be followed from source to mouth. The Pei Yun Ho is no exception to this rule. It is called the Pei Yun Ho from Tientsin to Tungchow. Then it is called the Chao Pai Ho from Tungchow to where the two rivers, the Chao Ho and Pai Ho, flow together. Then one can follow either of these two until they branch out into other minor rivers with different names. In a similar way the Yung Ting Ho branches out into the Sang Kan Ho and the Sang Yang Ho, each of these again losing their names as they branch out into other sub-tributaries.

The Chao Pai Ho and its continuation, the Pei Yun Ho, is dyked in from 20 miles above Tungshow to Tientsin, a distance of nearly 100 miles. The dyke system has been well maintained, but is irregularly constructed, being in some places scarcely more than 100 meters apart and at other places they diverge to more than 1,000 meters distance apart. The river bed is very sandy the whole way and large sand-dunes are a common sight along this river, especially where the effluents branch off and where breaks have been frequent. The sand is very fine, is easily stirred up by the wind, and is a source of great damage to the neighboring fields.

The Pei Yun Ho may in flood have a maximum discharge of not less than 80,000 c.f.s. As it originally was designed as a link in the imperial transportation highways and as it is comparatively very near to Peking, it has received a good deal of attention, both by the emperors personally and by their hydraulic advisers, to make it an efficient canal for navigation. In the reign of Chien Lung, about 250 years ago, a magnificent flood effluent was excavated from Ho Hsi Wu, midway between Tientsin and Tungchow, to the coast. The canal, called the Ching Lung Wan Ho, had an original capacity of from 35,000 to 40,000 c.f.s., but is now so silted up that its capacity has been reduced to less than 10,000 c.f.s.



The works controlling the discharge into the canal consist of a masonry weir known as the Tu Men Lu weir and is perhaps the best structure of its kind in China. It is still in good order and is a fine monument for early hydraulic engineering in China. Unfortunately the designer made no provision for controlling the discharge and as the elevation of the spillway is only slightly above normal stages of the river, all ordinary floods found their way into the canal without having sufficient magnitude to flush through to sea. The result has been that all the silt was dropped in the middle reaches of the canal.

After the Chao Pai Ho in 1913 broke through into the Chien Kan Ho, a district called the Pao Ti Hsien, situated along the lower Chien Kan Ho, has been yearly flooded and a population estimated to be nearly half a million people have become practically destitute.

Just below Pao Ti Hsien the Chien Kan Ho flows into the Chi Yun Ho, also called the Pei Tang Ho, to which it is a tributary. The Chi Yun Ho has its source in the mountains to the north-east of Tientsin. Its drainage area is about 3,000 square miles, and its flood flow may approximate that of the Chao Pai Ho.

The dyke system of the Chien Kan Ho, after the Chao Pai Ho broke through and occupied its bed, naturally became far from adequate. To aggravate the condition it almost invariably happens that the Chao Pai Ho and the Chi Yun Ho are in flood at the same time because their drainage areas are adjoining and the mountains separating the two water sheds are not high enough to cause any deflection of the rain clouds. The result is, of course, most disastrous to the Pao Ti Hsien district. The Pao Ti Hsien problems is one that requires immediate solution. The technical difficulties are not insurmountable, but the economic interests are so many and so conflicting, and the people are so suspicious that there may be other motives for carrying out the relief work than those officially stated by those in charge of the problem that nothing has yet been achieved.

The plans proposed for the solution of this problem are the following:

(1) Reversion of the Chao Pai Ho at Niu Mu Tun, a village 15 miles below Tungchow to S.E. At this point the combined Chien Kan Ho and Chao Pai Ho and the old course of the Chao Pai Ho, here called the Pei Yun Ho, are only two miles apart. To make a cutting between the two rivers here is comparatively easy.

(2) The building of a diversion dam on the Chien Kan Ho just below the proposed cutting with regulating works for flood flow as well as ordinary flow.

(3) The construction of a strong dyke system from the break to the cutting.

(4) The building of a dyke a kilometer to the south of the Ching Lung Wan Ho and paralleling it. The present Ching Lung Wan Ho will form the northern dyke of the channel thus formed. The construction of new head works for the new Ching Lung Wan Ho defluent.

(5) The construction of a diversion dam with regulating gates and navigation locks across the Pei Yun Ho below the Ching Lung Wan Ho. The maximum flood discharge of 85,000 c.f.s. of the Chao Pai Ho will then be taken care of in the following manner:

15,000 c.f.s. through the diversion dam across the Chien Kan Ho.
70,000 c.f.s. through the Niu Mu Tun Cutting. Of this
60,000 c.f.s. will be diverted through the Chien Lung Wan Ho.
10,000 c.f.s. through the regulating works across the Pei Yun Ho.

An unsuccessful attempt was made by an Italian engineer, shortly after the 1913 flood, to divert the Chao Pai Ho back into its old channel via Tungchow. A stone and timber dam was constructed across the river just below the break. It was finished in 1916, but the 1917 flood washed it away completely. The result of this has been that works of foreign river engineers have been much discredited amongst the Chinese, who proudly point to structures like the Marco Polo bridge and the Tu Men Lou weir, which have withstood the onslaught of floods for centuries.

The Ta Ching Ho Problem.

Unlike the rest of the rivers in the province, the lower Ta Ching Ho is not a heavy silt carrier. There exists large swampy areas along its middle course which in flood time become lakes that act as regulating reservoirs. The Ta Ching Ho has two main systems of tributaries, the northern or Chu Ma Ho system and the southern or Chu Ling Ho system. The Ta Ching Ho is also connected to the Yung Ting Ho by two overflow canals from the latter, as mentioned under the Yung Ting Ho problem.

Little thought has yet been given to the Ta Ching Ho problem. It is difficult to analyze on account of the intricacy of its tributary system and its relation to other rivers, notably the Yung Ting Ho and the Hu Tuo Ho. During severe floods both the Yung Ting Ho and the Hu Tuo Ho will discharge a large amount of water into the tributaries of the Ta Ching Ho, and what really happens is not yet fully understood.

Two of the most notorious rivers of the province, the Sha Ho and the Tang Ho, are tributaries of the Chu Lung Ho.

Both the Sha Ho and the Tang Ho are normally dry, but their beds are over a mile wide, sandy and ominous looking. The Peking Hankow Railway bridges across these rivers are washed out whenever a more than ordinary flood occurs on any of these rivers. The rise of the river is so sudden that to an on-looker it seems as if a wall of water was rushing down stream.

Two alternative systems suggest themselves when flood control plans are being contemplated.

One is to improve upon the present method by making the dyke system highly efficient and by increasing the capacity for storage of the swampy areas in the plain by heightening and strengthening the dykes surrounding them, with the outflow from the reservoir effectively controlled.

The second alternative is to control the flood run-off in the hills by a number of retarding basins similar to those in the Miami Valley in Ohio, but conserving as much of the flood water as possible, for use of irrigation. This last plan, if feasible, will increase to no small extent the low water flow of many of the rivers and probably provide low water flow to rivers that at present are dry. It would prove a great boon to the farmers living along the dry courses.

The lower Ta Ching Ho is one of the most important navigable rivers in the province. When the river stage is above normal, it is possible for steam launches 100 feet long and drawing 4-5 feet to ply between Tientsin and Pao Ting Fu.

The Tzu Ya Ho Problem.

The Tzu Ya Ho is formed by two large river systems, the Hu Tuo Ho and the Fu Yang Ho, which flow together at Hsien Hsien, a city practically in the middle of the plain. Both the Hu Tuo Ho and the Fu Yang Ho are tremendous flood carriers. It is probable that these two rivers were the chief causes of the flooding of Tientsin in 1917.

The Hu Tuo Ho.

The Hu Tuo Ho has its origin amongst the Wu Tai mountains in Shansi, not far from where the Sang Kan Ho of the Yung Ting Ho drainage area has its origin. The mountains here, as already mentioned, are extremely rugged, absolutely barren and present a most gloomy aspect to the visitor. The valleys are deeply covered by the loess soil and the river is therefore heavily silt laden during flood. Shortly before the Hu Tuo Ho reaches the plain it flows through a low gorge four miles long and one mile wide, the sides of which are composed of a densely packed mixture of loess, sand and gravel. The bottom of the gorge is flat,

(Continued in the June Issue)

Electric Dish Washer Scores Against Germs

Investigation of Restaurant Methods Shows It Aids in Fight Against Bacteria—890,000 Germs Found on Coffee Cup in Eating Place Where Dishes Were Washed by Hand.

A count of as many as 890,000 bacteria was found on coffee cups in restaurants where the dishes were washed by hand, while the highest number in another where an electric dish washer was used was only 13,000, in the course of an investigation made in a small eastern city. The investigation was made in 1918 by Roy C. Dearstyne, and the results are described in a recent number of The American Journal of Public Health. It came about in response to a question as to the relative safety of the methods of washing dishes used in eating places in that city.

Six restaurants were chosen for the purpose, one being a colored eating place and the others of the type familiar to the average city. With the exception of the one where an electrical dish washer was used and whose proprietor employed proper precautions in using it, they represented, the investigator says, "Every phase of the old system of washing in hot water, and drying with a towel, from the worst to the best, and included various degrees of temperature, soapiness and cleanliness which the respective proprietors considered adequate and necessary."

It was much the same with water glasses. The highest bacterial count on those washed in the electric dish washer was 2,700. In the others, the highest count ranged from 50,000 to 1,200,000. The lowest in the electrical dish washer restaurant was 1,200, while the lowest in the others was from 2,000 to 10,000. Similar conditions were observed with regard to spoons. The highest bacterial count on a spoon in the restaurant where the electrical dish washer was used was 17,000; the lowest, 400. The highest and lowest in the other eating places were as follows: 620,000, 1,000; 600,000, 1,600; 300,000, 5,000; 32,000, 1,700; 7,-700, 1,000.

The comparison is made clear and emphatic by the following table, which represents an average of nine of the lowest of ten counts taken on each utensil at each place, the last, No. 6, being the restaurant where the electrical dish washer was used:

Utensils	Rest. 1	Rest. 2	Rest. 3
Coffee mugs	26,000	100,000	290,000
Water glasses	23,000	130,000	120,000
Spoons	3,400	8,200	70,000
Knives	1,500	20,000	No Test
Forks	1,500	11,000	3,200
	Rest. 4	**Rest. 5**	**Rest. 6**
Coffee mugs	160,000	130,000	3,700
Water glasses	33,000	No Test	1,700
Spoons	13,000	2,700	1,800
Knives	6,400	2,700	1,800
Forks	2,600	7,600	1,600

The investigator draws the following conclusions:

"1. It is certain that in most restaurants and other public eating places, too little attention is paid to washing, drying and handling dishes and utensils.

"2. The value of the machine dish washer over the old system of hand washing as determined by the numerical bacteria growth on utensils can be seen from the above tabulations."

With millions of Americans eating regularly or occasionally in restaurants and patronizing soda fountain counters, and with epidemics making their appearance from time to time, the importance of these figures is apparent. Nor are they without interest as applied to the home.

Out of Jurisdiction.

Glenn H. Curtis, at a dinner in Los Angeles, aviation week, said of the Wrights, good-humoredly:

"They don't own the air, you know. Did you hear about that conversation that was overheard between them at the Dayton plant?

" 'Orville,' cries Wilbur, running out of doors excitedly, 'look! Here's another aviator using our patent!'

" 'He certainly is!' shouts Orville. 'That's our simultaneous warping and steering movement to a T!'

" 'Call a cop!' screams Wilbur. 'Get another injunction!'

"But Orville, who had looked up through his binocular, laid his hand gently on his brother's arm.

" 'Come on back to work, Wilbur,' he said. 'It's a duck.' "

The average man wastes a lot of energy in laughing at his own jokes.

Intensive Education.

Teacher: "I am going to send for mother, Johnny, and show her what a shocking composition you brought in today."

Johnny: "All right. Send fer her—I don't care. She wrote it, anyway."

Copenhagen

"Hello, Copenhagen," said Norman Moore the other morning, meeting his thin friend just outside the Architects' store room.

"Hello, yourself. Vat you're doing 'round here?"

"Just checking up to see if you're on the job."

"Jah. Aye sane you bane looking for me. That's all right. Aye bane hare all the time already scrubbing after the way these hare Architectures bane messing tangs up. Aye bet you tank Aye got noting to do but yust vork all time up hare. Aye bet Aye see vat the Dane says before they got nother party lake this.

"Vat you looking so down in the mout bout, Norm? Aye lake to see little more cheerfulness out of them owl-eyes of jung feller lake you. Don't you bane worrying because you ain't had luck getting by that fancy costume before somebody beats you to it. Lots folks got worse tame that. Aany how, Yubilees comes too late. Jung feller ain't needing to take girl to hop or teater or such places now. You know bout river-walking, Norm?

"Aye taught you ain't. Aye tell jou all bout how these fellers got it all down. You know this hare Roy Heidelberger? Aye bet you he knows every foot that river bank so's he can walk in his sleep and not fall in. Yust as soon it comes a little warm like this, Roy yust says ain't it too hot to go by dance, let's go down by river bridge and set. Hay yust valks the girl up and down till she bane tired nuff to set, they set long vile, Roy yust tank of sometang to say once in a while, that ain't cost much. Then he takes girl home. You yust belief me, that ain't needing no fancy costume.

"Thas hare fellow Beardmore got a better system even, too. He yust get his girl trained so she pack up lunch wit little hot coffee to help when he ain't thinking noting to say. You vant learn bout these hare tangs. Vat you got college education for if you don't pick up little tangs like that?

"But if anybody ask you how these hare Enyeneers got started river-walking, Aye tell you vat Aye tank. You know this hare Roy Satori? Nice boy wit little mustache getting good start? Jah, you know him. Aye bet you he bane the best river-walker in the whole lot. You look some day how he got them steps pretty near wore out down to the water. He sure bane one good little river-walker. You want some more news how to do it, yust ask him.

"Tank it over Norm. River-walking great little sport round here. Every Enyeneer got to try it someday. Aye tank you want to try.

"Yah, Aye guess Aye got to see who is ringing that bell. Good-bye."

Logical Result.

A flivver in Newton, Kansas, broke the arms of four persons who attempted to crank it in less than a week. That's what comes of crossing a bicycle with a mule.—The Legionaire.

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EDITORIAL

The Voice of the Student

On the morning of April 13, a mass meeting of the student body of the University convened to consider ways and means of effectively protesting the proposed reduction of the legislative appropriation for the coming biennium. The gathering in no way exceeded "the right of the people peaceably to assemble," but as an expression of real student sentiment it was a healthy symptom. Many of the members of the student body cast votes in the election which sent our present legislators to St. Paul, and a good share of the rest will have a voice in the re-election or defeat of these same men at the next election. As the years go by, the University of Minnesota is coming to have a larger and larger body of alumni to whom it ought to be able to look for support at such a time.

Few students and alumni are more intensely interested in the equipment and support of the institution than are the Engineers. Unaided by any such munificence as the Mayo Foundation, their very existence is at stake with the reputation and quality of the instruction offered here. An academic college may be many years wearing out its copies of Horace, or exhausting its supply of the interesting works of Euclid, but modern Engineers are not made either by a consideration of the construction of Caesar's bridge across the Rhine nor by the use of experimental machinery so antiquated that it belongs in the same class. It is both expensive and important to keep Engineering equipment abreast of the times.

The student demonstration may not have influenced the legislature; it does look to the day when a united alumni body will be solid in its support of not only its own publications, like the Techno-Log, but will be so powerful as to assure the faculty and president of ample and cheerful financial support.

Are you a Goop?

"The Goops they wet their fingers
To turn the leaves of books,
And leave upon the margins
Their gum and lollypops.
Don't be a Goop!"

So ran one of a series of library mottoes popular some years ago. During the present quarter, the Goops have invaded the library of the College of Engineering in force. These, however, are grown-up Goops, whose destructiveness is such as to deserve a more forcible name. Service and equipment in the Engineering library has long been so superior to that in the main library that the men of the college have shown their appreciation of it by behavior suitable to the time and the place. At present the deeds of a few young vandals are bringing the whole college into disrepute, and a little strong-arm admonition administered at a timely moment by upper-classmen suggests itself as the most suitable remedy.

The large gray volumes in the lower shelves have been made disgustingly dirty by having the mud and dust from shoes wiped off on them. The recesses of the shelves behind the books have been used for waste repositories by able-bodied youths too lazy to walk to a basket. The new tables are fast becoming covered with ink spots dropped from careless pens. A mere recitation of these facts makes one wonder what sort of homes these men come from, and what sort of surroundings they would create for themselves if entirely unrestrained by civilized requirements.

Furthermore, our debonair friend "E. T." has registered his protest against decent furniture and respectable equipment by carving his initials on one of the new tables. If he has exhausted the surface of the piano and dining table at home, we respectfully suggest that his mama get him a set of sloyd with plenty of blocks for his birthday.

Let us speak softly to these young offenders and try means better suited to impress upon them the undesirability of the continuation of their practices.

PUBLIC SPEAKING

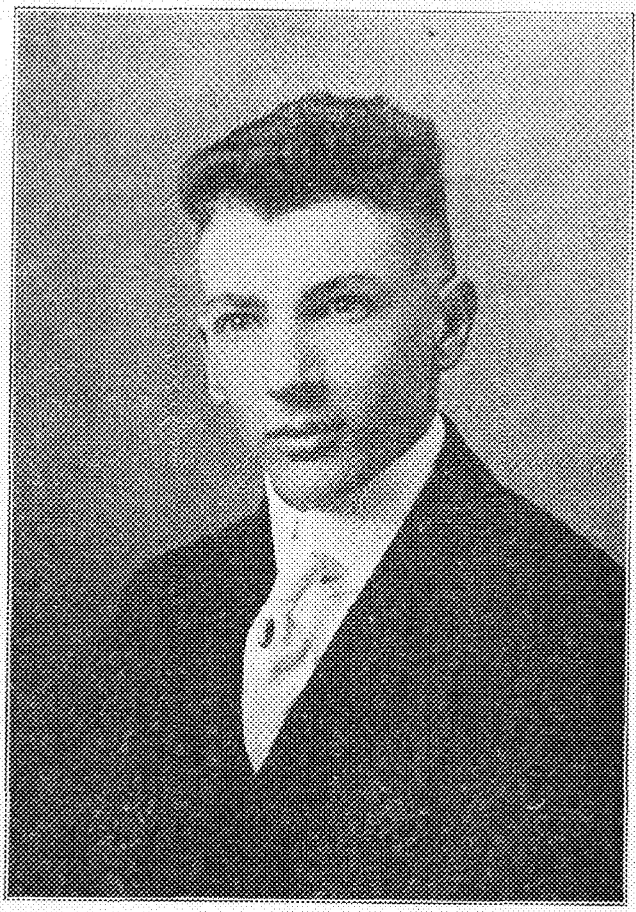
It is an Engineer's business to spend other people's money. At best that is a delicate matter. At worst, it is almost impossible to satisfy many of the dyed-in-the-wool mugwumps that they are getting their money's worth. It is an engineer's business to know what other men need in their business equipment, what corporations need for the conducting of their business, and what towns and cities must have for sanitary and aesthetic reasons. It is one thing to know what is correct, essential, and useful, but it is another to be able to go into a directors' meeting, a session of the town council, or a caucus and sell that thing to the people who are placing the order. Cities as well as small towns all over this part of the world have plenty of monuments to the failure of Engineers to show buyers what was safe and sensible in construction and planning of all kinds.

To judge by the quality of the speeches and discussions staged in recent meetings of the Engineering students, the present generation of Minnesota Engineers is no improvement in this respect. Man after man rises to give voice to opinions which his audience are anxious to hear, but fails to interest them because he drones on and on, repeating himself endlessly, tacking rambling statements together with interminable "and's" and getting no where. Daniel Webster said that 'the only way to learn to be an orator is to make a speech every time anybody is damn fool enough to ask you.' Graduate Engineers cannot afford to wait for this trial and error method of learning public speaking. Out of nearly a thousand Engineering students, the number who have elected public speaking this year is twelve. The facts, coupled with the size of the audiences at Engineers' meetings speak for themselves.

