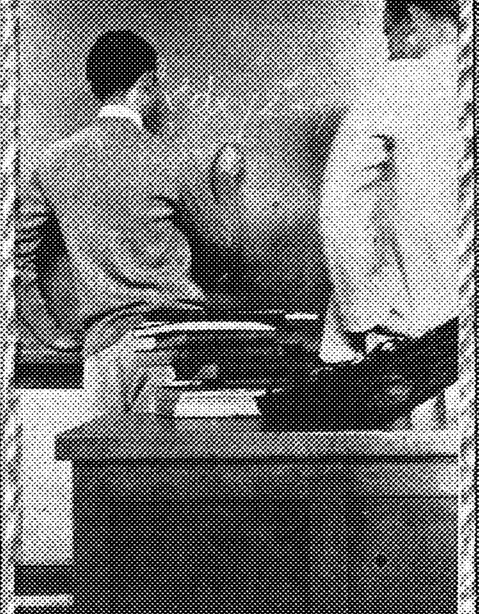
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



Volume VIII — OCTOBER 1927 — Number 1

The MINNESOTA TECHNO-LOG

University of Minnesota

October, 1927 — Volume VIII — June, 1928

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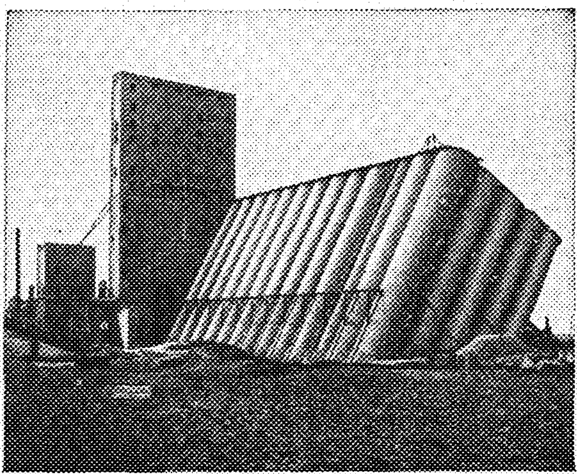
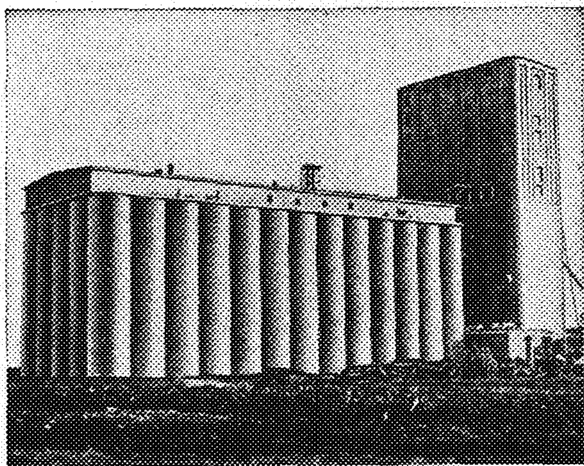
Competent Service—Confident Owners



CONDITION OF ELEVATOR AT TRANSCONA, CANADA, WHEN TAKEN OVER BY THE FOUNDATION COMPANY

JUST a quarter of a century ago four young men, with a broad background of training and experience in the engineering construction field, formed The Foundation Company. Today the company is at work in every continent, in both hemispheres, and on both sides of the Equator, on engineering construction of almost every known type.

IN order to successfully meet the unusual engineering problems presented, it has been the policy of The Foundation Company since its inception to retain a personnel highly specialized and efficient, with initiative and judgment. Over one hundred and fifty men with over ten years service with the company, are now on the rolls; a great factor in inspiring repetition of contracts.



ELEVATOR RIGHTED AND PLACED ON PIERS SUNK TO ROCK

As indicative of the service rendered by The Foundation Company over this period of years, these partial lists of repeat contracts have special significance. In one case no less than thirty contracts have been awarded by one owner.

S. S. White Dental Mfg. Co.		Great Northern Paper Co.		Corn Products Refining Co.	
Factory	1917	Hydraulic Construction	1916	Water Supply	1918
Power House	1919	Boiler House	1921	Tunnels	1919
Factory	1926	Power House and Dam	1922	Industrial Plant	1921

THE FOUNDATION COMPANY

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Industrial Plants
Warehouses
Railroads and Terminals
Foundations and Underpinning
Filtration and Sewage Plants

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PITTSBURGH
CHICAGO
SAN FRANCISCO

LOS ANGELES
MEXICO CITY
CARTAGENA, COLOMBIA
LIMA, PERU

MONTREAL
LONDON, ENGLAND
BRUSSELS, BELGIUM
TOKYO, JAPAN

Hydro-Electric Developments
Power Houses
Highways
River and Harbor Developments
Bridges and Bridge Piers
Mine Shafts and Tunnels

BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

THE MINNESOTA
TECHNO-LOG
MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

VOLUME VIII. MINNEAPOLIS, MINN., OCTOBER, 1927 NUMBER 1

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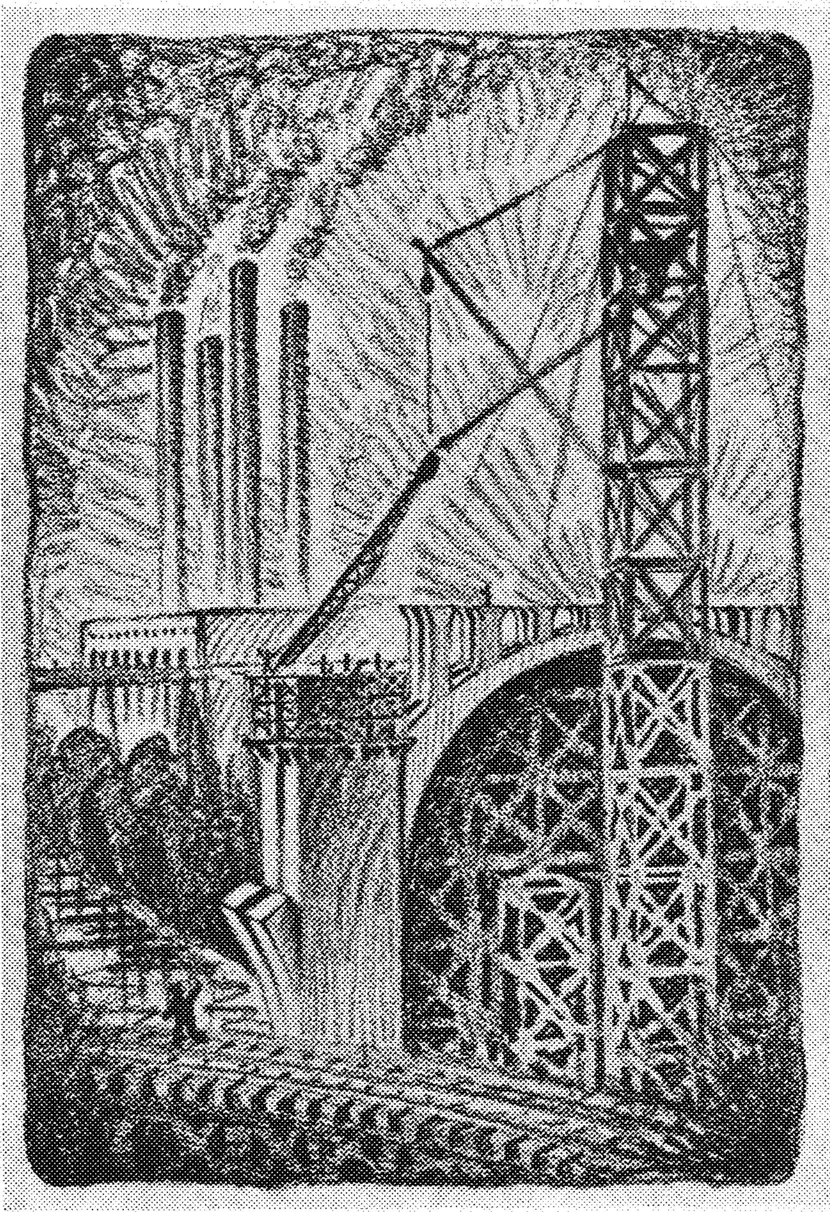


Leading to a Greater University---
The New Cedar Avenue Bridge

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII | OCTOBER 1927 | Number 1

Petroleum Engineering

Peculiar problems are met with in this field of endeavor, which is offered this fall as a new course of study in the School of Mines and Metallurgy

By Elting H. Comstock
Professor of Mine Plant and Mechanics,
University of Minnesota.

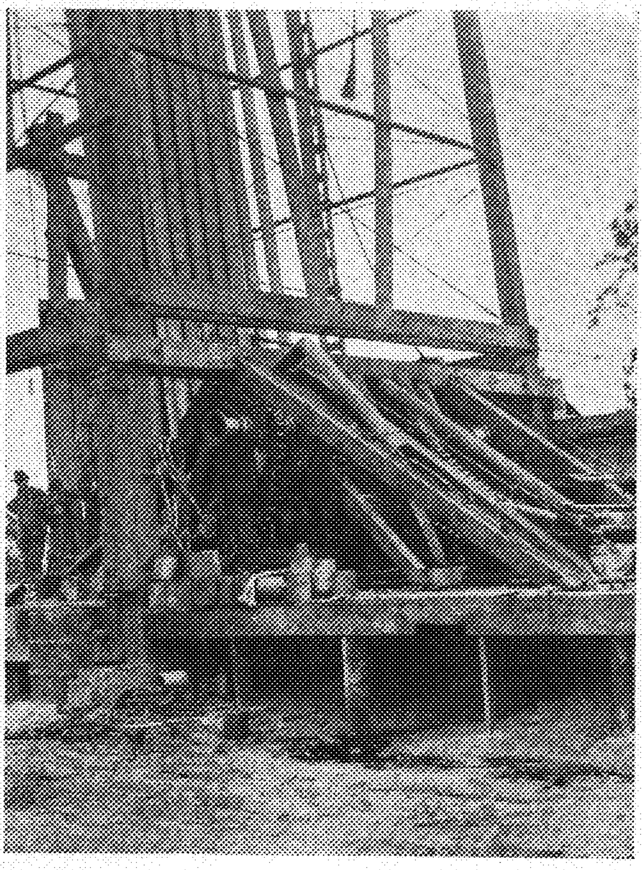
GOOD LUCK is responsible for the wealth of many of the so-called successful oil operators, who once were failures as lawyers, dentists, preachers or whatnot.

If the truth were known the very wells which were responsible for their success were drilled on a "hunch" without any study having been made of the geology of the district, just as one of the successful mining men of our state picked out iron ore lands by climbing a tree and looking over the country. In many cases the methods of drilling the wells have been entirely unsuited to the formations passed through and as a result—unnecessarily expensive operations. The oil industry, in spite of its rapid development, is still in its infancy and consequently suffers from many of the ills of childhood.

As has always happened when some have achieved success in a new field, a horde of dishonest promoters have sought to line their pockets at the expense of unwary investors whose better judgment is put to sleep by the tales of the sleek stock salesman. Most of these fake promoters admit that a study of the geology of the district has not been made. They have better methods, if not more scientific ones, for their methods do get the money of those who desire to "get-rich-quick." Their wells are located by the willow "witch-stick" or some modern improvement to which a fancy name, as the "doodle-bug," has been applied. In the hands of some ex-preacher a "doodle-bug" will sell an almost unlimited amount of stock.

Out of the chaos of the early days the geologist was the first to lead the way. He has shown that he is able to furnish scientific help to the industry, and every legitimate company now employs a corps of trained geologists. Great as has been the advance of the industry due to the recognition of the value of this branch of science, it is becoming more and more apparent that some one is needed who knows more than mere geology.

The field is open to one who knows the essentials of oil geology, who knows the essential economic principles involved in the industry, who knows something of drills and the troubles and difficulties of drilling, who knows the various methods of production, of storage, of distribution, and who is familiar with the forms, contracts and other documents met with in the industry.



DRILLING A WELL BY THE ROTARY SYSTEM

A stem and bit are rotated by means of the mechanism shown. Water is pumped down through the inside of the drill stem and flows back through the hole outside of the stem carrying the cuttings up.

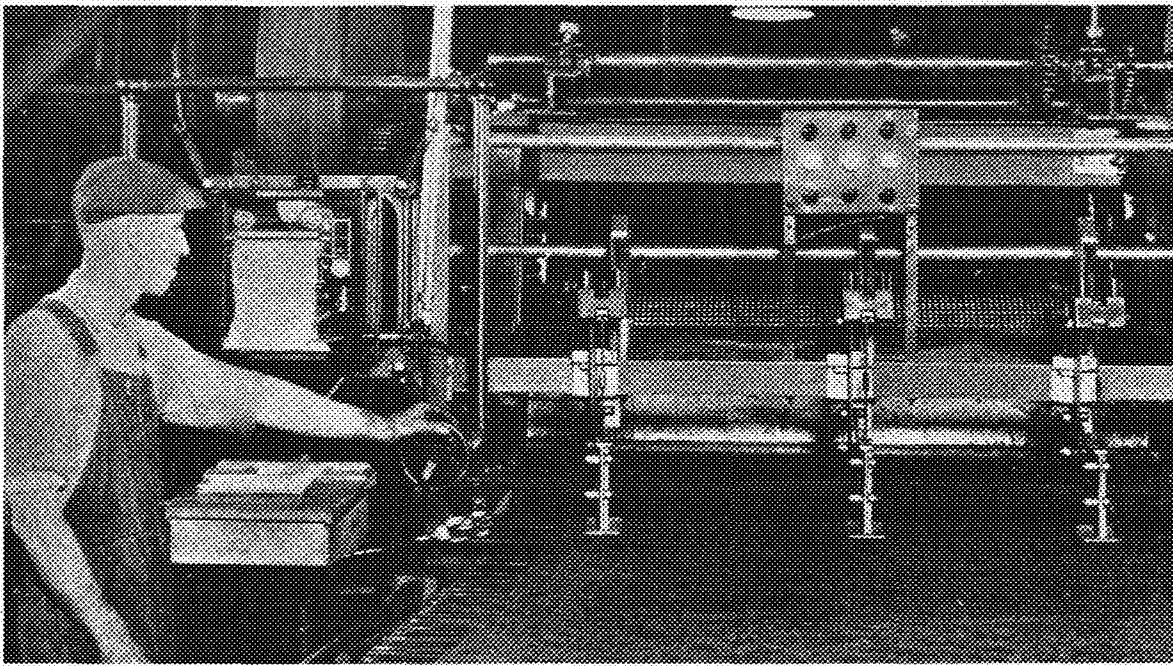
On such a man the title of "Petroleum Engineer" is conferred, and just as in the mining field the mining engineer becomes the balance wheel between the various departments contributing to the success of the mining venture, so the petroleum engineer attempts to secure a co-ordinated effort among those responsible for the success of the oil prospect.

The problems of the petroleum engineer are many and varied. In locating a prospective well, he must bring to his assistance a thorough knowledge of certain phases of geology. He must know what geological horizons are favorable and what are almost sure to be barren. He must have a background of historical geology, so that he will recognize the fact that though a certain horizon may be barren on one continent, in another part of the world where conditions were different during that geologic age, oil may have been deposited. He must know the nature of the reservoirs in which the oil is found and be able to make use of his geological knowledge to anticipate where such reservoirs may possibly be located. To the successful solution of the problem of locating oil, it will be necessary for him to apply his knowledge, not only of rocks, but of the fossils found in the rocks, many of which can only be identified with the use of the microscope.

WHEN a location has been selected which seems worth prospecting, the legal right to proceed must be secured. This may be done by purchase of the land together with all rights thereto; by purchase of the oil and gas rights alone; or by leasing the oil and gas rights. To intelligently recommend which method to select requires that one be able to place a valuation on the property.

The value of a property may be considered in two different senses. One, called the "exchange value," is the amount for which it can be bought. The other, called the "productive value,"

(*Continued on page 20*)



FELTING MACHINE RUNNING OUT FINISHED INSULATION MADE FROM FLAX STRAW

A mixture of pulp fibre and water goes into the machine from which comes out a finished continuous board. The material, which still contains one pound of water per square foot, is then sent to the dry kilns, after which it is cut into shorter lengths.

Minnesota, the Home of Insulating Materials

Many kinds of low temperature heat insulations are manufactured; the university laboratories have pioneered in experimental work on these materials

By Frank B. Rowley

Professor of Mechanical Engineering and Director of the Experimental Engineering Laboratories, University of Minnesota.

THE manufacture of insulating materials is of particular interest in Minnesota due partially to the need for these materials in building construction and partially to the fact that more new insulating materials have been developed in Minnesota than in any other place in the United States. In making this statement the word "insulating materials" is applied to those used for low temperature work such as refrigerator construction and ordinary building purposes. The high temperature insulations, such as used for temperatures of 212 degrees F. and above present very different problems.

In 1910 the total capacity for the production of insulating materials in Minnesota was less than 50,000 feet per day, and there were many times when the mills were idle for lack of orders. Today the capacity is over 500,000 feet per day with every indication of a healthy growth in the future.

Some of the larger producers in the state are The Flaxlinum Insulation company of St. Paul; The Universal Insulite company, International Falls; Wood Conversion company, Cloquet; The Union Fibre company, Winona; the Waldorf Paper Products company, St. Paul, and the B. F. Nelson Company, Minneapolis.

The real start in the insulating industry in Minnesota came in 1909 when a small company was organized at Leroy, Minnesota, under the management of George H. Ellis, who has probably had more to do with the development of insulating materials than any other single person. This company was moved to St. Paul in 1910 and is now known as the Flaxlinum Insulation company.

The original purpose of the company was to build insulation for refrigerator cars and when the plant was completed in 1911 it had a capacity of about 20,000 feet of insulation per day. Somewhat prior to the time the Flaxlinum company was established, the Union Fibre company of Winona was formed as a combination of various tow producing plants of the Northwest. These plants were manufacturing tow from flax as an upholstering material and also formed it into a quilt used as an insulating material for refrigerating car work. They were not, however, manufacturing any board or semi-board materials. The semi-board was the form manufactured by the Flaxlinum company and was the beginning of this class of insulating materials in Minnesota. The board form followed later.

The early problems in the manufacture of insulating materials were not as simple as might now be supposed. There were not only many difficult problems in the manufacture of these materials, but it was necessary to create a market for them. The first conception was to use them in refrigerator car work only, and even in this field one-half inch insulation was considered sufficient, whereas today refrigerator cars use insulation from two to two and one-half inches depending upon the construction. In 1910 the application of a special insulating material to houses was not thought of. It is said that the Flaxlinum company had a salesman on the road for a full year in 1911 who obtained but one order for a house insulation, and even this insulation was only one-quarter of an inch thick.

FROM these small beginnings the market has gradually expanded and with it many new industries have come into the field. At present in Minnesota it is very rare that a house is built without some form of insulation, and in many cases houses are now built with as high as one and one-half inches of material in the walls and two inches in the ceilings. The increase in cost of heating and especially the introduction of gas for domestic heating has had much to do with the public interest along this line. The increased demand has brought with it the development of new forms of materials, and at present there are three general classes, the board, the semi-board, and the quilted forms. Added to these there are other insulating materials which are filled or poured into the spaces to be insulated.

PRACTICALLY all of the raw products for the board or quilted forms consist of some fibrous form of material, such as flax straw, sugar cane fibre, wood fibre, etc. In the manufacturing process it is essential to separate these fibres, to clean them from non-insulating objectionable portions and to form them into the finished product.

A review of the industry shows many interesting manufacturing processes. Consider first the treatment of flax straw for flaxlinum. In this process the straw is first bailed in the field and shipped to the plant. It is then run through a so-called tow machine in which the fibres are separated from the sheaves, dust and other impurities. The tow or fibre is then put into large cookers or digesters in which they are cooked in caustic soda under 125 pounds steam pressure for six to eight hours. This cooking softens and sterilizes the fibres, separates the gummy materials and leaves them in a condition to be fabricated into a finished board.

From the digester the material is thoroughly washed and then passed through a felt machine similar to a Fordnier paper machine where it is formed into a flexible board. From the felt machine the board is passed through artificial driers and then cut up into the proper size for the market. The manufacture of board from sugar cane, cereal straw, and corn stalks follows the same general process, although, of course, there are different treatments for the different fibres and in many cases some form of waterproofing material is added to the pulp.

Insulite represents a somewhat different class of materials in that it is a wood fibre product. Originally it was made entirely from the screenings taken from paper pulp or in other words it was a by-product of the paper industry. Soon the demand for the material increased to such an extent that the by-product could not supply the raw material which made it necessary to grind wood specially for the insulating stock.

The fibres for insulite are prepared similar to those for paper with the exception that the process is not carried to the same refinement. The fibres may be either separated by the sulphite process or by the grinding method. In either case they are mixed in beaters with excess water. In the beating process a resin size is generally added to the pulp to water proof it. From the beaters the pulp is formed into sheets on a cylinder machine similar in many respects to the cylinder paper machine. The sheets come from this machine twelve feet square, and after passing through the drier are cut to proper sizes for the market.

BALSAM wool made by the Wood Conversion company is a wood fibre material fabricated into the form of a quilt. The fibres are prepared by digesting them for a short time and then passing them through high speed grinders. From the grinders the pulp is passed through driers from which it comes as a cotton like material. This material is built up on a batting machine by blowing it in layers and at the same time spraying a fire proofing and cementing mixture between the layers. After the proper thickness has been built up, a sheet of craft paper is cemented to each side by hot asphalt. The completed quilt is then trimmed and stored in rolls.

A different process than any thus far described is used in the manufacture of Masonite, a board form of material made from wood fibre. In this case the wood from which the fibres are separated is placed in a steel cylinder under steam pressure of 800 pounds per square inch. After remaining in this cylinder for about one minute, a valve is suddenly opened discharging the wood at a high velocity, suddenly releasing the pressure. This sudden release of pressure separates the fibres and leaves the material in a condition to be manufactured into the final product. It is then formed into sheets which are pressed and dried in hot presses.

The manufacture of many other insulating materials might be described, and there are many details which are of extreme interest in the various processes, but those given will serve to represent the necessary steps for the construction of typical insulating materials.

Many forms are finding their way onto the market and they are being used not only as insulating materials, but as substitutes for lumber, such as for sheathing and plaster base material. The demand for insulation has now become so general that many materials are sold as insulating materials which have but very little claim to the title. It is a very difficult thing to draw the line between insulating and non-insulating substances. In fact there can be no sharp distinction drawn as all materials will resist the flow of heat to a greater or less degree and are, therefore, to that extent, insulators. It is at the best an arbitrary distinction.

IN order to evaluate the different materials, some standard must necessarily be adopted. This standard is known as the heat transmission constant of the material, and is defined as the number of British thermal units transmitted per hour through a piece of material one square foot in area, one inch thick with a difference in temperature of one degree between the two surfaces. If this difference in temperature is taken as that of the two surfaces of the material, it is known as the hot plate constant. Taken as that of the air on the two sides of the material, it is known as the hot box constant.

(Continued on page 26)

A MINNESOTA INDUSTRY AND THE UNIVERSITY

Perhaps, like the Editor, the reader has never before realized the extent and importance of the insulation industry in Minnesota. Nevertheless, it is an industry in which this state is now leading the country. Low temperature heat insulation materials have been the subject of much development work, and more new types of insulations have been developed here than in any other place in the United States.

Knowing that little is known of the Minnesota insulation industry, Professor Rowley has in this excellent article outlined the history of its development, described the various types of materials made, and explained the methods of their manufacture.

Under the direction of Professor Rowley, the experimental laboratories have pioneered in gathering data about these materials. Since 1920 various insulations have been tested and compared. At the semi-annual convention of the American Society of Heating and Ventilating Engineers held this spring at Sulphur Springs, W. Va., the "hot box" method of testing heat transmission through insulating materials, which was developed here, was adopted as the standard method. Professor Rowley presented at this meeting a code for the testing of air filters which are used for ventilation purposes.

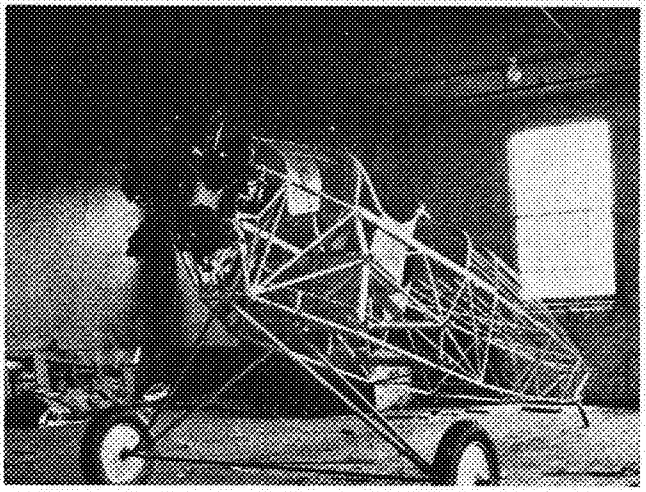
During the coming year by means of a joint fund of $3,500 with the American Society of Heating and Ventilating Engineers more research will be carried on. John Beal, and Clifton Carlson, graduates of 1927, are to work under fellowships, and A. B. Algren will spend his full time on this research.

Since there are many industries which are subject to experimental work by the university, this is the first of a series of articles, each complete in itself, which will bring to the readers of THE TECHNO-LOG various state industries which are being experimented upon at the University of Minnesota.

A Light Airplane

Product of the Mohawk Aircraft corporation of Minneapolis, established largely by former Minnesota students

By LAWRENCE A. CLOUSING



THE WELDED STEEL FUSELAGE

This construction gives strength without bothersome wire bracing. In front is mounted the five cylinder radial air cooled motor.

IMAGINE yourself going out to a hangar which is on a nearby field. Stepping on the electric starter of your light sport model airplane you start the motor, run the plane out onto the field, and then with a friend as passenger take off and fly to Minnesota's football game with Michigan.

Foolish? Not quite as foolish as it might seem.

Just this last month there has been built in Minneapolis and flight tested at the Wold Chamberlain flying field a small sport or business type of monoplane which bids fairly well to promote many such trips—electric starter, too. It could very well make such a trip in four or five hours at a cost of less than $5.00 for gasoline and oil. Moreover, the idea of flying to football games is not new—Minnesota students have done that already—and development work is bringing light planes closer to popular prices both in original cost and in upkeep.

With a structure that is entirely free of objectionable wires and bracing, this product of the first Minneapolis commercial airplane manufacturing concern presents a most attractive and clean appearance. Two wings are placed low down on the body, tapering both in chord and thickness as they go out from the plane. The fuselage is neatly built, and presents fine lines. In the fuselage right above the wings are placed the two cockpits which are staggered in order to make them as roomy as possible and still have them interconnected. Plenty of room is available for grips and miscellaneous baggage. Due to the low wing type of construction and because of the position of the cockpits, the plane has most remarkable visibility. Everything is visible from a few feet in front of the plane to within a few feet back of the wing. It is powered with a 60 horse power five cylinder radial air cooled motor that uses but four gallons of gasoline and one pint of oil per hour at the full plane speed of 109 miles per hour. This is the same as about 25 miles to the gallon of gasoline. Throughout the whole structure every effort has been made to have the plane fool proof, simple and inexpensive.

IT was with plans of this airplane in mind that the Mohawk Aircraft corporation was established in Minneapolis last spring by a group of former Minnesota students and the designer of the plane, Wallace C. Cumming. This is the first commercial airplane manufacturing concern in the city. George A. MacDonald, a graduate of mechanical engineering last spring who is better known as "Archie," is chief pilot of the concern, obtaining his pilots training in the Naval Reserve in which he is now commissioned as Ensign. Leon A. Dahlem, the president of the company and also an Ensign in the Naval Reserve, took several engineering courses, although he has also been a student in the academic colleges. Earle D. McKay, another Ensign in the Naval Reserve and a graduate of the class of 1915 in civil engineering, and Sumner Whitney, a graduate of the School of Business, are the fifth member and treasurer of the concern respectively.

Not least of the credit for the construction of the plane should go to Cumming. He has designed various planes before, and while working for the Alexander Aircraft company, he designed the original Air King plane and was co-designer of the Eaglerock plane.

In the Mohawk plane he has incorporated many of the best features of light planes. The tapering wings, which are set at a slight dihedral, are of thick section so that internal bracing can be used entirely. They are strong enough to hold a man on the end without appreciably deflecting, and they have been tested by equally distributing a load of 3,000 pounds over the entire length of each wing.

THE plane has a span of but 30 feet 6 inches and a length of only 20 feet 2 inches. Without trouble, simply by removing four pins, the wings can be taken off or put on in a few minutes. This makes it possible to store the plane in an ordinary garage. Due to a special

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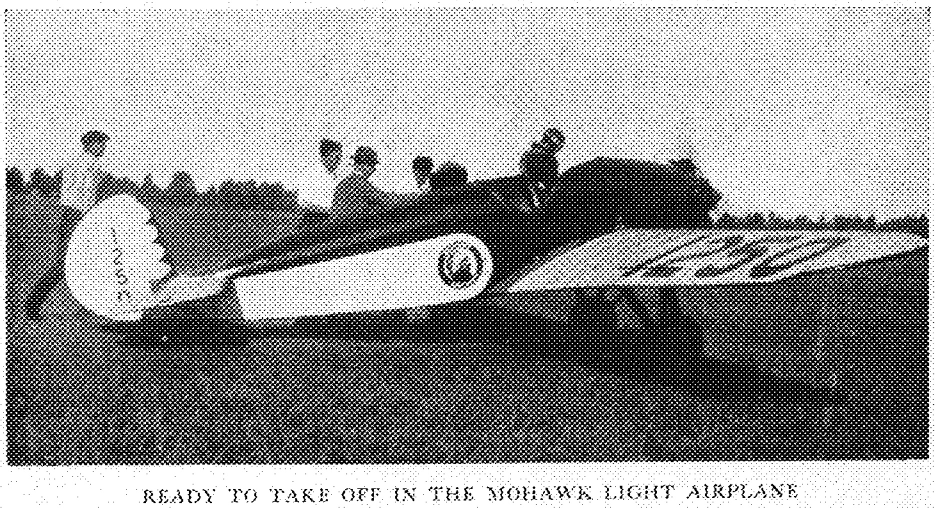

READY TO TAKE OFF IN THE MOHAWK LIGHT AIRPLANE

Note how the entire lack of wires and bracing gives the plane a neat and clean appearance. Preparations are being made for a test hop with Archie MacDonald as pilot.

Transportation on the Mississippi River

After waiting many years, citizens of the Northwest now enjoy the savings in freight rates which are effected through the barge line

By William C. Hill, C '29

BARGE line—dreams of pioneers—magic words for the Northwest—these were realized this year when the S. S. Thorpe tied up at the new municipal docks of Minneapolis with four steel barges of freight.

Since the days of the Minneapolis saw mills a dream that the city would some day be the head of navigation has been carried in the hearts of the forward-thinking citizens of Minneapolis. Even in those early days the politicians were convinced that river navigation would be the one great boom for the Northwest, and Congress was prevailed upon to vote $20,000,000 for making the upper Mississippi practical for navigation.

Already the savings on the two shipments made this summer have shown that the barge line would be all that its backers claimed that it would be. Even before the completion of the warehouse, the tow boat S. S. Thorpe on August 19 tied up at the new terminal with four steel barges of hardware and miscellaneous freight. On September 8 the C. C. Weber with two barges similarly loaded docked. Each took on a return cargo and immediately left down stream.

The savings estimate on freight rates of the various articles for New Orleans are from 60 to 65 per cent on grain and from 15 to 30 per cent on manufactured articles. The upstream rates average a saving of about 5 per cent which is much smaller than the downstream saving, although the saving on coal may amount to as much as $2.00 to $2.50 per ton. Grain, the biggest export of the northwest territory, can be shipped at 14.8 cents per 100 pounds by barge while the rail rate is 36.5 cents per 100 pounds.

Minneapolis grain dealers are now contemplating the construction of a 1,000,000 bushel, $150,000, elevator to serve the needs of the terminal. The future of the terminal is now a certain thing, and with the river traffic continuous from the first of April to December first the Northwest will have a chance to save a great many thousands of dollars. Seasonal congestion of the railroads, a thing that started all this talk of getting back to water navigation, will be cleared.

A short review reveals that citizens of Minneapolis have put up a long fight in order to secure this service for the Northwest.

In 1894 a high dam was proposed, but two smaller dams with locks were decided upon. One to be placed between Franklin avenue and Lake street, and the other to be below the Old Soldiers home. Later this scheme was found to be impracticable and the upper dam between Franklin avenue and Lake street was abandoned after spending about $700,000. From then until 1910 anything pertaining to navigation on the Mississippi was looked upon with disfavor.

THE railroads had by that time realized that a barge line, well organized and efficient, would cut down their freight revenue, so they took measures to stop anything that might look like serious competition on the river. Competitive river rates were established on railroads parallel to barge lines that were far below the actual costs of railway operation. Freight rates in the interior, where the menace of a barge line was not felt, were then raised to offset the river loss. In fact there were known to be cases where as long as a river steamer was in port the freight rates were lowered to below cost and when the boat was fortunate enough to receive a cargo, or had enough passengers to pay to leave town, the rates were immediately jumped to normal.

This state of affairs, of course, could not last long. One of the two had to leave, and it was the little river freighter that had to find other fields of enterprise. Thus until 1915 when the Interstate Commerce Commission said that railroads could not continue ownership of parallel railroads, the railroads had a complete freight monopoly on the river and the common carriers were not profitable.

In 1910 the present plan for making the river navigable up to the Washington avenue bridge was adopted by the government. This called for a high dam to be erected just above the Old Soldiers home that would form a lake four and eighty-six hundredths miles long, and from 800 to 1,000 feet wide, with a depth of from nine and one half feet at the bridge to 30 feet at the dam. This dam also called for a lock 80 feet wide and 350 feet long, and a power station for generating electric current. The next step in river improvement was taken by the Minnesota State Legislature in 1913 when it appropriated $300,000 for a dock and freight handling facilities.

THAT same year a committee was sent from the Minneapolis Council to Washington to recommend that a sea wall be built. Little else was asked for as the traffic was too light to spend very much money. By 1916 the city saw that the only feasible way to handle the freight after it was unloaded on the docks was by a railroad, and so they entered into an agreement with the Minneapolis and St. Louis Railroad company whereby the railroad was to build and maintain sufficient trackage to handle the traffic offer-

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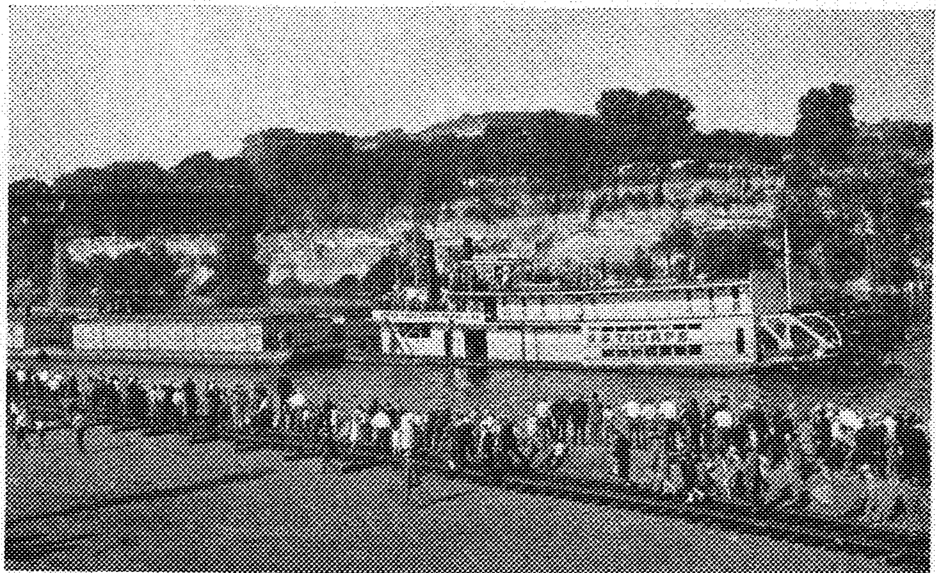


THE S. S. THORPE DOCKING AT THE MUNICIPAL PIER

Reminders of picturesque old southern river scenes like this now will be a common occurrence in the Minneapolis harbor. The tow boat is an oil burner, and is constructed on modern design.

"Rah-Rah-Rah-Rah,—Minn-e-so-ta,—R-a-a-a-y!"

Engineers and foresters take the leading part in producing for Minnesota a brass lunged, iron throated group of rooters

By LEON A. MEARS, E '29
Chairman of Rooter Section as Appointed By Prof. O. S. Zelner

BY this time everyone ought to know there is going to be a real, honest-to-goodness rooter section in the stadium this fall.

More interesting about the above statement is the fact that this rooter section was started by a little row between the engineers and foresters last spring. Every engineer and forester who was in school last spring will remember the skirmish between these two groups on Engineers' Day, and the battle on the "Ag" campus a day later. After these spirited clashes, men from these two groups met, seeking the reason for the existence of a grudge against each other. After spending an entire afternoon so speculating, they finally came to the conclusion that there was absolutely no reason for the engineers and foresters to be enemies. On the other hand, these two groups were more alike than any other two groups in school. Consequently they should be the best of friends. We can all remember the resulting get-together of these two colleges, and the congenial atmosphere that was felt by everybody at the mixer.

At another meeting of the representatives of these groups, an attempt was made to develop on a sound and permanent basis the friendly spirit born of the mixer. So the engineers and foresters decided to get together in one group in the stadium to give the University of Minnesota a lasting rooter section.

Allow the plans for an Engineer-Forester rooter section in 1927 to drop for a moment, while we see what success past rooter sections have had at Minnesota and in the Big Ten. Everyone has heard the word "rooting" so often that it is natural to suppose every university in the Big Ten has a rooter section. After this guess, it might pay to take a look at the actual facts.