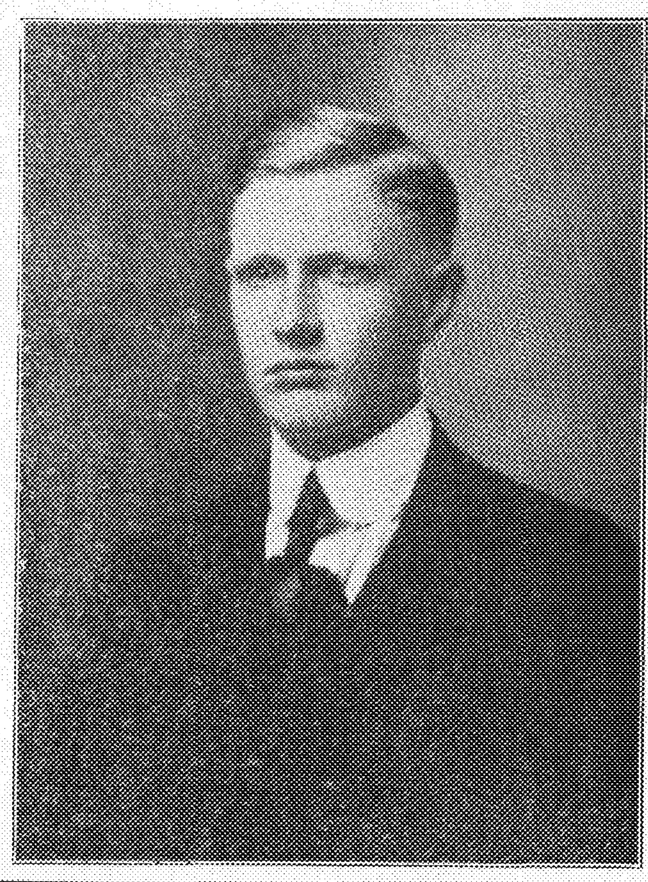
Obituary

Many friends and several organizations assembled April 15th to pay tribute to the memory of Lieut. I. D. Gracie, whose body was recently returned from France. The body was met in St. Paul by student representatives and members of the Phi Sigma Kappa fraternity, of which he was a member. Gracie was first with the Royal Flying Corps, and later flew with the Seventeenth Aero Squadron, A. E. F., of which he was a member when he was killed, August 12, 1918. Gracie was well known in the Twin Cities, and was active in athletics and student leadership at Macalester while he attended there. .

He was also a student of Engineering at the University of Minnesota, serving as staff photographer for the Gopher. The body was sent for burial to Bemidji, the home of his parents.



Fred L. Simons, E. '24, stricken with typhoid fever while at his home in Spring Valley, Minnesota, died of the malady on April 4th. Simons was well liked both by classmates and instructors, and his loss is keenly felt by those who had been associated with him. .



The Engineering College lost a good student by the death of Erving H. Graf of the class of '23. Graf contracted paratyphoid during the recent epidemic, and died April 6th at his home in St. Croix Falls. He will be greatly missed by his fellow students in this college.

The Chippawa Development

By R. E. WESTBERG, E.E. '26

The largest project for the development of hydro-electric power going forward at the present time is what is called the Chippawa Development. It is being undertaken by the Hydro-Electric Power Commission of Ontario, a utility owned and operated by the government of the Province of Ontario, Canada.

This Commission is the largest Central Station concern on this continent, if not in the world. It supplies power to many of the municipalities and industrial factories of the Province from its own generating stations and over its own transmission lines. The field of its operations is widening year by year and, although the Commission has been adding to the equipment as rapidly as possible, the demand for service has been so great that during the past winter it was necessary, in addition to purchasing power from other companies, to place restrictions upon the use of electric heaters, irons, etc., in order to keep the factories supplied with sufficient power. With the Chippawa Development completed, however, and delivering power, this condition should be ended and it is expected that the power demand will be taken care of for some time to come.

The Chippawa Development consists of the construction of a canal from Chippawa, three miles above Niagara Falls, to Queenston, seven miles below; and of the generating station at the latter point.

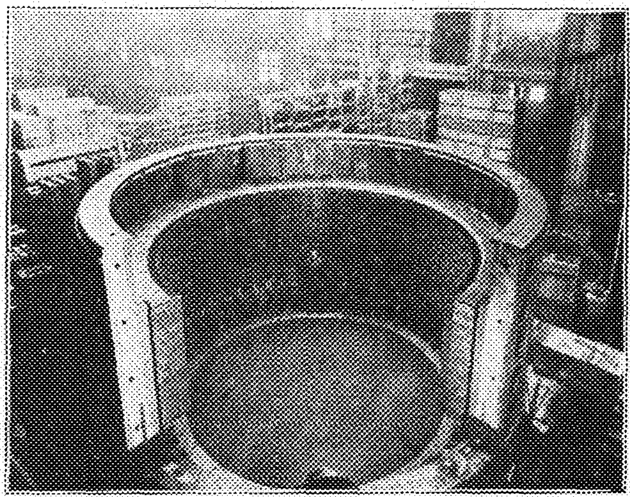
The canal is approximately 12 miles long and has the novel innovation of making a river run backward in its course. It is divided into four sections, the first of which utilizes the Welland River, which empties into the Niagara River at Chippawa. Now, however, the Welland River draws water from the Niagara and for four miles literally runs backward. From this point the canal proper begins and this second section is an earth section 6,250 feet in length with a bottom slope of .0001208 and side slopes of 1½ to 1. It is to be rip-rapped lined and in the design Kutter's formula was used with a roughness factor of .035. The third section is a transition section of 300 feet and changes from the trapezoidal to a rectangular cross-section, and the fourth section is a rock section 36,252 feet long and 48 feet wide. The bottom slope of this section is .000213 and a roughness factor of .014 was used (Kutter's formula). The concrete lining is to be carried up 32 feet above the finished grade for 13,500 feet, 31 feet for a distance of 11,500 feet, and 30 feet for the remainder of the section.

The rock section is divided into two on account of the Whirlpool Gully, where the rock surface falls below the canal grade and it is necessary to carry the canal partly on fill and use a trapezoidal section 2,450 feet in length because of the foundation. The intermediate section has a bottom width of 10 feet, with side slopes of 1½ to 1, the bottom slope being the same as for the rock section.

The capacity of the canal is 15,000 c.f.s. with uniform flow and extreme low level of the Niagara River at Chippawa.

The equipment of the power house will consist finally of eleven main generating units of 45,000 kv.a. capacity each—a total of approximately 600,000 h.p. At present, however, the installation will consist of five units, the others being added as the demand for power requires.

These generators are 3 phase, 25 cycle, 187½ R.P.M., 16 pole, vertical shaft type, water-wheel generators designed to operate at a generating voltage of from 12,000 to 13,200 volts. Each generator is provided with two guide or steady bearings as well as one thrust bearing of the Kingsbury type designed to carry the total weight of



Generator Frame With Section Removed

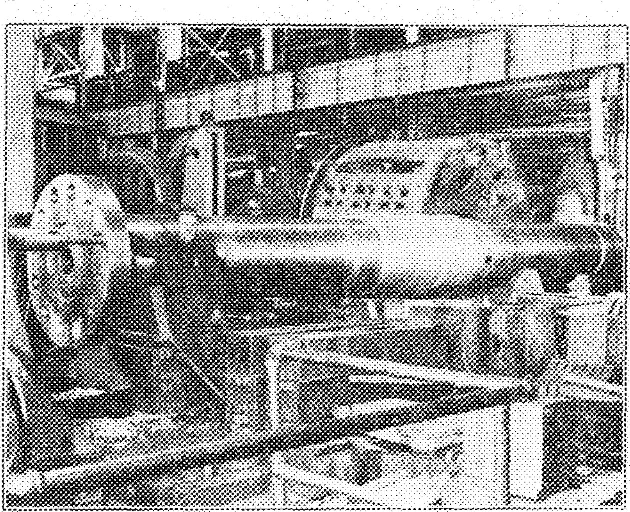
the rotating parts of generator, exciter and water-wheel, which amount to approximately 1,000,000 pounds. Of this amount the generator parts comprise 300 tons. This thrust bearing will be 69 inches outside diameter, have a fit along the shaft of five feet and will weigh about eight tons. It is designed to carry a load of 500 tons and the babbit contained in each bearing will weigh 450 pounds. The thrust collar, upon which the weight rests, has a diameter of five feet nine and one-half inches and weighs 11½ tons.

All bearings will be water cooled, the guide bearings having cast water jackets, while the thrust bearing will have cooling coils of copper tubing immersed in the oil bath. About 600 feet of one and one-quarter inch tubing is required for this purpose.

The thrust bearing will be carried by a massive cast iron bracket (shown in photograph No. 1), which in turn will be carried by the generator frame. The generator frame will be made in two parts, the upper part, into which the laminations are assembled, consisting of quarters, the lower part of halves. The outside diameter of the frame is 25 feet, the diameter of the laminations 17 feet eight inches, and the height 15 feet. The upper frame with the laminations built therein will weigh about 190 tons, the laminations being 108 tons of this weight. Photograph No. 2 shows the frame with one-quarter of the upper part removed, and the size may be judged from the workman standing inside.

Inside the lower frame will be mounted the lower guide bearing bracket which will be provided with supports for four hydraulic jacks for lifting the rotor and for four air-operated brakes for bringing the rotor to rest quickly by pressing against a flange cast on the rotor spider. The flywheel effect of the rotating parts will be 21,500,000 pounds feet squared.

The rotating part of the generator will consist of a cast steel hub mounted on the shaft and a laminated sheet steel rim into which the poles are dovetailed. This sheet steel rim will consist of 135 tons of laminations, while the poles weigh 7,000 pounds each. The main shaft will be 30 feet in length and 30 inches in diameter and the finished weight 34½ tons. It is shown in photograph No. 3. The coupling on the end is to connect to the water wheel, the diameter being four and one half feet. In the background may be seen the cast steel rotor hub as it came from the foundry and before any machining had been done upon it.



Main Shaft

The winding of the stator will be by form wound coils 12 feet long and containing approximately 160 pounds of copper each. One such coil is shown in photograph No. 4.

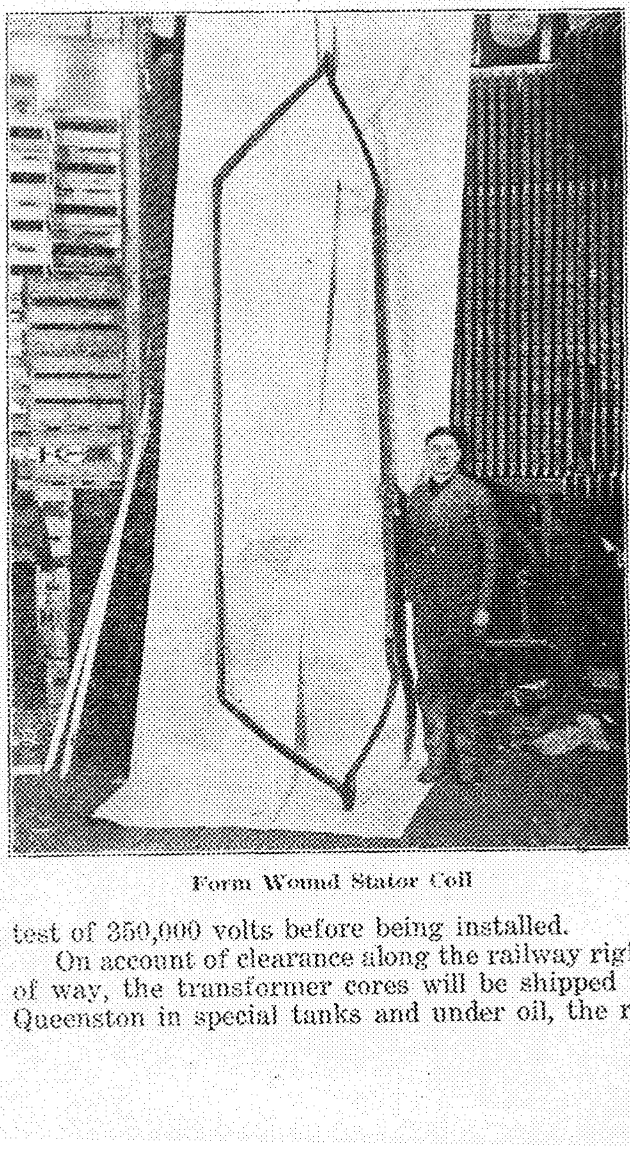
The total weight of the generating portion of the unit will be about 700 tons and the unit when installed will stand 30 feet above the floor. Two 150 ton cranes will be required in the power house to handle the heaviest piece.

Each unit will be excited from a 150 kw. 250 volt shunt wound, direct connected exciter mounted at the top of the rotating field.

The transformers for the main generating units are to be water cooled, shell type of 15,000 kw. capacity each at 80% power factor. They are designated to operate in delta or star, with taps to give 76,200 to 63,500 volts at full load delta (80,640 to 67,200 volts open circuit) or 13,200 to 110,000 volts at full load star (139,600 to 116,400 open circuit) on the high tension side, while the low tension side is wound for 12,000 volts but may operate continuously up to 13,200 volts.

These transformers contain over five tons of copper and 30½ tons of enameled sheet steel, together with seven or eight tons of fuller board insulation each. The coils will be 12 feet in height and the containing tanks will be 19 feet high and 10½ feet in diameter. With the terminal bushings, which will be of the condenser type, in place, the transformer will stand nearly 30 feet from the floor. The core of the transformer is to be vacuum dried after assembly, which process consists of putting the core into a large airtight tank and exhausting the air therefrom, at the same time heating it by means of steam coils around the tank to a temperature slightly above 100 degrees (Centigrade). It is estimated that from ten days to two weeks will be required in this case to complete the process. It may be of interest to note here that the vacuum tank used is about 15 feet in diameter and 20 feet deep, and it is possible to obtain a vacuum of 26 or 27 inches on it by means of a small steam operated air pump. Also, that the method of ascertaining when the process of drying is completed is as follows: air is admitted to the tank and a small manhole cover at the top is removed so that two wires on long poles may be let down to the core. The insulation of the transformer core is then tested between the high tension coil and the iron and between the low tension coil and the iron by means of a megger. When a resistance of over 1,000 megohms is obtained the core is sufficiently dried.

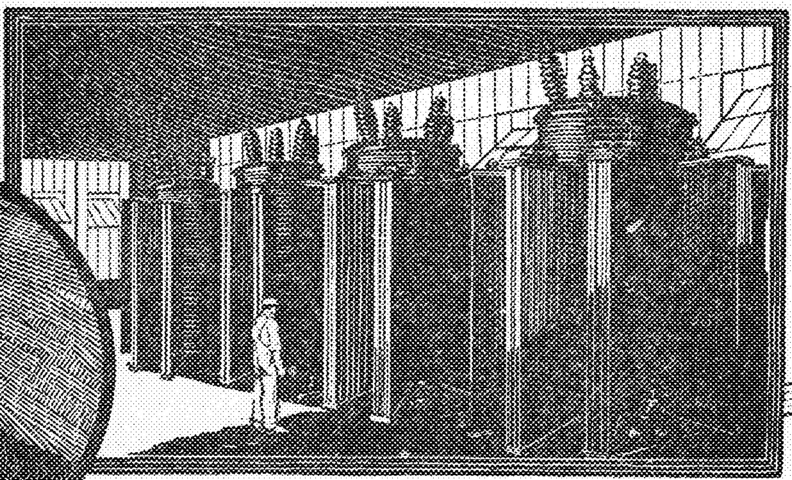
The insulation test for the transformer after complete assembly will be 280,000 volts while the terminal bushings will have to stand up under a



Form Wound Stator Coil

test of 350,000 volts before being installed.

On account of clearance along the railway right of way, the transformer cores will be shipped to Queenston in special tanks and under oil, the re-



GEORGE WESTINGHOUSE
the founder of the Westinghouse industries

The Vision of This Man

Gave America Alternating Current

Thirty-odd years ago state legislatures were being importuned to prohibit the distribution of alternating current on the pretense that it was dangerous. Today, legislatures are asked only to compel its makers to distribute it more widely and sell it more cheaply.

Times have changed since Westinghouse bought the Gaulard and Gibbs Transformer patents, and brought Alternating Current to America. This was the necessary preliminary step to the tremendous developments that Alternating Current, once known as "Westinghouse Current," has made possible.

To eliminate all the alternating systems and apparatus that are in use everywhere today would set this country back thirty years; but there was a time when all the resources and courage that Westinghouse could command were required to withstand the bitter opposition of those who fostered direct current instead. The whole Electrical Industry now recognizes that there is a proper field for each system, but it was all or nothing in the late '80's, when the question was first raised.

The original alternating current system was hardly practicable, even for lighting purposes. From it, however, have resulted all the modern applications of the alternating current system, the many methods and devices for transmitting current at high voltages and stepping it down to lower pressures by transformers located in connection with the consuming apparatus, whether in the home, in industry, or for the Public Service.

The foresight, the engineering genius, and the courage of Westinghouse fathered the evolution of Alternating Current, one of the greatest modern commodities.

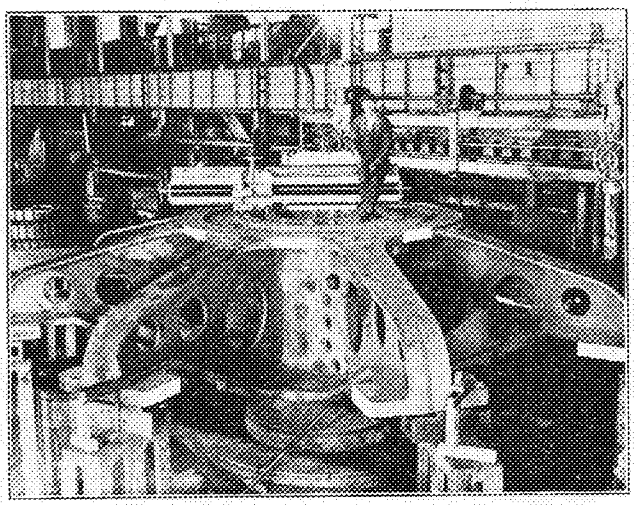
Westinghouse

WESTINGHOUSE ELECTRIC

mainder of the oil, of which there will be 6,500 (imperial) gallons per transformer, being shipped separately.

Comparing these dimensions with those given several months ago in the **Techno-Log** of some transformers being installed by the W. E. & M. Co. of Pittsburgh, it will be seen that, as regards size, these transformers are the larger. In capacity, however, they are not, since, being for a lower frequency, they require more iron. A 15,000 kw. 60 cycle unit would require only 16 tons of iron instead of the 30½ tons as given above.

The station will be protected by triple pole, quadruple break, oil immersed type "GA" circuit breakers on the high tension side. These breakers are built for a maximum operating voltage of 135,000. The terminals, which will be similar to those used on the transformers will have to undergo an insulation test of 400,000 volts at the factory.



Thrust Bearing Bracket

Special arcing tips are used on these breakers in which the upper tip follows the lower tip and retains contact for seven inches after the main contacts are parted and then is returned by a spring, thus making a quick break. The terminals are provided with static shields at the bottom as well as at the top (one static shield at the top is the usual practice) and an arcing shield over the contacts. The static shield at the bottom of the terminal is to prevent the porcelain arcing shield being broken by the strain due to the static field surrounding the bushing with a high voltage on the line, such as would exist under a surge. The bushings are designed for a current of 500 amperes and the breakers are capable of disrupting a current of 6,000 amperes on short circuit.

In addition to the high tension breakers there will be triple pole, double break, oil immersed breakers on the low tension side, designed for 3,000 amperes at 12,000 volts, the conductor being solid copper rod two and three-quarters inches in diameter.

These breakers are to be electrically operated by closing and trip coils controlled by relays with a provision, of course, for manual operation in case of necessity. The control system of the entire station will be "remote control."

In addition to the main generating units, there will be four service generators installed for use on local work and these are also to be vertical shaft type, water-wheel generators of 2200 kv.a. capacity at 2300 volts, 3 phase, 25 cycle, 500 R.P.M. They will be supplied with thermocouples embedded in the windings for temperature indicators and the thrust bearings are to be cooled by water cooling coils inside the bearing housing, the same as the main bearing of the larger units. Only two of these service units are being installed at the present time and their work will consist of the lighting, heating, etc., of the various transformer and switch houses as well as the supplying of power for the numerous motors that will be required for maintenance.

The information and photographs are of the machines being manufactured and installed by the Canadian Westinghouse Co. of Hamilton, Ontario. This company is manufacturing thre of the five units for which contracts have already been granted by the Hydro-Electric Power Commission, as well as all of the transformers (15) and high tension circuit breakers, and part of the low tension breakers. The remaining two generators are being manufactured by the Canadian General Electric Co. of Peterboro, Ontario, while contracts for the switching equipment and control system have not yet been granted.

The Fighter and the Quitter.

The quitter drew from the field apart,
Weary of limb and sick at heart,
And muttered in accents low:
"Let the fight go on, I shall try no more,
My eyes are dim and my back is sore;
I'll take not another blow.
For it's all of no use, I can plainly see,
I never could gain the victory."

"Oh, what is the use!" the quitter cried,
"I've done my best, and I've vainly tried,
The odds are against me here.
Not another step will I take ahead,
"For I couldn't succeed," the quitter said,
"Though I fought for another year.
What's the use of fighting, when you can't see
One chance on earth of a victory?"

But the fighter said, with a stern set chin:
"It's a battle tough, but I'm out to win,
And the odds are big, I know;
And I'm pitted against some better men,
Yes, vastly better than I, but then,
I'll give them all blow for blow.
I'll admit things look rather bad for me,
But I'll give them a fight for their victory."

"You never can tell," the fighter said,
"When your chance will come to forge ahead,
And your day will come to rise;
And better men you can sometimes trim,
If your nerve is good and your courage grim,
Luck breaks with the man who tries.
And nothing could be e'er so sweet to me
As to turn defeat into victory.."
—Edgar A. Guest.

Workaday Adventures

By Berton Braley

THE RODMAN

They sing the praise of the Engineer
And talk of the trails he breaks,
Or the work he does on each new frontier,
And the change that his labor makes,
And it's fair enough, I guess, but I—
Well, **I'm** on the job, you see,
And I sometimes wish, with a patient sigh,
That somebody'd mention **me.**

For I am the Rodman,
The labor-and-plod man,
Whose share of the glory is small;
I'm sort of a hack horse,
A caddy—a pack horse,
For I am the Rodman, that's all!

The Engineer squints through a transit lens
And scribbles a mark or two,
While I must stand there firm and tense
And hold the standard true;
Then while he swaggers along ahead
And whistles a tune or three,
I carry the kit till I'm nearly dead
But—nobody mentions **me.**

For I'm just the Rodman,
The close-to-the-sod man,
Who's subject to any old call,
Whose job needs assurance
Of strength and endurance,
I'm merely the Rodman, that's all!

Now, the Engineer is a man of skill,
And I'm just a sort of dub,
But together we work on plain and hill;
Together we eat our grub.
And after a while perhaps I'll shine
In an Engineer's job, maybe.
So now and then I'd like it fine
If somebody'll mention **me!**

For though I'm a Rodman,
A labor-and-plod man,
A good bit of praise wouldn't pall.
I wouldn't mind hearing
A word that is cheering,
Though I am the Rodman, that's all!

Blissful Ignorance.

"The opera was just darling, Mrs. Smith," declared Mrs. James Orphington Rex, as she felt of her diamond ear-rings to make sure if they were at the proper angle.

"I know I would have enjoyed it," answered Mrs. Smith.

"You would have had fits over it, Mrs. Smith. Calf was so cute, and they all sung in Latin."

A sneeze saved a snicker, after which Mrs. Smith asked: "What opera did you hear, Mrs. Rex?"

"I have it written down on a card here in my bag. I wanted to get it just right. You see, the name was on the curtain and I copied it from that. It was 'Asbestos.' "—Judge.

College News

Mr. George Herrold, city planning engineer of St. Paul, gave a practical and interesting talk on the problems connected with laying out a city before the student's branch of the A. S. C. E. on Monday evening, April 5. "There is no danger of Minneapolis making a mistake by purchasing too much land for park purposes," said Mr. Herrold. He then called attention to the fact that property values decrease rapidly in those districts in which no parks exist.

Another honor has been bestowed upon the Engineering College in the election of "Dusty" Kearney, '22, as captain of next year's basketball team. Dusty has played in every game this year and in most games last year, and his performance has always been characterized by the same fighting spirit and determination which placed him high up on the list of conference guards this year. His election was a foregone conclusion, and under his leadership Minnesota is assured of the hardest fighting team in the Big Ten array next season.

We have just been informed that the newly established firm, The Chernus Construction Co., has received a contract from Hennepin County to construct several reinforced concrete bridges. Maurice Chernus, '21, is the junior member of this firm.

Harvey C. Rath, sophomore Electrical, is in the university hospital, suffering from blood poisoning, caught through an infection of the foot. Rath was bothered for some time previous, but did not consider it serious until last week.

Samuel Sutherland and Rudolph Kuhlman were respectively elected to the offices of engineering representative on the Daily board of publishers and the Gopher board of publishers in the general elections. LeRoy Grettum, candidate for the office of managing editor of the Gopher, was defeated by the polling of an unusually large academic vote.

Carlos del Plaine, editor-in-chief of the Techno-Log, was recently elected to the board of directors of the Apollo Club, an over-town musical organization composed mainly of business men. This is the first time that a student at the university has been honored by being chosen for a seat on the governing body.

Professor F. H. Bass spoke to a group of boys of high school age at the St. Paul Y. M. C. A. on the evening of Thursday, April 14th. These boys had elected Engineering as their chosen profession in a recent "Find Yourself" campaign, which had been conducted in the capital city, and Professor Bass was asked to give them some idea of what the profession is like.

Members and instructors in the signal corps of the R. O. T. C. are being kept busy installing wireless telephone apparatus at dances and parties for the entertainment of the guests. The skepticism of the guests at the Military Formal about the genuineness of the demonstration was so great that Maj. Engels was compelled to put up the aerial inside the hall instead of outside in order that there might be no wires leading from the room.

Representatives of the General Electric company, Westinghouse Electric and Manufacturing company, and the American Telephone and Telegraph company have been interviewing the senior Electricals and Mechanicals during the last few weeks. A number of students have signed up.

Members of the student branch of the A. S. M. E. heard one of the most interesting technical lectures of the year on Tuesday, April 15, when Mr. Arnold Pfau of the Allis-Chalmers company presented a papar on "Modern Hydraulic Turbines of American Design." The lecture was illustrated with lantern slides, and delivered in a manner which held the interest of the assembly throughout the evening. Mr. Pfau is an acknowledged authority on hydraulic machinery and apparatus, and is himself the author of many important developments and inventions.

A close correspondence between good scholarship in college and eminence in Engineering is shown in an investigation made under the auspices of the American Association of Collegiate Registrars by Prof. Raymond Walters of Lehigh University, who presents a report in the current issue of "School and Society."

It was found that, of 392 distinguished Engineers graduated at 75 technical schools, colleges and universities, 182, or 46.4 per cent, stood in the highest fifth of their classes scholastically at graduation; 109, or 27.8 per cent, stood in the second highest fifth; 72, or 18.3 per cent, in the middle fifth; 14, or 3.6 per cent, in the next to lowest fifth; and 15, or 3.8 per cent, in the lowest fifth.

Figures for a group of 189 alumni of five eastern Engineering schools were somewhat different in the upper classes, the second highest scholastic fifth having the largest percentage. In all groupings of the eminent Engineers there were less than 4 per cent in each of the two lowest scholastic fifths.

Of 730 names on the Registrars' association list of distinguished Engineers, practically 80 per cent were found to be collegiate graduates, 16 per cent men of secondary school education and practical training, and less than 5 per cent men who started in college but did not finish.

The arbitrary basis of eminence in this study of a professional group was taken to be the holding of office, membership in important committees and service as representatives of the four "founder" Engineering societies, civil, mechanical, electrical, and mining and metallurgy, for five years, 1915-1919.

From Secretary
American Association of Collegiate Registrars
Lehigh University, Bethlehem, Pa.

The Engineers played their first game in the intramural baseball series on the Varsity grounds on Monday, April 18, with our ancient baseball enemies, the Laws. The game was scheduled to go five innings, but because of the approaching darkness the Laws refused to finish the last period. The first four innings were uneventful; both teams played excellent ball, and the beginning of the fifth found the Laws on the long end of a 2-0 count. Then things began to happen. The Engineers tightened up all around and held their opponents scoreless during the first half of the fifth. Harold Sturner, hurling for the Laws, walked MacMurphy and Dick Daly immediately after the Engineers came up to bat, and Ed Olson made first on a fumbled short hit. Sturner made a wild throw, and MacMurphy scored; Daly and Olson took second and third. Buck Roy walked, and Chet Bros fanned, leaving Harry Brown at bat with the bases full, one down and the Laws one point in the lead. After drawing two balls, Wahlstrom failed to stop another wild one, and Daly scored, making it 2-2. Olson took third and Roy second.

The Engineers were a joyful crew at this time, with good reasons for being so—one down, a man on second and third, and Harry Brown at bat. At this point the Laws took advantage of the darkness and walked off the field, refusing to finish out the inning. The rest of the game has not yet been played off, but under the terms of an agreement entered into by both sides the game will begin exactly where it left off and the inning finished under those conditions.

The lineup for the Engineer-Law tilt was as follows:

Engineers		Laws
Willard Frantz	P	Harold Sturner
Dick Goodridge	C	James Wahlstrom
Dick Daly	1B	Rudolph Swore
Robert MacMurphy	2B	Perry Moore
Buck Roy	SS	Lester Friedl
Harry Brown	3B	Casper Aaberg
Frank Pond	LF	Rudolph Clark
Chet Bros	CF	Paul Carroll
Ed Olson	RF	Samuel Lord

A lot of new material has been unearthed around here, and it is probable that the lineup for the game with the Pillrollers will be altered. There is still room for good players, and any man with pro or semi-pro experience or who has played on school teams is invited to hand in his name to Manager Dick Goodridge.

Professor Bass addressed the Chicago Chapter of the American Association of Engineers on April 15th. Professor Bass is a candidate for the presidency of the society.

The Engineering College was represented in the dramatic contest conducted by the Cosmopolitan Club by Percival Loye, '21, and Clarence Teal, '23. Loye played second mate in the winning Garrick Club production, "Bound East for Cardiff," and Teal played the part of an Arab shiek in the Masquer's play, "Simoon." Mr. Loye also directed the cast and managed the stage in the Garrick Club play.

Students in the Department of Architecture are recovering from the effects of staging their largest and most successful annual Jubilee. Preparation for the festivities began on Monday morning, April 18th, when all classes in Architectural Design were dismissed for the week. Each person reported to the head of the committee on which he had been appointed by Rheuben Damberg, and active work was begun at once. Results were apparent the latter part of the week, when wild-looking Architects, bedaubed with chalk in all colors of the spectrum, were seen moving grotesque-looking sections of scenery from the improvised attic studio to the auditorium. Meanwhile the third floor corridor had sprung into a riot of color and decoration. Drawings representing the best work done by the students during the current year were placed on exhibition. On Friday the Daily generously gave a page to the interests of the Architects.

The costume ball in the evening was preceded by an "open house" and tea dansant in the afternoon. The number in attendance at this function indicated the increasing interest shown by the other students of the University in the affairs of the Architects. The costume ball in the evening was the grand culmination of the day's festivities. Immediately after the Grand March, a playlet entitled "A Rubbing Study" was presented by the freshmen. The playlet, which was written by William E. Willner, Gladys Brouillard, and Glanville Smith, was coached by Ralph Hammett and Clarence Atwood, and gave a very logical explanation of Nero's motive in burning Rome. Several special stunts added to the fun, one of them being a parody on "Il Trovatore" by Roy Papenthien and Frank Moorman. The evening proved to be a very delightful one, and those who enjoyed it were satisfied that the Jubilee is entitled to its place as one of the major events of the University year.

The annual elections of the student branch of the A. A. E. were held Thursday, April 7, in the main auditorium. The officers elected for the coming year were: Loring Slade, president; Walter Nielsen, vice-president; and Hubert Berdan, secretary-treasurer.

Irving Marshman, sophomore Electrical, who was kept out of school during the first two weeks of this quarter by an attack of inflammatory rheumatism, has now returned, and will be able to finish out the year.

A public lecture on Einstein's theory of relativity was delivered by Prof. H. G. Swann of the Department of Physics on Friday, April 8, in the Chemistry auditorium. This lecture, the third of a series delivered under the auspices of Phi Lambda Upsilon, honorary chemical society, was very well attended by the Engineers as well as by the rest of the university public. While we are compelled to admit that we were pretty well fogged up at times, the lecture as a whole was extremely interesting and, coming from a man who had the subject very well in hand, it proved instructive and valuable.

Alumni Notes

M. C. Barnum, M.E. '11, who for the past seven years has been manager and treasurer of the Northern Machinery Company of Minneapolis, has purchased a controlling interest in the company and will be the new president. G. A. Du Toit, Jr., M.E. '10, who has been affiliated with the Minneapolis Steel & Machinery Co., has severed his connection with that company to become associated with the Northern Machinery Co. as treasurer.

Fred T. Paul

Fred T. Paul, C.E. '09, has been elected new president of the Twin City Chapter, American Association of Engineers. Mr. Paul is also president of the Engineers' Club of Minneapolis. Since graduation, Mr. Paul has been continuously in the city engineer's office of Minneapolis, except during the war, when he served in the army. He spent fifteen months in France and was mustered out a captain in the Engineering Corps. During the first two years with the city he was on general survey work; during the last eight years he has been an assistant engineer in the paving department.

Elmer E. Adams, C.E. '06, has been appointed district engineer in the civil engineering department of the central division of the Great Northern Railway, with headquarters at Great Falls, Mont. This district comprises the territory from Williston, North Dakota, to Spokane, Washington. Mr. and Mrs. Adams are also to be congratulated on the birth of a son, John Bennett. They are now living in Seattle, Washington.

O. F. Beeman, Ex. '21, is working for Kelly & Shefchik, an architectural and engineering firm of Duluth. Beeman writes that he likes his work very well and that he is getting some very good experience. After May 1st he will be located at Virginia, where he is to open an office and have charge of a large school construction job.

The Belt Line R. R. keeps E. W. Seeman, '20, busy on concrete and steel design. Seeman has been with the above concern since last July at Chicago and Joliet, Ill. During a recent visit to the "U," he advised the late graduates to "make good fellows of themselves and saw wood."

W. H. Hoyt, '90, of Duluth, chief engineer of the Duluth, Mesaba and Northern railroad, has returned from a seven weeks' vacation spent in Florida and Cuba. Mr. Hoyt was accompanied by his wife and daughter.

J. C. Holland, C.E. '04, has resigned his position as chief engineer of the St. Joseph Structural Iron Works of St. Joseph, Missouri.

We wish to correct some of the errors in the Minnesota Daily of April 22nd, regarding the whereabouts of some of our Architectural alumni. Harvey M. King, '17, has lately been made Professor of Architecture at Oregon, where he has been teaching for the last year. Walter R. Mixer, '17, is connected with the University here in the capacity of Assistant Building Superintendent at the Farm School. George C. Emery, '19, is connected with an architectural firm in Boston, Mass., where he is adding much to his already proficient eastern culture. George attended Pennsylvania last year, but he is still a good Minnesota booster.

An alumnus of the Architectural department, George Fraser, '19, has gained considerable distinction at Cornell University. During the year he has been elected to Gargoyle, the local honorary Architectural fraternity. His campus activities have also been rewarded by an election to Phi Kappa Phi, an all university honorary fraternity which bases its elections on character, scholarship, and record of service to the university. Mr. Fraser has lately won the Warren Prize Competition, a Beaux Arts problem entered into by students of eastern colleges.

Louis Rask, E.E. '03, was a recent visitor at the "U." Mr. Rask gained distinction a few years ago by re-designing the General Electric rotary convertor for railway use, thereby doubling the output for a given size. He is at present connected with the General Electric company at Schenectady, in charge of applying electric propulsion to ships of the merchant marine.

W. C. Beckjord, '09, assistant engineer with the American Light & Traction Co., of New York, is at present stationed in St. Paul, making some engineering reports for the St. Paul Gas company.

Carlos C. Hansen, '20, who has been employed in the St. Paul office of the State Highway Department, has been sent to Aitken to do some special work under the county engineer there. His address is c/o County Engineer, Aitkin, Minn.

R. T. Elstad, '18, is employed by the Oliver Mining company, at Coleraine, Minn., as a mining engineer. Other alumni with the same company are C. S. Johnson, '21, and Leon Battles, '18.

Herbert Kessel, Chem. '18, has severed his connection with Montgomery Ward & Co. He left for California on April 14th and it is rumored that Herb is going to try out the theory that two can live cheaper than one.

Henry M. Lende, '20, is now staying at the St. Paul Y. M. C. A. Lende is in the accounting department of the Great Northern Railway. In a letter recently received by Lende from "Casey" Tufts, '20, the latter tells what a wild town Massilon, Ohio, is. Casey is with the Plate Steel Co.

A. R. Robison, E.E. '09, who was connected with the Mussel Shoals development during the war, is now with the J. G. White Co., of New York, and is at present stationed at Philadelphia.

Don Marshall, '19, and Vance Peterson, '20, are getting along so well improving the manufacture of Ivory Soap, that Procter and Gamble have sent a representative to the university to find more Electrical Engineers and Chemists.

Truman Hibbard, E.E. '97, was elected general manager of the recently organized Electric Machinery Company of Minneapolis.

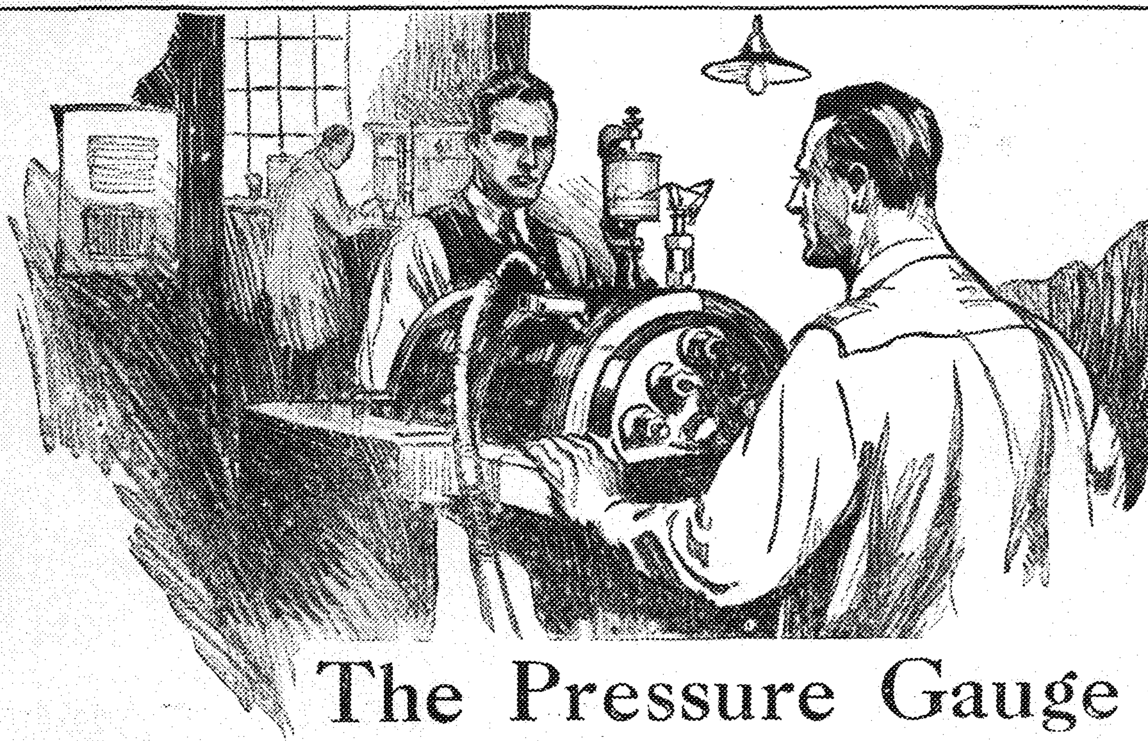
Merle Williams, '20, is now at Harvard, taking post-graduate work.

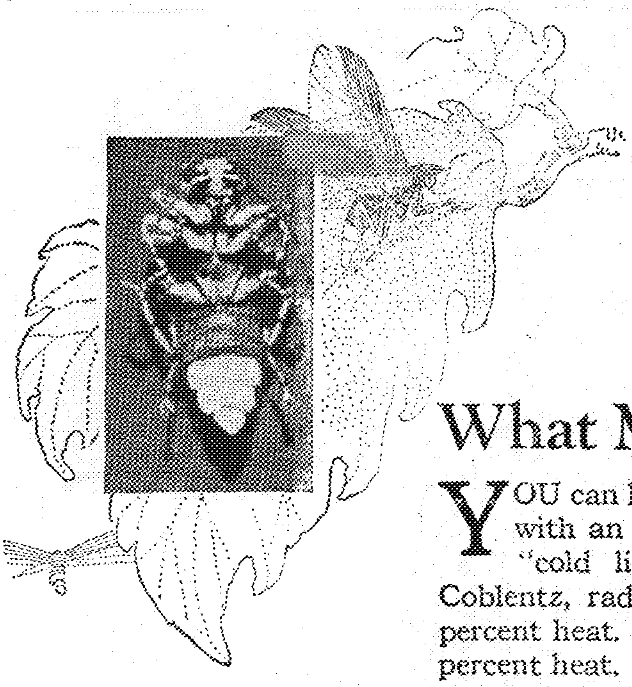
Cecil C. Hurd has resigned his position as assistant advertising manager of the Pillsbury Flour Mills company to become connected with the Ives Ice Cream company, of Minneapolis.