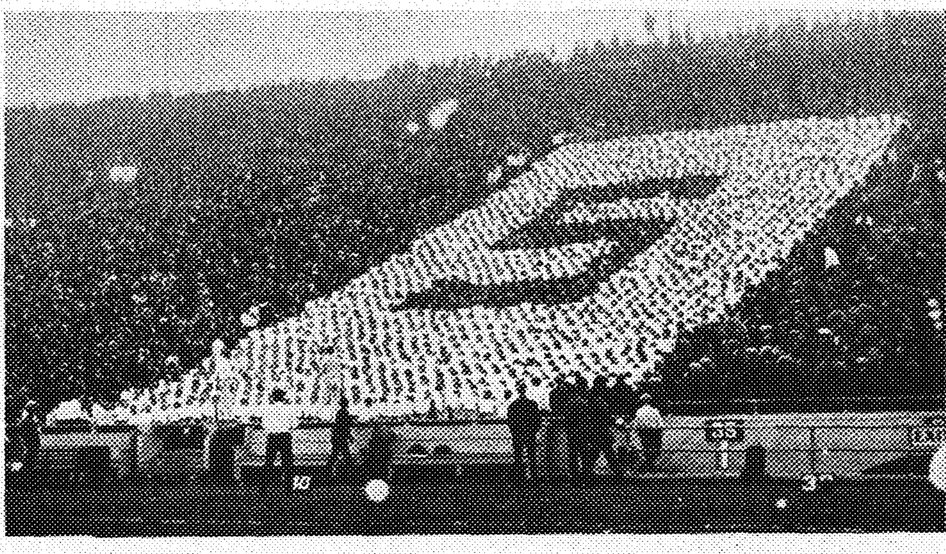
Going back to 1925, we are completely floored upon discovering that no university in the Big Ten had a rooter section well enough organized to give a colored display in the stands. Furthermore, only three or four had any kind of a rooter organization at all. Then in the year following, Michigan was the only university in the Big Ten to attempt a section giving colored displays. A badly formed yellow and blue "M" was the extent of their colored display. In 1925, Minnesota had a rooter section started by an engineer, Barton Juell. However, he graduated in 1926 and consequently with no leader the section died a premature death, and Minnesota was again left without an organized rooters' section.

In this same manner, attempts for better Minnesota rooting have failed in the past. Bud Bohnen, Minnesota's rooter king the few years following the war, was deeply interested in promoting a rooter section at Minnesota. To do this he organized the Knights of the Northern Star, which organization he had intended should form the nucleus of a rooter organization. This organization, however, failed in its purpose, and conditions were left little better than before. In this way, attempts to form rooter sections at Minnesota could be followed back many years, but all the attempts were temporary, and today we have little in the way of organized rooting to show for them.

GOING out of the Big Ten, we find rooting which has been decidedly successful over a long period of years. California has had a successful section for thirty-five years. Flawless formations are made in the student section by experienced manipulation of small pieces of colored cardboard. On the west coast, the rooter sections have made many complicated formations. In Washington last year, a battleship was formed by the section. The experience of these schools proves that the existence of a successful rooter section is not a mere day-dream.

With these facts in mind, a few engineers and foresters obtained plans from schools that had successful sections. From the returned letters the best points of each plan were picked and in that way a real foundation for the Engineer-Forester rooters' section was secured. In addition letters were written to Minnesota alumni, who have been interested in starting such sections at Minnesota in the past. The alumni were asked to tell of their projects and if possible give the reasons why their organizations were not successful. In this way it was planned to profit by the experience of the pioneers in the game and so try to avoid failure in this present plan.

ABOUT the time the answers began to come back from the western universities and the alumni, the organizations around the campus heard inklings of the news, and as the proposition sounded like more than a pipe-dream, they were anxious to co-operate. The chairman of Freshman Welcome week had planned to have as many freshmen as possible together in the stadium, as in this way he had hoped to get the freshmen better acquainted and create a spirit among them that has been noticeably lacking in the past. After talking it over, it was decided that for the good of both projects it would be best for the two groups to combine and all sit in one section in the stadium. In this way the rooter section would be given a larger number to work with, and would be able to do things that would have been impossible in divided, smaller groups.



A COLORED DISPLAY ROOTER SECTION ON THE WEST COAST
Formations are made by the means of hats and cards that show school letters or symbols. In some cases displays are made that depict animals which have feet that move and eyes that blink.

When the ticket committee was approached on the matter of getting a special section in the stadium reserved for this group, they claimed it would be impossible. It was pointed out that if the students from the engineering college were shown favoritism in reserved seats, other colleges would have to be allowed similar favors, and such partiality was strictly against their practice. The ticket committee claimed that if other students in the university were allowed to join the section, the section would have more chance for success, since it would then be all-university in scope and would have the backing of the entire student body.

LEON A. MEARS
Mears has been appointed by Professor O. S. Zelner to take charge of the rooter section.

As a result, the finished plans for the section differed considerably from the original Engineer-Forester rooter section. The finished plans provide for a section of 1,300 university men, with the engineers and foresters grouped together in the center of the section. The freshmen will form a border for the section, and a part will be left open to men from any college in the university. In this way the engineers and foresters still are the nucleus of the section. It was because these colleges had in the past shown the school what real college spirit was that they were chosen to have the center of the group. They are the leaders in showing Minnesota real university spirit. In order to have some group upon whose shoulders the responsibility for the success of the section could definitely be placed, a rally committee was chosen, consisting of a group of men representative of the entire university; men well known on the campus, who would put the proposition across.

When the answers were received from men interested in rooting at Minnesota in the past, it was found that there were very definite reasons why the sections had failed in previous attempts. In the first place, some men had secured seats in the section because they wanted to get good seats in the stadium easily. When these men did get in the section they were not anxious to co-operate in promoting a Minnesota spirit. In order to prevent this from recurring, every person will have to purchase a maroon and gold hat before he can change his ticket receipt for a seat in the section. This hat will be necessary in the formations and will be an all around hat suitable for campus use. It is thought that in this way the uninterested will be reduced to a minimum.

Another reason for failure was that although girls were not supposed to be allowed in the section, the fellows exchanged seats in such a way that girls did get in the section. Queer as it may seem, girls did not seem to add to a men's rooter section. Consequently no girls are to be in the section.

A third objection was that there was no provision for the perpetuation of the organization. The moving spirits who graduated left no one to carry on their work. In order to prevent this, a Rally Committee has been created. It is hoped this committee can be made a permanent institution, composed of seniors and juniors, so that when the seniors have graduated, the juniors will still be in the university to carry on the organization the following year.

The answers from the Western Universities have been studied and a good working plan has been evolved. The section will have its own rooter king, possibly more than one. Blue prints of the section are being made up, and on these blue prints accurate plans of all the formations that are to be made will be mapped out. Then the Rally Committee can decide from these plans which ones to form at a particular game. For example, the brown jug formation would be particularly effective at the Michigan game, while a badger would be appropriate for the Wisconsin game.

After the formations have been chosen by the committee, representatives will go out to the stands and map out the seats according to formations. A card tacked to each seat will call for different colors in the different formations. For example: 1. Maroon; 1. Gold; 3. Gold, etc., in which case the person sitting in the seat would hold up a maroon card when the first formation was called, a gold card for the second, and so forth. Thus all know what to do.

Of course, the section will be on hand at all times to start the yelling. If the game goes against us, and the students as a whole become disheartened, the rooter section will give everybody the pep they ought to have, and possibly turn defeat into victory by urging the team to push just a little harder.

"PI" THOMPSON IN ACTION
Engineers and foresters will be behind "Pi" this year at the Minnesota football games.

For the first game of the season this year, there will be no rooter section, as seats in the stadium are not assigned this year until after the North Dakota game. At the next game, with Oklahoma, the section will be ready to start. The freshmen will still be wearing their green hats, and so will be forming a green border to the section. They will discard their green hats the night before the next game, and will be permitted to wear the maroon and gold hat at the following games.

Many times in the past, intricate plans have been drawn up for some proposition, and yet the proposition has not succeeded. It has lacked support. It remains for the engineers and foresters to accomplish.

Engineers!

The first successful colored display rooter section on this side of the Mississippi river.
Are you in on it?
It is here to stay, so you might as well be a charter member; you will cherish it when you are an alumni.
Boost your college by boosting the university.
Is anything more satisfying than real help to your alma mater?
Not for mollycoddles—but for real Minnesota men. Join now and help the team toward a championship.

News from the Technical Campus

Vacation—with sneaking cunning—quickly slips by, once again bringing us back to the familiar haunt of slide rules, text books, and fierce looking integrals.

Mechanical Engineering Building is Remodeled

Scarred remnants, torn up ground, and a big blotch of revealed yellow brick on the rear of the standing part of the mechanical building serve to bring back to the engineers of former days memories of their old foundry and forge shops where in the soft black dirt and under the smoky ceilings they packed molds and made many hammer blows on odd shaped pieces of iron.

With the destruction of these two shops, the technical college students have lost a famous landmark. No longer does the crumbly red brick shelter serve to remind us of our toil.

It was necessary, however, to tear down this section of the building in order to make room for the new auditorium. Now the forge and foundry are between the Power Plant building and the Mechanical building. Here under a shelter not yet dirtied with the sparks and smoke from the forge or the vapors of molten iron, the freshmen engineers will wield their hammers and tongs.

Shortly after the close of the spring quarter, workmen began the task of tearing down the old foundry and forge shops at the rear of the Mechanical Engineering building. While this was being done other workmen began to build a wall and roof to connect the power plant building or old Electrical building with the Mechanical building.

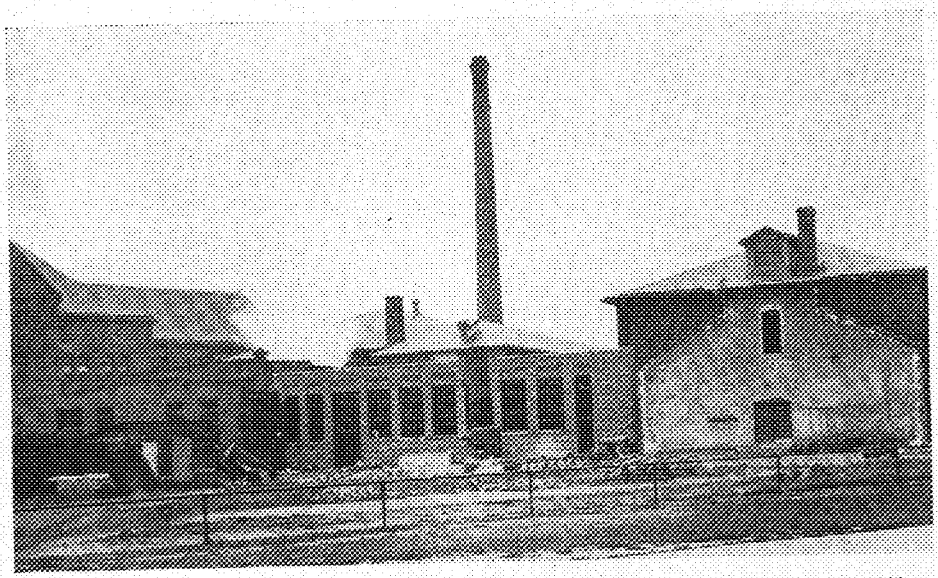
Construction of the addition was let out on contract, but the other work such as the erection of the melting furnace and forges was taken care of by the university buildings and grounds department.

The forge shop will have forty-two new forges of the permanent type, which forges were made in our own shops. Patterns were made under the direction of Mr. Richards in the pattern shop, and all castings were made in the foundry by Mr. Moffett and his helpers. The machine work necessary was done by hired student help. While the forge shop has approximately the same floor space as before, the arrangement of equipment is now much better.

The foundry also has approximately the same floor space but is longer and more narrow than before. The traveling crane now reaches all parts of the molding floor. Molding benches are lined up along both walls parallel to the rails of the crane, and the single runway which divides the foundry in two. The cupola has a better location, and the loading platform is to be roomier and more easily accessible. A new oil-heated soft metal furnace has been ordered. Only one of the brass and aluminum melting pits has been retained.

The two shops have a new concrete floor which facilitates the task of sweeping (this cannot be appreciated by the freshmen). Light cut off to the machine shop by the addition has been compensated for by installing windows in the roof of the machine shop.

Material from the old building was used as much as possible. Bricks were brushed, and after they were laid they were cleaned by an acid solution which has made them look like new. All lumber that could possibly be used again was refinished and used with new lumber. These economies helped to keep the cost down to twenty thousand dollars, which includes all new equipment and the cost of moving.



RAZED—DESOLATE REMAINS ARE REMINDERS OF TOILING FRESHMAN DAYS

Torn from the old mechanical building to make room for the new auditorium, the forge and foundry leave their scars in the wall. The newly roofed portion in between the two buildings now houses the forge and foundry. In the foreground, the cupola recalls memories of scorching hot iron.

Miss Phoebe Oster and Former Professor E. R. Martin Are Married

Evidently the electrical engineering building is not the dull, staid place that students often begin to think it is after they have been running tests in the laboratory and worked on problems in the design room. For just this September marked the culmination of an unknown, delightful romance between Miss Phoebe Oster, former stenographer of the department, and Mr. E. R. Martin, former professor of electrical engineering at the University of Minnesota. On September 10 they were married.

After October 15, they will be at home in Wilkinsburg, Pennsylvania, at 332 West Street.

Mr. Martin left the university for the East several years ago to work for the Westinghouse company, while the former Miss Oster was stenographer of the electrical department until about a year ago when she was transferred to the chemistry department.

Free Year Books to be Given in Gopher Subscription Campaign

Free Gophers will be given to the winning team in the annual Gopher subscription campaign which will be staged during the second or third week of school. In charge of the campaign in the engineering, chemistry, and mines college is Leon A. Mears, junior electrical. Team captains will be appointed in each of the colleges and they in turn will appoint their respective teams. Every junior is eligible to be on one of the teams, and any one desiring to be a member of one of the teams may communicate with Leon Mears for assignment to his proper team.

Students Fly During Summer; Aviation Course Offered This Fall

Flying proved of interest to a number of engineering students during the summer. Up at Great Lakes, Ill., at the naval Reserve Air station Donald Stevens, Lloyd Berkner and Lawrence A. Clousing, who hold Ensign commissions, flew in the Navy seaplanes. Down at Hampton Roads, which is an advanced student training station, Keith Krieger and John Diffley finished up their training this year and took the examination for commission of Ensign in the Naval Reserve. They were up at Great Lakes, Ill., for a short time early in the summer.

Men desiring to gain a general knowledge of airplanes, their structure and theory, may register for a course being offered this fall and throughout the school year at the University of Minnesota in conjunction with the course in actual flying as offered by the Minneapolis unit of the Naval Reserve Aviation force.

This course which is to be taught by Ensign Earle D. McKay, who has taken the place of Ensign Weld as the commanding officer of the unit, is necessary preliminary course to the training in actual flying which is given by the Naval Reserve during the summer.

Professor Maney Resigns to Teach at Northwestern University

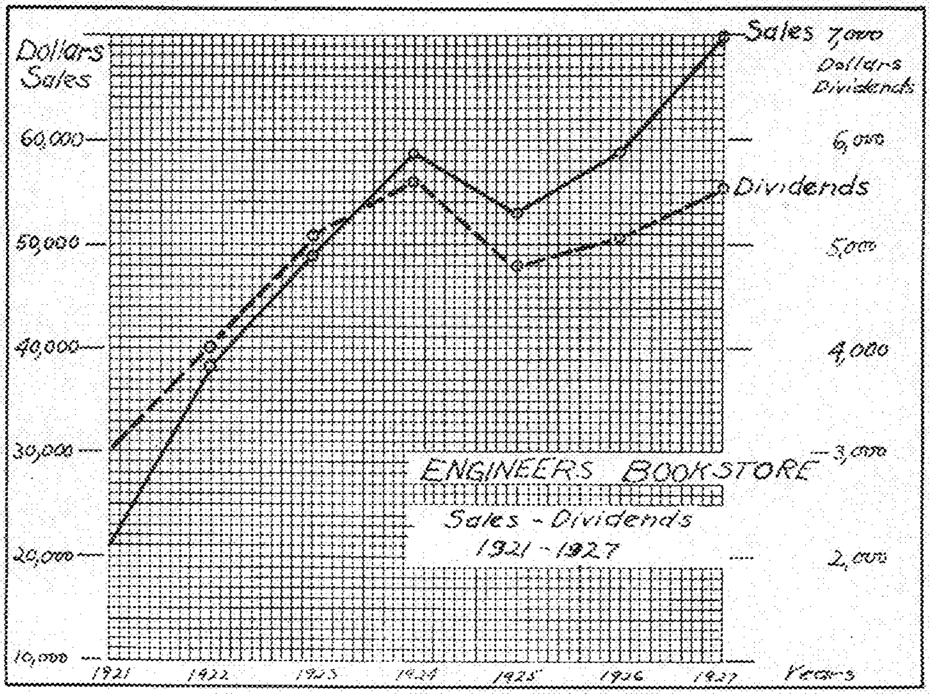
With the resignation of Associate Professor George A. Maney early this summer, the structural engineering department has suffered the second loss during the year. This spring Assistant Professor Maurice B. Lagaard was lost to the department, and Professor Maney has resigned to accept a professorship of structural engineering at Northwestern university.

His loss will be felt, as through his special researches and publications he has brought prominence to the University of Minnesota. He has been instructing here since 1912, having graduated from the University of Minnesota in the civil engineering class of 1911. He studied for one year at the University of Illinois, and returned here in 1912 with a degree as master of science in theoretical applied mechanics. With the exception of his war service and short leaves of absence he has taught here continually.

During his service at the University of Minnesota, Professor Maney developed a method of analyzing secondary stresses and other stresses in rigid frames, which method is now recognized as the standard of today. His paper on the "Analytical and Experimental Study of Secondary Stresses in the Kenova Bridge," which was compiled with John I. Parcel, received a column of editorial comment in the Engineering News-Record. Also his method of determining deformations and deflections of reinforced concrete beams has become one of the two of three standards now used.

The latest major publication of Professor Maney is "An Elementary Treatise on Statically Indeterminate Stresses." This book, which took both Professor Maney and Professor Parcel seven years to complete, has been accepted as a text book in at least eight of the major universities of the country.

Professor Maney has not confined himself solely to publications. In 1918-19, following the war, he was in charge of the concrete ship frames analysis. In 1919, as consulting engineer for A. Bently and Sons of Toledo, Ohio, he won a competition with twelve leading eastern engineers in the design of a 10,000 ton floating and lifting reinforced dry-dock. In 1923-24 Professor Maney was consulting engineer on the Santa Fe Terminal building at Dallas, Texas. This building costing $4,500,000 was the tallest reinforced concrete structure in the United States at the time. Last year he was the consulting engineer for the State Highway department on the proposed reinforced concrete arch bridge over the Mississippi at Champlin, Minnesota.



FINANCIAL GROWTH OF THE ENGINEERS' BOOKSTORE
The drop in sales and dividends during the year 1924-1925 is due to the closing of the branch store in the School of Business and the discontinuance of the sale of candy.

Seven Years of the Engineers Bookstore

Entering the eight successful year of its existence, the Engineers Bookstore is doing much for the engineering students. It is giving them books and supplies at a much reduced rate; it is justifiably maintaining a dividend rate of one-sixth; it has established a $1,000 loan fund for engineers who might be in financial straits; it has recently given to the college a beautiful and handsome trophy case; it gives trophies for engineering activities, and keys to the prominent college athletes; it helps to foster school spirit.

This institution started from a co-operative sales organization which declared its first dividend of $2,127.98 in 1921. Now it is an organization whose net sales for the fiscal year ending May 30, 1927, amounted to $55,685.54. The dividends to be paid back to members upon their return to school this fall will amount to $6,966.91.

The first board of directors was elected in 1920 under an amendment to the by-laws of the organization and Howard C. Jacobson, a senior in the College of Engineering, was appointed to manage the newly organized bookstore. Under Jacobson's able direction the bookstore grew from the experimental stage to its present status. In 1925, Jacobson resigned his position to devote all his energies to a manufacturing organization of his father.

Harold D. Smith, E. E. '25, was then elected to suceed Jacobson as manager of the bookstore and he is holding the position at the present time.

In 1922, because of popular demand for a cooperative bookstore for other colleges on the campus, the Engineers Bookstore established a branch in what was then called the School of Business. This branch proved to be a losing proposition, so it was closed in the spring of 1925. The bookstore in addition to engineering supplies had also carried a stock of candy.

The graph indicates a steady upward trend in sales and dividends when the reason for the sharp drop is taken into account. The sharp peak and drop shown for the year of 1924-1925 is caused by the closing of the branch in the School of Business. The discontinuance of the sale of candy also lowered the sales considerably. However, the same steady climb in sales and dividends is noted, after this peak. The sharper increase in dividends indicates that more people who are buying at the store have become members.

The bookstore is adding a line of fiction books this fall allowing the students to secure good books conveniently. The first books will probably be in the modern library binding, as are several of the books required by the English department. If the demand for the books is great enough, additional titles will be added from time to time selected upon the advice of the English department.

The board of directors who guide the policies of the store keep in contact with the plans and work of the store by means of semi-monthly meetings. The board consists of nine members; three from the faculty, five from the student body each of whom is from a separate department, and the Bookstore manager. For the year 1927-1928 the following men will serve on the board: John Ramey, chairman, architecture; Arthur Burris, secretary, electrical; Irvine Sinnott, mechanical; George Schoepfer, civil; Carlyle Linden, chemical engineering; Dr. C. A. Mann, chemistry, Prof. W. H. Kirchner, drawing; Prof. O. S. Zelner, civil; and Harold D. Smith, manager.

"What About Our Faculty and Alumni?"

FACULTY

Civil Engineering

Prof. Frederic Bass motored East with his family.

Prof. John I. Parcel taught structural engineering in summer school.

Prof. A. S. Cutler spent several weeks in Michigan and upon his return went to Cass lake to take charge of the summer surveying camp for senior civil engineers.

Prof. O. S. Zelner worked for the U. S. Army Engineers office on flood control of the upper Mississippi river. Professor Zelner was an instructor in the summer surveying camp.

Prof. Leonard F. Boon worked for the Minneapolis Bridge company as designer until leaving for summer surveying camp at Cass lake.

Mr. Hibbert M. Hill worked for the Northern States Power company as hydro engineer.

Messrs. Arne A. Jakkula and James R. Johnson worked for the Minnesota Highway department.

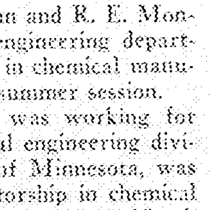
Chemistry

Professors C. A. Mann and R. E. Montonna of the chemical engineering department, taught the course in chemical manufacture during the first summer session.

Mr. I. Lavine, who was working for his Ph.D. in the chemical engineering division of the University of Minnesota, was appointed to an instructorship in chemical engineering at the University of North Dakota, Grand Forks, N. D.

Dr. R. S. Livingston of the University of California has been appointed as an assistant professor of physical chemistry at the University of Minnesota.

Prof. L. H. Reyerson sailed from New York on August 20 to spend a sabbatical year in the laboratory of Prof. Herbert Freundlich, director of the division of chemistry of the Kaiser Wilhelm institute. Professor Reyerson will work on problems related to the nature of a catalytic surface in chemical catalysis. Professor Reyerson was one of the American delegates from the National Research council to the 8th conference of the International Union of Pure and Applied Science which met at Warsaw, Poland, Sept. 1 to 9.



Prof. G. H. Montillon, associate professor of chemical engineering, acted as Sanitary Engineer for the State Board of Health during the summer.

Early in October Prof. I. M. Kolthoff of the University of Utrecht will assume his duties as a professor of analytical chemistry at the University of Minnesota.

After spending his sabbatical year at Cornell university, Prof. R. E. Kirk has returned to the University of Minnesota with a degree of doctor.

Another member of the School of Chemistry on sabbatical leave this year is Dr. L. A. Sarver of the division of analytical chemistry. He will study at the University of Toulouse with Prof. Paul Sabatier, and at the Sorbonne in Paris.

Prof. P. H. Brinton, who recently resigned as professor of analytical chemistry, has gone to Washington, D. C., where he will establish a private research laboratory and make his home.

Dr. L. I. Smith of the School of Chemistry, with Professor Butters, made an extended trip to the West Coast. They returned during June and July.

A new staff of assistants has appeared in the School of Chemistry this fall. Braving the popular hoodoo of thirteen, the School of Chemistry has put all of these men on their teaching list: Henry B. Bull, University of South Carolina; Gordon D. Byrkit, University of Washington; Donovan E. Kvalness, University of Montana; Donald R. Blumer, University of South Dakota; L. Wallace Cornell, University of Minnesota; Byron E. Lauer, Oregon State college; Josephine M. Winter, University of Wisconsin; Barnard M. Marks, University of Missouri; Charles Rosenblum, University of Rochester; Robert V. Yohe, Drake university; James E. Holst, University of Minnesota; Elmer H. Northey, University of Minnesota; and Edward C. Truesdale, Harvard University.

Drawing and Descriptive Geometry

Mr. Archibald taught one session of summer school. After doing some work for the Republic Creosoting company, he took his vacation at Big Birch lake.

Manning, Maxwell, and Moore, a concern at Muskegon Heights, Michigan, has secured the services of Mr. Brongersma, and he will not resume his work at the university this fall.

Shortly after the commencement exercises Mr. Cruzen left for Washington where he spent the summer in the great, big northwest.

Following a trip to Iowa, Mr. Doseff returned to the Twin Cities where he has done considerable modeling and designing during the summer.

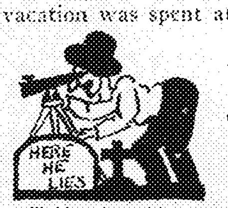
After teaching one session of summer school, Mr. Eggers busied himself with the revision of a text book.

Mr. French taught one session of summer school and engaged in engineering work. His vacation was spent at his summer home at Cass lake.

During the summer Mr. Kirchner attended the 40th reunion of his class at Worchester Polytechnic institute and visited several schools and industrial establishments in New England and New York. He is preparing his text on descriptive geometry for the publishers, and he is also writing a book on perspective. It is his intention to visit the Graphic Arts Exposition in New York.

Mr. Myers has been busy all summer superintending the construction of his new home.

Mr. Schuck taught one session of summer school and also did some work for the Republic Creosoting company. His vacation was spent at Big Birch lake.



After spending the early part of the summer surveying a cemetery and in subdividing farm land, Mr. Levens took a six weeks' tour.

Following his teaching during the first session of summer school, Mr. Quaid went on a vacation tour early in August.

The Donovan Construction company, which was engaged in laying mains for a gas plant at Waseca, Minnesota, was aided by the services of Mr. Shultz.

Mr. Williams also spent most of the summer at Waseca working for the Donovan Construction company.

Electricals

Prof. F. W. Springer spent the summer working on the development of storage battery charge regulators and temperature regulators for automobile use. He spent three weeks in the East—Detroit and New York—visiting, vacationing, and negotiating a patent sale, returning August 7 with his family who have been in New York all summer.

Prof. W. T. Ryan attended the annual convention of the N. C. E. A. which was held on Lake Superior, June 22-26, and submitted a report as chairman of the Educational Committee.

The committee's principal activity during the past year was to encourage employees of the central station companies to take the short courses which have been prepared especially for them by the National Electric Light association. The number of the above courses subscribed for increased 200 per cent over the previous year. A plan is also being worked out which will bring about more cooperation between the central station companies and the department of electrical engineering of the university. Professor Ryan was re-appointed as chairman of the above committee for the ensuing year.

Prof. E. W. Johnson spent the summer in the generation department of the Northern States Power company, Minneapolis, making a survey of system voltage.

M. E. Todd, assistant professor of electric power engineering, spent about seven weeks during the summer visiting points in the East. He attended the summer National Convention of the A. I. E. E. at Detroit, June 20-24. The following week was spent in and near Newark and New York City where he visited the Bell Telephone laboratories, New York, and the plant of the Weston Electrical Instrument company at Newark.

From July 5-Aug. 6, he attended the Professors' Conference at the General

Electric company, Schenectady, New York. This conference consisted of inspection trips, lectures, conferences and work on special problems.

There were side trips to outlying points, chief of these being the transformer factory at Pittsfield, Mass. During this time, Professor Todd had the pleasure of meeting many former Minnesota engineers.

Prof. J. H. Kuhlman has spent the summer writing his book on electrical machine design. He is consulting engineer for the Meyer Governor company, Minneapolis, where he has worked on the development of regulating devices.

Prof. G. W. Swenson has been connected with the Northwest Bell Telephone company, division engineer's office at Minneapolis, this summer. He has been engaged in designing inductive coordination schemes for toll lines and in testing loading schemes and repeaters.

He vacationed for a while in the north woods on the Cloquet river—lots of good fishing—toured through Superior National Forest to Ely and Winton.

Mathematics and Mechanics

On account of the large registration in summer school many members of the department were engaged in teaching. Messrs. Dalaker, Doeringsfeld, Hartig, Herrick, Holman, Jones, Miller, Priester, Siler, Warne, and Wilcox were active in either the first or second half of the summer school.

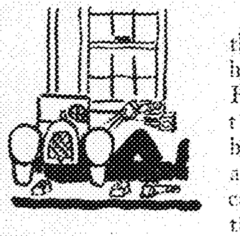
Prof. J. O. Jones taught summer school and tried fishing in Cass lake, but he was too interested in flood control problems to catch many fish. He is working with the government in an effort to solve the problems of controlling floods on the Mississippi river.

Prof. McClintock did something that can't be done; he invented and perfected a submerged float control that works.

Mr. Hermann and Mr. Wells were with the Northern States Power company.

"Doc" Holman went fishing, returned to summer school, and visited his parents in Nebraska.

Prof. G. C. Priester took a long vacation at his summer cottage on Norway Beach, Cass lake, in preparation for some hard work on the elasticity theory. He is to do experimental work on this at the University of Michigan where he will spend his sabbatical year.



Summer school and the program bulletin have kept Prof. C. A. Herrick busy during the summer. He bought a new car and, being a mechanical engineer, soon had the usual experiences of a tyro. The car is in the repair shop.

"Hans" Dalaker was at his log house on Woman lake making some fierce looking integrals for his new calculus.

"Herr" Boehnlein has been studying aerodynamics and hydrodynamics with Doctor Prandth at the University of Göttingen in Germany during the past year. He arrived in the United States on the 6th of September.

Professor Siler immediately after summer school started for parts "X."

Prof. W. H. Ingram, who filled Professor Boehnlein's place during the past year, has accepted an assistant professorship at the University of Washington, Seattle.

Professors Brooke, Wilcox, Hartig and Professor Becker of Hibbing Junior College were the Minnesota representatives at the Conference on Teaching Mechanics at the University of Wisconsin, July 10 to 31. The conference was conducted under the auspices of the Society for the Promotion of Engineering Education.

Mines

Prof. Anders J. Carlson has resigned his position to accept a position in the School of Mines of the University of California. His new work is in the field of petroleum.

Prof. Walter H. Parker spent much of his time during the summer in the oil fields where he has studied drilling and production methods.

Dr. L. J. Weber, instructor in metallography, has resigned to accept a position as research metallurgist with the Aluminum company of America and is located in their research laboratory at New Kensington, Pa.

A. C. Forsyth, Met. E. '24, is returning to the School of Mines and Metallurgy as half-time instructor in metallography. Forsyth has been with the Bethlehem Steel company, principally in their steel foundry, since 1924. He will devote half time to graduate studies.

Henry S. Jerabek, graduate of the School of Chemistry in 1925, has been appointed half-time instructor in metallography. He will devote half of his time to graduate work.

Dr. O. E. Harder attended the annual convention of the American Society for Steel Treating held in Detroit September 19 to 24. He presented a paper, as joint author with Dr. L. J. Weber and T. E. Jerabek, on Normal and Abnormal Carburizing Steels.

Ray Allard spent the summer assisting Professor Lambert with the tax commission work.

Louis S. Heilig, graduate of the School of Mines and Metallurgy, 1915, and who for several years has been with the Minnesota Tax commission, is returning to the

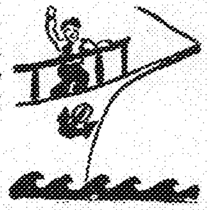
(Continued on page 28)

Chicago Alumni Display Old St. Pat Spirit

BOAT trips, luncheons, dinners, and just plain get-togethers mark the life of the Minnesota engineering graduate who happens to settle in Chicago, for this city has one of the strongest alumni organizations. The engineering graduate here hasn't a chance to lose connections with his former classmates, because the good old fashioned engineers' spirit still holds the grads in its bonds.

A boat trip sponsored by the Chicago unit of Minnesota Engineers on Sunday, June 26, 1927, turned out to be a real success. The arrangements were in charge of a committee composed of Roy Olson '23 E (Chairman), Earl O'Brien '25 C and George Bailey '22 C who saw that everything was in "ship shape."

There were about 70 in the party, and entertainment such as bridge, dancing, "sea gazing," etc., were provided for the "customers." On the way to Milwaukee, Joe Meagher, '25 E, flew over the boat in an aeroplane from the Great Lakes Naval Station and exchanged greetings. Later Joe met the group in Milwaukee and returned home on the boat.



On the arrival in Milwaukee a few buses were filled up with engineers wishing to make the sightseeing tour. The tour included a trip to the brewery where pretzels and various other "accessories," for which Milwaukee is noted, were served. Needless to say every one felt at home, and when boarding the boat to return home several fellows displayed an old fashioned stein, which had been "promoted" as a souvenir of the trip.

Every one seemed to have had a very enjoyable time, and all declared their intention of attending our next annual outdoor affair.

As described by Frank C. Appleman, who is this year's secretary and treasurer, the club is most democratic. Since the main purpose of the club is to get the fellows acquainted, the meetings are absolutely free of all formal speeches. Each man gives a short talk after introducing himself.

Spice and variety is added to the meetings by means of a novel system of organization. Each time the club meets, a 2nd vice chairman is elected. This automatically makes the 2nd vice chairman elected at the previous meeting the 1st vice chairman, and the 1st vice chairman the chairman. Thus every meeting has a new chairman, because no one can be chairman more than once. Of course the entertainment for the meetings is left to the chairman.

Only the secretary-treasurer has what might be considered a permanent office. Every December this officer is elected for a period of one year. He takes care of the correspondence and money, and sends out notices of meetings. Accurate check is kept on all of the alumni in the Chicago district, and a miniature address book has been put out by the Chicago unit.

The
MINNESOTA TECHNO-LOG
University of Minnesota

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Across the Editor's Desk

IT is with regret that the TECHNO-LOG announces the resignation of Curtiss Crippen as business manager. Financial troubles have caused Crippen to remain away from school during the coming year.

However, we are very fortunate to have already on the staff a man experienced in the business side of the publication. Carl E. Swanson, who was advertising manager last year, will fill the position of business manager. His tentative appointment made during the summer will be made permanent upon confirmation by the TECHNO-LOG Board.

It is also unfortunate that Oswald Mikkelsen, circulation manager, will not be back to school this fall. During the past he has faithfully taken care of the duties of his office, and he will be missed from the staff. His position has been filled by Frank Pesek.

AS we enter with this issue into the eighth year, we cannot help but look back to the founders and former editors of this publication. What toil, work and initiative the founding of this magazine must have been. What work and time the succeeding editors must have spent in shaping the paths and growth of our publication.

Especially does the present managing editor wish to pay tribute to last year's managing editor and business manager, Carl F. Luethi, and Sheldon F. Johnson. Due to their efforts the TECHNO-LOG has passed through another successful year, and it is a warm feeling of friendship that recalls to mind a year of work with them.

During the summer the managing editor and staff members have spent a good deal of time in work and study on various phases of publication work. To the editor this opportunity has been a tremendous source of benefit and pleasure, and if by this study the TECHNO-LOG can be made of more interest to the readers, we will feel fully repaid.

AFTER a summer of activity by the staff members, we are glad indeed to be the first student magazine to appear before the students of the University of Minnesota this fall. This has been possible only through the faithful work by the staff members this summer. Much work was spent on the June alumni directory, after which plans were immediately started upon for this fall.

Special mention should be made of the business staff men. Carl Swanson, Walfred Swanson, Francis Fox, Gerald Warrington, Sheldon Johnson, Curtiss Crippen, and Oswald Mikkelsen gave much of their time to advertising and general business work.

Walter Huchthausen, art editor, has ingeniously designed and drawn the pleasing front cover in which a border symbolizes every phase of engineering activity. Ralph Blyberg, William Hill, Francis Fox, Carl Sweet, Herbert Hathaway, and Nathan Davies have helped out in the editorial work of this issue.

Due to work during the summer and because of their qualifications, Francis Fox has been appointed as alumni editor, and William Hill has been appointed as news editor.

Let's Welcome the Grads This Homecoming

LAST year engineers had a special homecoming of their own in the engineering college. Room 137, where all year the students had written on the black boards and listened to lectures from the professors, was changed for a day or two into a comfortable place for the alumni to come and meet their former engineering buddies, while coffee and doughnuts were served. Floor lamps and nice, heavily stuffed leather chairs filled the room, rugs were on the floor and decorations were up and about. Every indication showed that the alumni enjoyed this effort to the fullest extent, because it provided for them a place in which they could expect to meet engineers only—classmates that they knew—instead of the general mass of university alumni.

Once again homecoming is drawing near. We won't forget the splendid arrangement of last year. The TECHNO-LOG will do all it can to help establish this separate meeting place for homecoming alumni as a permanent institution, and we are sure other organizations of the college will do much to help promote this plan. Last year the main engineering building was decorated in fitting style, but during this season's homecoming let us see that the building far outshines any other campus building.

So let's erase the chalk marks off of the black board, furnish and decorate the room, work out and execute a real outside decoration on the front of the engineering building, and really welcome all the engineering grads as they come back on October 22 to see how their college now appears after years away from it.

The New School Year

"WELL for cry—"; "How are ya kid"; "Slip it there old man," and with many handshakes and much patting on the back the school year of 1927-1928 is unofficially opened by the members of the student body. Old friends are remembered, tawny browned arms are displayed, the stories of summer vacations start, and every one is alive with aspirations for the coming year.

Some hope to study hard and better their marks—of course everyone has that aspiration to a certain extent—some to the extent of almost forgetting that there are other things. Some intend to go into some form of athletic endeavor—some into dramatics—some just want to take life easy—others try to plan how they can best get ahead—some might be interested in publications. It is to this last group that this editorial is written.