B. G. Japs, E.E. '09, is in the insurance business with the Lincoln Accident and Life Co., Lincoln, Nebraska. He lives at 522 W. 21st St., University Place, Nebraska, and when not writing insurance he raises trap-nested, pedigreed, S. C. Buff Orpington chickens.

Carl E. Lebeck, '20, has been appointed to the position of "Junior Engineer" in the Engineering department of the city of Minneapolis.

E. A. Dehn, C.E. '21, has gone to Portage, Wisconsin, where he will be employed by the General Engineering Co. in making surveys for paving, land drainage and municipal improvements. He will be employed in both field and office.





What Makes the Firefly Glow?

YOU can hold a firefly in your hand; you can boil water with an electric lamp. Nature long ago evolved the "cold light." The firefly, according to Ives and Coblentz, radiates ninety-six percent light and only four percent heat. Man's best lamp radiates more than ninety percent heat.

An English physicist once said that if we knew the firefly's secret, a boy turning a crank could light up a whole street. Great as is the advance in lighting that has been made through research within the last twenty years, man wastes far too much energy in obtaining light.

This problem of the "cold light" cannot be solved merely by trying to improve existing power-generating machinery and existing lamps. We should still be burning candles if chemists and physicists had confined their researches to the improvement of materials and methods for making candles.

For these reasons, the Research Laboratories of the General Electric Company are not limited in the scope of their investigations. Research consists in framing questions of the right kind and in finding the answers, no matter where they may lead.

What makes the firefly glow? How does a firefly's light differ in color from that of an electric arc, and why? The answers to such questions may or may not be of practical value, but of this we may be sure—it is by dovetailing the results of "theoretical" investigations along many widely separated lines that we arrive at most of our modern "practical" discoveries.

What will be the light of the future? Will it be like that of the firefly or like that of the dial on a luminous watch? Will it be produced in a lamp at present undreamed of, or will it come from something resembling our present incandescent lamp? The answers to these questions will depend much more upon the results of research in pure science than upon strictly commercial research.

General Electric Company

General Office Schenectady, N.Y.

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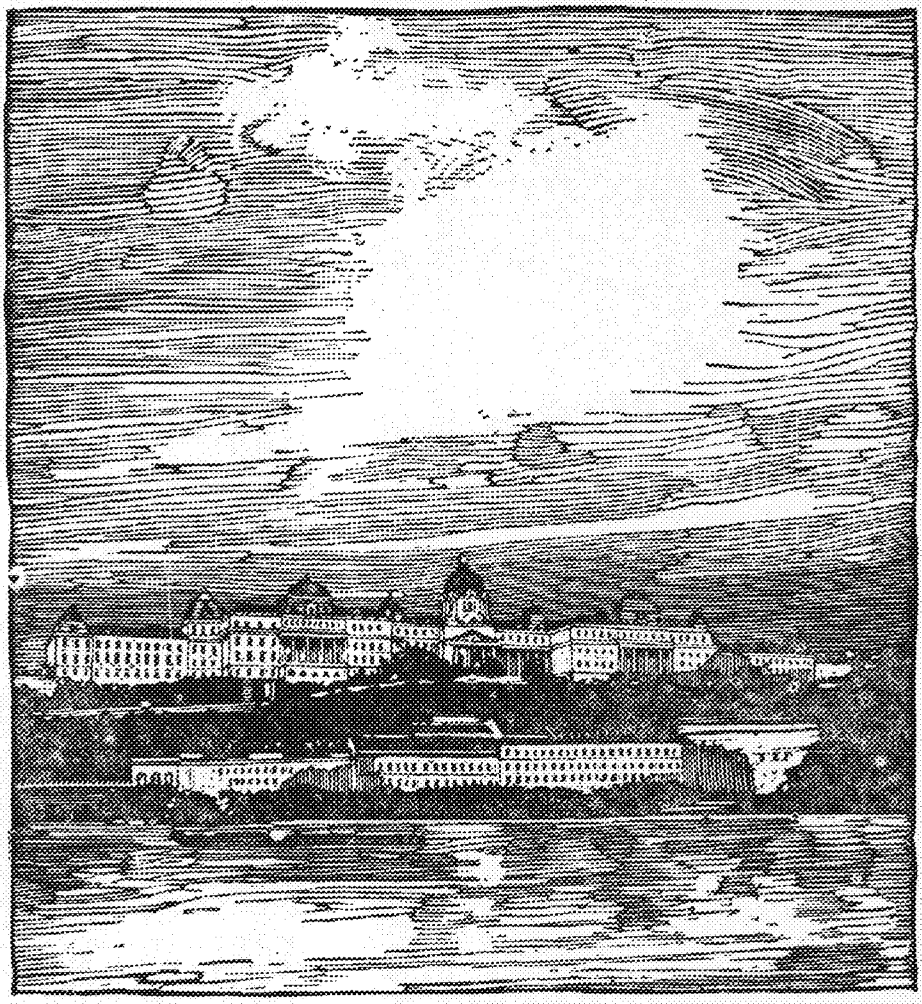
MINNESOTA TECHNO-LOG

Vol. 1 June 1921 No. 8

Lotus Delta Coffmann
President of the University of Minnesota



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VOLUME I JUNE, 1921 NUMBER 8

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The Sanitary Condition of the Mississippi

By Geo. R. Bailey and Paul Koob. B. Sc '22.

We are taking advantage of our opportunity, in this short introduction, to explain the two-fold nature of this investigation relative to the interests of the students of the University of Minnesota and the citizens of the city of Minneapolis. Our primary purpose in making the investigation was to gather data on the advisability of utilizing the Mississippi River for the extensive development of aquatic sports here at the University. In so doing we discovered conditions of which we believe the citizens of Minneapolis should be made cognizant. Thus we are presenting our material with these two objects in view: first, to determine whether, under existing conditions, the use of the river for aquatic sports is inadvisable; and, second, to enlighten the public as to how these same existing conditions effect their welfare.

For several years the proposition to establish a boat course on the river has been a subject of discussion. It has been argued by many that the University is allowing to go unused one of the greatest natural boat courses in the country. This argument has been strengthened by the construction of the government dam, which has converted five miles of river into an artificial lake, thus always assuring an ample sheet of water. At many other inland universities courses have been established and much enthusiasm has been evinced by the students of those institutions over the contests which have become an annual affair. It is generally conceded that no other sport presents so graceful and thrilling a spectacle as boat racing. It requires no great imagination to visualize such a contest as this on the Mississippi between the campus and the government dam. What a day it would be, with the students and public in general thronging the banks of the river, pennants and flags flying, and the long lines of automobiles winding along the River Road to keep pace with the racing shells.

Up to this point all is in favor of establishing the course and commencing the organization of a boat club. But not so fast. A few hitherto disregarded facts or at least facts to which no importance was attached have been lately found to be vital factors in the ultimate analysis of the question.

If you are among those who contend that the course should be established under present conditions there is no argument that will be as effective as a visit to one of the many sewer outlets which pour their contaminating waste into the river along the site of the proposed course. No one who has ever observed the infectious discoloration which pours from the mouths of these immense discharge tunnels would permit themselves to come in contact with the river water. And yet, no one who is at all familiar with boat racing will deny that it is impossible for participants in this sport to keep from coming in contact with the water. The crews, especially when just learning, are continually splashing the water with their oars, which not only is thrown onto the men in this manner but also reaches their hands by running down the oars themselves. From here the consequences of such a condition are easily followed. Men who are covered with perspiration are quite apt to wipe their face with their arms and hands and thus bring the water into contact with their mouth. There is also the constant danger of the shell being capsized and the men thrown into the river, in which case it is almost certain that water will find its way into the mouth.

Relatively few people ever pause to consider what a prodigious amount of sewerage actually enters into the river every twenty-four hours. Just to give you a faint conception of the amount that does enter, we have tabulated the location of the main outlets, the number of house connections and the sizes of all these Minneapolis sewers entering the Mississippi River from Forty-second avenue north to the Old Soldiers' Home at Minnehaha Park. Of these, seventeen discharge at points above the Franklin avenue bridge, and six at the bridge or below it. The estimated population tributary to the sewers which empty above the Franklin avenue bridge is 140,000, and over 100,000 at or below the bridge. The city of St. Paul discharges through nine outlets above the government dam. These are omitted from the tabulation given; but they are of considerable importance, as they are fed by 45,000 people.

Sizes of Sewers Emptying Into the Mississippi
33-in., 18-in. and 30-in.

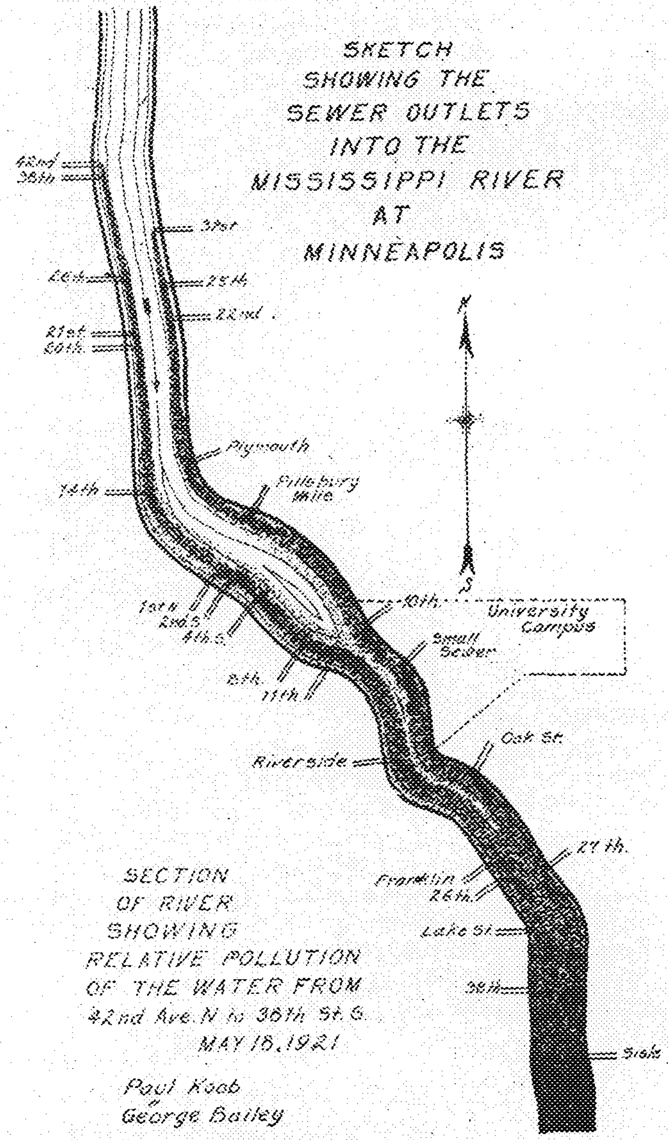
Sewer	No. Connections	Size
42nd Ave. N.	588	
38th Ave. N.	629	
N. M. Tunnel	11,389	
8th Ave. S.	848	44-in. and 36-in.
11th Ave. S.	2,852	72-in.
4th St. S.	2,579	60-in., 18 in. and 24-in.
2nd St. S.	68	24-in.
Riverside Park	29	
Main St.	4,822	
10th Ave. S.	1,546	72-in.
Oak St.	955	96-in.
Franklin Ave.	518	33-in., 18-in. and 24-in.
26th St. S.	9,202	46-in.
Lake St.	1,452	66-in. and 24-in.
38th St. S.	8,236	10-in.

According to the report of the Minnesota State Board of Health, the minimum flow of water in the river, as measured at the government dam on any day when investigations were conducted, was 4,190 cubic feet per second, which is equivalent to about 14.7 cubic feet per second per 1,000 tributary population. The government dam retards the velocity of the river considerably, which permits much of the suspended solid matter contained in the sewerage to settle out above the dam. These solids, on settling to the bottom, form masses of sludge and this is particularly true in the vicinity of the outlets. The decomposition of the sludge is carried on by bacterial action and aid of the oxygen in the water until it is exhausted, and this is facilitated by the higher temperatures of the summer months. On hot days in the latter part of the summer, it is not uncommon to see bubbles of gas arising to the surface and large portions of these submerged sludge masses, which have come to the surface, floating down the river. The floating of the sludge is cause by the gas formed by the live bacteria. Therefore, any floating mass of sludge is a veritable bacteria party traveling down stream. On still days during the late summer and fall offensive odors are noticeable, especially if the river is relatively low, and large areas of the decomposing deposits are left exposed by the receding waater. Since the government dam was constructed, it has been customary to open the gates in the fall and this practice leaves the shores covered with the accumulated deposits.

The offensiveness caused by the sewage in the river, both as an odor and as the thin, greasy scum from the sludge, could be eliminated by the use of screens at each of the sewer outlets; but this would not eliminate the danger of contamination and disease. The only practical method of really making the river safe for all forms of equatic sports would be construction of a tunnel down the middle of the river bottom which would be capable of carrying all the sewage to the government dam. Several methods of treatment would be possible after getting it to this point. It is interesting to note that authorities differ as to the period of life of pathogenic bacteria in natural water courses, the range being from four days to a month. This would seem to indicate that regardless of which extreme was assumed as correct, not only would the river at Minneapolis be in a constant state of pollution, but St. Paul also would be directly affected.

The following is the conclusion arrived at by the Minnesota State Board of Health's sanitation division: "The field investigations and the analytical results show that section of the Mississippi River between the University of Minnesota and the Old Soldiers' Home to be highly polluted and aesthetically objectionable."

As we have stated, the best solution of the problem would be to dispose of the sewage as we have suggested above; but, in view of the fact that sentiment in that direction is rather weak, the only alternative is an educational campaign to enlighten the people as to the danger of allowing themselves to come in contact with the river water. Just as an illustration of how little the people in general do know about the condition of the river, we can cite an instance that happened last summer. One of the downtown firms fostered a swimming meet during July, which was held near the Washington avenue bridge. Among those invited to participate in the meet were the Engineers at the University of Minnesota, who were then in summer school. But, being aware of the danger in taking part and being advised by Professor Bass, of the Municipal Engineering Department, that to do so would be hazardous at the least, they declined to enter the meet if held in the river. Among those who did participate were several young women and quite a number of young men. Fortunately, no direct harm resulted from the meet; but it was a miracle that no cases of sickness did develop. Two years ago, two little girls who were playing along the bank of river drank some of the water with the result that both of them died of typhoid fever. At the time there was considerable feeling over the matter and the papers gave the case a good deal of publicity; but, as with most incidents of this type, it was soon forgotten and there was no action taken to remedy the situation.



There is probably no case in which the river condition affects the public so much as it does in regard to the parks which are located along the river edge from Washington avenue to the government dam. These parks are supposedly laid out on an aesthetic basis, and yet, during the hot days of the summer months, whe nthey are most useful, people who frequent them are at times obliged to put up with the obnoxious odors which emanate from the river. The East River Road Park contains 72.2 acres; the West River Road Park 165.3 acres; the Riverside Park 42.28 acres, and the Minnehaha Park 142.4 acres; so that it is evident that a great many people are affected.

As further evidence of the general ignorance of the public regarding the dangers resulting from contamination of the water by sewage, we are quoting from a letter sent out by the Prospect Park Improvement Assn. "The Prospect Park Improvement Assn. has interested itself in securing the promise from the Park Board to construct canoe racks and motor boat docks along the east bank of the Mississippi River, if they will be used. At a meeting of the association held last night, Mr. B. L. Kingsley, a member of the Park Board, requested that a canvass be made of the entire southeast district, with the view of ascertaining the number of canoe racks and motor boat docks which will be needed for the coming season. The association feels that there is going to be a great opportunity here to enjoy the best boating privileges in the Twin Cities. Will you please give this all the publicity possible so that we may get as many as we can interested. The Park Board will do all the more for us if we will show a little enthusiasm." This letter was signed by H. G. Benton, president of the Prospect Park Improvement Assn. and dated April 25, 1921. There is but one conclusion to draw from this, and that is that it is the result of ignorance, for otherwise it would amount to gross negligence.

Our conclusion in regard to the whole matter is that the river is absolutely unfit for aquatic sports of any sort; that it is unfit for close association with municipal parks, and that it constitutes a menace to the health of any and all persons who come in contact with it. Furthermore, that as in all probability these conditions will not be alleviated, but will continue to grow worse, a public educational campaign should be carried on to warn the citizens of the city against the danger arising out of the present Mississippi River state of pollution.

MINNESOTA STATE BOARD OF HEALTH
Division of Sanitation

RESULTS OF ANALYTICAL EXAMINATION
OF SEWAGE IN MISSISSIPPI RIVER
AT MINNEAPOLIS,
1919-1920

Sampling Point		Total Bact. per c.c.	B. Coli per c.c.	Turbidity	Color	Dissolved Oxygen	Total Oxygen Demand
Camden Ave. Bridge	Max.	21,000	100	20	100	10.6	15.5
	Min.	650	0	5	50	5.2	1.0
	Aver.	4,750	20	13	63	7.9	5.0
Franklin Ave. Bridge	Max.	180,000	10,000	25	100	9.5	15.5
	Min.	22,500	10	10	50	4.5	2.0
	Aver.	89,600	3,100	15	63	7.2	8.3
Government Dam	Max.	425,000	10,000	70	100	11.0	27.0
	Min.	24,500	100	5	45	4.0	1.0
	Aver.	184,000	2,200	17	60	6.5	10.5

Experiences in Flying

By George A. Meyler, Law '21

I was a flying instructor in the American Air Service. I count that the most bitter disappointment in my life. We were all eager volunteers and keen to fight, and we were held in dreary southern flying fields to teach, teach, teach others.

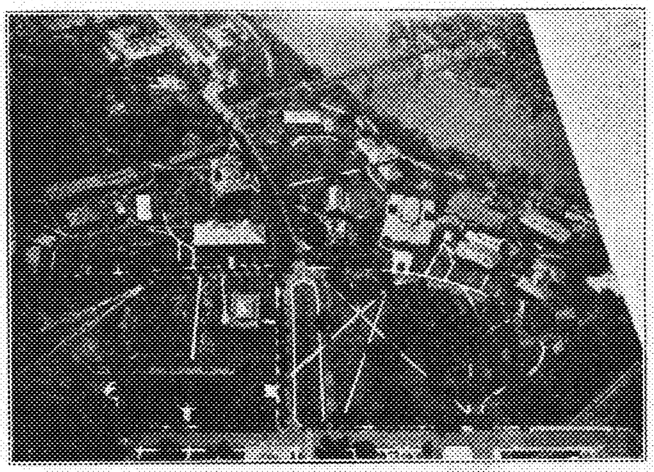
The student in the army aviation schools during the recent war began his work in the Ground School, where he learned nothing of value, and where he was made more or less miserable, depending on the efficiency and dyspeptic temperament of the C. O., a West Point ground-flier or kiwi. After graduation from the Ground School, the student went to dual stage. Here men who had offended the C. O. took him up and taught him the rudiments of the infinitely delicate art of handling a plane. After about two weeks, his chances of wrecking had been reduced from a certainty to a strong probability, and he was sent to the Suicide Club, officially named "First Solo." Here he and thirty or forty other candidates for a military funeral flew alone in a continuous circle, landing frequently. Incidentally, they took chances that a year later would have crisped their hair with horror. At first the solo student concentrated on learning to land his machine and on avoiding collisions.

A week or two later, came second solo with aerobatics and air work. This included spiralling down from 3,000 feet, landing within a hundred foot circle, and making figure eights over two spots on the ground. Flying ability was tested by requiring the student to estimate altitude and distance, land over hurdles and on a mark, and similar tricks. His feelings received a final harrowing from the officer whose duty it was to grade and criticise his work. Then followed four or five cross-country flights to neighboring towns fifty or a hundred miles away, and, if the C. O. was unusually foolish, maps of the country so traversed. That completed the course. If the man was lucky, he received a ten days' furlough to go home and tell his family wonderful lies about flying; if he was not lucky, he was merely commissioned. In either case, he now tasted the bitterness of disappointment. For the rest of the period of the war he either instructed in some camp himself or restlessly toured the country, always going to some new field to study some quite useless course. I ignore the tiny percentage who were fortunate enough to be allowed to engage the Hun in discarded English and French machines. The United States trained some 17,000 pilots between November, 1917, and November, 1918. For their use they built not a single air-worthy plane. Approximately 1,000 saw fighting, of whom 236 were killed, 279 wounded, and 183 forced to land and captured. (Statistics of Central Records office, quoted by Army and Navy Journal.) These figures deserve consideration from those generous critics who say: "The American pilots were all yellow." It has not occurred to these master minds that a reconnaissance or artillery-control plane is not meant to fight any more than a Marine is meant to spit six-inch shells out of his mouth. If any such critic cares to pay for the expenses of a flight, I shall be pleased to convince him, by his personal experience, that cowards avoid the air. The Royal Flying Corps attacked the Hun always and under all circumstances and drew Baron Richthofen's condemnation for their "stupid foolhardiness." Many of them were Americans. We in the U. S. Air Service were no different. Had we been given planes, the Hun would have regretted it.

In spite of the disappointment, the flying itself furnished many amusing incidents. An instructor climbed up on his seat to abuse his student—the student promptly dived and the instructor scrambled back into place, fearing that he might fall out. A pilot carelessly wrecked his machine and remarked to the fuming colonel: "Gad, Colonel! I've broken my wrist watch!" A plane struck and knocked over a latrine, to the discomfiture of the occupants. I was always content while flying, for there were the magnificent view, the perspective, incomparably superior to any mountain view, the exhilaration of the rush through the air, the sense of power one feels in ability to stunt, to tumble and sport in three dimensions, and the ever present tang given by the realization that there was danger, constant danger.

War flying can be divided into four classes. The reconnaissance planes constantly observe and watch the enemy, take photographs, report on troop movements or construction of any kind. The artillery control direct the fire of the batteries and report whether the shots fall short or pass beyond target or fall to the right or left. They used wireless telegraphy in this war; next time it will be wireless telephones. The bombing is, in my opinion, the most scientific arm. The navigation of the bombing plane is more difficult, and, from constant experiments with oranges and an automobile, I know how hard it is to hit a target from a plane. The combat planes escort the others and fight whenever they can find a chance. They are single-seater planes, with very powerful motors, and can attain a speed of 130 or 140 miles an hour—200 miles an hour when reported in the magazines. I was trained for a combat pilot; but instead of a 180 h.p. motor in the single-seaters, we had only 100 h.p.

We had a lot of fun with them just the same. Some cows wandered into the field one night, and a night pilot ran into one. We ate the cow (she was very tough) and kidded the pilot, who had a mashed face. Then we'd chase niggers. They were very much afraid of the planes, and any pilot who cared to dive within four feet of the ground could run them bowlegged. This gentle art was very popular in Park Field, Tenn. "Game" was too scarce in Florida for us to practice much. In San Antonio, in the fall of 1917, a brigade of the first draft were staging a rather shaky brigade review. Two planes dropped on them and scattered them from hell to breakfast. The pilots were careful not to turn broadsides to the reviewing stand and the powerful glasses of the staff, and so escaped with their numbers unknown.



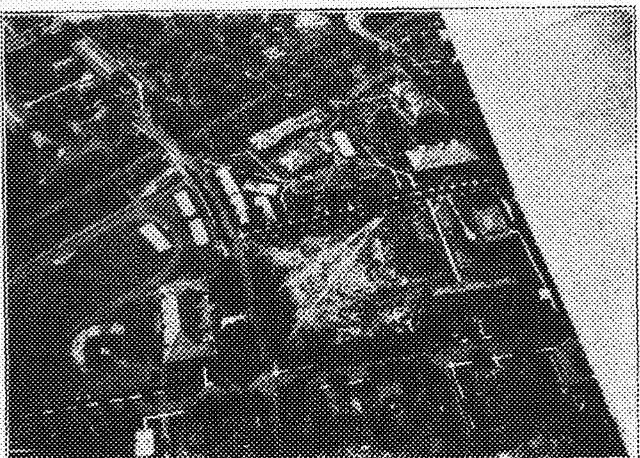
University of Minnesota Campus from the Air

Things hummed around Kelly Field for a few days, as they tried to persuade the culprits to convict themselves.

The real fun began, however, when we took the combat courses, and under the lenient control of Major Peterson, of the LaFayette outfit, could fly as wildly and shoot as recklessly as we pleased. We carried machine guns synchronized to shoot through the propellor. We practiced marksmanship on parachutes, on canvas cones towed behind another plane, and on the Florida cattle. When a beginner tries his hand on a tow-target, passing at right angles, he usually swings around until he is following the target plane—and his bullets are interesting its occupants. This seldom happens twice if the instructor in the target ship is allowed a few moments of uninterrupted conversation with the offender. Once when I was waiting for a student to come and bombard my shadow, I entertained two passing cowboys for a mile or so with stunts and low flying. They waved their hats and grinned at me. Suddenly, behind me, I heard the pup-pup-pup of a machine gun and saw the dust spurt around those cowboys. I opened my throttle and removed my shadow from their neighborhood. When the student had finished, I returned. They did not seem pleased to see me. Another day, I was locating parachutes which had drifted away from the Field. I located two in a marsh. The picker-up in the auto reluctantly stripped and waded in to retrieve them.He was neck-deep in water and 300 yards from land, when the familiar pup-pup-pup sounded and the bullets splashed around him. I whipped underneath and behind the student, so that he could not shoot my shadow again, and held that position until he took the hint and left. I've often wondered what the wader thought.

It is very hard to hit a target with a synchronized gun. The turret guns one can aim much more accurately. A bombing pilot of the Independent Air Force told me, with a holy joy, how he found a Hun division on the march one dawn and utterly ruined their formation. A target no bigger than a man is hard to hit at 1,000 feet; it's best to dive to 50 or 100 feet and give him a burst from there. One pilot had a forced landing on a part of the prairie devoted to parachute work. For half an hour he crouched under his motor and cussed his mates, whose bullet streams were spraying around him.

The wireless phone was greatly developed. Each plane in this group trailed 200 feet of copper wire and could talk or listen. The leader would direct the maneuvers of the flight. One day the major's wife picked up the ground receiving set and listened in just after a student had misunderstood an order and barely missed ramming the leader. I've heard that man when he was annoyed, and I'm not at all surprised that the major's wife smashed the set and spent a week trying to find out who had ben speaking.



Northrop Field and Parade, University of Minnesota

There were several collisions between planes or planes and parachutes, many wrecks, and a few deaths. I have heard it alleged that there are more casualties now than in war flying. I doubt it. When a man was killed during the war, his death was accepted without comment, and only his family and circle of friends knew of it. Now such a crash is press-agented by everyone who saw it or heard of it.

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I have no doubt that some day flying will reach the stage that the papers say it has reached now; but very many more pilots will have been buried by that time. There are such a multitude of things, any one of which may cause a crash. As for the future of aviation, I thought two years ago that the plane was eminently fitted for a war weapon and for fire patrol over the forests. I've seen nothing in the U. S. A. to make me qualify this belief. All the civilian flying has been circus stuff and passenger hops. I believe a majority of the pilots, the men who know the limitations of present day aircraft, share my doubts of a big commercial future for aviation. I've seen some who held contrary opinions converted; but none of the doubters have changed their minds. Some talk of immense mechanical improvements. When they come I shall reconsider my opinions—not before. The papers talk and talk, but not a single thing has been done in the U. S. in the past two years that could not have been done in 1917. The DeHavilland and the Curtis, on which I learned three years ago, is still the commonest type by far. Of European developments of aviation I cannot speak—I do not know.

Flood Problems in the Province of Chih-Li in North China

Continued from the May issue

By Sigurd Eliassen, B. Sc. '18

The bottom of the gorge is flat, the soil being clay. During low stages the river meanders irregularly over the flat bed. The slope of the bed through the gorge is approximately 0.006.

Immediately upon leaving the gorge the river spreads out to a width of three miles and where it is crossed by the Peking Hankow Railway it has a flood width of nearly five miles. The railroad has naturally had great difficulty in maintaining its bridges. A flood of more than average magnitude invariably washes out one or more of them and through-traffic on the road is usually suspended for months after. In 1917, when the maximum flood flow reached something like 350,000 c.f.s., three spans were washed away and regular traffic was suspended for more than a year. The largest flood in the memory of living man occurred in 1853, the same year that the Yellow River broke through towards the north near Kaifeng and drowned 250,000 people. Information of that year's flood leads one to believe that the Hu Tuo Ho can have a maximum discharge of 700,000 c.f.s., which is approximately equal to the discharge of the Mississippi at St. Louis during average floods..

High ground exists on the south side of the Hu Tuo Ho right down to the railroad. On the north side, however, after the river has left the gorge mentioned above, the ground becomes low and some of the flood water undoubtedly finds its way into a neighboring river to the north, the Tzu Ho, and from here into the Ta Ching Ho. This seems to have been the case in 1917.

Having passed the railroad, the Hu Tuo Ho is confined between dykes. Its present channel runs literally on a broad ridge, there being low land both to the north and to the south of it. Dyke breaks on this stretch have been very frequent, and the different courses the river has taken are numerous. Its silt content is mixed with much fine sand, and the deposits left on the plain after dyke breaks has made the soil very sandy and of poor quality. In years of scanty rainfall the farmers get no crops at all. The present year (1920) is a striking example.

No thorough study has yet been given to the Hu Tuo Ho problem; but it seems to be the opinion of engineers somewhat acquainted with the conditions that a radical solution of the problem can only be found in an extensive retarding reservoir system in the mountains, designed to lower the peak of the flood crest. Such a method of flood control would undoubtedly be a costly procedure, but designed in conjunction with a plan for irrigation it would be a blessing to the farmers inhabiting the district along its course between the railroad and Hsien Hsien. The Hu Tuo Ho runs, as already mentioned, on a ridge and is thus ideally situated for a main irrigation canal.

The Fu Yang Ho.

The Fu Yang Ho, the southern tributary to the Tze Ya Ho, is of a more self-regulating nature than the Hu Tuo Ho, due to the existence of a low area on its upper course which, during floods, becomes a huge lake. Its head-waters are composed of a number of "flashy" streams, of which the Sha Ho and the Ti Ho are the most noticeable. All the streams come together in the low-lying district, called the Ning Chin Po, which in successive rainy years becomes a marsh, but which in years of ordinary rainfall is very fertile.

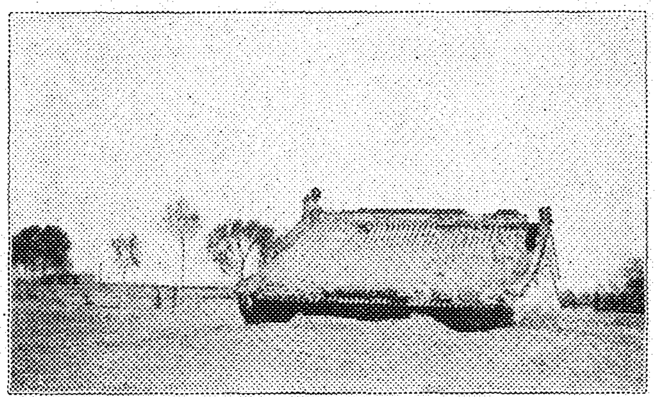
The natives have wrestled with the river problem in this district for thousands of years back, and records from old tablets show that all sorts of schemes have been tried out unsuccessfully.

From Ning Chin Po the Fu Yang Ho flows northeastward for 150 miles and joins the Hu Tuo Ho at Hsien Hsien. It receives no tributary on this stretch and is dyked the whole way. The Hu Tuo Ho occasionally breaks through at one place or another into the lower reaches of the Fu Yang Ho and the dyke system has therefore not been kept in a very efficient condition. The flood flow of the Fu Yang Ho has not been measured, but it is probable that it may approximate 200,000 c.f.s.

No study has yet been given to the Fu Yang Ho problem. As in the case of the Ta Ching Ho, two alternatives suggest themselves; namely, to encircle the low area of the Ning Chin Po with regulating works at the outlet to Fu Yang Ho, or to build an extensive reservoir system in the mountains.. The last scheme, if feasible, would do away with the marshy condition of the low land during rainy years and would ensure an ample supply of water for irrigation during years of deficient rainfall.

It was previously mentioned that the cause of Tientsin being flooded in 1917 was mainly due to the tremendous amount of flood water being carried down by the Hu Tuo Ho and Fu Yang Ho. The water overtopped or broke through the banks at the confluence of the two rivers at Hsien Hsien, inundated the whole of the country between Tzu Ya Ho and Nan Yun Ho and followed a number of abandoned courses of the Yellow River to Tientsin. As the dyke system round Tientsin had not been kept in order, the flood water found its way unhindered right into the city.

One of the immediately contemplated projects is a defluent canal from Tzu Ya Ho at Hsien Hsien running in an east-northeasterly direction to sea. It would cross the Nan Yun Ho or Grand Canal at



Ancient Temple buried in Silt

Chieh Ti and utilize the Chieh Ti Canal from Nan Yun Ho to the sea. This project, which would efficiently guard Tientsin from any recurrence of the 1917 disaster, would not, however, mitigate the flood evil in the interior of the plain. Other more extensive projects would be necessary to accomplish this.

The Nan Yun Ho Problem.

The fifth important river flowing into the Hai Ho at Tientsin is the Nan Yun Ho or Grand Canal. It has its origin in the province of Honan, not very far from where the Yellow River enters the plain. From Lin Ching to Tientsin it is styled the Grand Canal, while above Lin Ching it is called the Wei Ho. The Grand Canal, coming up from the south, crosses the Yellow River, continues northward and enters the Wei Ho at Lin Ching.

It is often heard that the Grand Canal is an artificially dug waterway from the Yellow River to Tientsin, but it is more reasonable to suppose that at the time of constructing the Grand Canal the Wei River already existed and was utilized as a part of the program of canalization.

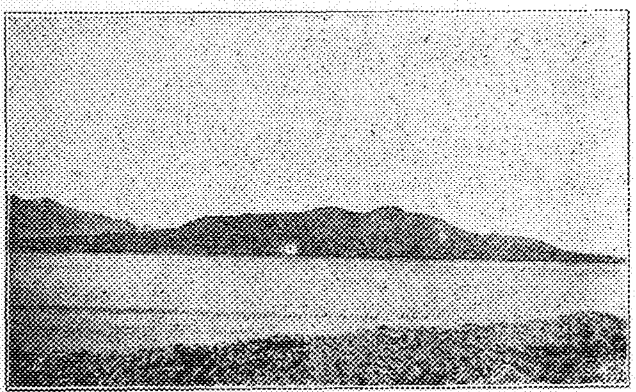
The Wei River, on its way across the plain, is joined by many important tributaries, the Chi Shui Ho, the An Yang Ho and the Chang Ho, of which the last one is by far the most important, in that it not only contributes the greater portion of the flood water, but also it is the chief silt carrier. The Wei Ho is dyked nearly the whole way from where it crosses the Peking-Hankow railroad to Tientsin. In many places before it reaches Lin Ching, it utilizes for its southern dykes the northern dyke of one of the many dry courses of the Yellow River. The dyke system as a whole is rather inefficient, which is only to be expected where the river course is nearly 800 km. in length along the dyked portion.

The method followed for dyke maintenance of this, as well as the rest of the rivers in the Chih Li province, is to forcibly proportion the repair work amongst villages in the Hsiens, or districts through which the rivers flow.

In some districts the officials are lax in keeping the dykes in good repairs and it therefore often happens that the water during floods overtops or breaks through banks and floods neighboring districts which have kept their part of the dykes in good order. When the government in Peking is weak and lets the Hsien officials run things pretty much their own way, it is, of course, hopeless to have an efficient dyke system. It has, therefore, often been said that floods are the result of bad government.

The most noted flood districts along the Wei Ho are the districts surrounding the confluences of the main tributaries. Here the slope of the river flattens out, the flood heights are increased by the slowing up of the velocity, overtopping takes place and when the water first gets outside it fills the valleys between the rivers and remains there for months. Generally it can only disappear by percolating into the ground or by evaporation.

Beyond dyke building, the Chinese have given little thought to the flood problem of the Wei River above Lin Ching, but below Lin Ching the flood water materially interfered with navigation of the Grand Canal, and to overcome the effect of floods as speedily as possible a number of defluents have been excavated leading from the river directly to the sea. The defluent channels are in order from Tientsin.



1. The Ma Chang Canal.
2. The Hsing Chi Canal.
3. The Chieh Ti Canal.
4. The Ssu Nu Ssu Canal.

Of these the Ma Chang Canal was designed both as a military transportation canal and as a defluent. The Hsing Chi and the Chieh Ti Canals were designed as defluents only. The Ma Chang Canal is still in use, though it is badly silted up. The Hsing Chi, Chieh Ti and Ssu Nu Ssu Canals are now practically valueless as defluents, although an attempt was made in 1919 to excavate the Ssu Nu Ssu Canal. The latter utilizes for the greater part of its length an abandoned channel of the Yellow River.

The control of the Nan Yun Ho seems to lie in an efficient upkeep of its dyke system and in keeping the defluents excavated to their original cross sections.

The tributary Chang Ho will probably have to be treated separately in the same manner as the Hu Tuo Ho and the tributaries to the Chu Lung Ho, namely, by checking the run off by a system of retarding basins in the hills.

The great alluvial plain of Chih Li suffers almost continuously from either floods or from droughts. Years when rainfall is evenly distributed through the summers are almost the exception. Utilization of ground water for irrigation is very common in some districts, in others one may travel for long distances without seeing a single well outside the ones in the villages, in spite of the fact that the level of the ground water is nowhere more than 15 to 20 feet below the surface of the ground. The soil is inclined to be "alkali" on account of the heavy surface evaporation and extensive capillary action; but this is greatly reduced where the fields have been mulched or ploughed after the harvest.

Viewing the flood situation as a whole, it is in its major phases similar for all the rivers, differing only in degree. It is the case of a tremendous volume of heavily silt-laden water coming rushing down from the hills and suddenly entering a densely populated plain where the dyked-in river channels are far from sufficient to hold the flood water.

If it were a question only of protecting Tientsine alone against a recurrence of the 1917 disaster, the problem of flood relief would be a relatively simple matter; but the problem, as the writer sees it, is to protect the whole plain from the frequent floods and at the same time to combine the flood control problem with a scheme for irrigation to overcome the droughts that now and again sweep over the country. In order that such a scheme may be realized, it is not enough to provide for a channel system of sufficient capacity from the foot-hills to the sea. The main solution for combating the flood evil must be sought in the hills, where the evil originates. It must be nipped in the bud in the manner frequently mentioned during the description of the physical character of the rivers, namely, by a system of retarding reservoirs in the hills.

This is urged for the following reasons:

1. The tremendous flood discharge lasts only a short while, and it is a question only of taking the peak off the flood crests, reducing the flood to one of normal magnitude.

2. The Chinese, during normal years, gather two crops a year. The first harvest is gathered early in June and the second during the last part of September or beginning of October. The spring is usually deficient in rainfall, the critical periods being April and May. The flood periods come invariably during July and August. It may therefore be possible to fille the reservoirs during the autumn, when rain still falls, and keep it there until the spring, when they may be emptied to provide flow for many of the otherwise dry river courses, from which water for irrigation may then be obtained. By the middle of June the reservoirs will be empty and ready to check the summer floods.

It is often the case that flood control projects and irrigation schemes are conflicting problems. Not so in North China. Here the two problems go together.

ittle study has yet been given in China to this form of flood control. The main eorts have up to now been directed to give immediate relief to the most affected districts in the plain by dyke building and diversion of a part of the flood water. Of course, even with a system of retarding reservoirs in the hills, it will be necessary to provide for an efficient channel system through the plain, for it must be remembered that floods in the tributaries to the rivers of the province of Chih Li are liable to be synchronous, which means that the lower reaches of the rivers will receive a tremendous amount of water even if the flood crest has been considerably reduced.

The chief argument against flood control by a retention basin system is that the life of the reservoirs will be short, due to silting up. This may or may not be the case, and will depend on the location of the reservoir and the above-lying loess deposits. Without an investigation, it is futile to speculate over the life of a reservoir. Only this much may be said: Floods of a magnitude that carries down silt sufficient to fill a reservoir to any marked extent occur perhaps not oftener than every tenth yeaar. If the reservoir capacity is reduced by one per cent after each such flood, the useful life of the reservoir may perhaps be more than 300 years, a period sufficient to warrant the undertaking.

Present Investigation of the Flood Problem.

The Chih Li River Commission.