Throughout the technical colleges there is no finer medium for getting experience in business, writing, meeting people, and in editing than there is right down in Room 37 of the electrical engineering building. There in the center of the technical college activity one can get experience in almost any line that he should wish to study on. The TECHNO-LOG can always use men, and you can always use the experience you might get down there. Why not come down and visit the office of your college publication?

Our Articles

APPARENTLY needless to say, the TECHNO-LOG is published for the interest, value, and usefulness of its readers. Whatever is of interest or value to the readers ought to find a way into our columns. This already stands as a fixed policy, but during the coming year we hope to encourage this to a greater extent. If any one should have an interesting bit of news in mind or a thought in the way of an interesting article we sincerely hope that he will turn it into the TECHNO-LOG office. We can serve the readers very much better if we have this close cooperation throughout the whole college.

In this first issue we have secured articles that we feel will be of interest.

Professor Comstock in the article on Petroleum Engineering has made a thorough review of the entire field of work of the petroleum engineer. He has shown the many difficulties that are encountered in this particular field. Since this is a new course that will be established at the School of Mines this fall the article will give anyone interested in going into this type of work an opportunity to see what he will meet up with both in his field and in the school work.

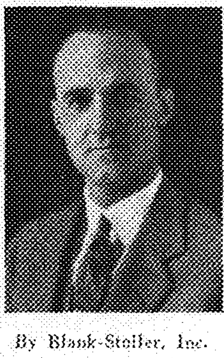
Minnesota has been noted for many things, but as yet it has not become popularly known as the home of insulating materials. In his article Professor Rowley has brought this before us. He has given us an idea of the large extent to which this industry has become developed in Minnesota. Through a study of many years he is able to present a so condensed and thorough review of the history of this industry in the state.

Airplanes and aviation are both quite in the center of the public eye during this day, and of interest is the first airplane manufactured by the first Minneapolis commercial aircraft company, especially when it is a concern composed almost entirely of former engineering students. A description of this product, which is one of the latest types of light planes, should prove of interest. As development work progresses more, it will only be a question of time before light airplanes will be dotting the skys.

Transportation on the Mississippi has always been a live subject. Many articles have been published on the proposed harbor of Minneapolis, and for years the citizens of the city have been trying to promote this method of transportation. It is only fitting that now with the completion of the project the TECHNO-LOG should give the readers an outline of the history of its development, the savings in freight rates, and various technical details that are no doubt questions in the reader's mind. William C. Hill, the author, has been in close connection with the work on the terminal all during the summer.

Football is of the greatest interest to engineers, and it is only because of the crowded scholastic schedule that engineers are forced to take that so very many do not try to make the team. During the past years engineers have been the ones to root most heartily for the team, so it is only fitting that the engineers should themselves go ahead and form themselves into a rooter section in combination with the foresters.

Alumni Sketches



By Blank-Stoller, Inc.

HARVEY COLE ESTEP, M '08

ALTHOUGH starting out in his freshman year with the idea of becoming an expert in locomotive design and construction, Harvey Cole Estep, a mechanical engineering graduate of 1908, is now one of the leading publishers of trade papers in the country. In commenting on his change of plans during college Estep humorously says:

"O. P. Briggs of Minneapolis, one of the prominent foundry and public men of that city, was responsible for changing the whole course of my career. Mr. Briggs offered a prize to sophomore engineers at the university (He still does,—Editor) for the best essay on foundry practice. I knew nothing whatever about foundry practice, but for some reason my essay secured the prize. This led to the publication of the essay in *The Foundry* in 1906."

Mr. Estep never lost connection with *The Foundry*, and immediately upon his graduation from school he started work on the publication. And with *The Foundry* he is still connected.

However, not only is he connected with *The Foundry*, but he is vice-president of the Penton Publishing company, publishers of *Iron Trade Review*, *Daily Metal Trade*, *Abrasive Industry*, *Power Boating*, *Marine Review*, *The Foundry* and other miscellaneous lists, books and bulletins. He joined the staff of this company upon graduation and has been connected with this company ever since.

For a time during the war he was secretary of the Cast Ammunition committee of the Ordnance department having to do with the manufacture of grenades, trench bombs and other cast ammunition. He was in Europe for a short stay during 1918, and in November, 1919, he left the United States for London, staying abroad for five years, in order to establish and manage the European branch of the Penton Publishing company.

He was born and raised on the Pacific coast in the Puget Sound country, coming from an engineering family whose father, grandfather, and great grandfather were engineers. His father, H. C. Estep, was one of the prominent railway construction engineers in the early days of the northwest. He was responsible for the location and construction of many hundreds of miles of western railroad, including the Northern Pacific, Oregon Short Line, Great Northern and others.

Since his father's work on the Minneapolis and St. Louis railroad kept the family in Minneapolis for a time during Estep's high school years, he attended the Minneapolis Central High school from which he graduated in 1904. He then followed up his training at the University of Minnesota.

THE WHOOZE WHO

Engineers All Freshmen Should Know

Prof. Zelner—The man who invented the extra long plumb bob for aerial surveying.

George Thwing—Gives advice to the love lorn (Freshman Advisor).

L l o y d Hoover—H e believes in "Hooverism."

Gordon Harris—His advice to freshmen: "Stay out of activities."

Sheldon Johnson—The biggest man on the Board of Student Publications.

Herbert Hathaway—"Girl shy." An Arab.

Moffett—If you like casting, see Moffett.

Doc. Holman—Wants every freshman to join a sorority.

E. E.—What engineers are the dumbest?

C. E.—Why, M. E.'s, of course.

E. E.—How come?

C. E.—Why, the other day one of them thought that he needed a step ladder to adjust some over head valves.

"Girls were harder to kiss in your day, weren't they, grandpa?"

"Mebbe, mebbe," ventured the old man, "but it wasn't so blamed dangerous. The old parlor sofa wouldn't smash into a tree about that time."—*Iowa Engineer.*

Freshman—They say that Prof. Jansky has been following Lindbergh's achievements with great interest.

Senior—That's not funny, he always has been interested in the aerial game.

A Question for the Civils

If Joe Armstrong's right arm was strong, would his strong arm, armed strong, block Dempsey's strongarm if it was stronger than Armstrong's.

"Thanks for the pony ride," said the Engineer to his friend as he left the examination.

Minnapolees, Minn.
Slosh Slish Valley, Minnesoota.
Dear Pa,

Say pa, you jest can't imagine how they is runin us around down hear. During the day we are coming or goin to lextures by the prfessors, and then we have to take tests on account to see how dumb we is. Thsoe profs kinda look at me hard when I write, but they needn't worry at thinking I would cheat. Maybe they think that after taking my coat off—on account it being so warm—some thing be wrote on my suspenders. But they ain't. I tried it but they were to dirty and the writtin wood not show. Tell ma my shirt is a little dirty too, but thet in a few days I will change it and send it back home. It isn't very dirty under the suspaender straps yet.

It seems theat the feshemen and sopomores have a scrap every year from the talk down hear—you sea the spops were froshmone last year and now they want to show what they have grown into. 'Cording to every body the sopes are kinda hard to beat, so's a bunch of us is conspiring to beat them this year. After the scraps is over with—it seems they is a big party down town some place at a show house—I think it is called the "Gahity." Seems thet everyone is a going strong for these things, cause talk sure does let us in on them from what I allowed.

When this here scraping is over, pa, I will tell you all about the business if nothing happens to stop on account getting hurt, rib knocked in or stepped on neck.

Jest now they is kinda a lot a talk about football and rootin. Rootin, pa, is where we all get together and yell. Weer goona have a big rooter sexshion in the stadium at the football games this year. There's gonna be 1300 of us engineers all in one place. These engineers and some big lumber jacks from someplace on the other side of the world got into a fight last spring, and now are setting together after makin up. Foresters kinda like to wear leather boots and coats and the such. But I feel rite at home with em pop, I don't wash much either.

Your son,
Patrick O'Malley.

A professor from a large Eastern university recently committed suicide, and the following letter was found on his body:

"Since I have started teaching I have been bawled out, held up, held down, cussed at, walked on, and cheated. I have been struck for war tax, poll tax, auto tax, road tax, gas tax, dog tax, and syntax; liberty bonds, baby bonds, school bonds, and bonds of matrimony; red cross, green cross, holy cross, and double cross; and I have been asked to help the students relief, Near-East Relief, and Stomach Relief; and so my end comes as a great relief."

Techno-Log Editor—Give you fifty cents for that joke.

Author (a freshman)—No; I never get less than a dollar for that joke.

Prof. Zelner tells us that the Annual Freshman-Sophomore Scrap is soon to be in full swing.

(Editor's note): Prof. Zelner has $50.00 on the freshmen, as usual.

Heard in St. Paul This Summer

"Want any ice today, lady?"

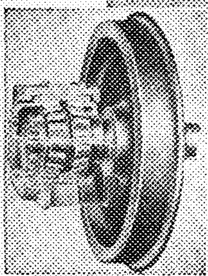
"No, thank you, your ice melts."

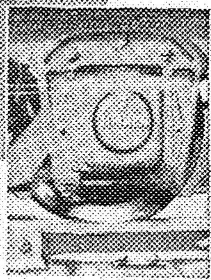
Young Artist (recently graduated from Minnesota)—See that picture over there? Well, I painted it, and a million wouldn't buy it!

Friend—Well, I'm one of the million!

Last night
I called on Anna
Anna was
Not dressed.
So Anna's Mother
Called to her,
"Anna, slip
On something
And come down."
Anna slipped on
The top step
And came down.
I was never so
Embarrassed in all
My life.

—*Voodoo.*





International Newsreel

Viewing a Timken railroad bearing application on display in the baggage car of the "Pioneer Limited." From left to right: President H. E. Byram of the Milwaukee Road; Mr. H. H. Timken, President of The Timken Roller Bearing Company; Mr. J. T. Gillick, Chief Operating Officer of the railroad; General Passenger Agent W. B. Dixon; and the Engineer of the train, Mr. Nicholas Kaiser

Railroad History in the Making

A new epoch in railroad history started when the "Pioneer Limited" and the "Olympian" of the C. M. & St. Paul R. R. entered regular service with every car on Timken Bearings.

Never before, anywhere in the world, have any anti-friction bearings been used throughout any Pullman train. These famous flyers of the Milwaukee Road are destined to make momentous and enduring railroad history.

The 88% reduction in starting load due to friction elimination only begins to express the value of Timken-equipped car journals. Eliminating wear, hot boxes, and by far the greater part of lubrication costs, Timken Bearings with their tapered design, Timken-made Electric Steel and *POSITIVELY ALIGNED ROLLS* have brought a new day in railroading.

As in every other field of engineering, Timken Tapered Roller Bearings are effecting both mechanical and economic improvement. The use of Timken Tapered Roller Bearings has come to be a proof of sound, progressive design. That is why Timkens are of vital concern to all engineers of the future.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Petroleum Engineering

(Continued from page 5)

is the amount of present capital which the profits can repay, together with a rate of interest commensurate with the risk. The profit will be the gross income less the cost of development and operation. What the gross income will be is, of course, largely problematical in the case of a prospect. What the cost of development and operation may be can be computed for various assumptions. Familiarity with costs of power, costs of labor, costs of supplies and equipment, costs of transportation, etc., is essential.

Whichever method is selected, all legal forms should be drawn up by a competent attorney who is thoroughly familiar with the legal procedure in the district. However, the engineer who is familiar with the different legal forms and the advantages and disadvantages of the various types of ownership, has a tremendous advantage over one equipped merely with technical information. Cases have been known where engineers have discovered errors which were overlooked by the lawyer.

After the necessary legal rights have been secured, drilling is started. There are two general systems of drilling in use in North America, the "standard" or cable drilling system and the rotary system.

In the standard or cable drilling system a heavy stem bit is attached to a cable and is raised and dropped in the hole by means of a walking beam driven by a suitable source of power. The cuttings are removed from the bottom of the hole from time to time by means of a bailer or sand pump and it is one of the duties of the crew in charge of the rig to keep a log of the formations passed through.

In the rotary system the cutting tool is attached at the lower end of a drill stem or pipe. The stem and bit are rotated by means of a turn table driven by suitable power. Water is pumped down through the inside of the drill stem and flows up through the hole outside of the stem carrying the cuttings with it. These are collected at the surface and made use of to complete the log. Casing is put into the hole from time to time, depending upon the character of the formations passed through, considerable judgment being required to determine how far behind the drill the casing shall follow.

EACH system of drilling has its advantages and disadvantages for different kinds of formations, and it is one of the functions of the engineer to decide which system had best be used on a given prospect. He should therefore be qualified to give a disinterested decision, the contractors usually being prejudiced in favor of one system or the other. The engineer should also be familiar with the drilling contracts entered into between the producer and contractor and the different items to be covered in such a contract.

The log kept by the driller must be carefully watched, and the samples of the cuttings from the various formations must be examined. The information obtained from these sources must be used to confirm or refute the original theory on which the decision was reached to drill the hole. The information will also be of value in determining the location of future holes, should they be drilled, regardless of whether in this case oil is struck or the hole proves to be dry.

The average log kept by the driller is a mixture of facts and guesses. The value of the guesses depends upon the experience of the driller. To interpret the log it is necessary for the engineer to learn from the driller what his experience has been and the meaning of the terms which he uses in writing up the log. This usually requires tact, good nature and a knowledge of human nature as the driller is likely to resent an approach which indicates a feeling of superiority.

HOW deep to drill a hole when oil is not obtained at the depth expected is a problem which frequently confronts the engineer. Many instances are on record of oil being reached after hope had been abandoned and drilling was about to be stopped.

It is not to be expected that the petroleum engineer shall be able to run a drill. That is an art in itself, only learned by considerable experience. He should know, however, the difficulties which the driller may encounter and how they may be overcome; whether the drill is operating properly or not, and if not, what the remedy is.

The engineer must be familiar with the various methods of bringing in a well as well as the means of controlling the flow. Lack of knowledge of the various methods of controlling the flow may result in what is called a wild well, some of which have been beyond control for several years.

Oil from new wells usually flows naturally in a reservoir. After a time the flow may become intermittent, pressure increasing and producing flow as gas accumulates and continuing until the pressure has decreased when the flow stops until the pressure again builds up.

After the natural flow stops some method of pumping is resorted to. The so-called gas lift is coming into very extensive use. Natural gas from the well is compressed in suitable compressors on the surface, piped down to the bottom of the well and allowed to enter the casing, where it mingles with the oil and produces a mixture having a less specific gravity than the oil surrounding the casing. The pressure of the oil surrounding the casing then lifts the mixture inside the casing on the principle that water and air are lifted in an air lift pump and for a time the gas light will serve to produce a discharge from the top.

WHEN this method will no longer work, some type of vacuum pump must be introduced for the final pumping. Under ordinary methods as now employed it is estimated that about 80 per cent of the oil remains in the reservoir. A wonderful field of research and the development of some system by means of which the oil remaining in the reservoir can be obtained is available to the petroleum engineer. Underground mining methods have been devised and are being experimented upon at the present time, but it is a question whether the best and most economical solution has as yet been hit upon.

Methods of storing and transporting the oil afford additional problems to the petroleum engineer. In this brief review of the field, nothing has been said of the various problems introduced by the presence of natural gas, separation of the gas from the oil and the transportation and marketing of the gas, with all of which the petroleum engineer should be more or less familiar. In addition he must know something of the various grades of crude oil and the products which can be obtained from them by means of proper refining methods.

It is the purpose of the course in petroleum engineering as offered by the Minnesota School of Mines and Metallurgy to prepare the engineer as far as possible to intelligently solve the problems with which he will be confronted in the field.

The study will include the two-year general course given to all students in the school, followed by geology, mechanics, oil field machinery, oil field development, and petroleum refining in the junior year. In the senior year the work will cover construction courses, economics of petroleum engineering, production technology, oil geology, micropaleontology and a thesis involving the development of a district and the installation of the necessary equipment.

Transportation on the Mississippi

(Continued from page 9)

ing the ordinary freight rates with an extra single switching charge to all shippers not on the M. & St. L. line.

This same year, 1916, the high dam was being constructed, and on June 29, 1917, just after the war was declared the lock was closed and the lake formed. Just five days later the "Dandelion," the first tow boat to pass up the Mississippi as far as the Washington avenue bridge, passed through the lock and tied up at the new municipal dock.

A year later, on June 26, the first tow boat, the "Helen Blair," pulled up to the dock and unloaded two barges filled with household goods and autos. By 1919 Minneapolis interests, aroused by Edward F. Goltra, St. Louis fleet owner and builder, pushed a bill in the state legislature for bonds for the construction of a river terminal. This bill failed and the matter lay idle until 1924 when the Minneapolis Real Estate board took a stand in favor of a barge line as the remedy of the disadvantageous rates that were keeping the Northwest from competing with the lake cities. The followyear S. S. Thorpe with a few Twin City business men organized the now existant Mississippi River Barge Line company, a corporation of the state of Delaware, and promised to have three towboats and fifteen steel barges in operation on the upper Mississippi within two years.

The Inland Waterways corporation, a government owned corporation, and the successor of the Inland and Coastwise Waterways Service, also pledged themselves to serve the upper river.

SO much interest was shown by the people of Minneapolis by 1925 that Mr. A. L. Crocker, commissioner of navigation for the city of Minneapolis, invited suggestions for the improvement of the municipal harbor. Several schemes were brought forth, the outstanding one being that of Francis M. Henry, a civil engineer, who proposed to make a harbor of the pool formed by the Saint Anthony Falls dam and to bring the tow boats and barges up to it by two locks through a canal 90 feet wide and 1,000 feet long, having a depth of seven feet. This plan, discussed in the November issue of the MINNESOTA TECHNO-LOG of 1925 by Mr. Henry, was not accepted as the expense would be too great.

So in February of 1926 the city of Minneapolis bought 21 lots below the Washington avenue bridge as a site for the future municipal dock, and in April of that same year $300,000 was voted for the land and improvements. This marked the beginning of the barge service for Minneapolis, as in May the "Gen. Allen" with four steel barges docked at the new municipal wharf.

IN the spring of 1927 the city of Minneapolis in conjunction with the Minneapolis and St. Louis Railroad started the construction of one of the best equipped terminals on the upper river. Connected with the main switching yards in the heart of the city it opens a cheap means of offering the products of the entire northwest to the South and East. Leaving the main line of the M. & St. L. track on the top of the river bluff about ninety feet above the terminal a single track with a maximum grade of four and fourteen hundredths per cent serves three house tracks and a crane track at the terminal. It is not expected that there will be much difficulty in the handling of the freight on this steep grade, as in other sections of the country where there are four per cent grades it has been possible to handle ordinary freight traffic without great difficulty.

The terminal consists of a warehouse and shed 300 feet long and 50 feet wide made of brick and reinforced concrete construction. All unloading is to be done onto an unloading barge anchored to two piers fifteen feet from the sea wall of the terminal. From there the freight is carried into the covered warehouse by an escalator and stored, or placed in freight cars and immediately shipped away. There is little or no handling of the freight by hand.

The greatest problem was getting a sufficient length of track to make a practical grade from the terminal to the freight yards in the city. This was accomplished by running the track from the main line on top of the bluff down a vacated street and projecting it some eight hundred feet down river from the terminal proper, and then wying back into the various service tracks.

A Light Airplane

(Continued from page 8)

metal ball connection joint between the wings and the body of the plane, control tubes to the ailerons on the wings are automatically connected when the wing is attached.

Although it carries a full load of 500 pounds, the plane itself weighs but 700 pounds. When manufacturing is started on a larger scale, after complete tests have been made on this plane, it is expected to reduce this weight to 650 pounds. Due to inability to get specification material this first plane has been made somewhat heavier. The motor weighs 220 pounds including the weight of the electric starter.

Although extras like cigar lighters have not been added to the plane, anything of practical value to the comfort of the passengers has been made standard equipment. The Mohawk plane is one of the first to use a new type of shock absorber in which a plunger works in compressed air and oil. This combination effects, during the landing, an absorption of the shocks without bouncing the plane. A large cowling, which extends around the two cockpits, so effectively keeps the wind from the occupants of the plane that it is possible to fly without goggles. As yet the plane is controlled from only one cockpit although with slight changes it can be made dual control.

The landing gear is of the split type, in which there is no axle between the wheels to catch on tall grass, and the 26 inch wheels are placed six feet apart in order to give the plane stability when landing. Landings are made at a speed of less than 35 miles per hour, which is exceptionally low for a plane that has a maximum speed of 109 miles per hour. The speed range of 74 miles per hour is possible even with the small motor because of the lack of parasite resistance. No wires or braces are present to drag through the air, and every protruding part has been streamlined.

ALTHOUGH every square foot of wing area carries ten pounds when the plane is fully loaded, it is possible to make slow landings and take offs because of a cushion effect that the low wing has when it comes close to the ground. Usually this high wing loading calls for high speeds both in the air and in landing. The Mohawk plane has a good high speed, and yet a low landing speed because of the closeness of the wing to the ground. In addition to good high speed this highly loaded wing, according to Cumming, will travel through the bumpy or turbulent air without being affected by the air bumps.

Because of the low landing speed, large wheels, remarkable visibility, special shock absorbers, split axle, and good distance between wheels, landings have been made simple and safe. The plane will take off with a run of 150

Roger Bacon was thought to be in league with the devil and thrown into prison for his scientific researches which included the development of gunpowder.

The scientific research of the Hercules Powder Company in the use of blasting powder gave to the world the modern methods of blasting known as Hercoblasting.

Magic— Old and New

A LITTLE less than six hundred years ago, Europe learned of gunpowder. Friar Roger Bacon, the "admirable doctor" of thirteenth-century England, a Franciscan monk who was finally thrown into prison for commerce with Satan, mixed saltpetre, sulphur and charcoal, and made "thunder and lightning" to his own great entertainment and his neighbors' terror. The worthy friar did not put gunpowder to more practical use than magic. It never occurred to him that, confined, the gases from a flash of powder would exert great force that could be applied to many purposes of war and peace. It was not long, however, before someone stripped away the supernatural, and in 1346 firearms are said to have made their appearance, at the battle of Crecy. Equally early, gunpowder must have been applied to blasting purposes.

From this humble and quaint monastic beginning, explosives have steadily increased in use and importance. Chemistry has made one improvement after another. Engineering has found a multiplicity of new uses. Hercoblasting is an example in point.

E. M. Symmes, an explosives chemist of the Hercules Powder Company, devised a new blasting method by which Friar Bacon might have performed real miracles for his gaping contemporaries. It is called Hercoblasting. And it consists of column-loading black blasting powder of special granulation in well-drill holes and firing with Cordeau-Bickford detonating fuse. Where this method is applicable, it has accomplished remarkable results at great savings.

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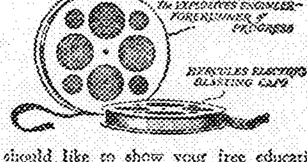

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feet, and it will land in a very short distance.

THE motor called the Air Cat is manufactured by the Detroit Aircraft Engine corporation, and has economical fuel consumption. Although rated at only 60 horse power, it will develop 83 brake horse power at 2,400 r.p.m. The fuselage is constructed entirely of steel tubing, welded by the oxy-acetylene torch. This metal construction gives to the plane good strength and insures to the occupants the greatest safety in case of an accident. The tapering wings are constructed of two tapering spruce box spars that come closer together as they go out from the fuselage of the plane. About every 12 inches a rib made up of mahogany plywood is placed. The leading edge of the wing is covered entirely of plywood.

In order to secure good controlability of the plane at slow speeds a lip has been placed on the lower leading edge of the ailerons. Thus when either one is in the extreme upward position the air is caught from below also, thus tending to lower the wing still more. This feature has made it possible to move the wings up or down very well even at stalling speeds. Although this feature was entirely original with the designer, the Curtiss Condor, a late type of military bombing plane, also uses the feature. As far as the makers know the Mohawk is the only commercial plane using this so called "Frize type" of aileron.

In all tests made the plane has shown itself to be stable in operation, although not so stable as to prevent good maneuverability. Even at stalling speeds good aileron control can be maintained, largely because of the lip on the ailerons.

The plane has been placed in extreme climbing or stalling angles without having it go into a spin. Although thorough attempts to place it into a spin have not yet been made, the makers doubt its ability to spin at all. This feature would greatly add to its safety when in the hands of an amateur pilot. The plane has not been stunt tested yet, but its sturdy construction should obviate all danger from reasonable stunting.

BECAUSE of the neat and clean appearance of the plane during its tests at the flying field many people have expressed their desire of buying one. However, the company has not yet placed them on production, and will not do so until this first plane has been thoroughly tested. It was entered in the Light Commercial and Sport Plane National Air Races which were conducted at Spokane, Washington, on September 23 and 24. Here the plane, which was flown from Minneapolis was to compete with the various other types of light planes throughout the country. As far as the makers can now tell the sale price of the Mohawk plane will be about $2,500 complete.

Technical Details of the Mohawk Light Airplane

Span of wings—30 feet 6 inches
Length of plane—20 feet 2 inches
Mean chord of wing—4.4 feet
Root chord of wing—5.5 feet
Tip chord of wing—3.3 feet
Wing area—124 square feet
Wing loading—9.75 pounds carried per square foot of wing surface
Power loading—16 pounds carried per horse power
Maximum speed (not yet fully tested, but according to indications and calculations)—109 miles per hour
Climb at full load (not yet fully tested, but according to indications and calculations)—900 feet per minute
Stalling speed (not yet fully tested)—Below 40 miles per hour
Landing speed—Under 35 miles per hour
Airfoil section—U.S.A. 35 modified
Motor rating—60 horse power
Total weight—700 pounds
Full load—500 pounds

Minnesota, the Home of Insulating Materials

(Continued from page 7)

These names were derived from the methods used in determining the constants. In the first instant, the constant is determined by placing the material between two metal plates, the temperatures of which may be determined by thermocouples. In the second case the constant is determined by a special constructed box, and the temperatures of the air on each side of the materials are taken. In each case the heat flowing through the material is usually determined by electrical means.

As the constants determined by the two methods are different making it necessary to specify definitely whether the hot plate or hot box constant is used in making comparisons. There are two conditions which have a decided effect upon the constants obtained. They are the average temperatures between the two surfaces and the moisture content of the material. Practically all materials have a higher transmission rate at the higher temperatures than at the low temperatures. Thus, unless the mean temperature in which the test is made is specified, the results will not be definite.

All materials used for insulating purposes are also more or less hydroscopic, and in some cases will absorb twenty per cent of their weight in water, depending upon atmospheric conditions. This absorbed moisture may increase the transmission constant by fifteen per cent. Thus a material which might give a constant of .32 when tested in dry winter weather might run as high as .36 in the summer when the atmosphere is more nearly saturated.

The interest at Minnesota in insulating materials is not confined entirely to the manufacturing processes. For the past seven or eight years much research work has been done at the University to determine the properties of the various materials and also the effect of these materials when placed in wall sections as insulators. The results of part of this work have been reported in previous issues of the Techno-Log. In the course of the tests on wall sections a special design of hot box apparatus has been developed which at the last meeting of the American Society of Heating and Ventilating Engineers was adopted as the standard method of testing wall sections.

The experimental laboratories are now equipped with both the hot box and hot plate apparatus and through a co-operative arrangement with the American Society of Heating and Ventilating Engineers are starting on an extended research program. This program will cover not only the heat transmission through various materials, but will also include a study of the various fibres which go to build up these insulators with the purpose of determining the fundamental differences in structures of insulating materials.

"What About Our Faculty and Alumni?"

(Continued from page 15)

university as assistant professor of mine plant and mechanics.

Prof. E. H. Comstock, professor of mine plant and mechanics, atended the annual meeting of the Society for the Promotion of Engineering Education at the University of Maine during the last week of June, presenting a paper entitled, "Modern Educational Tendencies as Affecting the Preparation of Engineering Students."

ALUMNI

Architects

'22—William E. Willner is spending a year studying in Paris. He left New York last spring and from his letters to friends one would gather that he is getting along famously. The day after landing in France he wrote thusly, "The language here is very simple. I already speak it fluently." We wonder if any of the French understood him.

'24—Emil F. Backstrom, listed in the June TECHNO-LOG directory as with the Bertram Grosvenor Goodhue's association, now is in the office of Allens and Collins, 415 Lexington avenue, New York City, where Eddie is also wielding a mean pencil and brush.

Chemists

'25—Alfred A. Reiter, who received a master of science degree in chemical engineering in 1926, is an instructor in chemical engineering at the University of Wisconsin. According to an announcement received during the summer, a baby boy was added to his family July 23.

'26—Kenneth Kobe is assisting in chemistry and is taking graduate work in the division of chemical engineering at the University of Minnesota.

'26—After a year of study at the University of Michigan, where he had a fellowship, Marvin Rogers received a degree as master of science in chemical engineering last June. He visited the University of Minnesota in the early part of August.

'26—William Schlafge received his master of science degree in chemical engineering this spring. He immediately put his knowledge of chemistry to use by going to work for the E. I. du Pont de Nemours company of Wilmington, Delaware.

'26—T. H. Rauen is chemical engineer with the Coppers Coke company of St. Paul.

'26—Joseph Kugler, who is working for his master's degree in chemical engineering, spent the summer with the Minnesota Mining and Manufacturing company of St. Paul.

'27—Minnesota's noted football player and captain, Roger Wheeler, has accepted a position as chemical engineer with the E. I. du Pont de Nemours company of Wilmington, Delaware.

'27—A summer school fellowship at Iowa State college, Ames, Iowa, kept J. H. Arnold busy for the three vacation months.

'27—K. Langguth is now working with the Ohio Brass Company of Mansfield, Ohio.

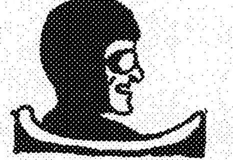
'27—E. Van Duzee, who graduated from chemical engineering, expects to do graduate work for his master's degree at the University of Minnesota. During the summer he took an automobile trip through the East, where he visited various industrial plants.

Civils

'21—George L. Lindsay, who is working for the Universal Portland Cement company, gave the Minnesota engineers of the Chicago district a rare treat last spring. He took them on a jaunt through the cement mills near Gary, Ind.

'23—Maurice D. Judd is now western Minnesota representative for Mason City Brick and Tile company. He makes his headquarters in Minneapolis.

'26—After taking post graduate study in business administration for a year at Stanford university in California, Clifford Anderson went to work in a structural plant in Los Angeles. Here he went right into the practical side of the work. He will visit in Minneapolis during September until he leaves for school.



'27—Carl F. Luethi is now with the United States Navy as as a naval aviator. At present he is at the Naval Air station in San Diego, where he is taking advanced training before embarking on Uncle Sam's sea dogs. Carl holds a commission as Ensign in the Naval Reserve, and is taking a year of active flying duty with the Navy.

Electricals

'23—John M. Newman, who is working for the Cutler Hammer people in Milwaukee, returned to Chicago with the Chicago unit of Minnesota engineers when they made their boat trip up to Milwaukee on June 26. John is said to be the same as ever, although he claims he has not "rolled the ivories" for some time.

'23—Last spring Roy H. Olson completed a course in law, and now he is with the Patent department of the Western Electric company in Chicago. Roy gets around to the engineers activities up there quite frequently. He was married August 29 to Muriel Sommermeyer.

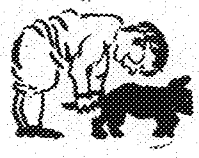
'23—We understand that Alvin C. Ward was married sometime during last July. He is working for the Western Electric company.

Engineers Let our advertisers know you are an engineer when you patronize them; they have shown their willingness to serve you by advertising.

'24—Carl W. Lauritzen is in charge of the electrical engineering department of the Valparaiso university. Carl goes up to nearly all of the engineers' meetings in Chicago to chat with the boys.

'24—Elwood Stimart is now with the Illinois Bell Telephone company at Rockford, Ill. He says he likes Rockford all right although his work and little daughter keep him busy. Elwood was in Chicago last February taking a telephone transmission course.

'24—Emil G. Anderson and LeRoy C. Little both are rooming at the same place in Washington, D. C. Both are engaged in work at the Bureau of Standards, where at the present time Anderson is in the photometric department. Anderson was through Chicago August 15 while on his way home for a vacation.



'25—Richard G. Taylor is now a construction engineer in the underground department of the Commonwealth Edison company. "Dick" still has his hearty laugh, and he believes there is nothing quite as nice as baby Jeane, now six months old.

'26—L. C. Ayshford is now working in the electrical engineering department of the city of Chicago.

'26—Paul B. Nelson came back from his six weeks' tour of Europe late in August, carrying back with him tales of strange sights, novel journeys, and interesting people. Paul says he gained much inspiration for an Arabs play next year, but that he has not had time to write it up. At present Paul is in Chicago editing the Scholastic Editor, a publication for editors of high school papers. The magazine is to be much enlarged since the offices have been moved from the University of Minnesota to Chicago, where it is now under the supervision of the Art Crafts Guild. Paul is living at the Allerton Club residence in Chicago.

'26—Ross Mahachek is still working with the Cutler Hammer company of Milwaukee. He has recently been promoted to the experimental department, where he has been carrying on experiments in brake linings. Ross is still much interested in aviation, and he flies in the government airplanes at Great Lakes, Ill., all he can.

'27—Lloyd V. Berkner will study for his master's degree during the coming year under a fellowship in which he will be in full charge of the radio station at the University of Minnesota. During the summer Berkner spent most of his time flying in the navy planes at Great Lakes, where he spent considerable time experimenting on a battery operated short wave radio sending and receiving set for airplanes.

'27—Andres H. Nielsen, W. S. E. Miller, Paul F. Rauscher, George H. Ringstrom, Boris Woloshin, F. J. Moosbrugger, and E. W. Jacobson are with the Central Station institute at 72 W. Adams street in Chicago. Here they are given student training courses for the Commonwealth Edison and the Public Service companies.

'27—According to reports, L. A. Weon and H. F. Wehlitz like their work with the Illinois Bell Teelphone company real well. At present they are rooming together in Chicago at 845 Newport avenue, apartment 2. However, it is doubtful whether their present combination will continue for long since we understand that Wehlitz intends to take on "added responsibilities" sometime this fall.

Mechanicals

'88—From all reports John O. Morris holds the honor of being the earliest Minnesota engineering graduate in the Chicago area. Morris, who is engaged in consulting engineering work, may be located at 1557 Monadnock building, Chicago.

'23—Now that Delton T. Waby of Chicago is a papa, we understand from the fellows around the Public Service company that his smile is broader than ever.

'24—Edward K. Nelson, who is sales manager for the Nelson Knitting Mills at Duluth, stopped off at Chicago for a while during his vacation in August.

'24—Andrew Saltwick at the present time is supervising the construction of a large dock on Lake Superior. Saltwick has the title of Superintendent of Government Craft on Lake Superior.

'24—Edward K. Nelson, who is now sales manager for the Nelson Knitting Mills at Duluth, was through Chicago on his vacation during August.

The Lund Press, Inc., Minneapolis

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FOOTBALL SCHEDULE

Western Conference

—1927—

October 1
North Dakota at Minnesota
Oklahoma at Chicago
Bradley at Illinois
Indiana at Kentucky
Monmouth at Iowa
Ohio Wesleyan at Michigan
So. Dak. at Northwestern
Wittenberg at Ohio State
DePauw at Purdue
Cornell at Wisconsin

October 8
Okla. Aggies at Minnesota
Indiana at Chicago
Butler at Illinois
Ohio State at Iowa
Michigan State at Michigan
Utah at Northwestern
Purdue at Harvard
Wisconsin at Kansas

October 15
Minnesota at Indiana
Purdue at Chicago
Iowa State at Illinois
Wabash at Iowa
Michigan at Wisconsin
Northwestern at Ohio

October 22
Iowa at Minnesota
Pennsylvania at Chicago
Illinois at Northwestern
Notre Dame at Indiana
Ohio State at Michigan
Purdue at Wisconsin

October 29
Wisconsin at Minnesota
Chicago at Ohio State
Michigan at Illinois
Indiana at Harvard
Denver at Iowa
Missouri at Northwestern
Montana State at Purdue

November 5
Minnesota at Notre Dame
Michigan at Chicago
Illinois at Iowa
Michigan State at Indiana
Northwestern at Purdue
Ohio State at Princeton
Grinnell at Wisconsin

November 12
Drake at Minnesota
Chicago at Illinois
Indiana at Northwestern
Iowa at Wisconsin
Navy at Michigan
Denison at Ohio State
Franklin at Purdue

November 19
Minnesota at Michigan
Wisconsin at Chicago
Illinois at Ohio State
Purdue at Indiana
Iowa at Northwestern

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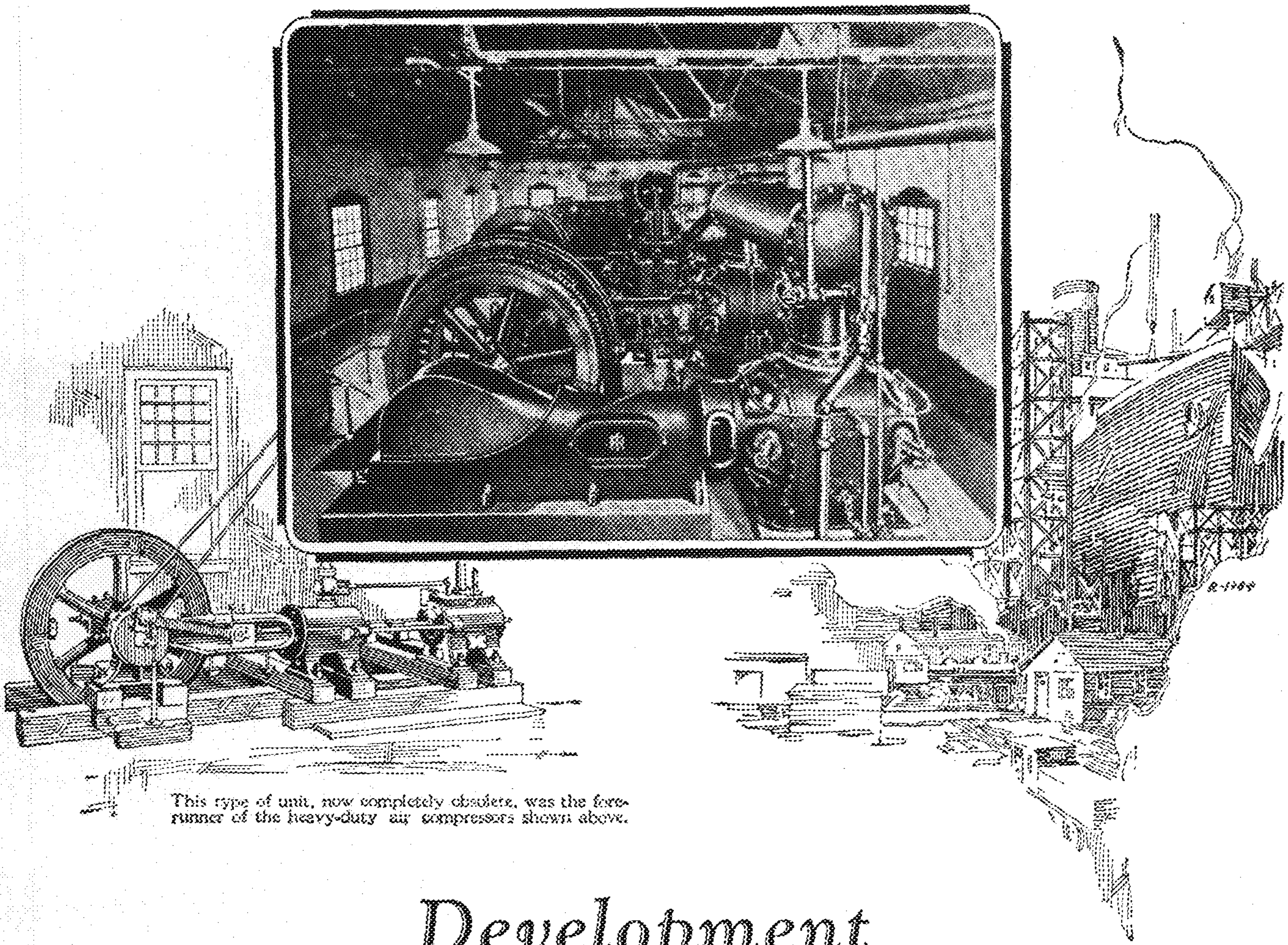
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Volume VIII NOVEMBER 1927 *Number 2*

Homecoming and Summer Camp Issue - Industrial Welding
The New Physics Laboratory - A Short Wave Radio Set for Airplanes



This type of unit, now completely obsolete, was the forerunner of the heavy-duty air compressors shown above.

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

Published monthly from October to June inclusive, by the TECHNO-LOG *Association, composed of the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines of the University of Minnesota.*

VOLUME VIII. MINNEAPOLIS, MINN., NOVEMBER, 1927 NUMBER 2

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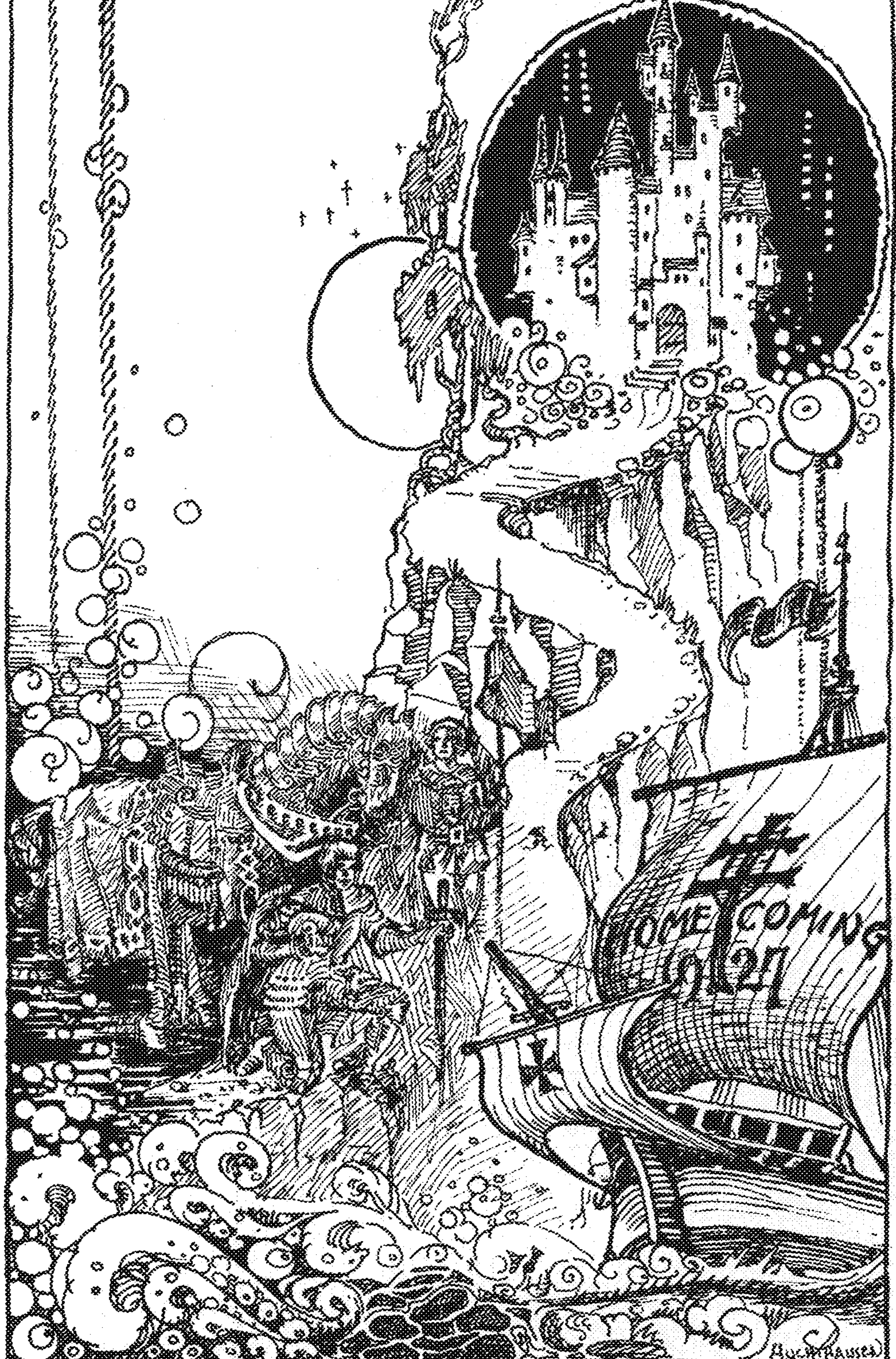

HOME COMING
1927

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII NOVEMBER 1927 Number 2

Industrial Welding

A review of the different processes shows their increasing use in industry; educators are thinking of introducing more thorough university courses

By Thomas P. Hughes
Instructor, Department of Mechanical Engineering, University of Minnesota

WELDING has a place of growing importance in our industrial life. Similar to many other scientific discoveries whose introduction into industry is comparatively insignificant at first, the application of modern methods of welding has in many instances revolutionized former procedure. This is due to the fact that welding by means of either, or all methods such as autogenous, electric and thermit have a range of applicability far greater in extent than the ordinary forge weld which depends for its execution upon the use of the forge fire, and such forging processes as hammering or rolling or pressing. In fact, but a very small part of the welding carried on in industry is done by the use of the forge fire.

In both production and repair work the former welding practices have largely, and almost wholly, been discarded in favor of one or more of the newer methods named. Far greater convenience, economy and the wide range of application are among the reasons for this. While the forge process is confined exclusively to iron and steel, the other methods include within their range nearly all of the non-ferrous as well as the ferrous metals now in use.

In order to point out the high degree of relationship that exists between the various welding methods and the courses in chemistry, metallurgy, and physics followed by the engineering student, we shall tell briefly what each process consists of and describe its peculiar field of usefulness in industry.

It is only within recent years that the electric arc for welding and manufacturing purposes has been developed. The phenomenon of joining and melting metals in the heat of the arc is, however, one of the oldest applications of electricity. While the exact temperature of the arc has never been determined, it is known that the most refractory material may be melted in its heat. The temperature has been estimated to be from 3600 degrees F. to 10,000 degrees F.

The use of the electric arc for the welding of metals is based on the principle that, when two electric conductors are brought together to form a circuit and are then suddenly separated a short distance, the current continues to flow or jump the gap between the conductors. In this intervening space the electrical energy is transformed into heat and is concentrated within a small area. The most desirable welding conditions exist when using a short arc length, because the shorter arc exposes the minimum surface for the least time to the gases of the air. This prevents oxidation and its possible inclusion in the weld. The average arc length is from 3/32 to 1/8 of an inch. For metallic arc welding by hand the usual range of arc current is from 50 to 300 amperes at an arc voltage of approximately 20 to 30 volts. When a carbon pencil is used for an electrode the arc current ranges from 25 to 600 amperes, at a voltage of approximately 40.

THE electric welding machine consists of a motor generator set capable of delivering the current at a uniform rate. The generator is electrically separate from the motor which drives it, and it may be driven by a direct or alternating current motor or by a steam or gasoline engine.

In addition to the arc method, there are two other applications of electrical energy to welding, namely "resistance" and "spot." Resistance welding has for its basis the principle that electricity flowing through a poor conductor meets with resistance and heats the conductor.

MINNESOTA'S FIRST WELDING CONFERENCE

The Mechanical department of the Engineering college is holding the first conference on welding and cutting ever held in the Northwest. This conference under the direct supervision of Thomas P. Hughes and Professor Carl Shipley is preceded by only a few similar conferences in the eastern universities. The latest improvements and savings in the application of welding to industrial problems are here brought to the interested people of the Northwest.

Beginning Thursday morning, October 20, and running through to Saturday noon, when the 400 guests of the conference will attend the Minnesota-Iowa football game, there will be a continual program of demonstrations and lectures by national authorities in their particular field. Such men as Mr. W. D. Brady, welding specialist of the General Electric Company; A. G. Bissell, welding engineer of the Westinghouse Electric company; Mr. Smith of Smith's Weldings Equipment corporation; F. E. Smith of the Haynes Stelliting company, and Mr. Gamble of the Minneapolis Gas Light company will present during the conference papers and moving pictures of improvements in their particular fields.

In this thorough and interesting article by Mr. Hughes, the entire field of welding has been covered, and not only has he described the processes in use but he has also shown to what extent commercial welding has and will develop. He says it is but a question of time before welding methods will largely replace rivets in construction of steel buildings. He also raises the question of why welding is not taught in the university when the courses take up a good study of rivets. More and more, however, universities are realizing the need of training men in this new branch of work, and Minnesota now has the best welding laboratories in the country.

This article is the second of a series which will describe to the readers of the Techno-Log various subjects of commercial interest in which the university is interested. In an early issue another article will appear describing other things upon which work is being carried out.

In operation, a good conductor such as copper, carries the current to the work. The work itself, mainly iron or steel, completes the circuit. As the iron or the steel is a poorer conductor than copper the current, in passing through, heats the iron or steel to a degree where union may be obtained by compression.

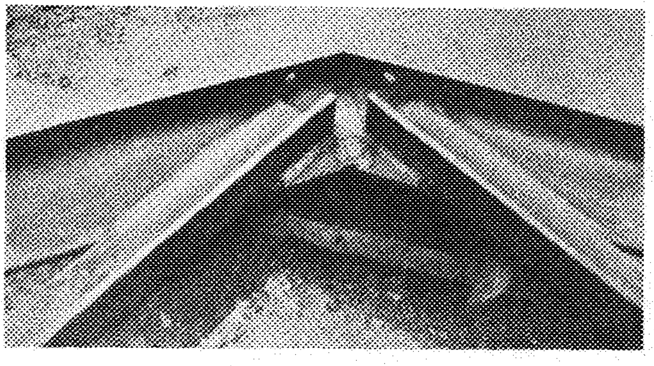
Spot welding is used largely on thin sheet metal. In this method a welded spot serves the purpose that a rivet would. It therefore is applied as in tank work, or vessels which ordinarily would be riveted. The metals to be joined are brought together between two electrodes; a suitable current is turned on and in its passage from one electrode to the other it heats up a small spot in the sheet to a point where fusion is brought about by pressure.

In their application to industry each one of the methods named has certain peculiar advantages which are too involved to be discussed here. However, since the arc process is in universal use it may be wise to analyze briefly its application. In many fields of work the arc process possesses certain advantages over the gas method, both of which are used largely on the same general types of work. These advantages are, in the main, ease of accessibility to jobs as in structural work, adaptability for work on overhead and vertical seams as the molten globules of metal are carried through the arc with such a force sufficient to make them cohere readily with the parent metal. Another advantage is the highly concentrated heat of the arc which leaves the properties of the parent metal adjacent to the weld much less subject to grain growth incident to high temperature.

THE arc method is becoming of more and more use as a means of replacing rivets in steel frame buildings. In this connection the process has passed beyond the experimental period. Some buildings have been completed which were wholly welded; other welded structures are now in course of construction; and we may confidently look forward to a day in the immediate future for a still greater application of welding.

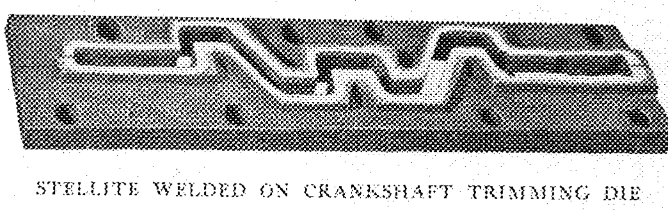
The process of oxy-acetylene or as it's commonly called "gas" welding is, in principle, very simple. Essentially, it consists of mixing two gases, acetylene and oxygen, in a suitable blow torch. They will produce a flame of a temperature of over 6,000 degrees F.

The acetylene gas used commercially is obtained from calcium carbide, a hard substance of a grayish color made of lime and coke in the proportion of 56 parts of lime and 36 parts of coke. These constituents are smelted or fused together in an electric furnace. After the fused mass is cooled it is crushed and assorted as to size. The gas is procured from the carbide by the addition of water either by adding water to the carbide or by the more common method of dropping particles of the carbide into water in an acetylene generator. This gas forms an



PEAK OF ELECTRICALLY WELDED ROOF TRUSS

explosive mixture with air, and may be easily exploded in the presence of a spark or flame when it is at a temperature of 24 degrees. Also, when compressed in ordinary containers at a pressure of 30 pounds or more it will explode even without air mixture, spark, shock or concussion. This makes it necessary to store the gas for commercial use in strong steel tanks, in which is first placed a porous substance such as asbestos cement. Then the tank is also filled with acetone, a liquid that has the property of absorbing 25 times its volume of acetylene gas at the pressure of the atmosphere (14.7 pounds). It continues to do this for each atmosphere of pressure it is put under. In this manner acetylene gas is safely shipped and stored at a pressure of 15 atmospheres or ap-



STELLITE WELDED ON CRANKSHAFT TRIMMING DIE

proximately 225 pounds. Each cylinder when full contains 300 cubic feet of gas.

IN the actual welding flame the following reaction takes place: $C_2H_2 + O_2 \rightarrow 2CO + H_2$. This constitutes in welding parlance a "neutral" flame, which means that it is neither oxidizing nor carburizing. Outside of this small, cone shaped, hot flame a second reaction takes place which transforms the products $2CO + H_2$ by the addition of more oxygen obtained from the air into CO_2 and H_2O. The temperature obtained in the first reaction is 6300 degrees F. which is too high for the H_2 and CO to form water vapor and carbon dioxide.

In its application to industry this process is by far the most widely used. In fact it will be found in use in small country blacksmith shops and garages, as well as in the largest and most modern organizations. Due to the fairly low initial cost of equipment and the ease by which its use may be learned, it has been very generally adopted by the small repair shop owner. Because it may be used to weld cast iron, in addition to iron and steel, braze malleable iron, bronze weld castings, and weld aluminum, it has been the means of furnishing employment for the former horse shoe man whose business has passed away with the advent of cars. It has saved much delay and money to farmers and others who may now have parts repaired which were formerly replaced by new ones. It is used in garages for carbon burning, frame welding, brazing and welding cylinder blocks, and building up parts. It is also used extensively with a tremendous saving of money, in railroad repair work.

IT was the practice on railroads ten or fifteen years ago to replace all worn or fractured parts of engines or repair them in the forge shop which entailed time and delay. Today, broken locomotive frames are welded in their place under the engine, braces. Worn parts on the motion work, such as the piston, cross head and rods are built up so that they can be remachined and used. Cracked cylinders are brazed; checks in side rods are first cut out and then new parts welded in; boiler sheets are cut and holes are burned out. With the proper organization and properly trained technical men the scope of usefulness of gas welding in the railroad industry can be materially increased. This process is extensively used in construction work, automobile manufacture, steel mills, arsenals, navy yards and the airplane industry.

One of the advantages of the gas method is that metals may be easily and quickly cut by means of the torch or the oxygen lance. Materials as thick as six or eight inches may be cut with the torch and materials, such as steel ingots, as large as 36 inches may be cut by the aid of the oxygen lance. In the cutting of large circles and certain designs two mechanical devices called radiagraph and oxygraph respectively are used. The parts to be cut are heated red hot with the welding flame and then an additional oxygen valve is opened which allows a direct jet of oxygen coming in contact with the hot surface to produce a rapid

(*Continued on page 54*)

A Short Wave Radio Set for Airplanes

Graduate electrical engineer conducts experimental work with a view to eliminating disadvantages of present equipment

By LLOYD V. BERKNER, E '27
In charge of the University radio station

DURING the past summer, a series of interesting radio experiments were carried out at the U. S. Naval Reserve Air Station at Great Lakes, Illinois. These experiments were carried on for the purpose of gathering data toward the development of a new type of radio transmitter and receiver to be used in military planes of the scouting and spotting type.

The experimental work was done with the idea of eliminating if possible a number of disadvantages in existing types of radio sets. As they operate on frequencies ranging from 1500 to 300 kilocycles, it is necessary to use a long trailing antenna and comparatively high power. This power must be furnished by a wing generator, as batteries of the required capacity would weigh too much. It can be seen that with present equipment of this type, the radio is "out" when the place is forced to the water. In addition the generator, which is driven by a variable pitch "Deslores self regulating propellor," continues to rotate at a high speed for some time after landing. It has therefore been the cause of many serious injuries to persons who have walked into the whirling propellor unknowingly.

The experimental work turned out very well, but before discussing the experiments it might be wise to describe something of the air station. The air station is maintained by the U. S. Navy on the shores of Lake Michigan near the U. S. Naval Training Station. It is an ideal place for both seaplane and landplane flying as breakwater furnishes ample protected landing space for seaplanes and flying boats in the roughest weather, while a large landing field lies adjacent to the beach to serve the landplanes.

The chief purpose of the station is to train men as flyers and to prepare them to take their place as commissioned officers in the U. S. Naval Reserve. These men are selected from the junior and senior classes of certain colleges and universities in the United States. After having passed a severe physical examination, they are prepared for their training, in ground school classes held at these various schools, and in special classes and drills held at their local Naval Reserve units. Classes of this nature have been held yearly at the University of Minnesota for a number of years. The men who stand highest in their classes at the completion of the ground school course are then sent to Great Lakes where they receive their primary flight training.

Here they are given from five to ten hours instruction "on the stick" in primary training planes after which they are "soloed" for thirty hours. Naturally, this training begins with easy flying, but later the men are required to handle the plane in nice style in acrobatics and precision flying. Upon the completion of this training they are sent at Hampton Roads, Virginia, where they receive advance training and solo in advanced types of ships. After receiving his commission, each man must do a certain amount of flying yearly to maintain efficiency. This flying is done during "active duty" periods in scouting and spotting planes. It includes long navigation hops over water to various ports around Lake Michigan, as well as inland flights.

These navigation hops are typical of scouting and spotting of gunfire operations during actual warfare, operations which are usually carried on far out at sea. Any information that the plane might gain is sent from plane to ship or shore by radio.

In the experimental set designed to be used in this connection it was desired to use a frequency of a high enough value to permit a short wing antenna to be used. This would eliminate the trailing antenna. The frequency of 9350 kilocycles (32 meters) was selected for a number of reasons. At this frequency the transmission efficiency is high enough to permit the use of battery power supply, thus permitting the operation of the radio set if the plane were forced down.

THIS set was designed in the electrical engineering laboratories at the University of Minnesota for the UO-1 scout. It weighed exactly 24 pounds without batteries. The transmitter consisted of two 2½ watt tubes in a master oscillator—power amplifier circuit. The oscillator was maintained in a shielded compartment in order that the generated radio frequency be kept absolutely constant. The common Hartley circuit was used with a fairly high shunt capacity across the coil to increase the stability. A choke in the plate circuit served to isolate the high frequency from the battery leads. The high frequency voltage was then applied to the grid of the amplifier tube, the output of which was coupled to the antenna. The amplifier

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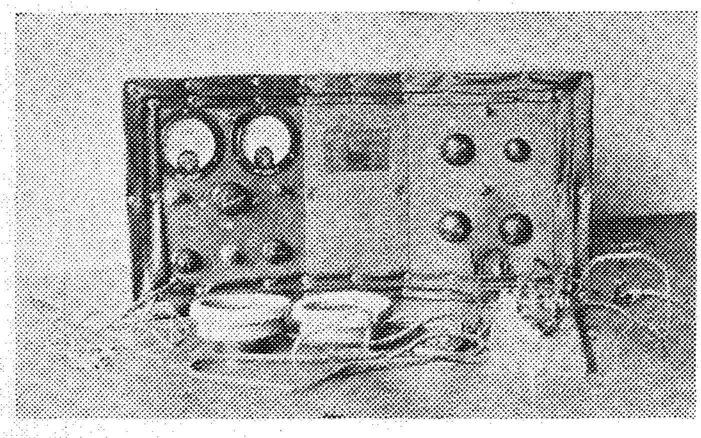
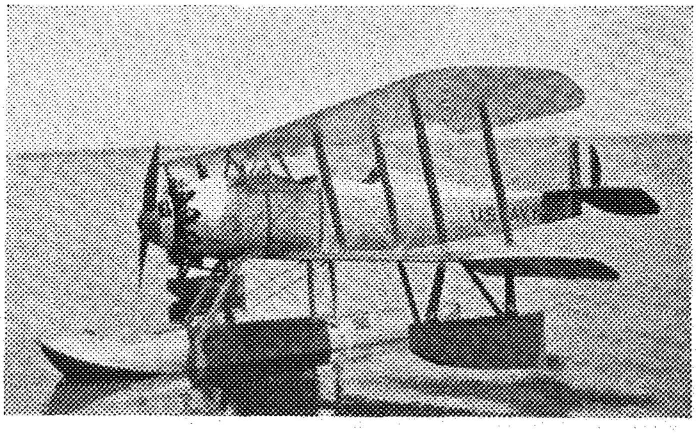


FRONT VIEW OF THE COMPLETED EXPERIMENTAL SET
The set is mounted in front of the operator in the rear set. The antenna wires go from the fuselage to the outside struts.



UO-1 SCOUT PLANE IN WHICH THE SET WAS INSTALLED
On the right side is mounted all of the receiving apparatus of the set while the left contains the transmitting controls and meters.

The New Physics Laboratory

General usefulness has been stressed; future expansion is provided for

By Henry A. Erikson
Professor and Head of the Department of Physics, University of Minnesota.

TWENTY-FIVE years ago when the department of physics moved into its present quarters, the Dalton atomic theory and the electromagnetic theory of light had become universally accepted, and the feeling generally prevailed that the boundary of knowledge in the field of physics had about been reached.

Now, after 25 years, in the same building, the department of physics is again about to move into new quarters. During these 25 years it has trebled in staff and enrollment, and also during this time the subject of physics has been revolutionized. The consequences of the discovery of Rontgen rays and Bacquerel rays shortly before this time were, however, beginning to indicate that there were yet fields to conquer, one of which is the study of the structure of the atom. Instead of a period of complacency, new discoveries stimulated a research activity such as the world had never seen. During this period the border line of knowledge in physics has been pushed far into the previous unknown and the feeling is general that much is yet to come.

The new Physics building, into which the department is about to move, is the culmination of an effort extending through the last twelve years.

In 1917, President M. L. Burton appointed a committee consisting of Dean J. B. Johnston of the College of Science, Literature and the Arts, Dean Allen of the College of Engineering and Professor Henry A. Erikson to determine the most suitable location for the proposed laboratory. The location recommended by the committee is the site upon which the new Physics building has been erected. A serious obstacle, however, existed in that the Northern Pacific railway tracks cut through the north side of the location. Through the foresight of the Board of Regents, the spirit of cooperation shown by the officials of the Northern Pacific Railway and the liberality of the state, this obstacle was overcome through the removal of the tracks so that by 1921 the site was clear.

THE Board of Regents set aside $450,000 for the erection and equipment of the new Physics building and authorized the drawing of plans in 1925. The department had been at work on plans during the three previous years and a preliminary outline was submitted by January, 1926, to Professor F. M. Mann, architect for the university, and Clarence H. Johnston, state architect. By January, 1927, the plans were complete, bids had been called for, and the general contract assigned to the Madsen Construction company, the lowest bidder. Excavation for the building began early in January, 1927. This early start proved especially fortunate as it permitted the placing of orders for steel, etc., before the spring rush. This advantage coupled with a

PHYSICS AT THE UNIVERSITY OF MINNESOTA

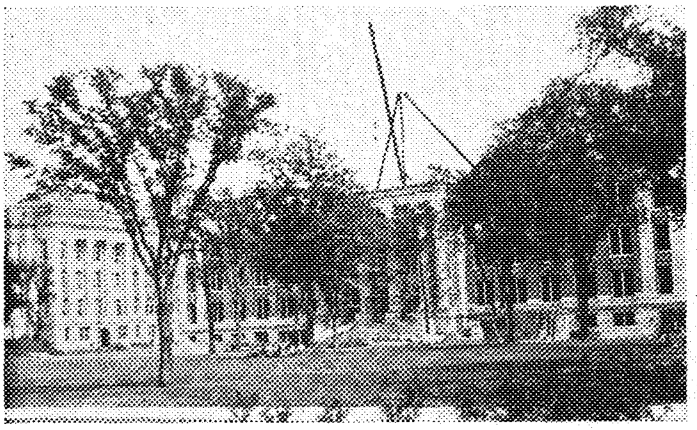
Physics deals with the sources of things. Engineering, on the other hand, deals with the things from the sources. Now it so happens that the sources dealt with in physics give rise to the things of engineering, and hence, from this standpoint, physics became, is, and must continue to be the parent of engineering. This gives rise to a relationship which is paternalistic, a relationship which, however, is, as it ought to be, friendly and mutually helpful. The two are of the same family. One discovers, the other utilizes. Physics, having discovered, hands over to engineering that which it has found. Physics is content with a thank you, whereas engineering must have a more substantial return.

The introduction of physics into the curriculum at the University of Minnesota dates back to the beginning of the university in 1869, when the subject was termed Natural Philosophy, and Mitchel D. Rhame, B.A., was instructor in civil engineering and physics. The work was conducted in the Old Main building and remained there until 1886 when the department moved into new quarters, consisting of four rooms, on the main floor of the Mechanics Arts building, the building now being used by the School of Business Administration. Fredrick S. Jones was then instructor of physics.

When the present Minnesota Union building was completed in 1890, the departments of physics and electrical engineering were assigned the east one-half of the building. The department of chemistry was assigred the west one-half. F. S. Jones, having returned from a two year period of study abroad, was promoted to Professor of Physics and head of the department, and Professor George D. Shepardson was called as head of the Department of Electrical Engineering.

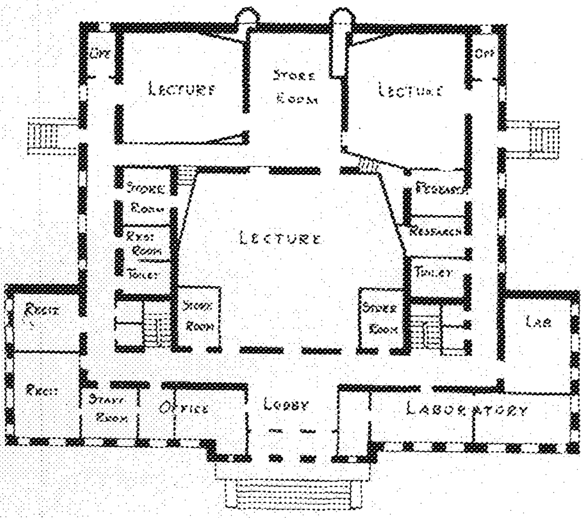
The Department of Physics remained in these quarters until 1900 when the entire building was assigned to chemistry and the Department of Physics moved into the north one-half of the basement of the present Armory. In 1902 the present physics building was completed and the department moved from the Armory in October of that year. On account of the limited appropriation ($66,000) it was only possible to plan a building of a size just sufficent to accommodate the work at that time. At the beginning of this period 25 years ago, the staff consisted of F. S. Jones, and John Zeleny as professors, and Anthony Zeleny and Henry A. Erikson as instructors, Professor Jones being the head of the department. In 1902 Professor Jones also became Dean of the Engineering College.

In 1909 Dean Jones was called to the Dean of Yale College and Professor John Zeleny became head of the department, also in 1912 becoming acting Dean of the Graduate School. During 1914-15 Dean Zeleny studied at Cambridge, England, on sabbatical leave and Professor Anthony Zeleny was acting head of the department. In 1915 Dean Zeleny was called as head of Physics in the Sheffield Scientific School at Yale and Professor Henry A. Erikson was appointed chairman of the department.



LOOKING AT THE FRONT OF THE BUILDING
This picture, taken late this summer, shows how well the building conforms to the general style of university architecture.

VIEWED FROM THE MAIN ENGINEERING BUILDING
One of the interesting stages of building construction in which engineering students evidenced great interest last spring.



FIRST FLOOR PLAN

favorable winter enabled the construction to proceed practically on schedule, and November 15, 1927, will find the building virtually completed. The work of the winter quarter will be begun in the new building.

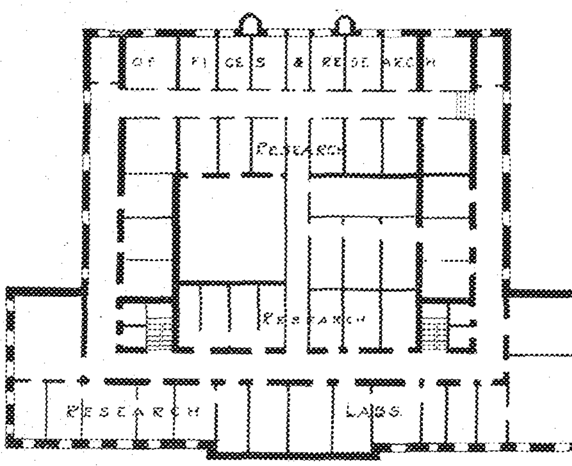
A general utility building for physics was the dominant idea throughout the work upon the plans. In view of the great changes taking place in the field of physics it did not seem wise to plan highly specialized laboratories. The needs of the work as they exist at the present time had to be taken care of, but in addition, it was highly important to provide full opportunity for meeting the needs of the future, as for example the opportunity to add additional space, the careful avoidance of curtailments which can not be set right in the future and to provide possibilities for modifying rooms so as to meet the situations as they arise.

THE complete unit will have a front of 205 feet and a depth of 180 feet. It is the front and central portion of this unit which are being completed at the present time. The dimensions are respectively 57x205 feet and 92x152 feet. The front part has five stories including the sub-basement and the central part has three stories including the sub-basement. Wings on the north and south sides will eventually extend as far as Church street giving a complete unit the size of the Library or Chemistry buildings. The possibility for future expansion is thus quite amply cared for.

It is gratifying also that it was found possible to meet the necessary curtailments in a manner such that matters may be set right when the time comes; furthermore, as the reinforced concrete columns support the floors and the building in general, the tile partitions are only fillers and therefore may be easily removed or modified as the future needs arise.

On the first or ground floor, the outstanding feature as far as the undergraduate work is concerned, is the disposition of the three lecture rooms which the location and therefore the shape of the building have made possible. These front on the one large apparatus storeroom, thus giving easy and equal access to the equipment for demonstration purposes. This arrangement is quite unique. These three lecture rooms, being on the ground floor, gives easy entrance and exit for the large groups thus avoiding the effort, disturbance and maintenance of stairways.

The seating capacity of these three lecture rooms are 500, 200 and 160. Sabinite plaster is used for finish and therefore should be correct from the standpoint of acoustics. Each lecture room is provided with a separate recirculating air washing unit. The air enters through large registers near the ceiling at the front of the rooms and is withdrawn through mushrooms placed in the floor beneath the seats. In order to minimize noise, the fans and washers are placed remotely in the sub-basement.



BASEMENT PLAN

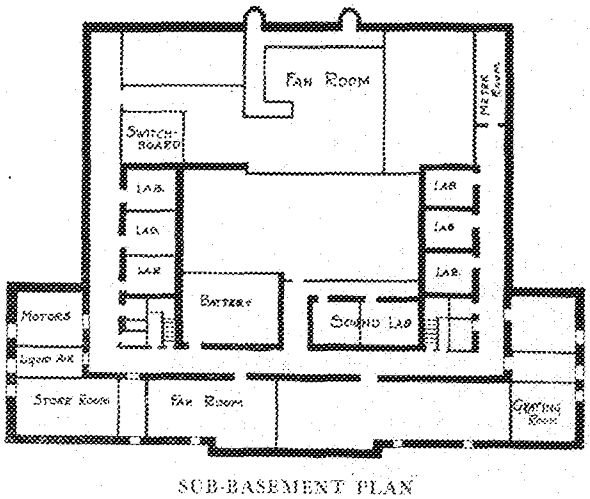
The lecture tables are 24 feet long and are each similarly equipped with gas, compressed air, high tension battery, low tension battery, three phase, 110 A. C., 110 D. C. and heavy current outlets. The lighting is through skylights provided with automatic shutters for darkening the room. These three lecture rooms will be used primarily for the demonstration lectures in the undergraduate courses. The general course in physics consists of a quarter course in Mechanics, a quarter course in Heat, a quarter course in Electricity, a quarter course in Optics and a quarter course in Acoustics. In each of the above courses there are three demonstration lectures a week. Each course except Acoustics is offered during three quarters each year. These courses involve about 1,800 demonstration lectures a year.

The general offices are located on the ground floor to the left of the main lobby. These consist of a waiting room, a secretary's room, and the chairman's office. Joining the chairman's office is a staff room and on from this two recitation rooms. Along the corridor towards the east are the ladies' toilet, ladies' rest room, advanced apparatus storeroom and the caretaker's office.

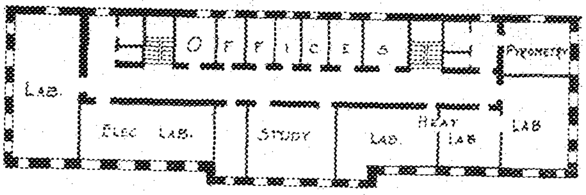
TO the right of the main lobby are three Mechanics laboratories each of a size such as will accommodate twelve to fifteen students. From thirty-six to forty-five students may therefore be taken care of at a time with one instructor in each room for each group of twelve. It is felt that from twelve to fifteen students is all an instructor can efficiently take care of at a time in the laboratory part. A larger number in a room gives rise to a commotion which interferes with efficient experimental work.

On the corridor towards the east from these rooms are the men's toilet; two research rooms, one of which serves also as a booth for the moving picture machine for use in conjunction with the large lecture room, and the lecture assistant's office. On this floor the corridors have red tile floors with terrazzo borders, the three lecture rooms have terrazzo floors, and the rest of the rooms on this floor are cement, covered with battleship linoleum.

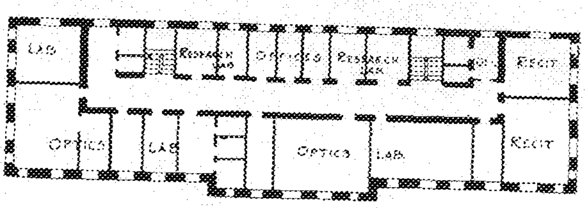
The division of heat occupies the south portion of the second floor. There are three laboratories, each accommodating twelve to fifteen students; which



SUB-BASEMENT PLAN



SECOND FLOOR PLAN



THIRD FLOOR PLAN

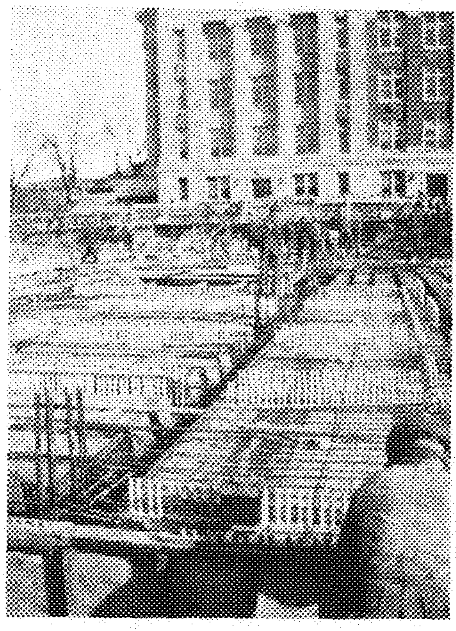
will be devoted primarily to the experimental work in the general undergraduate course in heat. An instructor will be assigned to each of the three groups of twelve. Each of these laboratories is equipped with alberine piers, tables and gas and electric outlets to meet the needs of the respective portions of the heat work. Adjoining these is a pyrometry laboratory equipped with piers, furnaces, hoods and outlets thus facilitating the use of the various pyrometers in heat and temperature work. Adjoining the pyrometry laboratory is a private research laboratory, and storeroom.

The north portion of the second floor is devoted to the division of electricity. The laboratory at the end of the front corridor has twenty-four stations, each provided with a galvanometer and instrument cabinet, two duplex battery outlets and 110 D. C. and 110 A. C. outlets. Each student has his own station and carries on his work individually. The large adjoining room is devoted to advanced and precision measurements in electricity. It is also provided with twenty-four stations. A storeroom adjoins this laboratory. On the east side of the front corridor are two seminar rooms and five offices. On the west side of the corridor at the center is a commodious study room.