The 1917 flood naturally lead to a popular clamour for flood control measures both on the part of the Chinese and the foreigners,—the foreigners being mainly interested because of the danger to Tientsin, especially as regards the relation between the Yung Ting Ho and the Hai Ho. During the winter of 1917-1918, a special bureau was established called the Bureau for Flood Relief and conservancy, with ex-Premier H. E. Hsiung Hsi Ling, a very progressive Chinese official, as director general and with Mr. Jameson, an American hydraulic engineer well known in China, as its chief engineer. The bureau was granted $100,000 for investigation surveys. From January to April, 1918, a number of traverses and level lines were run along the most important of the rivers in the province of Chih Li. Cross section of the rivers extending about half a mile on either side of the river were taken about every quarter mile. Several profile lines were run across the plain along routes where new outlets or defluents were contemplated. Altogether, four survey parties were sent in the field and the information they obtained only strengthened the idea that the problem was one of great magnitude and difficulty. Little time, however, was given to a solution of the problem in hand, as Mr. Jameson became seriously ill and had to return to the United States in the early part of May.

It was evident, however, that an organization stronger financially than the bureau of Flood Relief and Conservancy was necessary if the problem were to be attacked successfully. In June, 1918, by combined efforts of prominent Chinese and foreigners, the Commission for the Improvement of the River System of Chih Li or, as popularly called, the Chih Li River Commission was organized. The board consists of some of the best known foreign hydraulic engineers in China and some very prominent Chinese officials. Ex-Premier H. E. Hsiung Hsi Ling is the president.

After half a year's work, the Commission decided to make a complete and exhaustive study of the whole problem and to evolve a Grand Scheme of flood control. Some minor relief measures, however, were immediately called for and a sum of $3,000,000 was granted by the Chinese government for this purpose, from surpluses of the Chinese Maritime Customs and the Salt Gabelle. Of this sum, about half a million dollars were to be used for surveys and the rest for pressing flood preventive works. In August, 1920, the Commission was granted a monthly sum of about $45,000 from the Chinese Maritime Customs for carrying on the investigation work for a period of three years or until completed. A noted irrigation and flood control expert from India, Mr. F. C. Rose, formerly secretary of public works in India, has been engaged by the Commission as its technical adviser and chief engineer. Mr. Rose is also a member of the Commission.

The Commission has organized three departments:

1. The Topographical Survey Department;
2. The Hydrometric Department;
3. The Works Department.

The Survey Department was the first department established by the Commission.

There exists a number of very good sketch surveys of the province of Chih Li, notably that done by the Germans in 1905. The British has its general staff map of the whole of China drawn from various sources. The Chinese military staff has part of the province surveyed; but unfortunately their work has been found to be very unreliable and is used by the Survey Department only as a general guide for direction of its survey parties. It contains all the names of the villages and has the rivers located fairly correctly on it. None of the maps have contours or even elevation marked on them to a degree of usefulness. In other words, a topographic map in the real sense of the word did not exist, and the Commission decide to make a complete map of the plain with contour intervals of one-half meter. Due to important immediate flood relief measures, which the Commission contemplated to undertake as soon as possible, the Survey Department had to confine its activities in 1918 and 1919 to surveying, as speedily as possible, a number of the more important rivers in the northern part of the plain from where they leave the mountains to the sea. The topography of the river surveys extend to two kms. on ither side of the center line of the river. Cross sections have been taken every 500 meters and oftener when necessary. A double line of levels run in one direction form the vertical control. Chained traverses form the horizontal control.

Although the surveys have not been entirely satisfactory, they are by far superior to any of the existing surveys of the rivers, and have sufficed to enable the Commission to draw up plans and estimates for the more immediate flood control measures.

The writer was appointed Inspector of Surveys for the department in February, 1919, and has been with it ever since. In December, 1919, Mr. H. B. Merrick, formerly professor of surveying at the University of Michigan, was appointed engineer in charge of the department. Mr. Merrick had previously been principal assistant engineer with the Grand Canal Improvement Board in Tientsin.

In charge of the Works Department is Mr. R. D. Goodrich, a graduate of the University of Michigan, also from the Grand Canal Improvement Board.

The field staff is composed entirely of Chinese engineers. All draftsmen and computers are also Chinese.

Chemistry, the Heart of Industry

By RAYMOND E. KIRK,
Asst. Prof. of Inorganic Chemistry

Standing one day with the assistant superintendent of a large plant on a hill commanding a view of the entire works, I commented on the admirable way in which it was laid out. I had noticed the storage houses for raw materials, the buildings for each operation, and the storage houses for finished products. Prominent in the background was the power house with its chimnys crowned with light-gray wreaths of smoke.

But the assistant superintendent directed my gaze to a long, low structure, almost hidden among the larger buildings, and said: "There is the heart of the plant." It was the laboratory. "We can get along without any other part of the plant, but if that building be destroyed we shut down at once." Each operation of the plant was not only directed by chemical knowledge, but checked by chemical skill. Only by continuous functioning of the laboratory were the operating officials assured of uninterrupted, safe and economical operation.

The words of this plant official are symbolic of the relation of modern chemistry to modern industry. But yesterday the function of the chemist in industry was to make analysis of raw materials and, perhaps, finished products. These analyses were oftentimes limited to a very few determinations and were intended to establish whether the material met certain very meagre specifications. And these specifications, if not inadequate, were very often arbitrarily chosen without adequate knowledge of their worth. Nor were these analyses the final factors in determining the acceptance or rejection of materials.

But in modern industry we find a very different situation. Each process is carefully studied from the standpoint of the chemical actions involved and carefully controlled by chemical means. Continuous chemical control is essential to all operations having to do, (and what ones do not), with chemical changes. Why wait until pounds or tons of material have completed a transformation and then junk or re-work them because they do not meet specifications? Each company maintains a staff of research chemists to study and improve old processes and to investigate and devise new ones. Each new process is first tried out in the research laboratory, then developed on a small scale, and finally perfected as a plant operation. Plant operations are controlled by a corps of control chemists and are supervised by skilled industrial chemists.

In each group of chemists we find specialists in various divisions of chemical knowledge,—divisions, oftentimes, quite arbitrarily created. We find analytical chemists, physical chemists, organic chemists, bio-chemists and chemical engineers.

But, whatever their designation, the presence of chemists in industrial plants tells of the recognition, by the leaders of modern industry, of the fact that the materials undergoing change deserve the same scientific study and care that has long been given the machines used in the operations of industry. The science of chemistry is being called into industry as was the science of physics. And the reward to industry is in increased production and lowered costs. The companies who survive the present critical conditions will be the ones which have utilized to the fullest extent all the economies of method and operation possible.

It is of interest to note the influence of this new position of chemistry in industry with reference to the subject matter of collegiate courses in chemistry are being more and more stressed at the expense of new descriptive matter, quantitative expressions are being used and mathematical statements of chemical laws employed to supplement general statements. Chemical calculations find a place in even the most elementary courses, and the expert chemist must be an able mathematician as well. After thorough training in the general principles of chemistry, some attempt is made to illustrate at least a few of the manifold applications of chemistry to industry.

Although only a few years have passed since chemists have been employed, in such numbers, in supervisory positions, quite a number of chemically trained men already found their way into executive positions. This appearance of chemists in the "front office" is but a phase of the general movement toward placing technically trained men in executive positions previously filled only by so-called "business men."

So, from raw material to finished product, and from laboratory to office, we find chemists and chemical ideas permeating industry as never before. Much remains to be accomplished, and many plants operate with no chemical supervision; but already, in many of the progressive plants, we find chemistry to be the heart of industry.

Another Small Nation.

A Kansas man is reported to be the father of thirty-two children. It is not known whether he will apply for admission to the League of Nations or just let America represent him for the present. —Punch (London).

MINNESOTA TECHNO-LOG

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EDITORIAL

"The King is dead. Long live the King."

With the publication of this issue, the TECHNO-LOG completes the first year of its existence, and introduces to the College of Engineering the work of the newly appointed 1921-22 staff. Among those to whom the magazine is most deeply indebted is M. F. Wichman, to whose unaided efforts the first issue for 1921 was entirely due. In severing his connection, Mr. Wichman has assured the incoming staff of his whole-hearted support, the kind of help which will make the publication a real force on the campus. P. R. Wilson, Electrical Editor, will graduate this spring, and he leaves a place hard to fill with a man of equal ability and faithfulness. LeRoy A. Grettum leaves the TECHNO-LOG for a wider field of usefulness on the Minnesota Daily, where his work has already attracted the same attention and favorable comment as it has in our pages for the past year.

The financial success of this year's work is to be attributed very largely to the efficiency of Norman Moore, whose services we are fortunate to be able to retain, and to the work of C. M. Glidden, one of the departing members.

In general, the policy of promotion has been followed in forming the new staff. John M. Newman, whose excellent work has been generally recognized, becomes Circulation Manager, and C. T. Skarolid succeeds to the position of News Editor. Among the particularly valuable members of the staff who will continue their present activities are Miss Betty Sullivan, Chemical Editor, and Lester M. Bergford, Alumni Editor.

Special mention should be made at this time of the valuable and willing help given us from time to time by Alfred Green and Arthur Zimmerscheid.

OUR PREXY

The University of Minnesota has received the congratulations of the whole United States upon its inauguration of Dr. Lotus D. Coffman as president. The choice of President Coffman is one which appeals particularly to all Engineers. The Board of Regents have given us a school man for a school man's job. President Coffman has devoted his life to the business of public school management. At the University of Illinois, as Dean of the College of Education at this University, and as Director of Rehabilitation Education under the Federal Government, his work as an educator and administrator was marked by signal success and achievement. Compared with Universities which are directed by amiable clerical gentlemen or by distinguished chautauqua lecturers, Minnesota is the envy and admiration of all thinking men.

AQUATIC SPORTS ON THE MISSISSIPPI

"Look out below," was the cry with which the seventeenth century Englishman warned the passers-by in London streets that he was about to throw household slops out of the upper windows into the open gutter in the street which served as the sole means of drainage for the whole city. Resulting accidents, the stench of the city, and the resulting plagues and pestilences are better imagined than described. Minneapolis does not even cry "Look out below." Without a word of warning it pours out a vast, turbulent, disease-laden stream of household slops upon the natural playground of its children, and urges its youth to plunge into the putrefying mass of slime and nastiness.

The scientific facts, ably presented by George R. Bailey and Paul C. Koob in the article entitled "The Sanitary Condition of the Mississippi River," which is published in this issue, are shocking to every citizen who is at all interested in either sanitary or aesthetic matters in Minneapolis. If it were necessary for a city to so pollute a noble stream, the matter would not deserve mention; but modern sanitary engineering has rendered unnecessary this primitive practice of permitting refuse to be an offense in the nostrils of the world.

Baltimore, Milwaukee, Columbus, Atlanta are among the municipalities adjacent to large bodies of water which dispose of their sewage in such a way as to be both safe, decent, and hygienic.

The significance of the whole must not be overlooked. The nauseating odors that steam up from the river all through the summer will more and more diminish the value of river-side property and destroy the usefulness and beauty of the park and boulevard system of which we are so proud. Furthermore, river water containing the slightly diluted sewage from thousands of human beings is a death trap for every person who comes in contact with it.

Canoe racks? Rowing regattas? Swimming contests? Homes on River Roads?

Not until the cess pool has been removed and the river redeemed.

COMMUNICATIONS

The editorial in the March number of the Techno-Log prompts the writer to call attention to some fundamental principles involved in the taking of notes on material presented in class or lecture room.

When a lecturer or other teacher makes an address to students, whether it be a formal lecture or a discussion of topics connected with a recitation, the presumption is that he is presenting matter not otherwise readily available to the student. Barring the occasional offender who may prefer talking to conducting a real recitation, teachers generally recognize that it is both easier and more efficient as to time and effort of both student and instructor if a subject is taught from a textbook (even though it be somewhat out of date or otherwise imperfect) than if it is taught by lecture. It is, therefore, a fair conclusion that when a teacher presents material that is not in the textbook or is not otherwise readily accessible to the student, he does so from the conviction that such material is worth the effort of preparation, presentation and preservation.

The attitude of the student toward such presentation of material is varied. His appreciation ranges from recognizing its worth to considering it as a time-killer. He aims to discriminate between that which is of transient value and that which should be preserved, and should cultivate such discernment as an important part of his education.

The best method of preserving information imparted by lecture or by less formal remarks will naturally vary with the situation. The same holds true of information gathered from reading or otherwise. Much of such material may be absorbed in the more or less unconscious memory and become a part of ones general fund of information. On the other hand, one should not burden his memory with other information that is none the less valuable, such as most mathematical derivations, data and references to original sources of information, or to other available literature.

Whether one should make rough "field notes" at the time of the lecture and write them up more carefully afterward, is likewise a question for judgment. It is usually desirable that one take notes of important items presented in formal lectures, whether or not syllabi have been previously prepared and distributed.

It is a good plan for any Engineer or other student not only to acquire a fund of information, especially as to sources of information, but also to develop a plan for the systematic preservation of such information so that it may be readily accessible. This involves some sort of a system of record and classification which may be expanded without loss or transcribing. Material that supplements textbooks may well be preserved by notes written on the margins or on inserts of thin paper pasted between pages. A well annotated textbook is one of the most valuable parts of an Engineer's equipment. Much material will be gathered that does not readily find its best home in a textbook, and for such a definite place should be provided. Bound notebooks are convenient, but they are apt to become outgrown, and soon the material on a given subject is scattered through several books of differing sizes and styles. Loose-leaf notebooks lend themselves to better classification of material and to indefinite growth, but the sheets are liable to tear out and to be displaced or lost. I have found much satisfaction in the use of cards or sheets of paper of postcard size (3x5 inches) which may be preserved in envelopes classified by subject, these being subdivided from time to time as the material on a given subject warrants. A great advantage is that one may quickly gather up and take to a library or elsewhere practically all of his working material on a given subject.

Whether the student should be required to take notes, and whether such notes should be weighted as part of his standing, are questions for discussion. The teacher is likely to take the position that if the student does not appreciate the value of what is offered to him, it is the student's loss. It is also somewhat distasteful to a teacher to require students to make notes, though the paucity and general character of such notes are apt to be both disconcerting and illuminating to the lecturer. The general attitude of the writer is that the student should be held responsible for everything included in a course, whether offered as assigned lessons in text, in explanations by remark or lecture, by problems or by laboratory experiments, the student being rated by results more than by his method.

Geo. D. Shepardson,
Head Dept. Electrical Engineering.

Lest We Forget.

"How about this place, Jack?"

"Fine."

All right, me lucky lads, here we are again. The old firm. The old reliable, me lucky lads. The old reliable game of doozle and buck, the more you put on, the more you pick up. I said the more you put on, the more you pick up, and if you don't speculate you can't accumulate, and a faint heart never won a fair lady. We're here today and away tomorrow, and it's the only show on the ground, so gather 'round and see fair play. I'm old Johnny Fair-Play, all away from Holloway. Ha! Who says a bet on the Old Major? Jolly good bet to you, sir. Who says a bet on the lucky old diax, the old sailor's friend and the old heart? The old khaki girl, me lucky lads, where you like and where you fancy. And a jolly good bet to you, and I hope she turns up three times. Come on, me lucky lads, these are the little devils that's given you so much entertainment. You all done, you all through, and no one says the old club, the old Irishman's shamrock? All right, up she comes again and we have three lucky old clubs. Gentlemen, I couldn't coax you on them, and the old man smiles again. All right, off we go again, off to war we go again. "What did you say, Mack? Never again?—oh." First 10 years is the worst. Pop her down, me lucky lads, the old spade, good bet—three times. Half a franc on the old working party. "What's that, Corp?" I'm for one tonight—sanfarryan. Every other man a wheelbarrow. One hundred francs on the heart. A jolly good bet to you. Yes, sir, and if she turns up three times you won't see the old man's back for dust. The old man will pack up. Shower her down, me lucky lads, and be in time. Cup up in Ford cars and go away in wheelbarrows. I said wheelbarrows; what did you think I said? Fifty francs on the old grave-digger is a good bet. I hope she comes up three times. Half a franc on the old heart. A jolly good bet, and I hope she comes up ten times. Gentlemen, the old major's coming up with clean buttons this time. All right, you all done, you all—

"Who's that, Jack, coming 'round the corner?"

"Colonel."

"Do you think he wants a bet?"

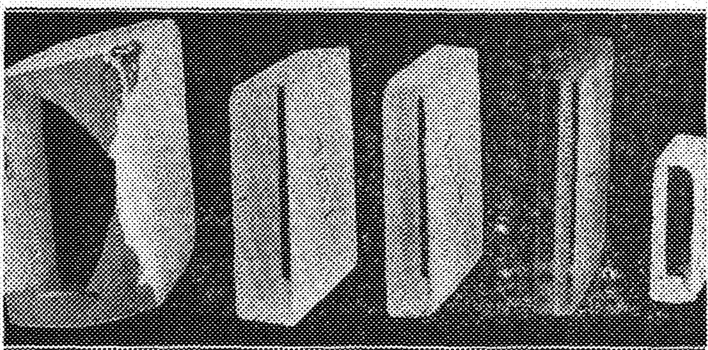
"No, I think we'll pack up. All right, me lucky lads, who says a bet on the old Bolshevik?"—The Manitoba Veteran.

American Optical Glass

By Glenn E. Matthews

It is difficult to picture the condition of the world today, were we to erase the development of optical glass from the pages of history. To appreciate it fully, we must make a brief survey of the work of the early discoverers. It is found, for instance, that burning glasses were known to both the Greek and Roman civilizations. We will take as our first authentic date, however, the period spanned by the years 1280 to 1311, which, according t o the eminent American optician, Mr. John A. Brashear, mark the time of the discovery of glass for spectacles. We must also mention Galilco for his work on the development of the astronomical telescope. Although there are knowledge many other names which should be mentioned, we will stop here and draw a picture of conditions in the world today as they might be conceived to be if optical glass did not exist.

To state exactly how much such a loss of knowledge would affect our progress is very difficult; but it may be imagined that we would be about 200 years behind conditions as we now live. For how limited would have been the advance in medical science, alone, had Pasteur not conducted his epoch-making discoveries with the microscope! All our comprehensive knowledge of bacteria, with the resulting ideas as to combatting disease, would not exist. The wonderful humanitarian efforts of the army doctors in halting the spread of typhus in Serbia could never have been accomplished.



Slabs of Optical Glass

Imagine a world without modern optometry! How much our efficiency of today would be handicapped, were the many millions of people in our country alone to be denied the gain in health and ability obtained by the use of these small pieces of ground glass.

Carrying our analysis still further, think of the loss to astronomical science were none of the intricate reflecting telescopes to be found. The famous observatories, such as Yerkes, Lick, Mt. Wilson and others, could never have been built, and the studies of the beauties of the heavens and the scientific observations would have been impossible to the extent which has been accomplished today.

Still another loss would have been that of the camera. This may seem trivial at first thought, but when we think of the wide use which the development of the lens has made possible we may realize the value of this one instrument. Think of the millions of photographs used every week in the periodicals of this country alone! How few people would ever see and appreciate the beauties of the world, the majesty of mountains, the power of cities, the grandeur of forests, or the glory of waterfalls, if photography were nonexistent. Our analogy carries us down to the period of the war of 1914-1918.

Suppose there had been no telescopes, no binoculars, no cameras, no special lenses. How would the agencies of war have been affected? Aviation could have been of little use to the armies had the binocular and camera been unavailable. Submarines would never have been built without the aid of the lenses in a periscope. Bat-

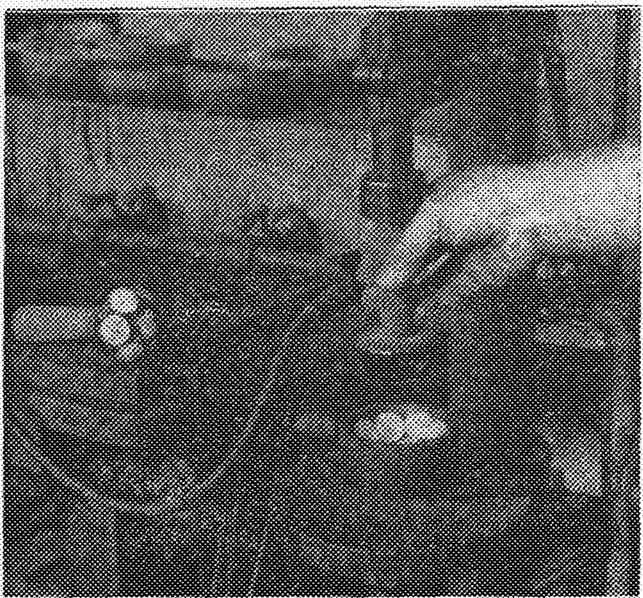
Great Nebula in Andromeda

tleships would be sadly handicapped if no binocculars or telescopes were to be had. Many of our large guns could not have been used if there were no range finders. The great search lights which used to play over the whole sky when there was an air raid on London or Paris could never have been made had it not been for the giant reflectors.