The third floor will be devoted primarily to the division of Optics. It will have two large elementary optics laboratories and a series of special rooms to be devoted to the intermediate and advanced experimental work in light. The south portion of the third floor has a series of rooms which are intended to be utilized as a portion of the future space to be devoted to the work in Astronomy.

ADVANCED and research laboratories occupy primarily the first basement floor area. Of these there are thirty-five in number. The shops are located off the north end of the front corridor. Of these there are: a main shop, a special shop for precision work, a supply room, a work shop, a student shop, and a glass blowing room with glass storage room. A winding stairway leads from the main shop to the dynamo room below where a forge is located. The various machines in the shops have individual drive and the work benches are provided with compressed air, gas, and standard six gang electric outlets.

The thirty-five research laboratories on this floor are equipped mainly according to a standard plan. While this plan is such as to give a general utility, an attempt was made to meet the needs of research in ionization and atomic structure which are the vogue in this laboratory. A brick pier having an alberine top 32 inches square and 2½ inches thick is placed a short distance to one side of the center of the room. Special laboratory tables have been designed which may be placed about the pier as the set up requires. Each pier is provided with a small porcelain bowl sink provided with two cold water faucets and an iron mercury trap in the waste pipe. The object of the sink is to provide flowing water for the condensers of the vacuum diffu-



PLACING THE CONDUITS
The many conduits shown lead to a large switchboard with which the new building is equipped

sion pumps so much in evidence these days in research laboratories. Each pier also has a gas, a compressed air, and a standard six gang outlet. The six gang outlet is standard for the whole building. It contains six duplex outlets, namely: 110 AC, 110 DC, two low tension battery giving up to 220 V. and two high tension battery outlets giving up to 6,000 V. each.

Five feet from the floor, and as a rule, on each of three sides of the room is a six gang outlet and a gas and compressed air outlet. The corresponding outlets in all the six gangs in a room are in parallel and the corresponding circuit goes directly to the switch board room except the A. C. outlets which are on the house lighting system. This gives a very desirable variety of voltage and current supply and minimizes the necessity of stringing wires throughout the room.

TWO steel channels three and six feet from the floor pass around the room. By inserting the heads of bolts in these channels, panels for mounting apparatus may be attached without marring the walls. Some of the research rooms although similarly equipped are larger than the above standard room. Two have two double piers, three have four piers and one has six piers.

The switchboard room is located on the east side of the front corridor near the center of the building and directly above the battery room in the sub-basement. The switchboard room is the main distributing room for the entire building. Into this room the conduits concentrate from the battery and D. C. outlets in all the gang boxes throughout the building. This room contains a direct current switchboard which is ten feet long and which carries the starting switches and regulating rheostats for the 5 K. W. and the 15 K. W. motor generators in the dynamo room beneath the shop. It also carries the generator feeder switches and rheostats and a series of double pole double throw switches which permit the sending of the current from either generator, or A. C., to the D. C. outlets in all the gangs or 150 ampere cabinets in the building. This board also carries the usual supply of voltmeters and pilot lamps.

Directly to the right in this room is the high tension battery switchboard. This board is seven feet high and 45 feet long. At the top is an ebony asbestos panel six inches wide, extending the whole length of the board and which carries 240 room terminals. Below this are 20 pairs of parallel horizontal bus bars extending the entire length of the board. Below these are 120 Westinghouse dead front switch blocks placed in a horizontal row which also extend the entire length of the board. The leads from the high tension battery trays, in the battery room below, pass through sealed porcelain tubes in the floor and terminals at the back of these switch blocks. By means of these switch blocks and suitable connectors to the bus bars and room terminals, it is possible to send any voltage, which is a multiple of 50, up to 6,000 volts, to any of the six gang

(*Continued on page 62*)

Signal Corps Camp Life at Fort Snelling

Communication men set up radio stations, establish telephone lines, carry on a mimic warfare, and win credit as one of the best drilled units

By George T. Wier, E '29

THE morning of June 16 dawned as a nice and bright sunshiny day. To the 800 odd men arriving at camp it was the beginning of a new life. Men from North Dakota, Iowa, Missouri, Nebraska, and last, but not least, Minnesota, were among the occupants of Camp Snelling.

The first thing the first few men did upon arriving at camp was to report to camp authorities and then go down to the "Processing area." The "Processing" consisted of a physical examination taking about three hours covering everything but finger-prints. After that their measurements were taken to fit them out as proper soldiers for Uncle Sam.

From there we followed the "gang" to our company supply building and received equipment. Then throwing it all in a tent shelter half, and receiving a rifle covered so thick with grease that it could hardly be recognized, we turned toward the barracks, our new home.

Here the dirty work began. Barracks had to be swept, scrubbed, and straightened up before any beds could be brought in. Some of the fellows, however, were smart enough not to report until about three in the afternoon and thereby escaped all the cleaning up to be done around the barracks. By evening everything was in an order suitable to Captain Gist, our platoon commander. Cots were then brought in and the first day was over.

The next morning reveille was blown by the fellow everyone hates. At 7 o'clock, after breakfast, we were instructed in the intricacies of making up our bunks in "morning style." Other instructions were given us as to the placing of "duffle bags," packs and civilian clothes. We devoted this afternoon's time to removing the "cosmic" grease from our rifles and bayonets. Strict instructions were given us that no rifles were to be entirely dismantled, but "Pass the screw driver" became a pass word. Only the army knows how to pack five pounds of grease on each rifle. The only way it could be removed was by taking the gun apart and bathing it in gasoline, having plenty of rags to soak up the grease. Cleaning a rifle during the basic drill is a snap compared to the procedure at camp. Not a speck of grease can remain on the rifle or bayonet, and the barrel has to be clean enough to reflect light. When all the guns were clean we felt proud of our "fighting equipment." Plenty of "elbow grease" had been used to remove "cosmic" grease.

After being at camp three days our regular routine held good every day of the camp. The only breaks we had were Saturday, and Wednesday afternoons.

The signal corps at camp consisted of 17 Minnesota men. These with the 80 Minnesota infantry unit made up the Minnesota delegation which occupied two barracks along side of each other. During drill periods the Signal Corps drilled with the infantry. At the beginning of the camp all were quite awkward, but as weeks passed the awkwardness fast disappeared. The Minnesota platoon consisting of eight squads, was drilled by Captain Persons with the assistance of Captain Gist. With much patience on their part they managed to make the Minnesota platoon the crack drill outfit at Camp Snelling.

WE had been at camp about eight days when we heard that we were to do some pistol shooting. Captain Persons took us down to the company supply room where Colt .45 automatics were issued. These all had questionably large amounts of grease on them that had to be removed before any shooting was done. After this we were taken down to the range where instructions were given us on how to shoot the revolver without hitting anybody. The targets were so large, and the range so small—15 yards—that it seemed that all one had to do was to point a gun in the general direction of the target in order to hit it. A few shots convinced us that the idea was absolutely erroneous. It takes quite a bit of practice to hit a target and much more to make a fair score.

After three days of shooting, nine of the 17 men qualified as "shooters" of one degree or another. Because of this fact we won a cup for the best men at revolver shooting. The Signal Corps was the only outfit to qualify in the shooting.

Every Monday and Thursday night a dance was given at the Service Club. On Mondays the infantry supposedly could attend and on Thursdays the medical and dental units were there. Before camp was over, however, anybody could go. Girls, collected from various girls' clubs, were brought out from the cities in large army trucks. Many a romance started while the boys were "tripping the light fantastic" with the lady friend.

Offsetting the good times there were the details, and each man had at least four turns on these. Details consisted of room orderly or janitor for the barracks, kitchen police or third cook, by far the most unpopular, table waiter, and the charge of quarters. This last job was to boss the room orderlies around. The greatest fear was that of being put on the Wednesday, Saturday, or Sunday details.

Our first practical work consisted of putting up and operating three portable radio sets of which one was used as a transmitter and receiver. These sets had a transmitting radius of about five miles on short waves. Four men were assigned to each set, two as operators and two as message center men.

Sending and receiving messages in code and on the "clear" comprised the work, and each man was given equal opportunity to "pound the key." Practical maneuvers were carried out with the medical corps in the sham battles. On our first maneuver we used radio, and on our second we used telephones. Our telephone work consisted of setting up about a dozen different posts where switchboards were brought into use. Useful experience was gained in the work of repairing all different types of the trouble that were out in the lines between posts.

Pole climbing was given as some of our routine, and at first some of the boys were quite timid! so timid in fact that it was almost necessary to furnish a ladder to get them off the pole. Many a laugh was furnished the onlookers by the pole climbers.

THE rest of our practical work consisted of field maneuvers with the Third Infantry of Fort Snelling of course using radio and telephone. At this time the National Guard Aero Squadron was encamped at Chamberlain Field nearby, and they also worked in connection in a sham battle.

Next came the eventful day of our practice hike. With a full pack consisting of blanket, tent, towel, clothing, and toilet articles, besides a rifle, the whole camp was taken on a 12 hour hike. We left camp a little after 7:30 a. m. and marched all day in 30 minute intervals with a ten minute rest between intervals, with the exception of lunch and tent pitching. We had lunch at Minnehaha Falls, served from a rolling

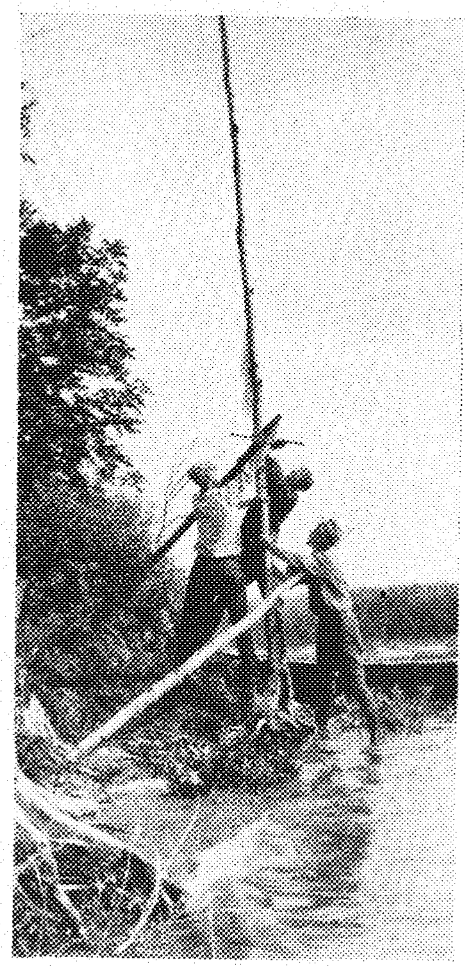
(*Continued on page 62*)

Once Again---

—the civil engineers have been at their summer camp, leaving a record of many unforgetable and interesting events

Triangulation, "Eric," Pajama Parade, "Steckman," Sah Kah Tay, and what not.

By Ralph P. Johnson and
Theodore W. Thomas, C '28



SETTING A TRIANGULATION BUCK
Wet feet are nothing to the men of the camp when it comes to performance of duty. The men are R. P. Johnson, Lande and Kopplin.

THE city of Cass Lake, dreamed of by all sophomore and junior civils, is a town of old buildings located on the west shore of Cass Lake. Being in the center of the Minnesota National Forest Reservation, it is ordinarily a quiet and peaceful place, but in the fall of every year there is a change. Old dilapidated Fords run about the town giving off many curious sounds and often blowing out tires; men dressed in big boots and rough working clothes are seen carrying surveying instruments about; and tents are raised on the shores of Cass Lake. Once more the people of Cass Lake know that the summer civil camp of the Minnesota engineers is in session.

Previously the city had been a busy lumbering center, but recently this industry died out leaving the town in a rather isolated state. During the last summer, however, the establishment of The Spear's Clark Training Camp served to boom things.

Norway beach, which is the traditional home of Senior Civils, is located on the southeast corner of Cass lake. It receives its name from the dense growth of tall Norway pines, the pride of the Minnesota National Forest, which form a massive wall to shelter the southern end of the lake. During the autumn of each year these silent sentinels of Norway beach are awakened by the sudden thundering of old Fords as the senior civil class members advance toward their much dreamed of camping grounds.

Camp was scheduled to start at noon on Friday, August 12. Several of the boys arrived early and made the cook and dining tents ready for the first official meal. The sounding of the dinner gong revealed a large portion of the camp to be present, all equipped with unusual appetites but rather questionable table manners. It was a case of every man for himself. Any man who moved his fingers slowly in the close vicinity of "eats" was in a grave danger of being speared by the forks of hungry engineers. The meal was eminently satisfactory and lived up to all predictions of previous classes.

After lunch each man or group of men was started on some definite task about the camp, which was calculated to make the place more comfortable and more inhabitable during the six weeks' stay. Tin cans were buried, a dock was built, gages set, and a general cleanup organized. It was here that Clarence C. Lande and his party of men showed unusual ability as sanitary engineers.

AT 5:45 the next morning, awakened by a terrible racket from the vicinity of the cook tent, we were startled but it proved to be none other than the redoubtable "Eric," cook of much fame, applying the axe in lusty wallops to the buzz saw gong. It was truly a sound easily capable of awakening the dead yet it was hardly sufficient to arouse part of the camp. Being out in the cold the covers felt mighty nice along about that time.

RATING ONE OF THE METERS
Lande and Lund are shown trying to rate one of the current meters by pacing along the Box Factory Canal at Cass Lake.

After breakfast the work of the camp was explained by Professor Cutler and the serious part of the course was taken up. The rotation of each man through the various duties of each separate survey was followed as nearly as possible. For example a man started as rear rod on the railroad survey. The next day he became rear chain, then head chain, and finally instrument man, or chief of the party. As chief of a party his most serious duty was to work in a two hour lunch period where only half an hour had been scheduled.

PERHAPS the largest piece of work carried on was the traverse run over the Great Northern and Soo Line tracks. The total length was in the neighborhood of 15 miles. Every sign, fence and building, every frog, switch and siding was accurately located in this tape survey. In addition the extensive yards of the Great Northern Railroad at Cass Lake, a division point, were also included. The entire survey was computed as a series of smaller closed traverses and was finally plotted down to a location survey for a new railroad running southwest from town. The preliminary survey was carried out through a real wilderness of hills and swamps. After levels had been run over the line and topography taken with a hand level, the data was plotted and a paper location was worked out on the map. This location was then staked out in the field and some of the spiraled curves were beautiful to behold. But the prize railroad problem was the crossover. This seemingly innocent problem consisted merely in staking out a cross over from the Great Northern tracks to the Soo. The two lines are converging at an angle of about 8 degrees. The problem was computed first and then checked by staking out the work in the field, and lucky was the party which checked out right the first time. All of the railroad work was carried out under the direction of Professor Cutler.

A LARGE amount of topography along the lake was taken in a series of stadia surveys. Every man had his chance at the various positions of a stadia party in addition to several days of plotting and computing. The star stadia surveyor was none other than Clyde Parker, who as chief of party arrived at the job after much struggling and coaxing had been spent on his flivver, only to find that he had no transit.

Under the direction of Mr. Zelner, a series of control traverses were run north of the city. Starting from these control traverses, plane table parties were sent out to make topographical maps which included the Cass lake golf course and much of the country lying west of there.

MAIN STREET AT NORWAY BEACH

A peaceful view of the array of tents after the usual Sunday washday activities have taken the time of many of the camp men.

Each man in camp was given the opportunity to show his ability at hydrography by rating meters and taking stream measurements. This work was carried on at both the inlet and outlet of the Mississippi in Cass lake.

A considerable amount of triangulation work was also done. An attempt was made to close the system around Starr Island. The results of this closure were startling to say the least. Distances were closed to 0.043 feet while positions did not check within three feet. These results Mr. Boone refused to attempt to explain. Along with triangulation each man was required to worry his way through the quadrilateral adjustment.

Throughout the entire period of camp at Cass lake various experiments were conducted. The class as a whole showed their interest in scientific research by conducting these experiments on their own initiative. Many interesting and novel conclusions were derived although much of the peculiar phenomenon still remains a mystery.

For instance, no one was able to determine just why three deuces should be better than two pairs, Aces by Kings; or why firewood should disappear suddenly without the knowledge of anyone. Amidon and Ringwood conducted an extensive experiment on fishing with outboard motor propellors. The experiment worked fine according to Roge until a 40 pound bass took possession of both propellor and shaft. Amidon turned in these results on his report although Mr. Boone is still skeptical about the fish story part of it.

Another experiment was conducted on the stretch of an invar tape. The results showed that the strain is directly proportional to the stress but that the yield point is reached very abruptly. Charlie Knox unearthed another tremendous problem to be solved by hydrology experts, when he found six inches of water in the rain gage immediately after a light fog. This proved to be dark mystery throughout the entire camp.

AFTER putting in a few weeks of work the camp became restless. In order to break the monotony and keep up the tradition of previous camps, one peaceful evening the entire group, bedecked in pajamas, swooped down on the city of Cass Lake. Some of the older natives were shocked while the younger members of the weaker sex were rather jubilant, as the ghastly figures snake danced through the streets and shouted "Gesundheit" as they stamped their way through hotels, theatres and drug stores. After leaving Cass Lake the procession started toward Bemidji. The transportation problem proved to be a rather serious one this particular evening. Each party consumed

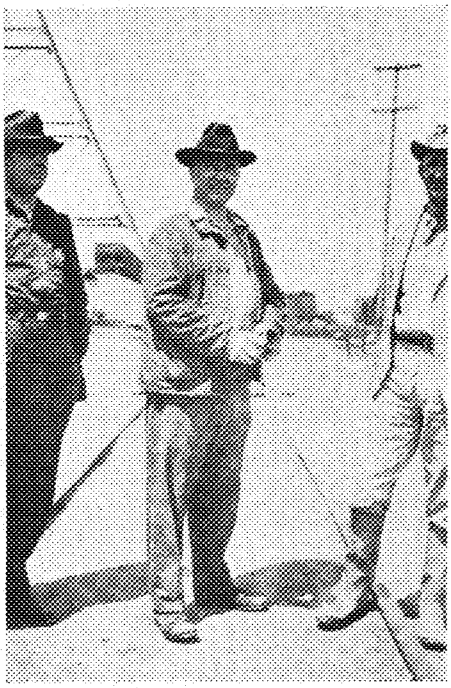
(*Continued on page 58*)

MEMBERS OF THE 1927 CIVIL SUMMER CAMP

Amidon, A. Erickson (Cook), Knox, Wielde, V. Erickson (Cook), Thwing, Mohr, Kopp, Daly, Ringwood, Frank, McNally, L. R. Erickson.
Bolton, Engstrom, Silliman, Rinell, Borne, Gard, Ferguson Kopplin, Normann, Thomas, Benson, Olson, Cutler.
Goldberg, Bernick, Bergford, Vorisek, Mayeron, Rydeen, Loucks, Prior, R. P. Johnson, Beaudin, Schroepfer, Boon, Zelner.
Gustafson, Briggs, Brattlof, Londe, Lund, Tauber, Moore, Parker, Dreveskracht, Tebo.
(G. B. Johnson not on picture)

With the Miners

During the spring and summer many of the classes take trips to the mining fields where modern methods are inspected



JUST BEFORE GOING UNDERGROUND
This shows Professors Comstock and Parker with the mine superintendent just before inspecting the Netta Zinc mine at Picher, Oklahoma.

Junior Geology Trip

By Ted Erck

On April 29, three cars containing seven School of Mines students majoring in geology, left Minneapolis for a seven hundred mile trip to the Black Hills of South Dakota. The unanimous opinion of everyone not going was that we would never get there. However, the roads had just enough time to dry up, and we got through just before another rainy spell blocked everything. The trip was uneventful, tire trouble being no event to Ford drivers. A .22 caliber target pistol, affectionately known as the "peashooter," furnished amusement but did no harm to game or livestock.

The first three weeks of the trip were spent in Lead, where we studied the Homestake mine and open pits, as well as the surface geology and a number of other mines in the surrounding region. When the snow was too deep we worked underground or examined the Homestake Mills.

The fourth week we spent in the southern hills, visiting a number of old mines and prospects and some active mines. A good share of the time was devoted to enjoying the scenery. Following this, we lived on a ranch five days while we mapped Bear Butte by plane table. The sixth and last week was spent at Galena, where each student mapped a special area.

As soon as the trip was ended the men scattered widely. Of the four seniors, one went to Rhodesia, one to Tennessee, one to Montana, and one to Texas. One of the juniors went on the geological staff of the Homestake company for the summer, while the other two went to work for the Minnesota Geological Survey.

Junior Field Trip

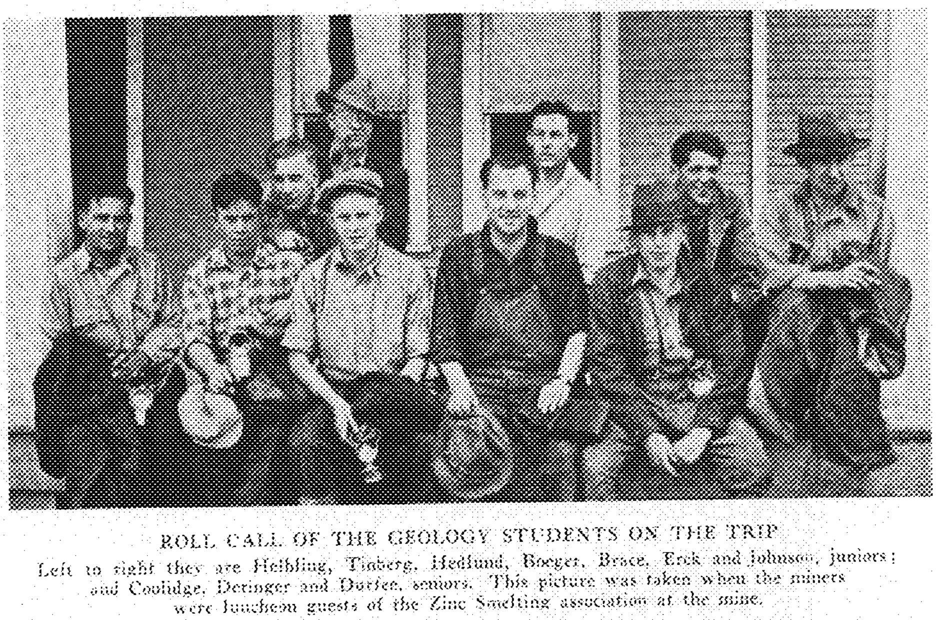
By Robert M. Tousley

Ten Juniors and three professors left Minneapolis on May 15 for the southwest. The party headed for Kansas City where they changed trains. The first inspection tour was at Cherryvale, Kansas, where the Edgar Zinc company is located. A complete day was spent in observing the various steps and processes through which the zinc concentrate is subjected. This plant is one of the largest zinc smelters in the southwest. After taking notes from which the report and flow sheets are made, the group left Cherryvale.

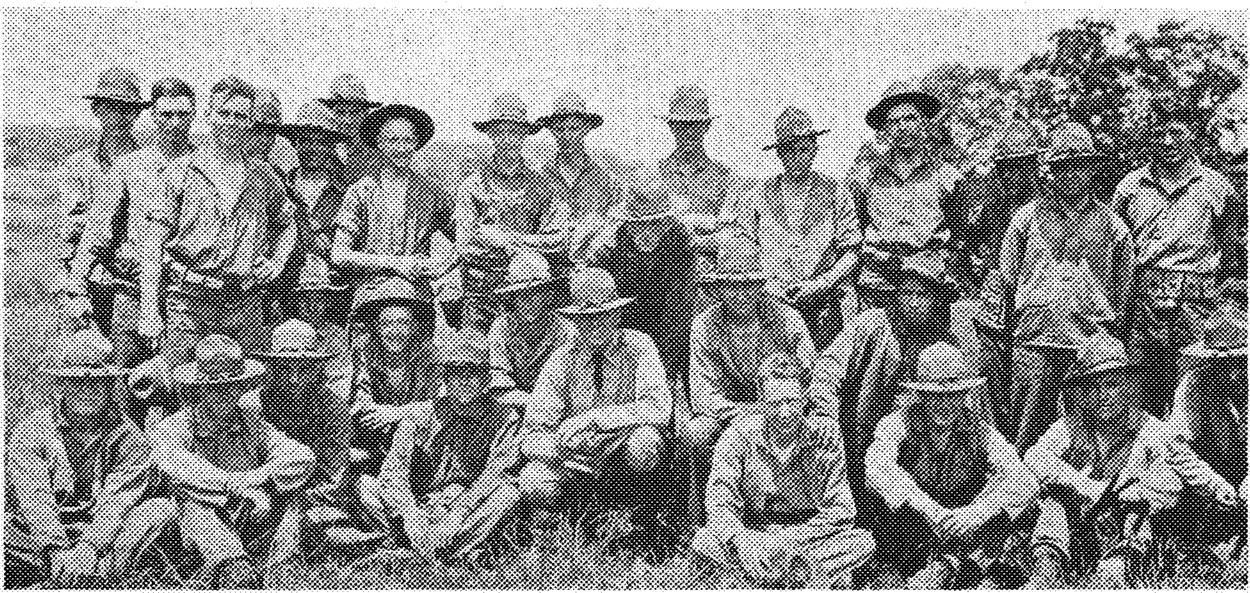
The next stop was at Joplin, Missouri, which is located in the tri-state lead and zinc district. Here the party spent a week studying the underground mining methods and the mill practices, which are characteristic of this district. The leadsmelter and fabricating plant of the Eagle-Picher Lead Company were visited and various treatments of ore and metal thoroughly studied. While at Picher, Oklahoma, the students and professors were guests at a luncheon given by the Tri-State Zinc association, speeches and entertainment were on the program.

From here the class went to the Cripple Creek gold mining district in Colorado. Colorado Springs was the headquarters during the stay in this district. The entire class went underground to study the mining methods used in the Cresson mine. After spending a morning in the mine, lunch was served at Cripple Creek. Cripple Creek is one of the old frontier towns of this locality, but is more or less dilapidated due to lack of upkeep and repairs after the big boom. After inspecting the famous Golden Cycle Mill a bus trip was taken over the Corley mountain highway.

The class spent a day in Denver on their way to Jerome, Arizona, which is located in the heart of the copper district. After a long ride through Colorado and New Mexico, the class spent a week in the copper district studying the underground methods, drill sharpening, milling and smelter practice. An intensive week of work and the trip was officially over. The students leaving for home by way of the Western coast and through the Canadian Rockies. During the trip 14 states and three provinces were passed through.



ROLL CALL OF THE GEOLOGY STUDENTS ON THE TRIP
Left to right they are Heibling, Tinberg, Hedlund, Boeger, Brace, Erck and Johnson, juniors; and Coolidge, Deringer and Durfee, seniors. This picture was taken when the miners were luncheon guests of the Zinc Smelting association at the mine.



MINNESOTA ARTILLERY UNIT AT CAMP KNOX, KENTUCKY

Front Row, left to right: Butler, Hanson, Dunshee, Ferguson, Patterson, Engstrom, Armstrong, Lieutenant Cassidy, Berzelius, Blair, Nichols, Epperley, Wielde, Sanford, Mullen.

Rear Row, left to right: Bock, Hakenjos, Bolton, Rydeen, Sinnott, Orowsky, Knox, Lundquist, Larson, Kuhfeld, Nelson, Bruess, Johnson, Thompson and Bergford

At the Kentucky "Knobs"

Fort Knox is the summer home of Minnesota's coast defense men during an interesting and intensive six weeks' training period

By LeRoy Engstrom, E '28

THE Coast Artillery R. O. T. C. summer camp, attended by students from Minnesota, was held at Camp Knox, Kentucky. This camp, which covers about thirty square miles, is located thirty miles south of Louisville in the region of Kentucky, called "The Knobs." Built during the World War it at one time had the largest force in training of any camp in the country.

Covered with dust the barracks, which were built only during the past war, might as well have stood since Sherman and his troops first tramped this part of the country. Before the Minnesota men left there were some very serious plans projected for bracing the second floor of their particular barracks, and making it into a real honest to goodness lake, as the only swimming pool in the camp was a shallow mudhole.

Nine hundred men were enrolled in the camp this summer in three branches: the infantry, coast artillery and the field artillery. Men from the Kansas Aggies, Washington University (St. Louis), and Minnesota, made up two batteries, "B" and "D", of the Coast artillery unit, of which the Minnesota men were assigned to battery "D".

For a few days the usual disorder incident to the arrival of new men and the assignment of bunks and clothing filled the camp. The drawing of equipment turned out to be a swapping party as most of the shoes and hats were obviously meant for some one else. Vain were the attempts of many to look like soldiers when uniforms were donned.

Even first call and the first sergeant were not sufficient usually to wake some members of the battery after that "early morning music" or reveille filled the air. Buglers who tried to show their variations of the calls were other items that the Minnesotans had to contend with, but after almost breaking up several of the early formations in disorder, the men joined in the game of trying to tell which call was which. The man with the watch was usually the winner.

Infantry drill instruction took place nearly every morning at seven o'clock under a Kentucky sun that is at least as hot as the well known Minnesota variety. After this drill, a few minutes were allowed for changing from O. D.'s into denim uniforms. Then in crowded army trucks we would be bumped and shaken along the road to the gun field where the drill was held for the day. Our first instruction was in the use of the forty-five caliber automatic revolver, the best kicker, ranking second only to the army mule. The ammunition allowance was small, and the firing consisted of only a short instruction fire and then the qualification firing. The grades of qualification were, in order of the rank, expert, sharpshooter, marksman, and those who didn't qualify; the last by far the most popular division.

Similar training was followed with the rifle. In both the revolver and rifle fire the Minnesota men were somewhat handicapped at the start as they did not have as much previous training at school as students from other schools. The annual trophy awarded to the coast artillery units for the highest scores in both branches of the arms was won by the Kansas Aggies.

OUR first taste of meals eaten in the open out of army kits, was received on the rifle range. Ptomaine poison failed to put in an expected appearance, though the kerosene taste took a long time to become neutralized. An extra order for flytox was sent in by the cook when someone discovered that flytox had inadvertently been used to flavor the soup. The major portion of the gun drill given us was on the three-inch anti-aircraft guns, and the .30 caliber anti-aircraft machine guns. These, together with 75 m.m. guns, are the principal weapons of the anti-aircraft corps, although experiments are being made with a higher caliber gun, and a .50 caliber machine gun that may supplement the present equipment. In addition to the

(*Continued on page 56*)

News from the Technical Campus

Student, Faculty and Alumni Activities — Technical Items of Interest

A Cadillac Chassis Is Presented to the University

THIS chassis valued at $20,000 was presented to the University of Minnesota by the Cadillac Motor company largely through the untiring efforts of Professor Zelner of the department of civil engineering. Several years ago Professor Zelner met Mr. Fribley at a football game at the University of Michigan and ever since then these two men have worked together with splendid results.

The University of Minnesota and the engineering college particularly, have every reason to feel honored by this gift because they are one of the six institutions of learning and research in the United States and abroad which have been presented a chassis. Other institutions which have these chassis are the Smithsonian Institute, Massachusetts Institute of Technology, and the Universities of California, Michigan, and Virginia in the United States. Abroad, one cut-open chassis, after making a tour of the leading automobile shows in London, Paris, Berlin, and other large cities of Europe, was recently presented to the technical high school at Charlottenburg, Germany, in recognition of outstanding engineering progress.

This chassis will be assigned to the automotive laboratory of the engineering school and will be used for instruction purposes after it has been on display until after homecoming.

The presentation was held in front of the main engineering building. In the picture are President Coffman, Dean Leland, Professor Springer and representatives of the Cadillac Motor company in addition to other members of the engineering faculty, and student body.

Du Priest Is New Mechanical Department Head

ON October 10, Prof. John Randolph Du Priest arrived from the Oregon State Agricultural College, to take charge of the Mechanical Engineering department. He was formally presented to the mechanicals at an A. S. M. E. banquet held in the Union Friday night, October 14. The banquet was held to give all new members a chance to find out the aim and purpose of the A. S. M. E.

Professor Du Priest has been very active along Mechanical Engineering lines for many years. He graduated from the Virginia Polytechnic Institute in 1901 as an electrical engineer, but later got his mechanical engineering degree from Cornell in 1912 and his master's degree in 1913.

He has had a wide range of experience which includes railroad shops, design of pipe lines and heating systems, drafting, chief engineer, consulting engineer, teaching of engineering at Cornell, University of Idaho, Rensselaer Polytechnic Institute, military research during the war developing war inventions, in addition to this he is the inventor of a connecting rod for steam, gas, and oil engines.

A new plan is to be initiated in the A. S. M. E. unit this year, over 200 letters will be sent to manufacturers all over the country asking them about the employment system in their plants, and, in case they send representatives to various colleges, to send one to Minnesota.

Chemical Faculty Go On Convention Trip of National Society

THE American Electrochemical society held its 52nd convention in the form of a Northwestern trip to visit electrochemical and metallurgical plants. About 100 members of the society took part, starting from Chicago on September 4. September 5 was spent at Minneapolis. Dr. C. A. Mann, local chairman, had arranged a program, including a drive around the Twin Cities, a visit to the School of Chemistry and to the Experiment Station of the state and Federal Bureau of Mines, luncheon as guests of the University on the farm campus, a technical session in the auditorium in the School of Chemistry, and a dinner at the Curtis Hotel.

The party left at 11 o'clock to continue the trip, making stops at Butte and at Anaconda, Montana; Wallace and Kellogg, Idaho; Seattle, Vancouver, and Trail, B. C.; Shelby and Great Falls, Montana; and Keokuk, Iowa, returning to Chicago on September 21. Dr. S. C. Lind, president of the society for the present year, and director of the School of Chemistry, and Dr. C. A. Mann, Head of Chemical Engineering of the University, joined the party at Minneapolis, together with Mrs. Lind and Mrs. Mann for the Northwestern trip.

Minnesota Students to Present Papers at Regional A. I. E. E. Meeting

GREAT Lakes District No. 5 of the American Institute of Electrical Engineers will hold a regional convention in Chicago on November 28, 29, and 30. The student branches will hold their convention on the 28th, at which time several papers will be presented by Minnesota students. "A Method of Design for Alternating Current Reactors Where a Direct Current Component Is Present" will be given by James P. Barton. "A Method of Securing the Compression Indicator

1927 Engineers' Homecoming

WE have all read about the Crusade of King Richard and of all the trouble and work his cohorts had to make these crusades successful.

This year there is a Crusade of the Knights of the North back to the home fold, to their Alma Mater where they plan to meet and greet their fellow classmates and acquaintances.

For the Knights of St. Patrick there is a special gathering place arranged in the Main Engineering building, room 135. This is the second annual engineer's Homecoming. It is being planned by a joint committee from the MINNESOTA TECHNO-LOG, the Engineers Bookstore and the Technical Commission. The Technical Commission has appointed Jack R. Ginnaty, junior electrical, as chairman. J. R. Newhouse, electrical, Don Shoemaker, civil, and Jack Crimmins, an architect, as the committee on general arrangements. The Technical Commission plans to appoint one of these men as the Chairman for the home coming next year.

Under Jack Ginnaty there are several committees working. One is decorating the room in the Main Engineering building. Another will take charge of the serving of refreshments after the game and yet another is to hold parking space for the returning engineering graduates' cars. This parking space is a new feature and is in charge of James Hartigan. It is to be located in the rear of the new Electrical building.

Melvin Elmquist, a sophomore electrical is in charge of the committee that will refurnish the rooms with lounges and easy chairs. This committee plans to remove all of the ordinary equipment found in the class room in order to make the room as comfortable and homelike as possible. It will be a place for married engineers to leave their wives, children, and luggage. Rest rooms will be kept open until the last homecoming engineer has left the scene of fond memories and departed back to his every day job.

Margaret Bradbury, in charge of refreshments, will see that all the engineers have enough to eat when they come back to room 135 cold and hungry after the game. Assisting her are Mary White, Ruth von Sien and Grace Jones. Publicity is being furnished by Bill Hill who is the news editor of the MINNESOTA TECHNO-LOG.

At the alumni dinner on Friday evening there will be tables for engineers as Mr. Robertson and Mr. Johnson of the class of '14 say that most of the members of their class come back every year.

Card of a High Speed Compressor" will be presented by Marcus E. Fiene. Mr. Fiene, a '26 graduate, worked on the above problem at the Research Laboratories of the General Electric company this summer.

This problem was successfully solved by Mr. Fiene after many others had failed and is essentially and electrical method developed in the General Electric company's laboratories. The Student Branch Convention is the first of its kind ever held by the Great Lakes District.

At the regular section meetings two papers will be presented by Minnesota men. "The Vacuum Tube Rectifier" by J. H. Kuhlman and James P. Barton will discuss a method of testing vacuum tube rectifiers to determine their practicability for radio receiving sets. "A Two-Range Vacuum-Tube Voltmeter" by C. M. Jansky, Jr., and C. B. Feldman will discuss the design, uses, and limitations of a new circuit employing the three-element vacuum tube as a voltmeter. Two overlapping ranges of voltages, together with a single operating battery are the unique features. The effect of wave form and the elimination of that effect are also treated in this paper.

Arrangements are being made for special cars so that the Minnesota section and the student branch can go as one unit. Special rates will be given all members wishing to attend. The student chairman and the student councilor will be sent at the expense of the Educational committee, which will also be in session at this time.

A joint meeting of the Minnesota section and the Minnesota Student branch will be held in the Men's Union on October 24. B. J. Jamison of the Commonwealth-Edison company and chairman of the Great Lakes District will be the principal speaker at this dinner meeting.

Present officers of the Minnesota section are J. E. Sumpter, chairman, and Gilbert Cooley, secretary.

Sophomores Beat Freshmen in Annual Class Scrap

By RALPH BLYBERG, M '29

ANOTHER engineering tradition was broken when the sophomores gained a decisive victory over the freshmen at the annual freshmen-sophomore field day on the parade, Saturday, Oct. 15.

Although the yearlings fought valiantly the more experienced sophomores defeated them in every event except the cowboy jousting and the tug-of-war. The second year men annexed 390 points to a total of 355 markers rolled up by the yearlings.

It was thought at first that holding the affair in the afternoon would cut the number of competitors down, but in the opinion of the men in charge, the field day was the most successful held by the technical men since the annual class scrap was first made an organized affair. The participants were not as numerous perhaps as in past years when the scrap was held in the morning, but the enthusiasm and fight displayed made up for any lack of numbers.

By fast rushing tactics, the sophomores gained 100 points at the start by shoving the push ball far down into their opponents' territory. The field, wet in the morning by technical upperclassmen, was the cause of many sloppy spills and it was hard to distinguish the frosh from the second year men after the first event was over.

Freshmen got their first win when they defeated the sophs in the cowboy jousting. The spills caused much merriment among the onlookers who lined the parade on all sides and cheered impartially for freshmen and sophomores alike. Coach Emil Iverson, judge for the events, was sprayed by a sheet of mud when a freshman "horseman" caused a large splash when he was ignominously hurtled into the muck. The frosh tallied 55 points in the event to 45 for the sophomores.

In the sack race it was nearly impossible to tell the contestants from the sacks in that they were both so muddied. Owing to the spectators crowding on the field and hampering the decisions it was necessary to stage the event a second time. One of the sacks was ripped to a frazzle in the first race so there were but four in the second. The sophomores overpowered their first year opponents and got 180 points to 145 for the frosh.

Selected men from each of the rival camps opposed each other on the greased pole and sloughed wildly with clubs of stuffed sacks in an attempt to knock the opposing man from the precarious perch. Some of the matches were won with neither side planting a blow, the effort in swinging the heavy sacks costing one man a seat. Other contestants socked madly for several minutes to end the match in a draw.

The object was for the contestant to knock his opponent off and still retain his own seat, frequent application of axle grease by upperclass men making the feat a difficult one. The sophomores also won this event garnering 65 points while the freshmen had to content themselves with but 35.

Forceful streams of water directed from a fire hose dampened the sophomores' spirit considerably when they were dragged through it by the jubilant frosh in the tug-of-war event. The second year men tried hard but they never stood a show when the fighting mad freshmen determined to at least give the sophomores a good ducking. As a grand finale the hose, out of control of the men handling it, sprayed the spectators thoroughly.

Much credit for the success of the final initiation of the freshmen into the College of Engineering should be given to the men in charge. Clarence Lande, athletic manager for the technical men, was the student in charge, and Otto Zelner, professor of civil engineering, was the faculty representative. The referee and timekeeper was Coach Emil Iverson who also officiated at last year's events.

The freshmen and sophomores abided by the rules well, and there was little or no unorganized scrapping in the morning before the field of battle was officially opened at noon. The rivals joined together the evening after the scrap and attended the usual theatre performance together.

Miscellaneous News

Arthur P. Burris, member of the Board of Directors of the Engineers Bookstore, was elected to the All-university Council by the Technical Commission last month. He fills the position left vacant by Joe Armstrong, when Joe was not able to return to school this fall.

It is interesting to note that the Great Northern electric locomotive for use in the Cascade mountains, which was in Minneapolis last winter, was tested by Roy Sjoberg, '26 electrical. His name signed out on the test slip and mounted behind a glass frame on the locomotive was noticed by Professor Kuhlman here when he was inspecting the locomotive last winter. It is one of the largest electric locomotives of its type.

THE MINNESOTA TECHNO-LOG Board at a meeting on October 5 confirmed the appointment of Carl E. Swanson as business manager of the MINNESOTA TECHNO-LOG. His appointment was made late during the summer by Lawrence A. Clousing, managing editor, when Curtiss E. Crippen, who had been appointed to the position last spring, found it impossible to return to school this fall.

Gordon C. Harris has resigned as editor-in-chief of the TECHNO-LOG to take up the position of assistant program director for the university radio station WLB.

A large loving cup, the first prize in the TECHNO-LOG subscription drive, has been awarded to Kappa Eta Kappa who turned in 230 subscriptions to overcome the competition. Triangle took the second prize of a box of candy.

Eight fraternities entered in the race besides the men who were working for the personal prize. The personal prize was awarded to Bill Thompson who outdistanced his competitors with a total of about 40 subscriptions.

Library and Bookstore Have New Books

IN the engineering library on the shelf labeled reserve there stands a number of new books which have been received since the close of school this last June. Although many of the books are in foreign languages, there are interesting titles such as *The Oil War*, *Hetch Hetchy* and the *Engineer and the Prevention of Malaria*. Of more technical interest are *Water Power Engineering*, *Mercury Arc Rectifiers and Circuits*, *Electric Power Equipment*, *The Mathematics of Engineering*, *Interpolation*, *Famous Prints*, *English Decorative Plaster Work of the Renaissance*, *Masters of Architecture* and many others.

Several new periodicals also in our library now are: *Experimental Wireless and Wireless Engineer* published in England, *Recherches et Inventions* published in France, in addition to a number of other French and German magazines.

In the Engineers Bookstore the com-

(*Continued on page 58*)

The
MINNESOTA TECHNO-LOG
University *of* Minnesota

Sophs vs. Frosh

SCRAP day! What a strange bit of human makeup it is that sends men into gorgeous hand to hand combat with each other. It cannot be distinctly discerned by psychologists, educators, or mind readers. That it exists, however, is not to be doubted—especially among the engineers during the sophomore and freshman years. Long after men become alumni, some of their fondest recollections center about class scraps of the olden days. Yet pacifists brand the class scrap as foolish, useless, non-essential, and even cruel!

However, we are not of that opinion. We believe the class scrap is one of the best ways for freshman and sophomore to get acquainted. Can you imagine a more intimate friend than a soph who tore off your coat and shirt? Of course there is much to be said both in favor and against a scrap, but there remains this outstanding fact that without some sort of organizing, the two lower classes, on whom the future of the engineering college life depends, would slide into the customary sluggish, academic habit that characterizes the big universities.

The engineers have been noted for their pep and organization. Therefore the sporadic, rowdy combats that formerly featured the annual scrap day have been abandoned, and in their place is the organized scrap that cements the coming classes on the engineering campus into well led and organized bodies that will mold the future engineering campus life.

As an organized fight, the arrangements for the scrap take planning, work, and thought. Those in charge deserve much credit for giving to the freshmen and sophs of this year a good, real, old fashioned fight.

Our Future

"IF my wife had to give up every mechanical contrivance in our home but one she would keep the oil burner," said the man across the table as we sat there waiting for the dessert to come, while the conversation drifted from the cold fall weather, to stoves, furnaces and coal, and then to oil burners. And he was right, undoubtedly, because the oil burner saved his wife the trouble of running down stairs every now and then to tend to the fire. Dirty coal didn't dust the house up, because there was none, and there were no ashes to take out of the furnace.

No, we are not press agenting oil burners, but when we heard this chance remark it was forcibly called to our mind that it is the engineer who has been making the modern home comfortable and luxurious. Think back, and you will no doubt remember how you had to pump the water from the well, or take the ashes out of the furnace. Many things have changed since then.

The above remark was typical of the feeling of a large majority of people. Take anything away from their house but leave the radio, or the vacuum cleaner, or the washing machine, or the electric iron, or almost any modern convenience which the average person has but doesn't stop to realize how or why.

A large field lies ahead, and though the engineer of today "looks through a glass darkly," he will in the future see these things "face to face." As a growing profession engineering is of great benefit to mankind. Who as an engineer can say that his field is overcrowded or in other words that engineering has no future?

Whither Whence

IN our little world of engineering in a corner of the campus where we spend four years or more studying the various technical subjects that lead up to graduation, how many of us really know what lines of endeavor we are actually heading for, and to what extent, when we do get out into the world of practice, we will fulfill the requirements of the job that we step into? Most of us know, or at least think we know, that our talents lie along civil, electrical, mechanical, or some other line of engineering, but beyond that our plans are usually rather vague. Shall it be the field of research, design, or construction; shall it be private practice, or public utility; or shall it be sales work, or some other semi-technical position that engages our energies after we get "outside"?

We might easily discover after an intimate analysis of ourselves, that our capacities do not run along engineering channels, but along some non-technical lines apart from engineering. This gives us no license to sit down and bemoan our fate for time wasted, however, because four years spent in studying technical subjects is not time wasted by any means, as hundreds of engineering graduates in commercial work will testify. The training received during those years is invaluable for the sake of the clear thinking and straight reasoning that it has developed, and these qualities are indispensable for success in any field.

In short, the first job for the young graduate engineer is "Know Yourself." A congenial line of work is essential for satisfaction and success, and to find that work, we must know our capabilities and appreciate our shortcomings, and be able to get into some line, engineering or otherwise, that appeals the most to our own peculiar characteristics.

Undiscovered country in industry

The globe's surface no longer holds much undiscovered country, but the pioneer-minded man can still find plenty of it in industry—particularly in the telephone industry.

In the Bell telephone companies throughout the entire country, men are now exploring the 1930's and 40's and 50's, charting the probable trend of population and the requirements for service.

In research and development, and in telephone manufacture as well, the Bell System takes seriously its responsibility to give adequate service now and to gird itself for a long future.

BELL SYSTEM

A nation-wide system of 18,000,000 inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

Around the World With Our Alumni

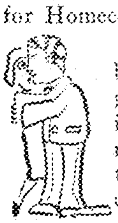
The next meeting of the Chicago Minnesota Engineers' Club is scheduled for Tuesday evening, November 8, 1927, at the Central Y. M. C. A., 19 S. LaSalle street, 6:15 p. m. Any engineers who happen to be in Chicago on that day, drop over to the "Y" and see some of your old friends.

Minnesota Engineers in Chicago are looking forward to the Notre Dame-Minnesota football game which is to be played at South Bend on November 5, 1927. The Minnesota aggregation from Chicago will number between 700 and 1,000 rooters. The Minnesota engineers will leave Chicago on a special train at 10 a. m. Saturday morning and will swoop down on Notre Dame at 12:30 p. m. All Minnesota men will be distinguished by a large maroon feather worn in the hat. These feathers will be sold on the train and at Notre Dame by the engineers' committee. The South Bend Electric line will provide the transportation and from all indications it appears that a good time is in store for all.

M. B. Lagaard, '15 C, F. R. McMillan, '05 C, and Professor Maney are planning on seeing Minnesota clean up on the Irish at South Bend November 5, 1927. Lagaard and McMillan are with the U. S. Portland Cement association, while Professor Maney is now teaching at the Northwestern University.

Architecture

'19—Ralph Hammett has just published a new book, "Romanesque Architecture of Western Europe," that has attracted widespread attention in the field of architecture. Mr. Hammett is now head designer for Hall, Laurence, and Ratcliffe, of Chicago. He is also lecturing on the history of architecture at the Chicago School of Architecture. He will be on the campus for Homecoming.



'25—Cyril Pesek, '24 and '25 basketball man, has become engaged to Muriel Fossum, who is a Delta Gamma. Pesek is now superintendent of construction with the J. C. Pendergast company of Minneapolis.

Chemistry

'23—E. L. McMillen, who was an assistant in the chemical engineering department last year, took his master's degree in chemical engineering last summer and has recently accepted a position as instructor in Lehigh University in Pennsylvania.

'24—Homer Hamm and Norman Bekkedahl visited the School of Chemistry as they drove through Minneapolis on an automobile tour recently. Hamm is with the Bureau of Standards and Bekkedahl is with the Bureau of Chemistry. Both are stationed at Washington, D. C.

'27—Arthur Elsen has recently accepted a position as chemical engineer with the Dow Chemical company at Midland, Michigan.

Civil

'27—"If it weren't for the fact that this is so much like a prison sentence in that I must stay here for two years, it would be just like a big vacation," said John Marcroft in writing up to the TECHNO-LOG about his work with the Public Works department of the Federal government at Guantanamo Bay, Cuba. "We quit work every afternoon at 3:45 and then follows a long horseback ride, a few sets of tennis, or a swim in the fine pool that has been fixed up in the bay." Down there John has been designing different types of water systems.

'27—Engaged during the summer and fall in the U. S. Engineer's office on flood control work were Fred Teske, Hugh Turriton, and H. J. Cristensen.

'27—Roy W. Kostner and E. O. Pearson are living together at 702 N. Monroe St., Peoria, Ill., and are boosting Minnesota to the skies as the football season gets into full swing. "Kas" is working for the Illinois State Highway Department while Einar is with the U. S. Engineers.

'27—"Nick" Preus and "Hank" Norman are also maintaining bachelor apartments at 155 Knapp St., Milwaukee, Wis. Both are working for the U. S. Engineers.

'27—A. J. Sperling who is a draftsman with the Minneapolis Steel and Machinery, in the structural department, forsook the ranks of his bachelor classmates by getting married shortly after graduation.

Electrical

'03—L. A. Rosok, manager of the Arizona Edison company, Bisbee, Arizona and wife, nee Dagmar Jensen, B. A. '04, spent their vacation in August sightseeing in the West. They drove over mountain roads at an elevation of over eleven thousand feet and went through the largest uncut pine forests of the United States. They also enjoyed some good fishing at Mary Lake, Mormon Lake and Roosevelt Dam. Mr. Rosok says that northern Arizona is the real vacation country for summer enjoyment. The weather is cool, there are no flies or mosquitoes and the scenery is wonderful.

'06—Nathan A. Cohen is now a patent attorney in Washington, D. C. His address is 466 H St. S. W.

'23—George J. Schottler has left the U. S. Patent office and is now practicing with the Washington Patent office of General Motors.

'23—Glenn W. Nordvall left the service of the Northwestern Bell Telephone company in 1925 and has been in the engineering department of the Northern States Power company at Minneapolis ever since. According to authentic reports he is married.

'25—Harold H. Heins has been connected with the Westinghouse company for two years being employed as a commercial engineer. He is now in the Railway Sales office of Westinghouse. He says that there are about 30 graduates from the E. E. department located in Pittsburgh. His home address at the present time is 1314 Wood St., Wilkinsburg, Pa.

'26—Sailing from the Atlantic coast to the Pacific coast in an electrically driven boat is the vacation type of job of Kenneth Ferguson who has been placed on the payroll of the Westinghouse company. He is in the marine department and is on this trip to gain practical experience in the way electric propulsion works in practice.

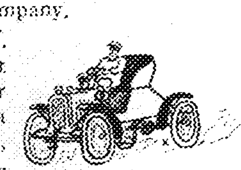
School of Mines

'23—Frank Mooney, who is now openhearth foreman for the Illinois Steel company at its Gary plant, took the fatal step and was married to Miss Helen Mahoney of Gary on September 12. He says that he likes his work but that Minnesota must beat Notre Dame and Michigan or he will be unable to stay in Indiana.

Mechanical Engineers

'98—Jos. G. Hubbell is manager of the National Inspection company, Chicago. Mr. Hubbell has been home quite ill the last couple of weeks but we understand that he is now improving.

'17—F. W. Hoosleaf visited the technical campus lately to see his classmate Professor George Swenson and to look over the Electrical Engineering building of which he had heard many favorable reports. Hoosleaf is Chief Engineer for the Timken-Detroit company.



'24—John W. Wagner writes that he and three other doughty Minnesota engineers, namely, Joseph A. Anderson, '24, Charles G. Simms, '24, and R. W. Rhame, '20, have invaded Michigan and are now safely ensconced in engineering positions with the A. C. Spark Plug company at Flint. They are doing well, like their work, and read the TECHNO-LOG.

'24—Edwin F. Koehler is still with the Hartford Accident and Indemnity company as safety engineer, with a territory comprising all or part of the following states: Missouri, Kansas, Iowa, Nebraska, Colorado, Wyoming, New Mexico, Oklahoma, Texas, and Arkansas. When he is not on the road he can be found at 356 Board of Trade Bldg., Kansas City, Missouri.

'26—R. S. Grant is a telephone engineer with the Chicago Rapid Transit company. Russell gets in on quite a lot of special circuits as this company has long lines connecting many points to Chicago such as Milwaukee and Benton Harbor, Mich.

A Short Wave Radio Set for Airplanes

(*Continued from page 39*)

used a single neutralizing condenser to prevent self-oscillation. A meter was provided in the plate circuit to indicate the correct value of filament current by means of a single switch. The antenna consisted of two wires, one on each wing, each approximately fourteen feet long. These wires were fastened about two-thirds of the distance from the lower to the upper wings on the aft wing struts, so that the least wing interference would take place.

The power was furnished by a 135 volt bank of common B batteries. The filaments were lighted from the 12 volt storage battery which operates the running lights of the plane. Keying was accomplished by breaking the oscillator plate circuit. The battery voltage was left on the amplifier tube at all times, and the plate current kept at the proper value by means of a 22 volt C battery.

The receiver consisted of an ordinary detector one step amplifier arrangement. Tuning and regeneration were controlled by means of condensers. The receiving set was connected through a 15 uuf. condenser to the electrical center of the antenna so that simultaneous transmission and reception was possible. The tubes were all mounted on flexible rubber mountings to prevent excessive vibration.

THE whole assembly was mounted in a frame which was swung flexibly in the mounting case by means of heavy rubber bands. The mounting case was designed to fit in the special radio compartment just in front of the observer who sits in the rear cockpit. The transmitter controls were at the left while the receiver controls were at the right. The key was placed on a shelf at the observer's right hand.

The first tests were made on the hangar aprons. During these tests, naval stations at Washington, D. C., and Mare Island, California, were received. Two way communication was also established with the radio station at the Naval Training station with which future tests were to be made.

The second tests were made with the engine running. Again two way communication was maintained. The smooth battery note of the set changed, however, to a very rough, unpleasant note which varied with the engine speed. This was traced to induced currents from the magneto circuit to the common ground circuit which acted as common return for the grid and plate battery circuits. This was cleared up by grounding the return circuits only at one point. A new phenomena was then noted.

A note which was ordinarily a pure whistle had a smooth pleasant modulation with the engine running. This modulation changed with the engine speed. This can only be accounted for by consideration of the steel propellor which was in use. The capacity of the antenna was apparently changed appreciably when the propellor was rotated from the perpendicular to the horizontal position. It is also possible that the effective resistance of the antenna might be affected by this condition. As this modulation was not objectionable, no effort was made to correct it.

THE next tests were made in the air. Two way communication was maintained a considerable distance from the station. Here several difficulties were encountered. At full throttle an objectionable magneto interference was experienced. It was observed, however, that as this was of a comparatively low frequency, it might be filtered out by means of a high pass filter. This would necessitate keeping the received signal at a comparatively high pitch which might also prove objectionable. A second difficulty was encountered in skip distance. It appears that the wave selected was somewhat too low for the necessary range to be covered. As a result the signals faded out at a comparatively short distance from the station, reappearing again at a distance of about 500 miles. Tests at these greater distances were made possible through the cooperation of amateur stations.

According to the latest theory, the optimum frequency for this type of work would probably lie between 6250 KC and 5000 KC (48 to 60) meters). At this frequency the skip distance appears at about 250 miles. This is approximately the maximum range (500 miles round trip) for the military airplanes for which the set was designed. At greater distances the signal again reappears.

The final tests were made on the water. Here the set worked satisfactorily. Two way communication was easily maintained without any appreciable difference in signal strength.

This experimental work has led to a number of interesting conclusions. In a set of this type, the chief disadvantages of the older sets are overcome. A plane which has been forced down can easily maintain communication with shore. However three disadvantages must be considered: magneto interference at full throttle, range reduction due to skip distance, and increased sensitivity of the set due to vibration.

Further experimental work is being planned at the present time in an attempt to overcome these disadvantages. This work will be carried on at the air station at Great Lakes, probably in conjunction with the electrical engineering laboratories at the University of Minnesota.

Industrial Welding

(*Continued from page 38*)

oxidation or burning. Another use of the blow torch which is coming more and more into use is in the process called "Stelliting." Stellite is an alloy of cobalt, tungsten and chromium (note that it does not contain any iron) which at ordinary temperatures has about the same hardness as hardened high carbon steel. This alloy retains its hardness through a wide range of temperature, losing practically none even when the metal is heated to a bright red heat. The alloy, by the aid of the oxy-acetylene torch, is applied to surfaces which are subject to severe abrasion, thereby increasing the life of a wearing part 20 to 30 times. Some of its applications include dipper teeth, roll crushers, trimming dies for drop forgings, hammers on hammer mills, punch and die operations, well drilling and oil field bits.

This process is the invention of Doctor Hans Goldschmidt of Essen, Germany. It is based on the reaction which occurs between finely divided aluminum and iron oxide or scale. The mixture is ignited by means of a small quantity of magnesium powder. In the reaction the iron gives up its oxygen to the aluminum leaving the iron free, the aluminum and oxide forming slag. During the reaction, a temperature of between 4500 degrees F. and 5000 degrees F. is obtained.

THE process is used exclusively for sections of large area and for welding or bonding rails. The parts to be welded are properly set up and held in place underneath a crucible which contains the thermit. After the parts are brought to a red heat by means of a blowtorch, a tapping hole at the bottom of the crucible is opened, allowing the molten metal to flow through a pouring gate and into a mold which surrounds the weld. After the ignition of the charge, the reaction is completed in about 30 seconds.

As mentioned earlier, the application

of the process is confined to the welding of large sections, therefore but little work has been done using this process in this territory, the railroads and street railway companies being its greatest users. On the coasts, however, in the ship building and repairing industry, it is used extensively, also in steel mills, cement mills and like industries. The process is equally applicable to steel and cast iron.

IT is with a sense of the large place now held by the science of welding that the universities and technical schools of this country are turning their thoughts to the training of technically trained minds to direct the application of this art in industry. There is today a great need for more trained engineers who can apply this process with maximum intelligence, and with maximum efficiency and results. Industrial engineers are invariably required to initiate new methods of production and procedures which will effect savings of time and materials, and therefore of money. The savings already effected through the use of welding and cutting are phenomenal, but its future possible application is still greater.

Let the dismantling of the U. S. Emergency fleet be an example of the tremendous economy which may result from the use of the cutting apparatus alone. In this instance every beam and plate, every rivet and bolt, was cut by the oxy-acetylene flame which was either automatically or manually controlled.

The engineer who has specialized in the welding field is not going to be grown overnight; he has to be developed. It is this fact that has principally caused serious consideration to be given by technical schools and universities to the inclusion of welding courses as a part of their curriculum.

Welding science suffers from a lack of trained and competent engineers. It is difficult to "sell" welding to many because they have either heard of weld failures, or because they are inherently conservative and choose to sit back and let someone else experiment. When jobs of welding fail the whole industry is discredited in their minds. But no doubt the reason for a large majority of such failures has been due to the fact that there was no competent welding engineer on the job. All the welding is now being done by so-called practical men; those who have acquired skill in welding materials, but who are, too often, sadly lacking in the fundamentals of science. Something must be obtained in addition to the practical man's accumulative knowledge.

As welding applications are as broad as industry itself, it is argued strongly by many that a condensed course in welding should be included in the university curriculum of the major branches of engineering, so that every engineering graduate will have some fundamental knowledge of the subject to fit him in case he is called upon to design and supervise welded pressure vessels, steel buildings, bridges or ships. The time is not far distant when such men will be in considerable demand. In order to at least partly meet this situation the freshman engineer at this university is given at the present time the basic principles of electric, oxy-acetylene and thermit weldings. The mechanical department possesses an electric arc welder of the latest design. It also has, undoubtedly, the most modern and completely equipped oxy-acetylene welding equipment of any university or technical school in the country.

In addition to these it has apparatus for the purpose of giving practical demonstrations in thermit welding. The freshman at the present time must be satisfied with only lectures and demonstrations on these processes, but the sophomore mechanical engineers spend considerable time in actual practice and in testing welded parts. This is, of course, but simply introducing the student to this science; he learns about welding only in a very general way.

It is, of course, obviously impossible to train men in the technique of engineering as broadly as they should be. As new developments and discoveries come along, the best that the schools can do for the student is to tell him something about them and give to him a broad foundation on which he may build. For if a man has a sound knowledge of physics, chemistry and metallurgy, he can soon acquire a knowledge of the welding.

There are two ways in which engineering schools can teach welding: they may include it in their shop courses, or they may include it in their design courses. So far, the first only has been adopted to any extent. This is being done not with the intention of making skilled practical welders of the students, but with the aim of imparting to them a certain degree of familiarity with the apparatus.

The inclusion of welding as a part of the curriculum in the design courses is something of equal importance yet to be done. No one seriously questions that the day is fast approaching when welded joints in buildings, bridges, ships and boilers will very largely replace riveted joints. When more research work has furnished sufficient data so that reasonable calculations may be made, there is no reason why a student should not be taught welding design as well as design of riveted joints, so that each engineer as he goes out of college is as familiar with a welded joint as he is with a riveted joint.

At the Kentucky "Knobs"

(*Continued from page 47*)

guns there is range finding apparatus, sound ranging apparatus and an anti-aircraft searchlight.

THE firing data for the three-inch guns is found by an angular travel method. The instruments used are two altimeters, a deflection corrector and a telescope. To measure the wind drift, the altitude of the target is obtained from the two altimeters which are set up, one at each end of a measured base line. Each instrument measures in the plane of the instruments the angle between the horizontal and the target. The length of the base line and the reading from one instrument are sent by telephone to the other altimeter where both readings are set on scales of the second altimeter, and this instrument then reads the altitude of the target directly. This altitude and a wind reading from the wind drift telescope are sent by phone to the deflection corrector, a machine which automatically computes the fuse setting and the lateral and vertical deflections which are to be set on the gun for firing.

In preparing a gun to fire it is bore sighted, that is the bore is centered on the target to make the sights parallel to the axis of the base of the gun when the setting on the sights is zero. In firing the sight is kept constantly on the target, and the axis of the bore of the gun is deflected from this line of sight by the amount of the deflections received from the deflection corrector. These deflections are computed to take care of the correction for wind, drift, etc. The firing with the three inch guns was at sleeve targets towed behind an army plane. This target was made of cloth and cone shaped about ten feet long with holes at both ends for the air to pass through. Observation of the fire was made at stations on the ground and by an observer in the plane. In the scoring of hits, the size and shape of an airplane in comparison with the sleeve must be taken into account, and also that shots which do not hit a target, but burst sufficiently near, will have an effect on the plane. Although the number of direct hits on the sleeve was very small, yet the theoretical scoring was quite satisfactory.

THE most enjoyable firing we had was that with the machine guns. The fire was both with the infantry mount and with the anti-aircraft mount. We fired a course with the infantry mount on the thousand inch range, and fired with the anti-aircraft mount at hydrogen filled balloons and at the towed sleeve target. In firing at balloons, a battery of four guns was placed on line, and the competition was keen to see which crew could puncture the greatest number of balloons as they were released and floated across the firing area. Even a passing hawk came in for its share of attention, and retreated so fast that none of the bullets could overtake him. We also had a few hours of night firing at balloons with the aid of a great billion candle power searchlight that kept the balloons illuminated. This searchlight together with sound ranging apparatus is used with the anti-aircraft batteries for night firing. It is electrically controlled so that a minute turn of a lever will traverse it in any direction.

A number of fire adjustment problems were taken up with the 75 millimeter field gun under the command of students who had each been assigned a different method of adjustment of fire. In all of the firing with the exception of that with the rifle and revolver, the crews, gun commander, and battery commanders, were all R. O. T. C. students. This was also true of the infantry drill, and the regular battery officers were only there for instruction and supervision.

THE athletic facilities of the camp were not very elaborate. However, there were baseball teams organized that played for the championship of the camp. Boxing and wrestling meets were held in the evenings with the coast artillery coming away with honors in all these meets. Volleyball proved a very popular game, and diamond-ball also came in for a share of the time. Toward the end of the camp a track meet was held.

Society of Louisville seemed to open its arms to the visiting Collegians, and three dances were held for the R. O. T. C. at the Kentucky and Brown Hotels. A daylight excursion on the Ohio River was also held with the girls of Louisville furnishing the lunches, and an overnight trip was taken by bus to the Mammoth Cave. Some of the men at first objected to going into the cave at night when it would be dark, but they found that *night and day* made little difference *inside the cave*. A camp was pitched near the cave and food served from a mess truck that had been brought along from camp.

Organized entertainment was not entirely depended upon. It was quite usual for men to come in late at night and find bed and blankets tied to the ceiling or missing altogether. One bunk was discovered in the grey of morning astride the ridge of the barrack where it remained until an officer discovered it and ordered it removed. Several members of the camp were also treated to

cold showers when it was generally thought necessary for the discipline of the camp. It was a simple matter—merely tie the man to his bed and carry him under the running showers and leave him. A barber shop was also started for men with artistic inclinations, but after the first enforced hair cut the rest paid regular visits to the post barber shops.

The camp was inspected by two generals; General Nolan, and General Hero. General Hero, who is chief of the Coast Artillery Corps, made a thorough inspection and gave us a short talk in which he stated that he was pleased with the work accomplished. He also said that improvements would be made in the camp for the following years.

A description of the camp would not be complete without saying something about the garage and cars at camp. The garage was a large field with furrows plowed in it into which the front wheels of the car had to be run by order of the camp commandant. The cars were mostly of the popular brand, and suffered from poor tires, or poor engines. It was almost impossible to make a trip to Louisville without seeing a half dozen of them by the roadside with tire trouble.

Perhaps the best thing that the camp offered was the chance to become acquainted with men from other universities. Through them we learned much about how they were doing things at their respective schools.

Once Again—

(*Continued from page 45*)

several hours patching blowouts even though the trip was only twenty miles. Immediately after the last car had been dragged into Bemidji, the snake dance was started. After yelling its way through several hotels and theatres the mighty human snake found its way into the famous Steckman Restaurant. Instead of being the wild-eyed monster which former classes had pictured, Mr. Steckman was found to be a mere human with a blushing face covered with forced smiles. Here Briggs, who led the parade, made a hero of himself as he directed the glee club. The famous Steckman song was sung several times before the playful crowd departed, each man taking souvenirs in the form of sugar bowls, salt shakers or anything else that could be moved.

After the demonstration at Steckman's the fleet of Fords was again called into use. The next snake dance formation took place at the Bemidji fair grounds. Here everything was being closed for the night. However, a little excitement was created when the snake dance led past a hamburger stand and dozens of quick hands started grabbing hot hamburgers from under a flashing cleaver.

LATER in the evening the engineers presented themselves at Sah Kah Tay lodge where a dance was being held.

Probably the greatest events occurring in camp as far as the students were concerned, were the football games with Bemidji and Cass Lake high schools. The Bemidji coach, thinking that he would like to have some light scrimmage practice for his team, challenged the camp to a game. It was indeed a sad afternoon for the Bemidji team; they lost more ground than they gained throughout the entire game. The camp team was composed entirely of previous high school veterans, and they were still playing true to form. Much credit for the camp victory goes to Kopplin and Silliman playing ends and Parker and Dreveskracht in the backfield. Wielde and Amidon also frightened the Bemidji team with dust filled beards and constant talking. Everyone played a good game, and after it was over everyone was happy—except Bemidji.

THE Cass Lake High School was the next victim to fall before the camp team. This game proved to be much like the one at Bemidji. Even though many of the star players did not show up for the game, the Cass Lake team received a drubbing that will not be forgotten for some time.

As in previous years, the most difficult problem to be solved while at camp was the erection of a suitable memorial. The totem pole idea was entirely out of the question so inventive minds were bent in other directions. After spending five weeks waiting for some genius to step forward with a suggestion, everyone became anxious and finally the decision was reached to build an arch: This was to be larger and of a different type than the one constructed last year. It was to be set at the main road instead of being near camp as the former arch was. Three days before breaking camp the work was started and was not completed until the last day. Most of the work had to be done at night, and as time was short, no initials or names were carved in the structure. However, it has been suggested that a bronze tablet bearing the names of all members of the class be set in the arch.

News from the Technical Campus

(*Continued from page 40*)

plete Modern Library of 142 volumes is on the shelf. New books are added to this each month, and all books are sold for 95 cents. These books have been selected with the aid of the English department, and are considered to be the finest works of the modern authors.

Arabs Start New Year in Good Financial Condition

FOLLOWING the presentation of a most successful musical comedy last spring, the Arabs have a sound financial foundation upon which to start work this year.

This is a summary report of income and expenses of "Broadcast."

EXPENSES

Costumes	$235.55
Scenery	133.35
Lighting	24.70
Publicity	181.21
Tickets and Ticket Material	37.60
Properties	3.79
Music	157.91
Dancing (coaching)	50.00
Music Hall Rental	35.00
Program	90.75
Refreshments	54.80
Music	33.32
Expense Total	$1,037.98

INCOME

Ticket Sales:	
Friday night, April 22	$ 404.25
Saturday night, April 23	508.50
Saturday matinee	195.75
Program Advertising:	127.00
Total	$1,235.50
Less Expenses	1,037.98
Profit	$197.52

SHELDON F. JOHNSON,
Business Manager.

Plans are already started for this year's spring production scheduled for April 12, 13, and 14. To date Charles Peterson and George Burch are writing plays. Other writers are requested to submit plays or synopses of a musical comedy for the Arabs, as the manuscript for the play will be picked on a competitive basis. Paul B. Nelson, who is now in Chicago, gained many ideas for a play while over in Europe during the summer although lack of time will prevent him from submitting a manuscript.

A general meeting of the Arabs is called for October 25 by Harold Ekman, president of the organization. At this meeting it is hoped to pick from the many synopses on western burlesque thrillers, Egyptian scandals, and floating universities, a plot for the spring play.

(*Continued on page 60*)

Minnesota Grads Work On Metropolitan Drainage Commission

JAMES A. CHILDS, civil '09, for the last eighteen years senior sanitary engineer of the Minnesota state board of health, has been granted a two years' leave of absence to serve as chief engineer and executive secretary of the newly created Metropolitan Drainage commission. Serving with him are N. W. Elsberg, city engineer of Minneapolis, and George M. Shepard, St. Paul city engineer, of the same class, '09.

This commission, authorized by the 1927 legislature, is making a survey of the sewage disposal and pollution problems of the Twin Cities, and is now seeking estimates of the costs of the engineering surveys of the Mississippi for this work.

O. C. Brownell, civil '26, Mr. Childs' assistant, has succeeded him as the acting senior sanitary engineer.

Radio Station Heads and Instructors in E. E. Are Appointed

NEW faculty members on the electrical engineering faculty this fall are E. R. Summers and L. C. Caverly, instructors, and Robert Edgar and Henry Tholstrup, teaching fellows. Summers comes from Wisconsin where he earned his masters degree last year, while Caverly gained his degree at the Massachusetts Institute of Technology. Edgar and Tholstrup are graduates of Minnesota.

Operation and engineering work on the university radio station WLB during the coming year will be in charge of Lloyd V. Berkner, who was last year chief operator of the 9XI, and a member of the operating staff of WLB. Professor C. M. Jansky, head of radio engineering, was in full charge of the station last year.

Succeeding Berkner as chief operator of 9XI, Jim Barnes, a senior, will have charge of the station for the year. There are positions open on the radio staff and Barnes says he would appreciate applications from radio operators interested in relay and experimental work.

Last year 9XI communicated with stations in every continent and from a study of the data obtained from these communications, it was found out the 9XI was the most consistent amateur experimental station on the air last year, both in the number of hours on the air and in the general efficiency of the operators.

9XI is one of the few sending stations to have a special license which places no limitations on the hours in the air, wavelength, or powers available.

Summer Doings of the Mechanical Engineering Faculty

MR. S. C. SHIPLEY spent the summer working on the rebuilding of Mechanical Engineering building.

Mr. J. V. Martenis was with the Western Electric company at Chicago, working on research problems during the summer. He was one of the six professors selected, from the engineering schools of the country, who were employed for the summer by this company. During his stay, he met many Minnesota graduates, all of whom are doing good work and holding responsible positions.

Mr. T. P. Hughes taught during the first session of summer school. He also made several additions on the text book "Principles of Forge Practice."

Mr. J. Flodin worked for the Western Electric company, Hawthorne Works, Chicago, Ill.

Mr. W. H. Richards worked on material for the text book "Pattern Making," besides teaching both sessions of summer school.

The New Physics Laboratory

(*Continued from page 42*)

boxes in the building or any multiple series combination of the 120 fifty volt trays.

When all the switches are up all the 120 trays are in series and by throwing every sixth switch down twenty sets of six trays in series are connected in parallel across charging bus bars. Each tray contains 24 storage B batteries of one-half ampere normal charging rate. A 55 watt lamp is inserted in the circuit of each tray. A panel at the end carries the starting switch and regulating rheostats for a 7.5 K. W. motor generator for charging purposes which is located in the dynamo room beneath the shop. By making proper connections on this board for example, 300 volts and 1,500 volts may be independently sent to the two high tension outlets on any of the six gang boxes in the building.

Next to the high tension switchboard is the low tension battery switchboard. This is 43 feet long and is identical in construction to the high tension board. By means of this board two independent voltages may be sent to the two low tension battery outlets on any six gang or four gang box in the building. Also any series parallel arrangement of a part or all of the 110 cells may be sent to any of the gang boxes. These cells have a normal charging rate of 20 amperes. When all the switches are up the 110 cells are in series. By throwing the center switch and the two end switches down, the two halves of the battery are connected in parallel across the charging bus bars.

The switchboard room and the battery room beneath it constitute the heart of the electrical circulatory system and they permit a range and flexibility of connections which will greatly enhance the facility with which experimental work may be carried on.

On this floor are also some rooms of a more or less special character, one being a Littrow grating room which is provided with a sunlight flue, a chemical laboratory, and a large X-ray room which connects with three adjacent research rooms through lead chambers. On this floor there are also five offices and a departmental toilet room with two showers.

In the sub-basement are located the five fan units for the ventilating systems, a dynamo room, liquid air room, battery room, reverberation room, sound proof room, and space for constant temperature and constant humidity rooms.

This description, though brief, will, it is hoped, give a general idea of the new home for physics in this university. While the building has not the completeness hoped for, it will nevertheless afford splendid facilities for carrying on the work of the department.

It has been found possible in addition to set aside a quite satisfactory balance for the purchase of additional equipment. As it is never wise to purchase highly special equipment in anticipation of a need, the available funds will be used for obtaining such instruments as will supplement the present equipment in order to more adequately meet the needs as they exist at the present time. Future special needs will have to be met as they arise.

With these new facilities the department looks forward to an epoch of enlarged activity and usefulness and hopes that it will be able to return to the state scientific and educational dividends which will amply justify the liberality extended to us.