In short, we may again repeat the statement that modern civilization would certainly be retarded almost two centuries if optical glass had never been discovered. All credit is therefore due to such scientists as Chester More Hall and John Dolland, who made the first achromatic lenses, the former in 1733 and the latter in 1755; and several years previous, in 1670, to Newton, that pioneer in physics, for the production of the first real reflector; while, in the following years, appear such names as Fraunhofer (1815) and Kirchhoff and Bunsen (1858) for their improvements of the lenses and designs of the spectroscope.

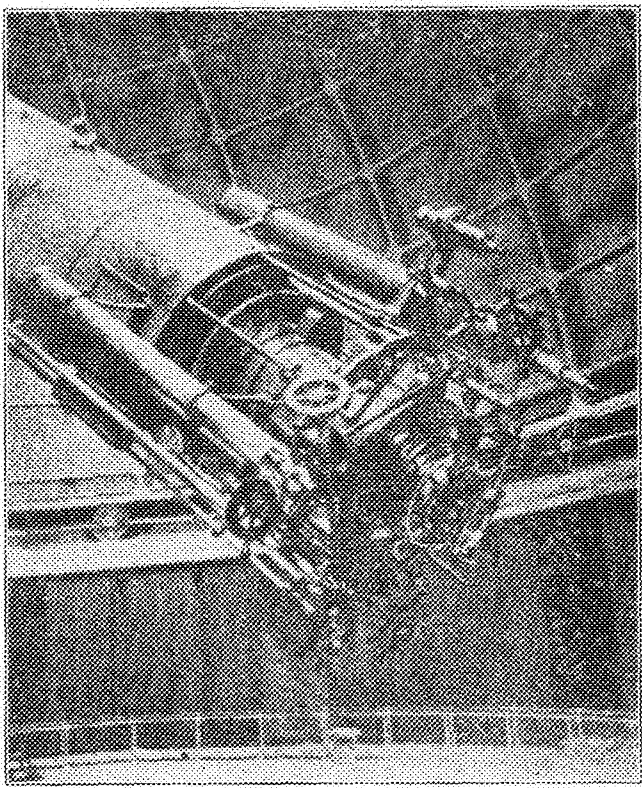
In the field of the manufacturer, we find that pioneer scientist of Jena Glass fame, Professor Abbe. Then, there are the names of Doctors Schott, Carl, and Zeiss, who rank alongside of Abbe. Two others should also ben mentioned, Mantois, of Paris, and Chance, of England. For many years, in fact, right up to the Great war, these masters of the art supplied the world with glass. Up to the year 1914, and for many years previous to that, America had been importing annually about half a million dollars worth of optical glass from these manufacturers. When the war came, the problem was put squarely up to our manufacturers and it was solved in true American fashion. In less than nine months after the importation ceased, America was producing optical glass of a quality fully as good as any European, and both France and England were clamoring for some of our product.

At this point it is of great interest to tell the story of one of the men to whom America owes much for his persistent efforts and the quality of his product. That man is John J. Bausch of the firm of Bausch and Lomb, of Rochester, N. Y. In 1853, Bausch went to Rochester and began in a very small way to grind glass lenses of superior quality. Year after year he struggled with the problem of the manufacture of optical glass, but always his experiments were a failure. He was forced to import all the glass for his lenses. Both he and his son worked on the problem up to the beginning of the war, whereupon they renewed their efforts. Three years passed and then came the day when they met with success. Bausch, at the age of 87 years, had reaped the reward for persistence and determination. But think of what it means to stick to one problem for fifty years! The little brick building in the gorge of the Genessee River, below the many larger buildings of the main factory, where the glass is made today, stands as a monument to his efforts. Last summer, when he celebrated his ninetieth birthday anniversary, still an active man, a holiday was declared for the whole plant and some $800,-000 was distributed among the employees. The reverence and respect with which he is held by all who know and work for him, is an example of confidence which could well be the envy of many of our manufacturers of today.



Lens Grinding Room

The United States Bureau of Standard and the Geophysical Laboratory at Washington took up the problem when the war broke out, and Major F. E. Wright, Ph.D., was placed in charge. P. G. Nutting, in an article in "Science," states that in all "Six of our large consumers of optical glass, a government bureau, and three glass manufacturers in this country at once started work on the manufacture of optical glass. To more fully appreciate their problem, it is well to consider briefly the requirements for its manufacture. In the first place, it is the most difficult problem of the glass-makers' art. According to Floyd L. Darrow, whose article on "The Story of the Lens" appeared in "The Mentor," No. 186, the manufacture of optical glass "presents problems requiring for their solution the technical training of the research chemist, the mathematical ability of the



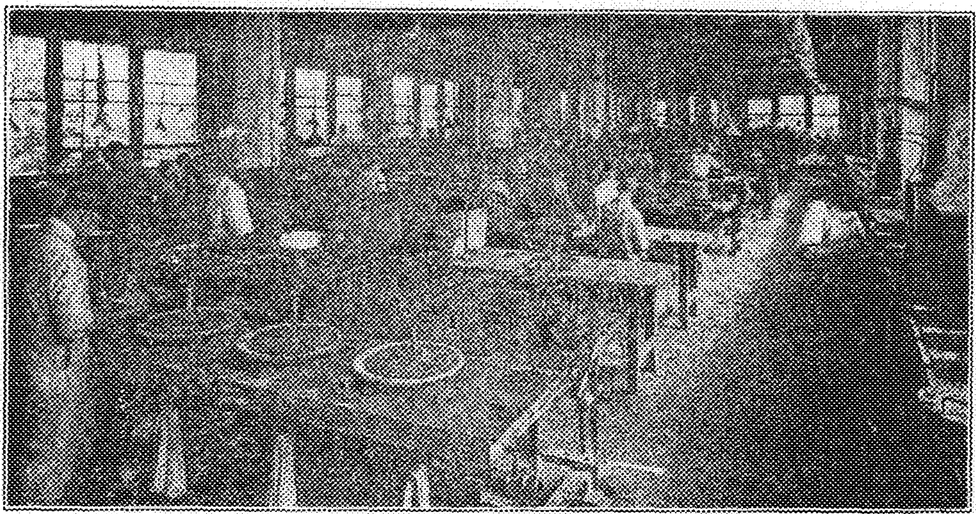
Eye End of Licks Telescope

physicist, and the skill of an expert craftsman." In the manufacture of optical glass, the two principle kinds used are crown glass, containing mainly silica, potash, soda and lime, and flint glass, composed chiefly of silica, potash and lead oxide. Darrow further adds, "There are six fundamental requirements of good optical glass: (1) Correct optical and physical properties. (2) Freedom from striae. (3) Freedom from bubbles. (4) High light transmission. (5) Freedom from color. (6) Freedom from strain. To meet all these requirements, there were necessary: a stirring device that would eliminate striae, or tiny grooves; melting pots more resistant to corrosive fluxes and freer from iron and sulphur than any made in the United States; and the purest 'batch' materials." For instance, in the preparation of the big "36" refractor for the Lick Observatory, the glass was poured twenty times at the Paris glass works, with one month consumed for annealing after each pouring, before it finally passed all tests successfully. It can readily be understood why the workman who handles the glass must be one possessing skill far above that of the ordinary craftsman.

But it is not only in the manufacture of the glass that the way is beset with difficulties, for the demand for skilled workers is increased, if anything, with the preparation of the glass for use. It should be a source of pride to Americans that all the large refracting lenses of the world were ground in the United States and most of the work has been done by one firm, that of Alvin Clark and Sons, of Cambridgeport, Mass. Quoting from W. D. Moffat's editorial in "The Mentor," "Alvin Clark, the father, (1808-87), was the son of a New England farmer, and taught himself engraving and portrait painting. It was while he was a portrait painter in Boston that he became interested in the manufacture of telescopes. In 1844, he constructed a small reflector, the success of which led him to the grinding of lenses. It was not long before the Clarks, father and son, as lens manufacturers became known the world over. In this great work the Clarks have won imperishable fame. Alvin Graham Clark, the son (1832-97), joined in his father's work at an early age, and it is under his direction that some of the finest lenses have been made. Five times between 1860 and 1892 the Clark firm was called upon to construct 'a telescope lens more powerful than any in existence,' and each demand brought forth a greater glass, ending with the giant Yerkes refractor. This famous lens is forty inches in diameter, weighs a ton and a half, and cost $125,000.00 * * * Since its area is forty thousand times greater than that of the pupil of the eye, it is able to make a star appear forty thousand times brighter than when seen with the unaided eye."

The Hawk-Eye Works of the Eastman Kodak Co., at Rochester, N. Y., now has a lens factory where skilled experts prepare these bits of glass for camera purposes. The details of this process are extremely interesting and give us a larger conception of the skill involved in the finishing of glass. An article describing the process appeared in the July, 1920, issue of "The Kodak Magazine," a plant publication, and is called "A Wonderful Piece of Glass." The writer states, "The simplest lenses which can be made for photographic purposes are made from a single piece of glass, the form being a crescent shape, which affords the best definition—hence the name, 'Meniscus.' * * * It was discovered a good many years ago that by combining two different kinds of glass in a lens, the blue and yellow rays could be made to come to a focus at the same point. Such lenses are called 'Achromatic.' The best shape for an Achromatic lens is the crescent, or Meniscus, so such lenses are called 'Meniscus Achromatic.' Owing to their form, these lenses produce a slight curvature of the edges of the picture. This would not matter in landscape pictures or portraits, but when the picture has straight lines near the margin, these lines would appear slightly curved.

To get around this the lens maker puts two Achromatic lenses together with the stop, or diaphragm, between them, so the curve produced by one lens is offset by the other; such a lens is called a Rapid Rectilinear, because it gives straight line images, and "Rapid," because, having a focal length half that of the two single lenses, and with the same stop it passes four times as much light, and requires only one-quarter of the exposurse.



Motor Driven Machine for Rough Grinding

As to the Anastigmat lenses—the aristocrats of the lens world; about thirty years ago, it became possible to produce optical glass from which lenses could be made that gave flat field images with the blue and yellow rays at the same focus. Anastigmat lenses have better defining power, but demand the most careful and highly skilled workmanship.

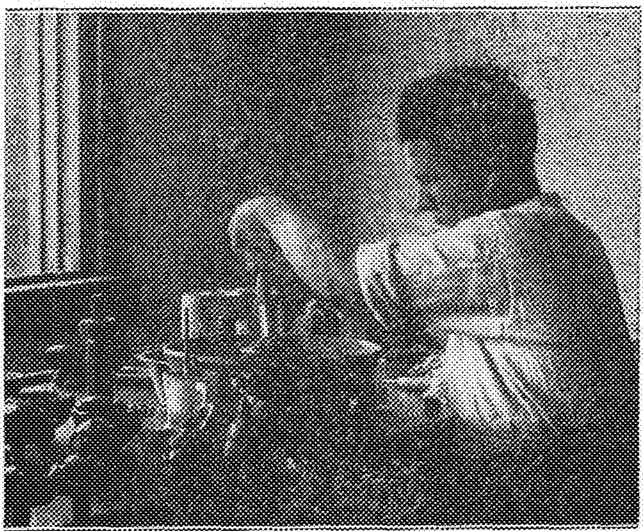
Let us follow the progress of a piece of optical glass through the Hawk-Eye Plant. The glass comes in slabs about an inch thick, eight inches long and eight inches wide, which are first cut into thin squares by means of diamond-tipped rotary saws and then ground into rough disks. These disks are now attached by means of black pitch to what is called a blocking body for the first, or rough grinding, each lens is examined for chips or other defects.

Each flat backed lens is then reduced to the proper thickness with a milling machine, and then subjected to three other grinding operations with different grades of emery. In the fine grinding, the greatest care is taken to bring the lens down to exact dimensions, the accuracy being determined to within two or three hundredths of a millimeter, a millimeter being only about four-

thousandths of an inch.

After grinding, the lenses are taken to a polishing machine, where they are polished with rouge in a special machine. During the polishing process, the lenses are frequently examined with a magnifying glass to make sure they are retaining their proper form. Other tests for accuracy are observed so that accuracy greater than one-fifty-thousandth of an inch is often attained."

Our review has served to point out clearly two things: first, that American industries can successfully manufacture and finish optical glass for all purposes; and, second, that there is a demand, though not as large as in other fields, for continued manufacture of this type of glass. The question then arises,—Are the industries sufficiently self-sustaining to continue to supply this small demand? When we consider that not an ounce of optical glass was made in this country before the war, and that at its close we were manufacturing twenty tons a month, one almost unhesitatingly would reply "Yes" to this question. A reviewer in the Literary Digest answers the problem in this way: "At least two of the firms at present manufacturing optical glass propose to continue in the field; several others, which have engaged in the work to assist in meeting the war needs, will cease manufacture soon. There is little profit in this product, and some patriotism will have to be combined with the profit and loss of the alance-sheet. It is not, and never will be, a very large industry, important as it is for the scientific independence of this country." The future looks hopeful when we remember that American made optical glass is as good as that of any foreign manufacturer. It is possible that one firm devoted solely to the manufacture of optical glass could supply the needs of this country. With the great achievement of the American scientist and manufacturer of the war period, who created the industry, as an incentive, it is to be hoped that the industry will survive and take its place along with other manufacturing accomplishments, distinctly American.



Fine Grinding

The Electrical Show

By J. M. Downie E. E. '22

Promptly at eight o'clock, Friday evening, May thirteenth, an electric sign mounted on the front of the Electrical building flashed out, letter by letter, the fact that the fourth Electrical Party had begun. Every two years the students in the Department of Electrical Engineering turn their efforts for a few days from the customary channels of conscietious application to their studies into new and devious pursuits. Many exhibits are devised, some to acquaint the layman with the nature of the work done in the department, others to mystify him, and still more to amuse him. The justly remembered successes of the preceding electrical parties were cast into the shadow by the brilliance and variety of the features presented this year. Every available square foot of space in the electrical building was utilized for some stunt or exhibition.

The lower and upper halls and stairway were effectively decorated in green and white and presented such a gala appearance that some of the Electricals didn't recognize the place. Mr. Linhoff and his assistants co-operated with the decorating committee, producing, with the aid of a few metal plates and festoons of bare wire, some very striking effects.

The lower laboratory presented a carnival appearance. On every side were exhibits and demonstrations ranging in character from the instructive to the deceiving, and from the serious to the ridiculous. There was a beauty parlor equipped to curb the vanity of the comeliest co-ed. Alex Hammerstrom exhibited an arc light that played all the latest dance music. This proved to be one of the most interesting and puzzling examples of electrical phenomena shown. One of the visitors with the social welfare at heart urged its development for community pavement dancing. He proposed the slogan "Every street intersection an open air pavilion; every arc light an orchestra." Near by, Larry Hayward presided over the oscillograph and advertised to make that mysterious force, electricity, visible to the naked eye. Maxwell's snakes, Ma, Pa, and little Mike writhed their appreciation of the rapt attention that was bestowed upon them. "Doc" Cassidy's Hair Restorer proved to be rapid if not permanent in effect and, moreover, adapted to the peculiar requirements of the college student as it was demonstrated to be able to raise hair on solid bone. Many of the patrons of Mr. Horace Lowry's 48 passenger yellow cars took advantage of the chance to see how it felt to chauffeur one of them while visiting the exhibit of street car motors and controllers.

Unbeknown to those in charge of the party, a mysterious Mr. C. K. Johnston slipped in both nights and, in spite of all attempts to prevent him, demonstrated a most amazing device which, if commercialized, will, no doubt, render electrical engineering as practiced at present a dead art. He called his exhibit a "tin can" motor on account of the appearance of the model and expounded most volubly on all phases of it except the principle of operation. This he candidly admitted he did not know. Most of his audience, after watching him dismantle his machine, reassemble it and then, by moving a wooden handle nailed to the frame, start it rotating, admitted that they didn't either.

An electric gun projected rings of copper through the air with more or less accuracy, according to the ability of the gunner, and considerable force.

The inviting aroma of fried eggs "flopped on both sides" made it unnecessary to have a crier to keep a crowd around the "Cooking on Ice" stunt. The sight of eggs sputtering in a frying pan resting on a sheet of asbestos and completely surrounded by cracked ice was enough to make even a Home Economic Co-ed wrinkle her forehead.

The wim-wam, or bucking motor, was unable either evening to decide which way it would go and, as a result, spent the time vacillating.

The bottle that never became empty attracted a lot of attention among that class of individuals whose only specifications to the tailor upon ordering a suit concern the dimensions of the hip pocket. Several inquiries were received as to whether or not the exhibit was for sale.

Many visitors stopped to watch the wooden ducks as they swam around in a miniature pond and to surmise as to what made them go. One gentleman, after gazing on them for some time, remarked that he didn't see how they could get used to water; he couldn't.

Monte Carlo up-to-date consisted of a crooked wheel operated by a lusty-lunged, jolly-faced gambler who begged to show the ladies how they couldn't help but win and then proceeded to separate them from their month's allowance.

An educational exhibit showing the transformation of mechanical energy into electrical energy, the measurement and distribution of this energy, and its re-transformation into mechanical energy again, gave a hint of the work-a-day appearance of the laboratory. The conversion of alternating current to direct current by means of the mercury arc rectifier was also shown.

Lovers of the occult gathered around the see-saw lamps and the magic lamp which, although connected to no source of current, burned brightly.

Souvenir hounds were satisfied and many others interested at the electric welding and electroplating exhibits.

The "Krazy House" made a big hit. Most of the adventurers did not need "Shorty" Shuirman's "Hold on tight, lady" to cause them to frantically clutch the arms of their chairs or escorts (depending on whether they desired physical or moral support) when they saw the ceiling where the floor ought to have been.

Glen Ransom modestly introduced his stunt by a brief history of the art of ventriloquism and an explanation of how he acquired his ability. Oscar, though now prepossessing in appearance, proved to be a youth of no mean accomplishment. He was slightly hampered at times by his defective eyesight; but, withal, gave a very satisfactory performance.

After ten o'clock the scene of the party was transferred to the Main Engineering auditorium, where a snappy three-piece orchestra furnished music for dancing. Ed. Anderson and his trusty cohorts furnished cake and ice cream and punch for the intermissions. The decorations were the most elaborate that had ever been seen in the auditorium. A canopy of maroon and gold streamers lent a gala aspect to the room, which was enhanced by many beautiful lighting effects. The scene was illuminated by a suffused glow changing constantly but almost imperceptibly in color. Blues faded into lavender shades, which were in turn superceded by warm reds and vivid yellows. The brilliant white shaft from a searchlight wandered erratically over the dancers. The man in the moon cast a pale beam from his station above the orchestra and was observed to wink sagaciously with his left eye at those of the guests whom he recognized as steady customers.

A feature of the evening was a sparkler dance. The undulating swirling flood of sparks which was produced by the sparklers carried by the dancers made a unique and beautiful picture. Another novel event was the wireless concert. A portable receiving outfit, equipped with an amplifier and loud-speaking telephone, reproduced music transmitted by radio from the station in the Electrical Building.

The chaperones for the party were Dr. and Mrs. Shepardson and Prof. and Mrs. Springer.

The executive committee, to whom in a large measure should go the credit for the success of the undertaking, consisted of Ray ,Sweet, E. C. Manderfeld and P. Raymond Wilson. Sub-committees were: the committee on stunts and exhibits, headed by L. C. Larson; and the committee on decorating, lighting and refreshments, headed by P. Raymond Wilson. E. P. Carlson was in charge of the finances, and L. A. Grettum managed the publicity.

The high frequency demonstration in charge of E. C. Manderfeld was interesting in ,the extreme. He used a large Oudin coil, which gave sparks a foot or more in length, and showed how, due to its peculiar properties, high frequency current at many thousands of volts pressure could be safely allowed to pass over the body. He also exhibited corona effects, Jacob's ladder, the electric pin wheel and the electric tree.

In the library on the second floor was the Electrical Home. Here all of the modern electric appliances for the home were exhibited, as well as some adjuncts to the perfectly equipped domicile which have not as yet reached the commercial stage. Among these latter were the baby spanker and the electrically operated still. Toast and coffee were served and all visitors were encouraged to feel "at home."

The electric communication exhibit included an automatic switchboard unit in actual operation, a portable field exchange for military use, and a set up showing how a call is made under the manual system of operation. Chas. T. Skarolid had charge of this exhibit.