Signal Corps Camp Life at Fort Snelling

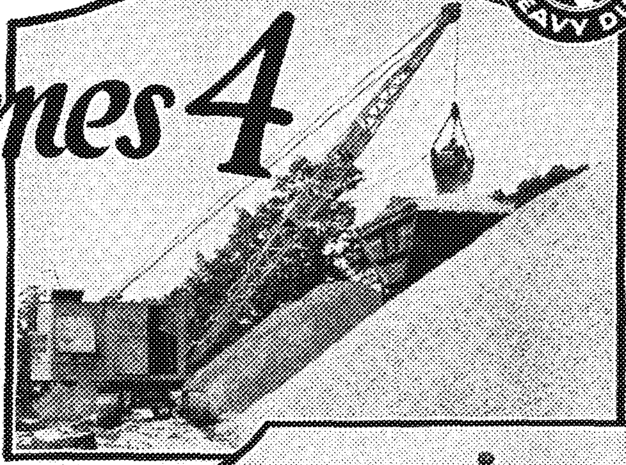
(*Continued from page 43*)

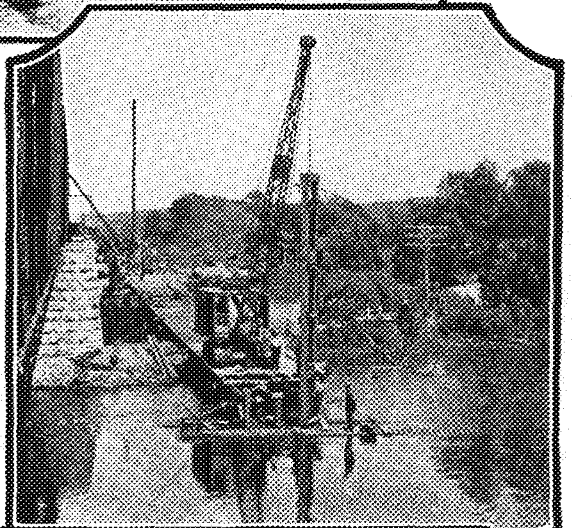
kitchen, and from there after an hour and a half rest we started our hike back to the barracks. At about 3:30 p. m. we ended up in a field near the U. S. Veterans' Hospital. Here camp was pitched and all the tents put up with hay inside for mattresses.

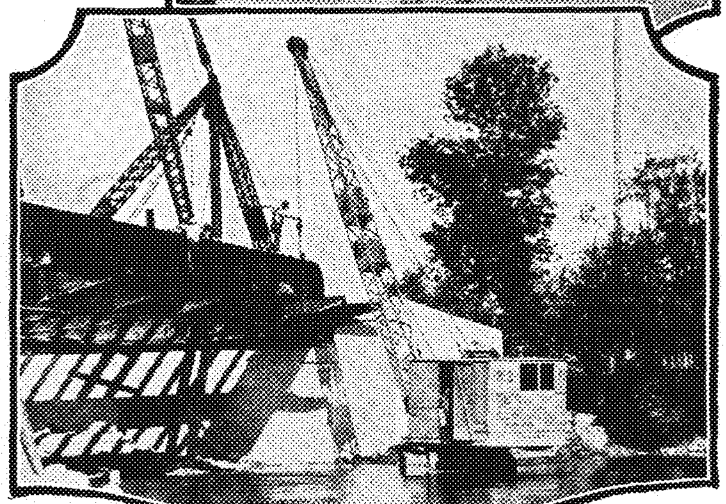
About 5 p. m. a heavy rain storm came up and was so severe that practically everything was soaked. After eating supper, orders were received to break camp and return to barracks. This was good news as we were all longing for a soft bed to sleep on again. Everyone of us was dead tired, but the hike back was made in almost record time.

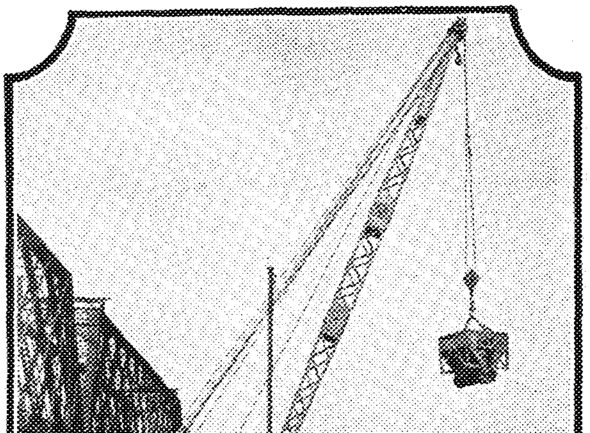
At the close of camp a cup was given to the best drilled platoon and of the three platoons competing, Minnesota won the cup. According to Captain Persons, or Major Lentz, this was made possible by the well drilled Signal Corps unit. At one time Major Lentz was all for bringing up some infantry men and having a drill competition with the Signal Corps. This, however, did not materialize.

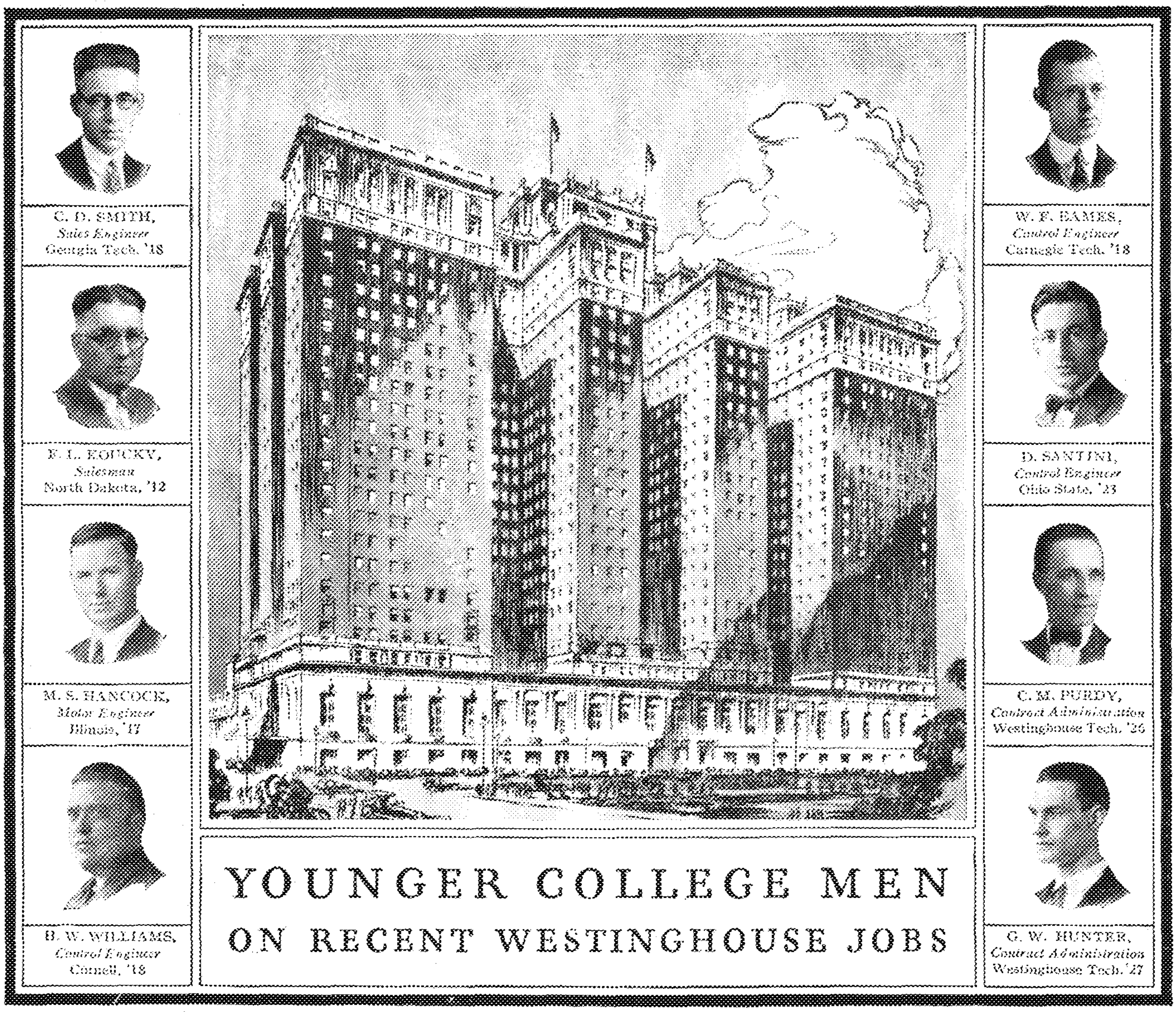
Vaudeville for two hours by local talent was one of the last things on the camp's program. The last night a dinner was given for the friends of the boys at camp, and afterwards awards were made by Colonel Welsh to the men of the camp who had participated in various events. A big dance was given in the Service Club after this and with demobilization the next morning, July 27, the camp was over.











The World's Largest Hotel

Great achievements in engineering are brought about by the harmonious work of many. The individual's largest opportunity comes through the exercise of his own creative talents in the field for which he is preëminently prepared.

THE larger a hotel, the larger loom the difficulties of ventilating it; of handling the crowds that ride its elevators. The larger, too, looms the interest of engineers in designing electrical equipment to meet such unprecedented demands, of salesmen in selling it, of service engineers in installing it and keeping it in top-notch operating condition.

To Westinghouse came the Hotel Stevens for ventilating motors, for its elevator system, for the electrical equipment of its laundry. To Westinghouse come many undertakings of such kind and size—a steady stream of imagination-stirring opportunities to do the never-before-accomplished. All of tremendous interest to college men who have ambition, resourcefulness, capacity; disciplined sales and engineering minds.

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. . .

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. . .

Here's a statistical job. The reports are in; thousands of figures to analyze. Looks like overtime for fifty clerks. "Certainly not," answers electricity, as a button starts the motor-driven sorters and tabulators. Key cards are punched with lightning fingers. Electric sorters devour 24,000 cards an hour. Tabulators add quantities and amounts in jig time, and print the totals.

. . .

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. . .

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This familiar mark appears on many electrical products, including motors that drive time- and labor-saving office machines.

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The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

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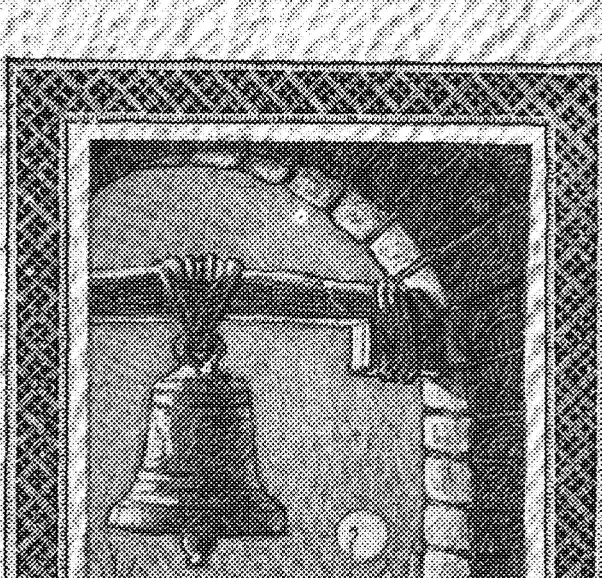

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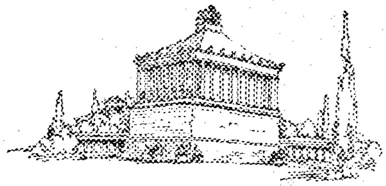
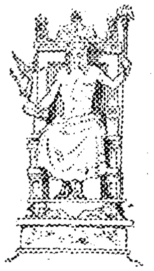
Engineering Library - Looking at the Field House - Band Trip
Automatic Airport Lighting - Petroleum Produced Electrically
Twenty Acres for Austin Athletes

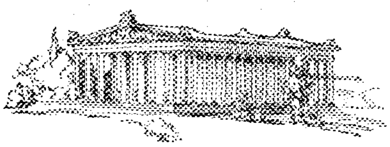
The 7 Wonders of the World



Mausoleum at Halicarnassus

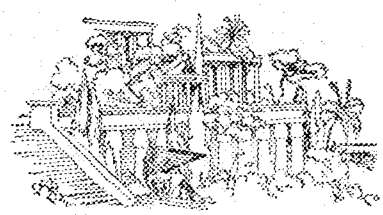


Statue of Zeus by Phidias, at Olympia

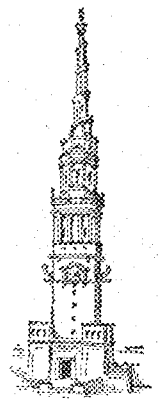


Temple of Diana at Ephesus

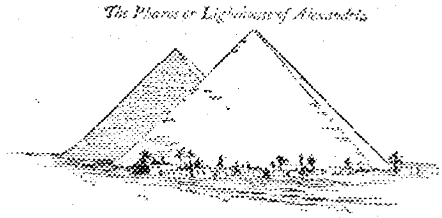
Colossus of Rhodes



Hanging Gardens of Babylon



The Pharos or Lighthouse of Alexandria



Egyptian Pyramids

THE Seven Wonders of the Ancient World were single monuments, glorifying one individual or at most a small group of people. Masterpieces of their kind, they yet had no influence on the life of the race which created them, and they benefited nobody.

There lies the difference between the old and the new civilization. The Seven Wonders of the Modern World are the inventions which have been of the greatest benefit to the greatest number of people. What are they? Although lists would differ radically, one item would be common to all. The Otis Elevator would surely be included as one of the Seven Wonders of the Modern World on all lists whether emanating from Greece, Egypt or Turkey; Lima in Peru, Shanghai in China or Hollywood, California. It is an international convenience, dedicated not to one person or even to one race, but to the comfort of any people whose buildings aspire towards the sky.

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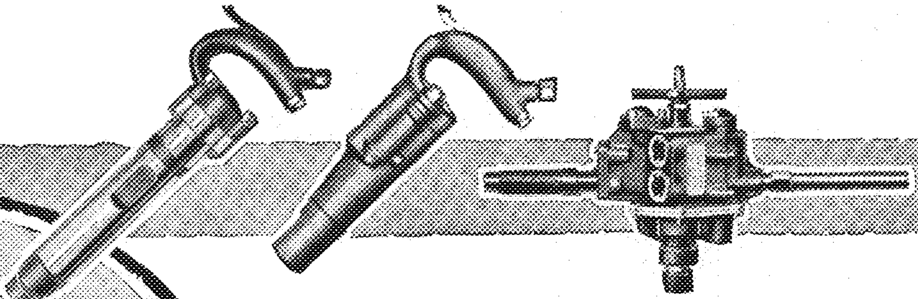

A riveting scene that is typical of structural steel work. The operator is more than 200 feet in the air.

Pneumatic Tools

Without the riveting hammer, or "gun," as it is sometimes called, there would be no towering skyscrapers—none of the massive structures that characterize our modern industrial life.

Few, however, understand the important work that falls to the lot of other pneumatic tools. Grinders, hoists, chippers, drills—they replace hand labor in every trade and speed the output of all our present-day commodities. There is scarcely an object of every-day use whose production at some point is not hastened or bettered through the skillful use of compressed-air equipment.

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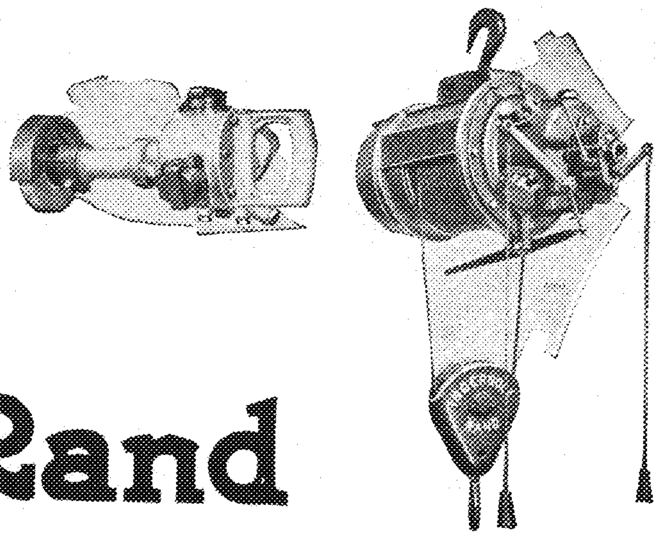

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VOLUME VIII. MINNEAPOLIS, MINN., DECEMBER, 1927 NUMBER 3

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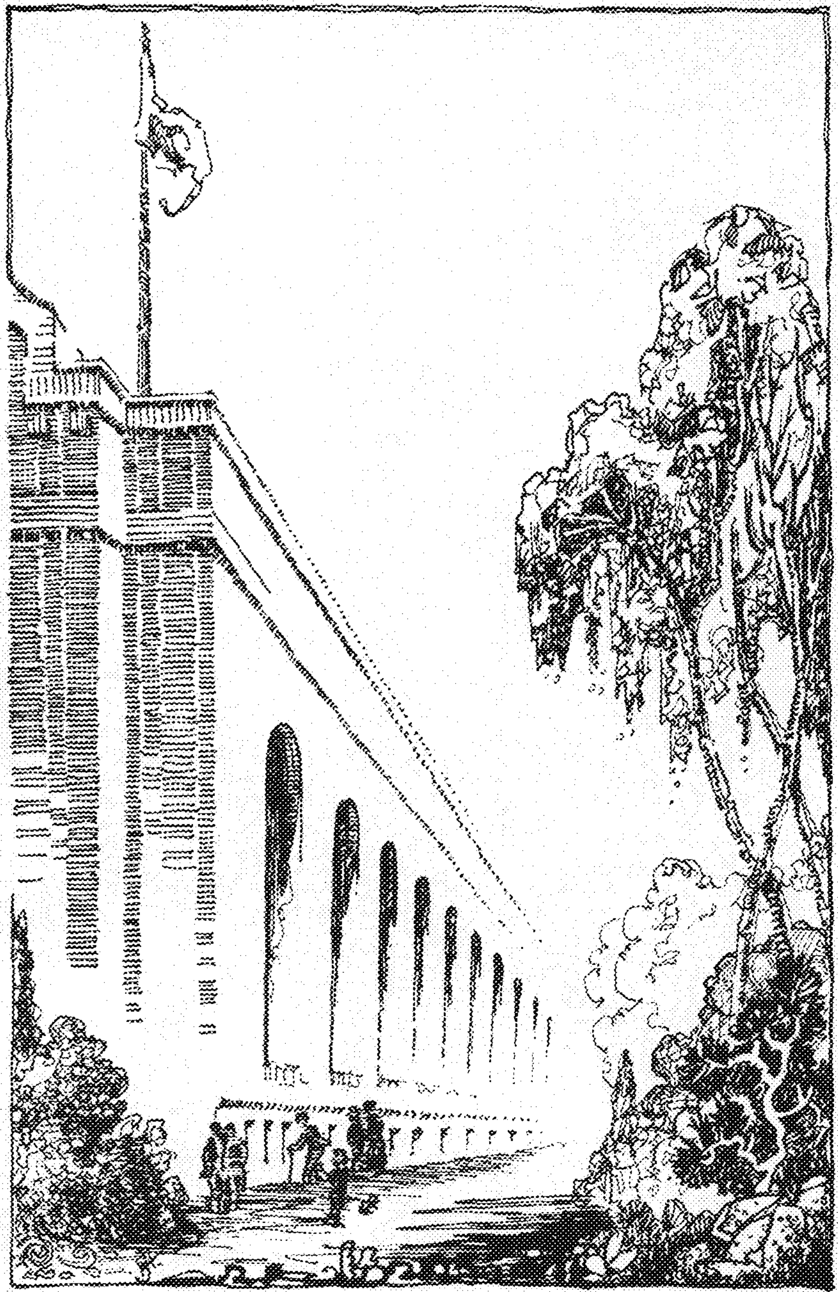


Minnesota's New Field House

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII DECEMBER 1927 Number 3

The Engineering Library

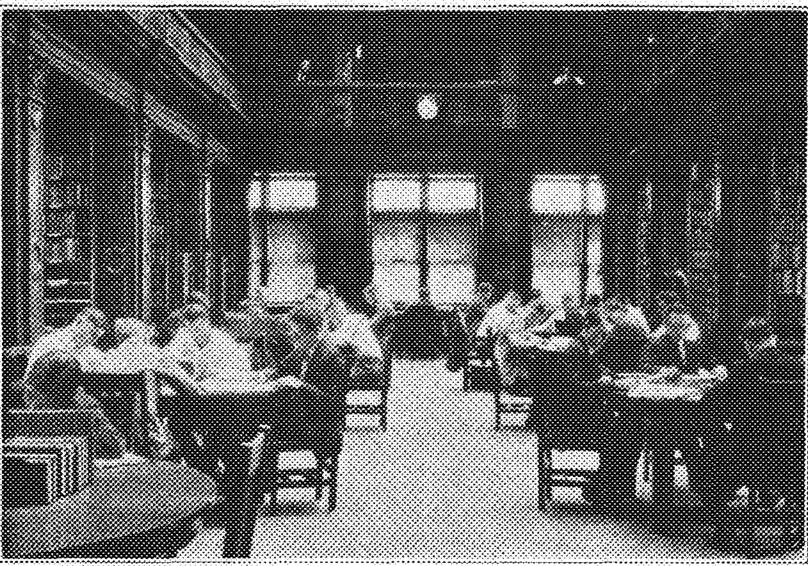
This article traces its history, and explains its effective use

By Mons H. Benson,
Part Time Student Librarian.

THE College of Engineering first dates from July 12, 1870, under the administration of President Folwell. It was known at that time as the College of Agriculture and Mechanic Arts. This college was one of the first two created, and Arthur Beardsley, civil engineer, was the first professor. At this time all students were required to attend the first two years in the scientific course of the collegiate department. The first bulletin of the University of Minnesota with announcement of courses was issued in 1874-75. This bulletin states, "The University is open free of charge for tuition, upon equal terms to all persons over fourteen years of age, whether residents of the state or not, who may pass the required tests and examinations."

Also, the bulletin states that in order to enter the engineering course students had to complete the two year scientific course of the collegiate department. This would be the equivalent at the present time of having engineering students spend the first two years in the S. L. A. college. Here they studied mathematics, mechanics, modern languages, the fine arts, English literature, political economy, ethics, military science, linguistics, drawing, shop work, surveying and courses which took up the study of old Latin and Greek men of letters.

Equipment for engineers was spare in those days. A room on the second floor of "Old Main" was provided for the use of classes in descriptive geometry, engineering and architecture. The apparatus consisted of a transit, a level, a "good compass," chains and tape measures and a full set of drawing instruments for the department of civil engineering. It is with great satisfaction that Professor Beardsley states, "Towards the third term (1871), a compass and a chain were procured, and the class received as much practice in the field with them as could be obtained without going out of hearing of the recitation bell in the fifty minutes per day which was all the time that could be spared from other work for this purpose."



INTERIOR OF THE ENGINEERING LIBRARY FROM THE ENTRANCE
On the average each student comes here 63 times a year. More than 20,000 volumes of technical information are stored for his use.

About that time a beginning was made in fitting up a shop for the mechanical engineers. "The University possesses a lathe," is announced in the first catalogue. Later in 1880 the mechanical engineering equipment includes a forge and anvil, a steam engine indicator, models and collections of drawings; the civil engineers have another transit and another level. The first testing machine was obtained in 1883 and placed in a basement room of "Old Main." The work shops were temporarily provided for in three rooms in the building of the Agricultural College.

In 1884 when President Northrup came to the University, plans for the new technical building were well under way, and this, the College of Mechanic Arts building, was occupied during the school year of 1886-7. The building provided room for all the engineering work, recitation rooms, laboratories and apparatus rooms. The tower and weather vane on the old building were familiar landmarks of the campus. It is interesting to note that after forty-one years of service the same weather vane is still pointing the direction of campus breezes.

During the occupation of the Mechanic Arts building in 1886, the college entered upon a period of growth and expansion, and in 1905 we find that physics, mechanical engineering, and electrical engineering have secured new buildings, while the civils, experimental engineers, mathematics and drawing departments still remained in the old building. The enrollment increased from year to year, and the classrooms, laboratories, and workshops soon were full. Finally the new Main Engineering building and the Experimental building were erected under the Cass Gilbert plan. The new engineering building and the experimental laboratory, which were occupied by 1912, mark the transition from the older period of growth to the new, with its increased faculty, equipment, buildings and its highly efficient organization.

FROM the very beginning of the engineering college technical libraries were built up within the several professional departments. When Professor Kirchner became chairman of the library commit-

(Continued on page 88)

An Engineer Looks at

The Field House

By Joseph A. Wise

Mr. Wise was appointed this fall as assistant professor of structural engineering in the civil department. During 1924-25 he served as an instructor in the same department, leaving to work in the civil engineering corps of the United States Navy in which he was given the commission of Lieutenant junior grade. He now comes back to Minnesota holding the commission of Lieutenant in the United States Naval Reserve. He is a graduate of the University of California.

FOR many years our football team has wanted an apt song to describe their feelings when "the rain descended and the storms beat" upon them during practice. Today they have a song whose chorus reads "Oh what do we do, what do we do on a dew-dew-dewy day?" And the answer that will echo from the Stadium walls tomorrow will be "When the Field House is nice and cozy—."

So that urge being noticed, it was only natural that other reasons should occur for wanting a field house built. Inadequate seating capacity of the Armory has compelled the basketball team to play at Kenwood Armory of late. The Field House will enable them to play for larger crowds closer home. Then too, track meets can be held indoors in such a structure, and baseball practice can commence earlier in spring. Tennis courts can also be laid out for winter play, and gymnasium classes can be held therein. For many years the project of building a Field House has been considered. When many of the other Big Ten institutions built their Field House, Minnesota not being free from the sin of covetousness wanted one too. Consequently the Senate Committee on Intercollegiate Athletics composed of eight faculty members, two alumni and two undergraduate students, finally developed a scheme for building such a structure. It was deemed difficult to secure funds from the State for this purpose. So it was decided after much consultation and conference, to issue, upon the approval of the Board of Regents, \$450,000 of 4½ per cent Gold Bonds. The proceeds of these bonds together with \$200,000 cash on hand received from intercollegiate athletics are to pay for the Field House. These bonds were sold last spring to a syndicate of Minneapolis and St. Paul banks. They are to be retired at a minimum rate of \$25,000 each year by using the income from intercollegiate athletics.

Field houses, armories and similar structures all over the country were visited by committees, and from the observations thus made they obtained a tentative outline for the Field House. The State Architect was engaged to design the structure. It was decided to locate it close to the Stadium for obvious reasons, and a tunnel is to connect the two so that the locker room space in the Stadium can be utilized in connection with the Field House.

The design of a field house is much like a problem in Geometry. We are required to produce a given construction. First we seek all the data that is germane to the solution of our problem. We proceed step by step to establish our result and conclude when the result has been obtained, *"quod est faciendum."*

Let us state our problem. It is to design a structure of given width and length, with a given clear height in the interior, a roof to shed rain and resist the passage of heat, an exterior appearance to harmonize with the surroundings, galleries for spectators and means of heating, ventilation and illumination. These comprise the main features, though, of course, many other minor considerations enter into our problem.

First we will choose our roof and its supporting system. On the exterior we have roofing to prevent the passage of rain. In this case slate particles are imbedded in the outer layer so that it will resist atmospheric deterioration and incidentally be more fire-resistant. The layers are lapped over one another much as shingles are, so that water cannot penetrate the joints. The roofing felt is made of woven cotton and wood fiber impregnated with asphalt so that it will not absorb water. The insulation, Flaxlinum, which comes in sheets one inch thick, is made of the flax plant stalks that are discarded in the process of making linen. These stalks are molded into sheets under high pressure. Due to the numerous air cells, this material is an excellent insulator. The 1/40 of an inch thick steel deck is known as a Truscon I plate deck, and the I shaped ribs stiffen and strengthen it. Roofing and insulation are fastened to this deck by screws 15 inches apart. Sixty-eight thousand screws were required. The roof weighs only six pounds per square foot but is as effective an insulator as a thirteen inch brick wall.

NOW we must support this roof. First we rest it on purlins, six feet apart. The deck comes in sheets twelve feet long, and is fastened to the purlins at every rib by a sleeve. This sleeve fits over the ribs and has a projection that is bent down over the purlins, while the purlins in turn rest on the arch ribs.

An arch is an inverted cable. Picture a string of beads held at the ends. It hangs in a curve, and the greater the horizontal force applied to spread the ends, the flatter will be the curve. The string is in tension at all points, and there is no tendency for it to bend. (It could not resist bending; if there happened to be any such tendency it would not be resisted, the shape of the curve would be changed.) Imagine the string carefully inverted so that it keeps exactly the same curve. This curve we will call the pressure line. A horizontal force at each end is now necessary to keep the ends of the arch from spreading. We now have an

THE LARGEST ATHLETIC PLANT IN THE COUNTRY

The new Field House is a steel framed structure 236 feet by 446 feet, rising 104 feet above the ground. The main structural units are three hinged arches. The project was initiated and promoted by the Senate Committee on Intercollegiate Athletics of which Mr. E. B. Pierce is chairman and Professor F. W. Luehring is executive secretary. Financing was supervised by Mr. W. T. Middlebrook, the University Comptroller. The structure was designed in the offices of C. H. Johnston, State Architect, the structural design being made by Mr. Edward S. Nelson (B. S., U. of M. '09). Inspector for the Architect and State was Mr. W. B. Marschner, who very kindly lent some photographs for use in this article. Madsen Construction Co. were the contractors. The total cost of the Project will be about \$650,000. While it will be the largest field house in the United States, it will not be the largest structure of its type (i.e. three-hinged arch framed building).

arch, but even a small pressure will cause it, not to change its curvature merely, but to collapse. Consequently it must be made stiff enough to resist a small amount of bending.

A THREE hinged arch is a three hinged arch *Mirabile dictu!* It really has three hinges, no fooling. One hinge is at each end at the bases and one hinge is at the center or crown. The pressure line is compelled to pass through the three hinges, because no bending can exist at those points, only pressure. That simplifies the analysis of the arch, and also, it may make the bending near the crown smaller and permit the arch to be smaller in depth there.

The arch ribs carry the weight of purlins, roof covering and any snow or ice on the roof. They must also resist the wind pressures on the roof. The maximum snow load was assumed to be forty-five pounds per square foot at the crown, decreasing to eight pounds per square foot (of vertical projection) at the gutters. These gutters conduct the rain water to the sewer. Wind load was assumed at 17½ pounds per square foot (of vertical projection) near the crown and increased to 30 pounds per square foot near the gutters.

Having given the loads and the shape of our arch, we can determine the maximum stresses by the use of simple methods that are given in any book on mechanics. Then we can select the sizes of steel bars for each member and design the connections (gusset plates). I shaped sections are used because they are the stiffest and most economical. All our main members have about the same dimensions measured in the direction of the length of the building and hence the gusset plates fit easily on the outside of the members. Holes are punched in the gusset plates and corresponding holes are punched in the flanges of members. Rivets which are heated to a white heat are then inserted in these holes and hammered by means of an air-hammer until they clamp the plate and member firmly. The pins are designed to resist the pressure of the arch, and the details near the pins require careful consideration.

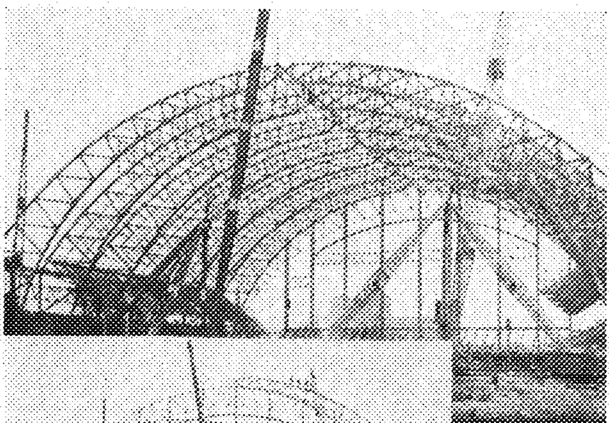
To resist the tendency of the arch to spread, horizontal tie rods (two channels) are used to connect the base pins. These tie rods are imbedded in concrete to protect them from corrosion. The end pins are inserted in cast steel bases resting on a concrete foundation on firm subsoil.

The two ends of the building are framed by the use of very large columns. These columns resist the wind pressures on the ends of the house, and also must resist the expansion of the building and carry the end walls.

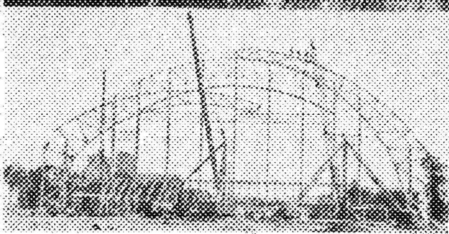
Steel expands .0000065 inch per inch of length per degree, Fahrenheit, rise of temperature. Since our building will be insulated and heated, the minimum temperature that may be expected will be 40 degrees F. and the maximum, 100 degrees F. For this change of temperature, the building will change its length about 2⅓ inches. The end walls are carried by the end columns, which resist the bending stresses. At the corners of the building, specially designed expansion joints are necessary to permit free movement of the end wall relative the side wall.

The walls are to be built of brick and stone to match the adjoining Stadium walls, in appearance and height. At five points in each side wall there are vertical expansion joints the full height of the wall which will be hidden by the use of pilasters. The wall is entirely independent of the steel frame, so that the expansion and deformation under load, of the steel frame, will not produce cracks in the wall.

Windows and ridge ventilators provide ventilation for the structure. Ventilation is particularly necessary in a house of this type, as experience with the Michigan Field House indicates that a fog tends to form unless ventilation is adequate. Skylights also were not used, partly for a similar reason; condensation would be a nuisance. The method of heating adopted assisted in maintaining a dry atmosphere. Air is heated by steam coils, and then forced by blowers into the interior. Heaters located on platforms under the balconies constitute the heating system of the house.



This picture, taken late this fall, shows the structure when nearly one-half of the arches were in place. Note how the arches are joined together at the center. The many derricks are necessary to lift the arches into place and to hold them there while they are being secured. The means of mounting the balcony seats can be seen plainly from this view. The huge structure, which mounts from the ground like some prehistoric monster, incloses enough space to permit an indoor football game.



In the center picture is shown the process by which the arches are raised into place after being partly assembled on the ground. This type of erection is somewhat novel.

During the summer this end section was raised, and the engineers utilized the information gained in deciding how to go about the erection of the other arches. These columns resist the wind pressures on the ends of the house, and also resist the expansion of the building.

ILLUMINATION presented a difficult problem. After many experiments and investigations, a type of lamp and reflector known as the Cahill lamp was chosen. The chief merit of this lamp is its freedom from excessive glare. Each lamp has a 2,000 watt incandescent bulb lighting element. There will be 64 such lamps, all adjustable in height and direction. Special attention was given to the arrangement of lamps over the basketball floor. Here the illumination had to be free from objectionable shadows and of fairly even intensity in all directions.

The details of design could be continued, and budding undergraduate engineers could be informatively profited by assimilating such a continuation. However, even they prefer being interested to being informed, so with a sigh of regret let us pass on.

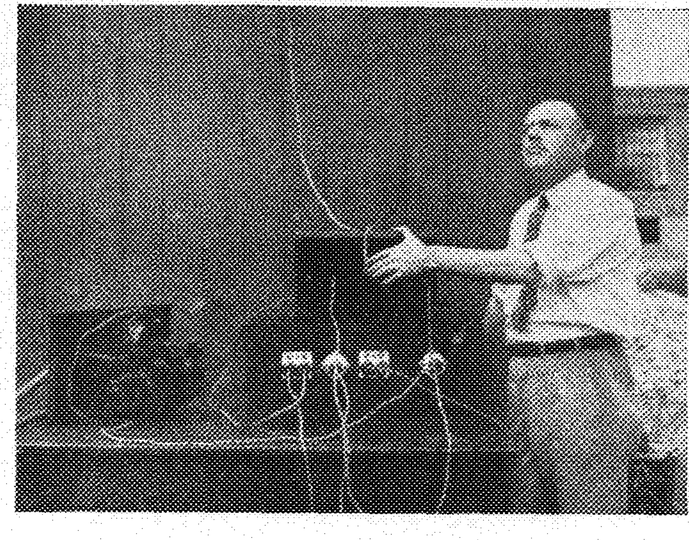
We must let the poets sing the epics of our Age of Steel and content ourselves with the more prosaic and drab recitals of the real. The workman in his denim overalls and miners cap now sitting five

(Continued on page 86)

Plane Automatically Lights Airport

Hum of motor actuates lighting switch by means of sound sensitive apparatus

By J. ROBERT GINNATY, E '29



THE APPARATUS AND MR. T. SPOONER
In spite of the large power of amplification necessary the apparatus is quite simple and unassuming.

NO longer will it be necessary to keep airplane landing fields brilliantly lighted all night—an enemy of night flying, the unilluminated landing field, was recently conquered by the modern wizardy of electricity at Bettis Field, McKeesport, Pa. In the first demonstration of a new invention or development, the hum of a plane, 1,000 feet in the air, closed a switch that lighted a bank of flood lights, and an instant later the pilot was gliding safely along the path of illumination that had been called into being by the motor of his plane.

Thousands of people witnessed this successful exhibition of sound-sensitive automatic lighting equipment, which has been developed by Mr. T. Spooner, an electrical research engineer of the Westinghouse Electric and Manufacturing company.

Merle Moltrup, chief of the air mail pilots at Bettis Field, completed the experiment by bringing his plane to the ground in the glare of the powerful lights that had been turned on by the steady throb of the airplane's motor and by so doing he has opened a new volume in the annals of aviation.

Essentially the function of the device is to use the drone of an airplane to control electrical energy. From a tiny current at first this controlled energy is increased in power by amplifiers until it is strong enough to throw a good-sized lighting switch. This switch locks automatically and the lights remain on until turned off by the field attendant.