College News

The University is preparing to build a group of tennis courts on the south side of Washington avenue. The funds available for this improvement are not ample for completion of the courts, however, and the superintendent of grounds is casting about for some kind-hearted contractor or excavator who may be induced to dump a number of loads of dirt for filling on the proposed site. These new courts will be quite handy to the Engineering campus and should be a stimulous to greater activity in the gentle game of "love" among the "bridge builders."

Mr. M. B. Lagaard, instructor in Civil Engineering, is contemplating accepting a position with the United States Bureau of Public Roads during the coming summer. Mr. Lagaard was one of a group of engineers, the majority of whom were Wisconsin and Minnesota men, who did excellent work in the design and tests of concrete ships during the late war. The work for the government bureau will be quite similar to that done on the ships, many of the same testing instruments being used in testing concrete and steel for public highway bridges. Other Minnesota men who were with the Shipping Board, assisting in the design of concrete ships, were Professors J. I. Parcel, G. A. Maney, L. F. Boon, C. H. Overholt and L. Norelius.

Defeating the Dentists by a decisive 7 to 2 score, the Engineers once more emerged the unbeaten intramural champions of the University, and the cup which has been on display in the Union will rest for the coming year in the Engineering library. The final game was played on Wednesday, May 25, on the Varsity diamond.

First class fielding and team work proved the Dents' undoing. Frantz, who did the hurling on our side, allowed several hits, but the support he received from infield and outfield alike saved the day. Goodridge did the heaviest stick work, nicking Norden for two three-base hits, and played his usual faultless game behind the bat, nipping ambitious base stealers with uncanny success. Pond made a pretty throw to home from deep left just in time to prevent Norden from scoring.

The lineup:

Engineers		**Dents**
Brown	1B	Seaton
Ed Olson	2B	Regnier
Magney	3B	Baade
MacMurphy	SS	Turner
Frantz	P	Norden
Goodridge	C	Fogelberg
Roy	RF	Merwin
Pond	LF	Rice
Mikesh	CF	Wennerburg

SUMMARY—Runs: Engineers 7, Dents 2; errors: Dents 4, Engineers 4; strikeouts: Frantz 3, Norden 7; hits: Engineers 8, Dents 6.

Manager Dick Goodridge wishes to thank the Sophomore, Junior and Senior classes for the base balls they donated. The batting practice which these balls enabled the team to receive was in a large part responsible for their splendid showing.

R. A. Lundquist, E.E. '05, was the principle speaker at the April meeting of the student branch of the A. I. E. E. The subject of his lecture was "Foreign Engineering Features That Might Be Adopted in the United States." Mr. Lundquist spoke three years ago on a similar topic.

Following the talk, an inspection trip of the St. Paul Gas and Light company's automatic sub-station for light and power in the Hamm building occupied the remainder of the evening. The meeting was held in the Elks' club at St. Paul, where dinner was served at 6:30 p. m.

On Tuesday, May 24, the Senior Civils in the Water-Power class made an inspection of the Coon Rapids dam and power house of the Northern Stataes Power Co. The trip was made by E. H. Grochau, Robert Muessel, C. W. del Plaine and Richard Daly, accompanied by Prof. Bass, who took the boys in his car and gave them a record ride.

A new organization, "The Journal Club," of Chemists and those interested in current chemical literature has been formed. It meeets every Tuesday at 11:30 a. m. Among the speakers who have appeared on the programs are Dean Leland, Drs. Frankforter, Mann, Sneed, Ryerson and Geiger; Wm. Tauer, Glenn Mathews and Lillian Cohen.

Henry S. Jerabek, a Chemist, has the honor of being the only Junior elected to two honorary societies this year. Mr. Jerabek was recently elected to Tau Beta Pi and Phi Lambda Upsilon, honorary Chemical fraternity.

Under the direction of Mr. Eugene Ingalls and Norman Cassel, the annual picnic and dance of the School of Chemistry was held at Edgewood, Lake Minnetonka, on Saturday, May 28.

Two of Minnesota's chemists, M. Cannon Sneed and Frank H. MacDougall, are the authors of new technical books which have attracted much favorable attention. Dr. Sneed's work is "Qualitative Analysis," and Dr. MacDougall's is "Thermodynamics and Chemistry."

Carlos del Plaine has been elected president of the Cosmopolitan Club for the coming year. Del Plaine has been prominent in all the activities of the organization for the past year, and he was instrumental in bringing the national convention of the Corda Fratres Association of Cosmopolitan Clubs to Minnesota for next December.

Spring dances have been given by three of the classes: the Freshmen entertained at the Plaza on Friday, May 13; the Sophomores at the same place on May 20; and the Juniors on May 27. These functions mark the close of social affairs in the Engineering College, and they wound up a year full of successful class and college activities.

P. Raymond Wilson and Maurice Gjesdahl took part in the Senior class play, "Behind the Beyond."

Major Ingles, of the Military Department, did considerable in obtaining stunts for the Electrical Show from various military posts and colleges throughout the U. S.

Henry Forbes did a porch climbing stunt the first evening of the Electrical Show. He gained entrance to the auditorium by climbing down a hose from the roof of the Engineering building and going in through the window.

Mr. R. A. Lundquist, mentioned elsewhere as the speaker at the last meeting of the A. I. E. E., is an outstanding example of Minnesota engineers who have made good. Graduating from the Electrical department in '05, Mr. Lundquist steadily forged ahead, and for the last five years has been a representative of the U. S. Department of Commerce, investigating electrical trade conditions in the Orient and Africa.

Three years ago, Mr. Lundquist made an inspection trip, studying the trade conditions in China, Japan, New Zealand and Australia, which covered a period of two years. He has made two trips around the world in the interests of the Department of Commerce, and recently he returned from a three year trip to South Africa and the Orient.

Mr. Lundquist spoke to the local A. I. E. E. three years ago, upon returning from his first trip, and old members recalled his interesting experiences at that time. His lecture on April 29 was very well delivered and received, and it proved a source of inspiration and instruction to every man who was present.

Great interest was shown by the student body in the annual elections held on Thursday, May 18. The ballot was unusually heavy and, with but few exceptions, the results were very close.

Defeating his opponent, Ed Mikesh, by a five vote margin, William Forsell was elected president of the A. E. S. for the ensuing year. Forsell is a Civil and will be a Senior next year. The other A. E. S. officers elected were: vice-president, C. L. Swanson; treasurer, E. F. Carlson; secretary, H. M. Hill.

Marked by several close races, the results of the contest for the Board of Directors of the Book Store were another source of speculation up to the last ballot. The Civils will be represented by A. E. Horstkotte; Electricals by LeRoy A. Grettum; Mechanicals by Chester Bros; Chemists by J. E. Scandling; and Architects by Frank S. Moorman.

For membership on the Engineering Student Council the following men were chosen: Junior Electricals, P. H. Williams; Junior Civils, George Bailey; Junior Mechanicals, C. F. Olmstead; Junior Architects, W. E. Wilner; Sophomores, Merle DeForrest and George Foltz; Freshmen, Joseph E. Meagher.

Dr. Shepardson and family are going on a trip abroad, sailing for Christiania, Norway, June 3. They will visit Sweden, Holland, Belgium, France, Switzerland and Italy if conditions are found to be satisfactory. They will return to Minneapolis in September.

Prof. F. W. Springer, of the E. E. Department, has gone on an inspection trip, visiting various universities to obtain information in regard to the NEW Electrical building.

Roy A. Palmer, E.E. '21, is to be married June 23 to Miss Gertrude Horton Bradbury, S. L. A. '21, daughter of Mr. and Mrs. W. E. Bradbury, 195 Fuller avenue, St. Paul. The wedding is to take place at Hastings, Minnesota. Congratulations, Roy!

Lawrence Hayward, Ray Sweet, Basil Maine, C. P. Carlson, Albert Beardmore and Roy Satori are going to enter the employ of the General Electric company at Schenectady, N. Y.

Ray Wilson is going to Cleveland, Ohio, entering the employ of the National Mazda Lamp Works.

Ray Wilson, Ray Sweet, Basil Maine and C. P. Carlson plan to make the trip by boat on the lakes.

Boxing matches, songs and travelogues featured the annual A. S. M. E. Sophomore party held May 25 in the main auditorium. Pres. Joachim welcomed the Sophomore associate members to full membership in the society.

Prof. Flather gave an illustrated lecture on his trip to New Zealand, which proved very entertaining. Refreshments helped make the party a big success.

Alumni Notes

Among those attending the Electrical Show were Ray Lockwood, Victor Engquist, Clarence Nelson, E.E. '20, and C. H. Reeve, E.E. '19.

Richard Olson, E.E. '19, spent a few days visiting at the U. He is with the Electric Machinery Mfg. Co. of Minneapolis and is located in Chicago.

Orlin Kruse, E.E. '20, spent a few days at the U. He is in the Manufacturing Methods Department of the Western Electric Co., Chicago.

A. A. McCree, C.E. '08, is making quite a name for himself as a highway builder. Since leaving the University, McCree's work has been characterized with the same energy that made him a football star during his college days. Prior to the outbreak of the war, Mr. McCree was engaged in railway engineering. During the war he built several army cantonments for the government. At the present he is associated with the McCree-Moos Construction Co, of St. Paul. This company is engaged in construction of highways, and last year they broke all records in the rapid laying of concrete. His address is 338 Aurora avenue, St. Paul.

A. W. Baker, M.E. '18, is designing tools for the Pan Motor Company, of St. Cloud, Minn.

George Peterson, M.E. '08, has left the employ of the Santa Fe Railroad to become supervisor of apprentices for the Duluth and Iron Range. Mr. Peterson has been employed by the former company for several years at Albuquerque, New Mexico. He is living in Minneapolis.

C. T. Delamere, Ex. '04, is now engineer for the Canadian Pacific Railroad with headquarters at Montreal. Mr. Delamere visited the University while in the city during the early part of this month. He is a member of the Delta Tau Delta fraternity.

E. Cole, C.E. '19, has recently taken an examination preparatory to entering the service of the U. S. Engineering Corps.

Reuben A. Lindquist, E.E .'05, a trade commissioner of the U. S. Department of Commerce, has recently returned from a three years' tour of Asia. Mr. Lindquist's mission was to obtain statistics relative to the electrical trade conditions of that country.

R. E. Ford, '95, a former instructor at the Troop Polytechnic Institute, was a delegate to President Coffman's inauguration. He is now engaged in business in Minneapolis.

The construction of the Franklin Avenue Bridge is being handled by Wm. Elsberg, C.E. '09. Mr. Elsberg has been employed by the city of Minneapolis since 1911 as an engineer.

C. Rockwood Nelson, Ex. '15, assistant engineer for the New York Central Lines at Cleveland, Ohio, was at the University during the inauguration, representing the Cleveland alumni.

H. S. Estep, M.E. '08, European manager of the Penton Publishing Co., sailed for England recently.

A paper on the proposed Great Lakes-St. Lawrence deep waterway was given recently by Edwin M. Grimes, C.E. '00, before the North Dakota Polytechnic Society. The paper dealt with the importance of the waterway to the northwest. He emphasized the fact that every lake port would in reality be an ocean port, and that the agricultural, mineral, and manufactured products of the middle west would be brought nearer the point of consumption. Mr. Grimes is supervisor of bridges and buildings for the Northern Pacific Railway at Fargo.

L. J. Dunlap, E.E. '17, is connected with the General Electric Co. in Iowa. He was in Minneapolis this month on business.

R. R. Herrman, E.E. '13, an instructor in mathematics at the College of Engineering, is recovering from a serious illness and operation.

W. I. Gray, E.E. '92, is an enthusiastic worker for the betterment of the University of Minnesota. Mr. Gray is deeply interested in the construction of a new electrical engineering building, and is a member of a committee endeavoring to raise the present salaries of professors and instructors in the College of Engineering. Mr. Gray is an electrical engineer of twenty-five years' experience and is well known throughout the state. He is an active member of local and national engineering organizations.

Alfred B. King, E.E. '08, formerly general sales manager for the Electric Machinery Co. of Minneapolis, is now manager of the Motor Division of the Fairbanks Co. of New York. His home address is Putnam avenue, White Plains, N. Y.

Wayne P. Martin, Ex. '11, was elected mayor of St. Louis Park on March 8. He is a native of Iowa, but he moved to St. Louis Park with his parents in 1902, where his father became engaged in a manufacturing business. Mr. Martin is the treasurer of a manufacturing concern in St. Louis Park.

Ray A. Lockwood, E.E. '20, is district equipment man for the American Telephone and Telegraph Co. Donald P. Loye, E.E. '17, is with the same concern. Mr. Loye passed through Minneapolis this month on his way to the Pacific coast, where he is to investigate the installation of long distance lines.

C. W. Hirleman, E.E. '13, of the Minneapolis School Board, is in charge of the new school building program.

Ralph Johnston, '17, holds the position of chief estimator for the P. J. Kalmar Steel Reinforcing Co. in their Chicago office.

O. I. Eberhardt, E.E. '03, has opened an office handling electrical equipment and supplies in the Board of Trade building at Scranton, Pa.

R. E. Baker, Chem. '11, is associated with the C. H. Young Cut Stone and Marble Co., of St. Paul, as vice-president and treasurer.

E. R. Boyce, '11, has been appointed Highway Engineer for Olmsted county. Mr. Boyce will make his home at Rochester, Minn.

H. E James, E.E. '11, is superintendent of telegraphs for the Northern Pacific Railway. During the war, James was a captain in the Signal Corps.

Hans Bernt, '20, is still in Duluth with the D. & I. R. Hans is in charge of all field work for the company.

C. H. Reeve, '19, is an instructor in electricity in Hibbing High School and Junior College.

Dr. D. J. Cowling, president of Carleton College, addressed a student convocation at 4:30 p. m. Wednesday, May 25. The meeting was conducted by President Emeritus Cyrus Northrop, who introduced the speaker and led the discussion following the address. Dr. Cowling came at the invitation of the Northrop Club. This was the first of a series of lectures which this club proposes to introduce upon the campus beginning again in the fall. Dr. Cowling gave a masterly discussion on the subject, "Is Christianity Practical?" The discussion which followed was extremely interesting and valuable to those who carried it on. Dr. Cowling has agreed to come again next year, when he will address the student body at a regular convocation, followed later in the day by a discussion group.

A physician claims to have restored two patients to sanity by pulling their teeth. When they see the bill they may go crazy again.—Pittsburgh Sun.

"How does the Reverend Mr. Cooper always have the front seats of his church so well filled?"
"His head usher is a streetcar conductor."—Watt's Watt.

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Gabe—What is an optimist?

Steve—An optimist is a cross-eyed man who is thankful that he isn't bow-legged.

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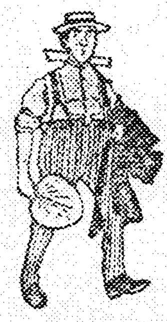

You save all this "worry" when
we're on your "job" and
a UNION Shop, too--
SEE ! ! !

W. S. NOTT COMPANY

Established 1879

Pioneers and Leaders in the
Manufacture of

Oak Tanned Leather Belting

Second Avenue North and Third Street
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CRANE CO.

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IRON PIPE, FITTINGS AND VALVES
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N. W. AGENTS FOR ARCO HEATING BOILERS

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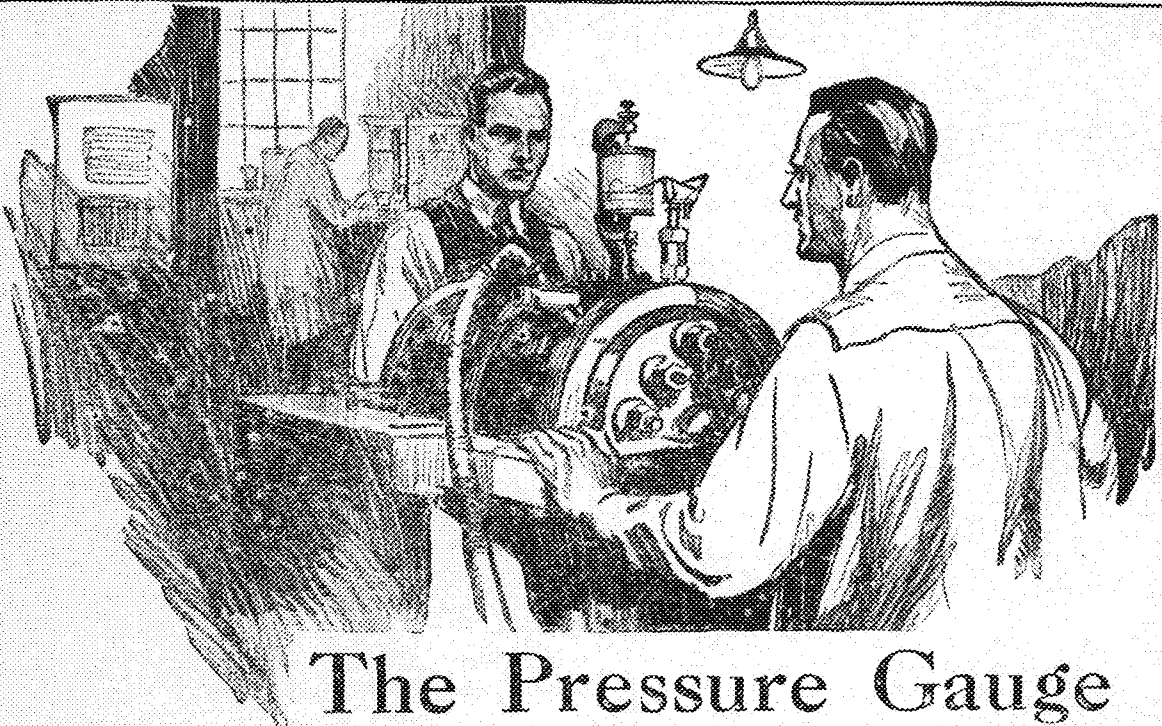

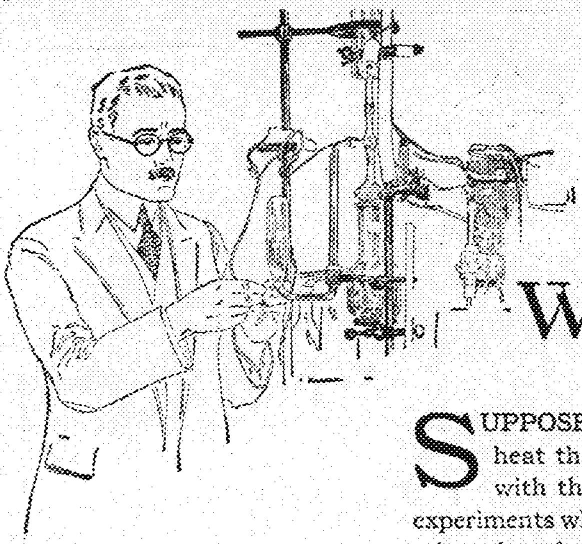

What Is Research?

SUPPOSE that a stove burns too much coal for the amount of heat that it radiates. The manufacturer hires a man familiar with the principles of combustion and heat radiation to make experiments which will indicate desirable changes in design. The stove selected as the most efficient is the result of research.

Suppose that you want to make a ruby in a factory—not a mere imitation, but a real ruby, indistinguishable by any chemical or physical test from the natural stone. You begin by analyzing rubies chemically and physically. Then you try to make rubies just as nature did, with the same chemicals and under similar conditions. Your rubies are the result of research—research of a different type from that required to improve the stove.

Suppose, as you melted up your chemicals to produce rubies and experimented with high temperatures, you began to wonder how hot the earth must have been millions of years ago when rubies were first crystallized, and what were the forces at play that made this planet what it is. You begin an investigation that leads you far from rubies and causes you to formulate theories to explain how the earth, and, for that matter, how the whole solar system was created. That would be research of a still different type—pioneering into the unknown to satisfy an insatiable curiosity.

Research of all three types is conducted in the Laboratories of the General Electric Company. But it is the third type of research—pioneering into the unknown—that means most, in the long run, even though it is undertaken with no practical benefit in view.

At the present time, for example, the Research Laboratories of the General Electric Company are exploring matter with X-rays in order to discover not only how the atoms in different substances are arranged but how the atoms themselves are built up. The more you know about a substance, the more you can do with it. Some day this X-ray work will enable scientists to answer more definitely than they can now the question: Why is iron magnetic? And then the electrical industry will take a great step forward, and more real progress will be made in five years than can be made in a century of experimenting with existing electrical apparatus.

You can add wings and stories to an old house. But to build a new house, you must begin with the foundation.

General Electric Company

General Office Schenectady, N.Y.

95-279-H