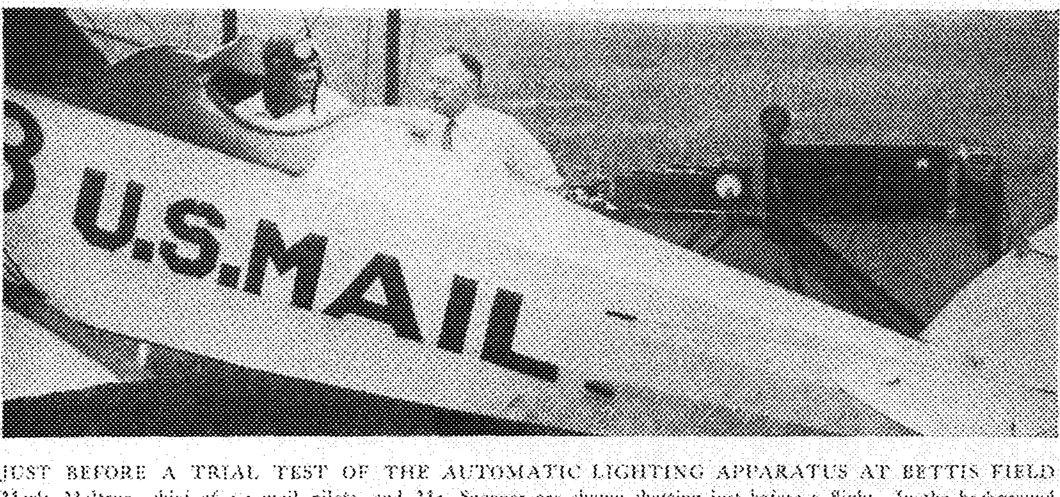
A loudspeaker constitutes the "ear" of the mechanism. It works in reverse order, inhaling, rather than exhaling, the sound. The loudspeaker laid on its back gives the apparatus a directive effect with reference to noises from above. A microphone completes the auditory section. After passing through the initial amplifier the impulse is received by a resonant circuit set, tuned to the dominant frequency of the airplane drone. Here a second amplifier does its work and then the thread is picked up by a device which has an amplifying power of 100,000,000.

The electrical impulse, which a split second before was awakened by the hum of the plane, is now ready for the time-limit relay—the last step in the process before the long arm of electricity reaches out to close the power switch. The time-limit relay is a vital unit in the Spooner sound-selective switch. Without this feature the automatic lighting mechanism might be operated by sporadic transient noises. With the time limit feature nothing less than the continuous hum, characteristic of a moving plane, will operate the apparatus and light the field.

Lacking this unit the apparatus would be like a nerve frazzled watchman, who, startled by the slightest disturbance, jumps to the lighting switch, not knowing whether the noise he heard came from the air or the earth. The time-limit agency gives the device the advantage of the self-possessed watchman who thinks and knows what he is about to do before he acts.

PRELIMINARY to the demonstration Mr. Spooner made frequent visits to Bettis Field studying the language of the airplane, to determine the nature of the sound he had to deal with. Chief Pilot Moltrup flew high and low while the engineer and his staff took notes below aided by a sound analyser.

The lights that went into action automatically came from a new type of airport projector. It is a unit designed to furnish sufficient illumination over an uneven field, at the same time keeping the source of light low and eliminating objectionable glare in the eyes of the aviator. It consists essentially of a steel drum 25 inches in diameter and 19 inches deep, mounted on a 2½ inch pipe standard. Mounted within the drum is a lamp socket with focusing adjustments.



JUST BEFORE A TRIAL TEST OF THE AUTOMATIC LIGHTING APPARATUS AT BETTIS FIELD
Merle Moltrup, chief of air mail pilots, and Mr. Spooner are shown chatting just before a flight. In the background can be seen the simple set used to control the lights.

Band Goes to Michigan

Band leads way on great trip; present William B. Stout with key. Many engineers take active part in the band

By Albert W. Morse, E '29

FOLLOW THE BAND was the war-cry of the 8,000 Minnesota rooters who helped to bring back the "Little Brown Jug" this fall. From the time that the more-than-a-dozen special trains left the Milwaukee station at intervals of 10 minutes on the evening preceding the Michigan game, to the return of the crowd on the following Monday morning, the band led the way, and after a continuous round of marching, playing and singing in Ann Arbor, Detroit, Chicago and Minneapolis at student demonstrations, the boys gave further evidence of their university spirit and physical endurance by contributing to the success of the State-Wide Testimonial banquet tendered the football squad at the Minneapolis auditorium on Monday evening.

Back of this splendid work by the band, and in fact the reason for the smooth-running and otherwise successful band and student trip as a whole, was the careful preparation made by Michael M. Jalma, director, and Michael J. Fadell, manager of the band. Two weeks before the Michigan game, these two men were the guests of the Notre Dame band at South Bend, when Minnesota tied Knute Rockne's team, and from South Bend the band leaders went to Detroit, where they arranged the celebration in detail with the city administration. They visited also the Ann Arbor stadium and the railroad terminal, mapping the exact routes of the parades.

The Band Special left at 1:30 for Ann Arbor, with 100 selected musicians aboard, in addition to five cars of rooters. No doubt the 60 men who were making their first band trip had no idea of impending disaster when they retired for a night's rest, but paddles and wet towels in the hands of the 40 more experienced members of the organization soon forcibly impressed upon them the fact that before they could be full-fledged band men they had to learn a few more "sharps and flats." James E. Specht was one of the engineers who first was initiated. Their greater numbers at first inspired the new men to resistance, but they got into the spirit of the affair and the initiation was a success.

Clear, brisk winter weather greeted the Minnesota crowd when it arrived in Ann Arbor on Saturday morning. The band special was the first to reach town, and as the other trains arrived the crowd fell in behind "Mike" Jalma's men for a parade around the campus, punctuated by a serenade of the university president at his home and by a concert outside of the Michigan Union for the benefit of the Michigan students. Then, after a lunch on the trains, the band led in the march to the stadium, a little over a mile away.

Two All-American players, our own "Herb" Joesting, and "Bennie" Oosterbaan of Michigan, were honored by the band between halves, when a "B-E-N" was formed facing the Michigan rooters, and through countermarching the men swung into a "H-E-R-B" facing the Minnesota crowd, followed by the playing of "Hail, Minnesota!" Later on a huge "M" 100 yards wide was formed by the combined bands of Minnesota and Michigan, 175 musicians in all.

After the game the band led in a wild demonstration on the field, playing, "The Little Brown Jug Ain't Where It Used to Be," a fact which the Minnesota rooters wished to emphasize. Several thousand followed the band to the trains.

William B. Stout, a member of the engineering class of '05, who heads the aeroplane division of the Ford Motor company, known as the Stout Aircraft company, rooted throughout the game in the Minnesota section, and, with his wife and daughter, was the guest of the band during the trip from Ann Arbor to Detroit, where he was presented with a gold key in recognition of his service as drum major of the band 25 years ago, and in recognition of his outstanding success after leaving the university.

Detroit was ready for the crowd when it began to arrive at 6:00 p. m. for a seven-hour stop-over. Thirty motorcycle policemen cleared the streets through the heart of the loop for the parade of Minnesota rooters, led by the band, and the Saturday-night traffic was kept at a stand-still for an hour while the football crowd marched to and from Grand Circus Park, about a mile and a half from the station.

AT Grand Circus Park, the band played before a large crowd of Detroit alumni. A police line around the inner portion of the park held back a curious throng while Mr. Stout was honored in the presentation ceremony. Edward E. Nicholson, dean of student affairs, spoke on behalf of the University administration, followed by Mr. Jalma, who gave the gold key to Mr. Stout. The manufacturer then gave an interesting account of his experiences in the band.

Mr. Stout was chosen drum major of the band because of his qualities of leadership, rather than on account of his musical ability. It was in the year 1902 that the Minnesota band was parading through the streets of Iowa City after a victory over the Hawkeye football team. The band became divided at a street intersection, and Mr. Stout saved the situation by assuming leadership of part of the organization during the remainder of the celebration, using a cane which he was carrying at the time. Shortly afterwards he was appointed drum major.

The band arrived in Chicago Sunday morning, spending some time in the recording studios of the Victor Talking Machine Co., where they played "Hail, Minnesota!", the "Rouser" and Sousa's "Minnesota March." In the afternoon they went to the Stevens hotel, the headquarters of the football squad, and there they played before the team, 1,200 Minnesota alumni, and a large number of Minnesota rooters.

IT was a tired outfit that boarded the train late that afternoon, and when they arrived in Minneapolis at 5:30 the following morning the cars were sidetracked and the band slept until 6:30.

They were on hand to welcome the football squad at the Great Northern station, when several thousand rooters greeted "Doc" Spears and his men.

During the day, members of the band attended their classes, and that evening they were called upon to participate in the Testimonial Banquet tendered the football squad, sponsored by various organizations throughout Minneapolis, and which was state-wide in character.

The equipment of the band was improved just before the Michigan trip by the addition of five new snare drums and a new bass horn, and the old equipment was overhauled. The maroon mackinaws and blue uniforms presented a striking appearance on the field, and at Ann Arbor the comment was made that Minnesota's outfit was one of the best drilled bands that was ever seen on the Michigan field. The band has its own soloist in the person of Julian Neville, who sang at the alumni meeting in Chicago.

(Continued on page 98)

The electro-chemical production of oil from ethane gas by two Minnesota experimenters has caused technical magazines to consider the possibility of—

Electric Discharges *for* Petroleum Production

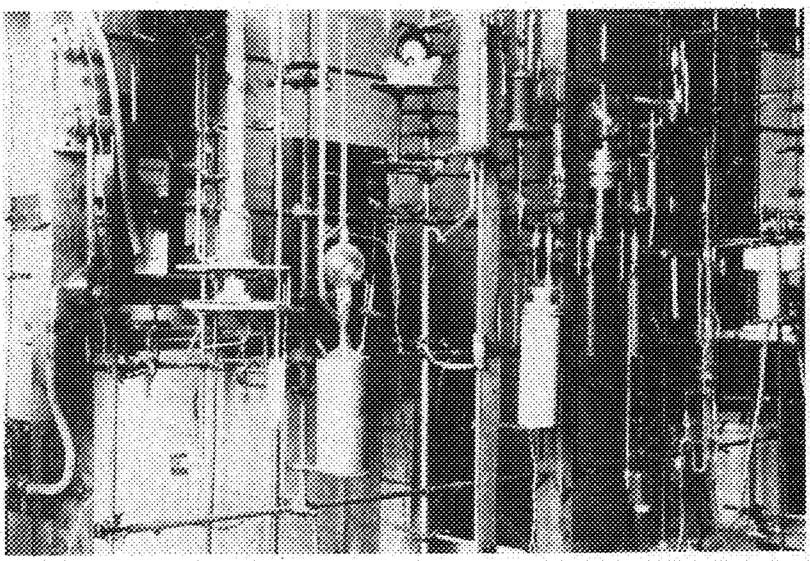
By Lawrence A. Clousing

NATIONAL publicity has recently come to two university research chemists as a result of their discoveries in the field of electrochemistry. Because of the experiments of these two men several technical magazines throughout the country have speculated on the possibility of producing petroleum by means of electric discharges through gases.

Professor Samuel C. Lind, director of the School of Chemistry, and Dr. George Glockler, research associate, have through a series of experiments, produced from ethane gas by means of electric discharges a small quantity of oil which in its physical appearance resembles lubricating oil. Briefly explained, in their experiments they have taken purified ethane gas and passed it into a glass cylinder where, subject to electrical discharge, it has been decomposed into oil and different gases.

Of the experiment the Electrical World in an editorial appearing September 17, 1927, says: "Many manifestations of the potency of electricity in industrial production processes have been had, and the end is not yet. A threshold type of experiment with numerous industrial possibilities was recently described before the American Electrochemical Society by Drs. Lind and Glockler. Previous experiments of Dr. Lind with radon emanations acting on ethane or other hydrocarbon gases showed that ionization resulted, one part of which brought about condensation and the formation of an oil. He then conceived the possibility of applying silent electrical discharges to the gases in the hope that similar results would occur. In the experiments made, electric fields were used instead of radioactive materials, and the results were very indicative of the occurrence of similar reactions. It is a far cry from these experiments to their commercial application, but a threshold experiment of this type will be carried much further under economic urge."

This editorial was also republished in the A. I. E. E. Journal for November. During the lecture session in Minneapolis on September 5, 1927, as a part of the Northwestern Trip of the Electrochemical Society during September, Dr. Glockler read a paper on the results of the experiments. Both Drs. Lind and Glockler have been experimenting on this subject for about a year. As a matter of fact, for 15 years Dr. Lind has experimented on the correlated line of decomposing gases by the use of radon. He has formed a liquid from ethane by that means. However, radon, which comes from radium, is too expensive a product to permit such an experiment to become of commercial value. With the substitution of electricity many possibilities are presented.



SET UP OF APPARATUS USED IN ELECTRIFYING ETHANE GAS

Ethane gas in passing from right to left is purified, cooled, and then passed through an electrical discharge chamber where it partly turns into a fluid.

Natural gases, or the wasted gases from coal might be turned into veritable gold mines by the use of properly applied electric discharges. However, the experiment in its present stage is almost wholly impractical. In the first place entirely too much energy is utilized in converting the gas. In the 61 experiments accomplished, 10 kw.-hr. were used to produce 5 grams of oil.

As a result of the present experiments an oil has been produced that resembles a heavy grade of lubricating oil. It is very viscous, and it has the reddish yellow color of lubricating oil. However, it also has a penetrating odor that has not been identified. The density of it is less than that of water, being only 0.862. It is very soluble in benzene. In composition it contains no nitrogen, and as determined by combustion it contains about 85.48 per cent carbon and 13.09 per cent of hydrogen.

In the paper presented at the Electrochemical Lecture, Drs. Lind and Glockler have discussed the way in which they have obtained this gas. They say, "One of the readiest means of producing ionization of gases is naturally by electrical discharge. The chemical effects of electrical discharge of various types in different gaseous systems have been studied by numerous authorities. One disadvantage common to all the modes of discharge is that the ionization is unknown, and hence can not be quantitatively correlated with chemical reaction as in the case of a radiation from radon.

"As a first step toward meeting this difficulty it appeared desirable to choose one of the hydrocarbons already studied under alpha radiation (from radon), and to subject it to electrical discharge to see whether the same products are obtained and in the same proportion. Ethane was chosen rather than methane since the latter affords no opportunity of studying methane elimination and its ratio to hydrogen liberation.

"TO furnish a suitable type of electrical discharge a Siemens ozonizer was chosen as readily lending itself to being built into a completely closed glass system. The all-glass circulating pump of Porter, Bardell and Lind was employed to circulate ethane through the discharge region."

One of the problems of the experi-

(Continued on page 96)

Twenty Acres for Austin Athletes

Professor Zelner has designed one of the largest and most complete athletic fields in the Northwest now under construction at Austin, Minnesota

By William C. Hill, C '29

REALIZING that the rapid development of athletics and physical education in the public high schools demands additional equipment and space both indoors and out, the school board of Austin, Minnesota has started construction on one of the largest athletic fields for high schools in the state. Not only Austin, but many of the cities, villages, and rural districts now have athletic facilities far superior to those possessed by the University not so many years ago.

When early this year the school board of Austin acquired a 20 acre tract of nearly level land within eight blocks of the city high school, plans were immediately projected for the erection of an up-to-date athletic field. Professor Zelner of the surveying department of the College of Engineering of the University of Minnesota was called upon to design the field.

To begin with the design of a field must be such that the field embodies the utmost in the line of utility and beauty. The Austin field would seem to fulfill both requirements. Having had considerable experience in this particular line Professor Zelner with the suggestions of the athletic staff of the University of Minnesota turned over to the school board of Austin the accepted plan.

Professor Zelner has had much experience in the design of athletic fields in the northwest, and it seems that the field at Austin includes the best of a long list of fields he has designed. Among the fields that Professor Zelner has laid out are the Minnesota Stadium, the North Dakota Stadium, and the John Marshal high school field in Minneapolis.

LYING close to the big high school is a 20 acre tract of clear meadow, ideal for an athletic field. 1,278 feet long by about 640 feet wide this field before grading was gently sloping with only an orchard in the southwest corner to complicate the work of construction. A topographical map made by the city engineer of Austin, George Brown, former student of engineering at the University of Minnesota, showed a slight terrace effect in the western half of the field. This was almost perfect for a football field, as it afforded natural drainage of the surface waters off the field during the fall of the year without much outlay of money for grading. The remainder of the 20 acre tract was virtually level allowing for the construction of baseball diamonds, tennis courts, and other outdoor play grounds as outlined in the plans.

Plans submitted by Professor Zelner carried out the theories of Fred Luehring, director of athletics at Minnesota, Doctor Clarence W. Spears, head football coach, Doctor L. J. Cook, Minnesota's nationally known former basket ball coach, W. R. Smith of the intramural sports department, Louis Keller, and Potsy Clark. The class on athletic administration conducted by Sherman Finger, varsity track coach, also added several features that they thought important for any up to the minute athletic field. Thus it would again seem that Austin has one of the best high school athletic plants in the entire northwest, if not in the country.

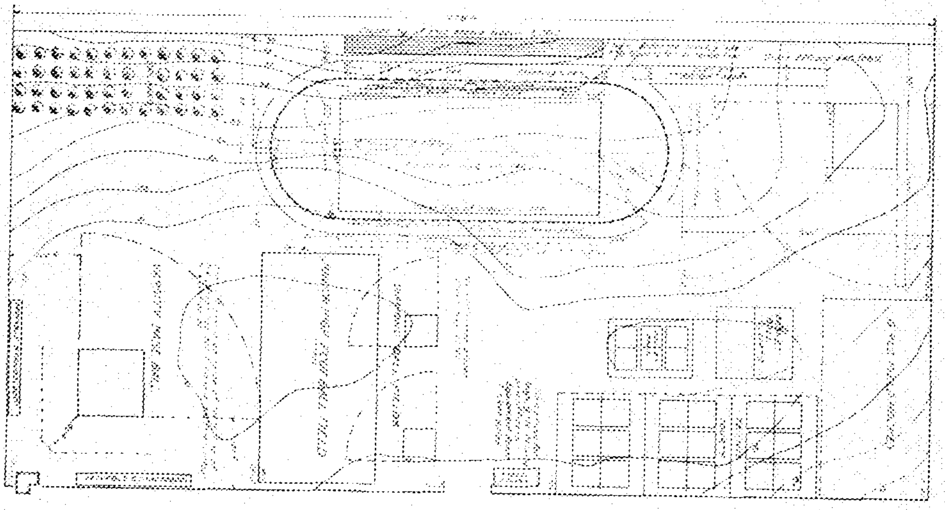
A full sized football field with a quarter mile track encircling it is the main feature of the plant. Wooden stands seating about 3,000 spectators will line the west side of the field with room for portable stands that seat about 1,800 more to be erected. These portable stands will be essentially for the baseball diamond in the southeast corner of the field, but can be moved to the football field when some big football game or track meet is held. There is a junior, or practice football field slightly shorter than the regulation one, another baseball field in the northwest corner of the field, and two diamond ball fields. In the northeast corner of the tract is the mixed play grounds, that is, play grounds for both boys and girls. Here are the nine tennis courts, three volley ball courts, two basket ball courts, and the girls hockey field.

Several novel features of the track should be emphasized. In the field events both the broad jump and the pole vault can be run off in directions to take advantage of the prevailing winds. The start and finishes of the races are in front of the stands where the spectators can get the full benefit of the races. In the quarter mile dash, and in the half mile run a turn has been eliminated so that better time can be expected in these events.

IN the design of the field, Professor Zelner took cross sections of the width of the field and found the average profile. With this situation in mind, he designed the grading of the tract so as to have the cuts and fills balance as nearly as possible. In this manner the cost of construction was kept at a minimum.

The main entrance is on the east side of the tract where Bridge street abuts. Here there is to be a field house that will have locker rooms for boys, girls, faculty, and officers' equipment rooms, and ticket sales. Facing the entrance will be the football field with its stands on the farther side. A small terrace on the near side of the field, sloping toward the entrance, will be laid out with flower beds as an aid to the beauty of the tract. The immediate area just inside the entrance will be utilized as a parking space and will probably be graveled and rolled hard. This space will be large enough

(Continued on page 98)



LAYOUT OF THE AUSTIN ATHLETIC FIELD

Space is provided for sports of all kinds. Much care was taken to properly place the various sports so as to obtain the greatest efficiency.

News from the Technical Campus

Student, Faculty and Alumni Activities — Technical Items of Interest

Technical College Enrollment Shows an Increase

THE total enrollment of the technical colleges this year is larger by 96 than it was during the fall quarter of 1926. Of all colleges the School of Mines shows the largest increase in freshman enrollment.

There are 28 more freshman in the School of Mines than there were last year. In other technical schools and departments the increase in freshman enrollment is as follows: civil, 13; electrical, 9; mechanical, 14; architecture, 7; architectural engineering, 11; interior decoration, 4; pre-business, 6; agricultural engineering 3; and chemistry, 17. Chemical engineering showed a decrease in the freshman class enrollment of 9.

Classified below is the registration of each college for both this fall and last fall.

FALL QUARTER, 1927

	Fresh	*Soph.*	*Junior*	*Senior*	*Special*
C. E.	68	70	42	47	....
E. E.	154	124	82	70	....
M. E.	78	74	45	35	....
ARCH.	98	62	18	16	1
ARCH. E....	15	31	11	9	....
CHEM.	58	44	37	21	....
CHEM. E...	23	18	11	9	3
MINES	40	18	16	13	....
INT. D.	....	5	4	....	....
PRE. R.	10	10	....	....	....
AG. ENG....	6	2	....	....	....
UNDEC.	52	....	....	....	3
Total ...	602	453	267	224	7

The total for all Colleges is 1,533.

FALL QUARTER, 1926

	Fresh.	*Soph.*	*Junior*	*Senior*	*Special*
C. E.	55	69	45	52	....
E. E.	145	120	79	73	....
M. E.	64	64	37	34	1
ARCH.	91	40	15	20	1
ARCH. E....	4	23	11	10	....
CHEM.	41	49	28	18	2
CHEM. E...	32	19	11	3	2
MINES	12	17	14	15	....
INT. D.	....	....	4	1	....
PRE. B.......	4	10	....	....	....
AG. ENG.	3	2	....	....	....
UNDEC.	97	....	....	....	....
Total	548	413	244	226	6

The total for the fall quarter of 1926 was 1,437.

Freshman Architects Welcomed With Traditional Banquet and Party

ON October twenty-eighth, the faculty and upperclassmen of the department of architecture extended the traditional welcome to the 1931 class.

Professor Mann, head of the department, and speaker of the evening was introduced to the new students by Homer Tatham, president of the Architectural Society. He extended the welcome of the faculty, and told of the traditions and ideals of the school. Speaking of the career of the architect, he cited the ideals and the duties of these engaged in the profession and the important part these played in the lives of successful men.

A humorous skit, written and enacted by the students, caricatured the members of the faculty, presenting their various characteristics and individualities that the new men might learn to know and appreciate them more fully.

The remainder of the evening was spent in dancing. Girls of the department served refreshments. A five piece colored orchestra blared the latest music as the auditorium became the scene of general mixing and merry-making during which introductions were made and the Freshmen officially became part of the family known as "The Department."

Honorary Fraternities Announce Fall Initiates

The honorary fraternities of the engineering college have announced the fall of 1927 quota of elections.

Tau Beta Pi announces as follows: Harold Ekman, A '28; LeRoy Engstrom, C '28; Emil B. Enquist, E '28; Lawrence Clousing, E '28; Wilmer P. Hedlund, Mines '28; Wilbur Japs, M '28; Douglas O. Johnson, E '28; Alfred H. Lee, E '28; Ben Mayeron, C '28; William J. McGinnity, A '28; Eric F. Peterson, C '28; Erling B. Saxhaug, E '29; George Swenson, Ch '28; and Selmer Von Stocker, M '28. These announcements were made public at the fall banquet held at the Curtis Hotel, December 2nd. Dr. C. A. Mann was toastmaster.

The civil society, Chi Epsilon, elected Carl J. Eyberg '29, Fred C. Fredickson '29, Eric F. Peterson '28, Nordahl T. Rykken '29, and Stanton B. Wallin '29.

Eta Kappa Nu electrical honorary announced the following men as new members this fall: L. V. Soderholm '28, T. A. Gustafson '28, A. P. Schavone '28, R. D. Furber '28, J. E. Specht '29, I. Vigness '29, C. J. Johnston '29, and R. C. Freeman '29.

Pi Tau Sigma, the mechanical engineering fraternity, elected as fall of 1927 members: Elo L. Tanner '29, Lester J. Rowell '29, Chester L. Nelson '29, Robert H. Heyer '29, and Otto J. Pfeifer '28.

Agricultural Engineer Is Author of Article in Scribner's Magazine

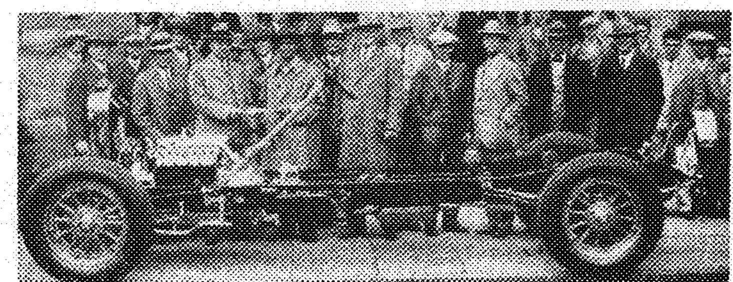
IN a recent issue of Scribner's magazine there appeared an article on "Engineering in Agriculture" written by Harry Burgess Roe, graduate of general engineering in 1908 and who is now an associate professor of Agricultural Engineering at the University of Minnesota. As an authority on the subject he is well qualified. He has been with the work here at Minnesota since the inception of the course in agricultural engineering in 1925 and on this same subject he wrote an article in the October, 1925, issue of the MINNESOTA TECHNO-LOG.

"The object of agricultural engineering," he writes, "is to eliminate useless labor on the farm, to make farm life pleasanter and to make the farm business more profitable."

According to Mr. Roe it is thought by many that the agricultural engineer is unnecessary, that his work could be done by the civil, mechanical and architectural engineers.

But we read:

"The planning of the farmstead, that is, the arranging of the buildings for the greatest convenience and economy of labor, as well as the greatest comfort and beauty, requires a knowledge of farm work and living conditions which the architect trained to city-planning does not usually



RECEIVING THE CADILLAC CHASSIS

In the picture are President Coffman, Dean Leland and representatives of the Cadillac Company who presented to the University of Minnesota one of the six cut open chassis to be given to American schools. In the spring the chassis will probably be moved from its present position in the Main Engineering Building to the Experimental Building.

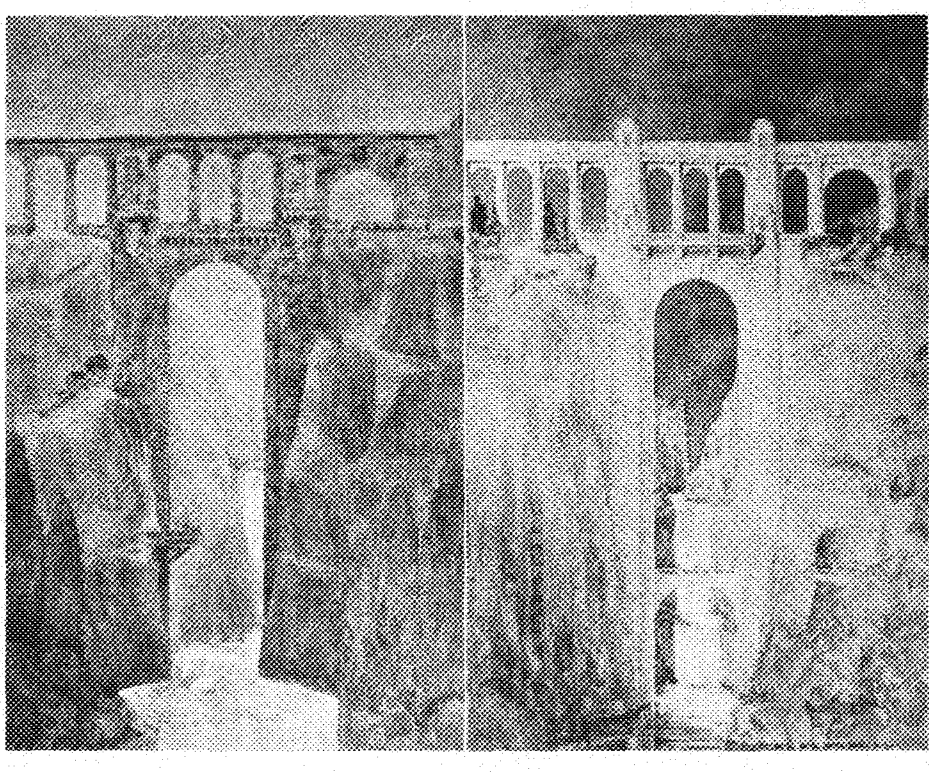
have. . . . In designing a plow bottom, a grain drill, or a threshing machine, one deals with very different forces and conditions than must be considered in designing a weaving-loom, a sewing-machine, or a power-plant. . . . The proper design and installation of a farm tile drainage system or of an irrigation system requires a knowledge of soil texture, soil water movement and moisture relations of field crops. It is therefore a very different problem from planning and building of a railroad or a city water or sewer system. It is evident that land-clearing, drainage and irrigation are, by their very nature, agricultural engineering."

He continues by saying the investment in buildings, machinery and equipment on the average farm is twice the investment of livestock. But in spite of this fact, much more scientific study has been given to livestock than to farm buildings and farm equipment.

Improvement of waste areas has been delayed because large reclaimed areas are still unproductive, owing to the fact that improperly trained men designed and installed the drainage systems.

The demand for agricultural engineers is steadily increasing, and it is the opinion of farm equipment companies and public utility companies that the agricultural colleges are not preparing them in sufficient quantity.

Mr. Roe is the second engineer at Minnesota who has written for Scribner's within recent years. Roderick Siler of the mathematics department was the author of an article several years ago.



WIN HIGHEST AWARD IN PROBLEM OF SENIOR ARCHITECTS

These two designs of an aqueduct and bridge submitted by Winston Close, left, and Walter Huchthausen, right, received mention in the first short problem of the senior architects. The water-main which comes out of the mountain side is 215 feet above the river.

Professor Springer Patents New Type of Voltage Regulator

LIKE many professors of the university, Professor F. W. Springer, head of the department of electrical engineering, every summer plans to develop some device to be patented. Now after waiting four years he has received from the United States Patent office notice that a voltage regulator device developed by him during the summer of 1923, has been patented. A long wait for the fruits of labor? Not to Professor Springer: he knows considerable about the patent business.

The invention relates to regulators for alternating current or direct current supply systems, and it has for its object the provision of a device whereby the current or voltage of the system may be regulated or adjusted and be automatically maintained at any desired voltage or current. The different feature in this new type is the use of a transformer in a special way.

The application for the patent was filed in February, 1924.

Mr. Richardson Tours Europe During the Summer

SPENDING the summer touring the western half of Europe, Harlow C. Richardson, head of the English department of the engineering college, has returned with interesting anecdotes about the places and people he met.

Landing in France in the early summer, Mr. Richardson visited the more famous cathedrals and chateaus in the central and southern parts of France. After taking a swim in the Mediterranean Sea, Mr. Richardson entered Switzerland where he was fortunate to be able to see one of the first meetings of the League of Nations at Geneva in session. That Mr. Richardson said was one of the biggest thrills that he had during the trip. From Geneva he went down the Rhine by steamer and entered Holland where he saw the gigantic engineering project that Holland has started for the reclaiming of the Zuyder Zee, an immense area of land that has been under water for some time. The Dutch hope again to add this to their country making it almost one-half as large as it is at present.

It was in the latter part of September that Mr. Richardson left France on the *Ile de France* with the Mayor Walker party from New York and several other well known people, among whom were Walter Damrosch and Rube Goldberg of cartoon fame.

Eta Kappa Nu Convention to Be at Minnesota Next Year

NEXT year on November 2 and 3 Minnesota will act as hosts to Eta Kappa Nu, national honorary electrical engineering fraternity, chapters of which are located in the principal schools in the country who have good departments of electrical engineering.

This year the convention was held in Cincinnati, Ohio, at the University of Cincinnati to which Lawrence A. Clousing, president of the Minnesota chapter, was the delegate. At the convention a complete reorganization of the governing body of Eta Kappa Nu was voted on. This reorganization creates an executive secretary who will work full time on fraternity affairs.

Professor Kirk Returns From Sabbatical Leave

PROFESSOR R. E. KIRK has returned this fall after a sabbatical leave of absence in the East where he studied at Cornell university at Ithaca, New York.

Following the line of study that he has been interested in here at Minnesota, Professor Kirk took up research work on the oxidation and hydrogenation of the oxides, in the field of inorganic chemistry.

Following his work at Cornell, Professor Kirk toured the Atlantic seaboard and attended the meeting of the American Chemical Society at Richmond, Virginia, where it met September 26 and 27. From there he went to Detroit and attended a similar meeting, coming direct to Minnesota to take up his teaching duties in the inorganic department of the School of Chemistry.

Techno-Log Wins Awards: Alumnus Heads E. C. M. A. Group

THREE awards were made to the MINNESOTA TECHNO-LOG at the Engineering College Magazines Associated convention which took place at the Ohio State university in Columbus, Ohio, on October 21 and 22.

THE MINNESOTA TECHNO-LOG was judged from a field of 21 college publications to have contained the best single student article during the past year. This was the article "All Clear-Contact" that appeared in the December issue of last year. Second place was given to the TECHNO-LOG on the best single editorial, and second place was also given on the best alumni section.

Also at the convention Paul B. Nelson, E '26 and former managing editor of the publication, was elected western vice-chairman of the Engineering College Magazines Associated. He was nominated by the Minnesota delegates, Lawrence A. Clousing, managing editor, and Carl E. Swanson, business manager. He succeeds Professor W. Otto Birk, head of the English department at the College of Engineering, University of Colorado.

The Engineering College Magazines Associated is composed of student technical publications at 21 leading colleges and universities in the country, and was organized in 1920. Professor Leslie F. Van Hagan of the University of Wisconsin is chairman of the group, and Willard V. Merrihue, of the publicity department, General Electric company, is the eastern vice-chairman.

Professor John W. Gruner Returns From Sabbatical Leave

JOHN W. GRUNER, assistant professor of geology at the University of Minnesota, returned this fall from a year's sabbatical leave to resume his duties here.

Mr. Gruner spent part of his leave visiting in the laboratories of numerous institutes and universities in the United States and Europe. While attending at the German Mineralogical meeting, which was held at Dusburg on the Rhine, he delivered a paper on *The New Hypothesis of the Origin of Soudant Ores*. Mr. Gruner was enrolled at the University of Libect in Germany. Here he with two professors utilized the X-ray laboratories in the study of crystal structure.

"There is an outstanding difference between the universities of this country and of Europe," Mr. Gruner states. "Those of the United States have fine buildings but are poorly equipped, while in Europe the conditions are reversed and many an unsuitable building houses a fortune in instruments."

Minnesota to Have Most Complete Welding Laboratory

THROUGH the remodeling of the mechanical building there has been set aside a room for the teaching of the various commercial methods of welding now in use. This room when completed will be one of the best equipped welding laboratories in the country.

Special equipment has been furnished to the welding room by Elmer of the Smith Welding Equipment corporation of Minnesota. Each table is equipped with gages and separate leads to oxy-acetylene torches. This equipment which has attracted so much attention is of the latest type and consists of torches, nickel plated gages, welding hose, regulators, and special equipment for the cutting of cast iron. The cutting of cast iron has bothered the mechanical engineers for some time as the iron oxide does not flow, but remains on the surface and retards the work.

A $1,100 Lincoln electric arc motor generator set has been donated to the mechanical department for use in the welding room.

Night Classes Month by Month

Evening Student Certificates Presented by President Coffman

THIRTY-NINE evening students marched proudly over the campus last June to receive from President Coffman their certificates for work in the engineering department of the extension division of the University of Minnesota.

Thus for the first time in the history of the university have evening students received their certificate of work from the President of the University at the June commencement.

The 13 engineering students were: George Campaigne, Peter Hansen, Max O. B. Pieper and Fred Zollner of mechanical engineering; Norman Kantor and Karl Larson of civil engineering; Elmer H. Fristedt, Arthur C. Green, Joseph Haefner, C. E. Harrison, Earl W. Jacobson, Lawrence B. Paist and Robert W. Ward of electrical engineering.

Many Students Attend Evening Classes

IT is past the regular school hours. The 5:20 bell has rung, and the students after heaving an immense sigh of relief have left for home leaving the engineering buildings seemingly deserted for the night. But as night draws on they suddenly again come to life. Little by little light breaks out into the darkness from many windows of the engineering buildings. The halls of the main engineering building are soon filled with people, and into the class rooms they go. It isn't long before the instructor arrives, and classes again are in full swing.

Perhaps the average student doesn't know it, but the evening classes have a large attendance. The Electrical, Experimental and Main Engineering buildings are open five nights of the week.

These night school classes are attended by 531 persons from Minneapolis, and 129 persons from St. Paul. The classes are conducted under the Extension Division of the university, and work in them leads to a degree.

However, the university in order to accommodate the evening students in the best possible way, has also arranged to have classes held in the Minneapolis Court House, and in St. Paul the Extension Division has arranged classes to be held in the Y. M. C. A., the Mechanics Arts School, and the American Hoist and Derrick company plant. Also in Duluth classes are conducted at Central High School and Washington High School.

This year the enrollment in the evening classes has increased considerably, and the number of people taking courses this fall has increased considerably over the number taking courses during the fall of last year. This can be seen from the following summary of the registration for engineering subjects in the Extension Division.

City	*1927*	*1926*
Minneapolis	531	461
St. Paul	129	140
Duluth (incomplete)	89	107
Total	749	708

Storeroom Is Added to Chemistry Building

DURING the three months of summer many improvements have been made at the University of Minnesota. At the main entrance of the chemistry building one will notice that the lawn has been sadly mutilated. It is here that a concrete room, thirty feet long, ten feet wide, and ten feet high, is buried. This underground room cost approximately $3,000. Its purpose is for the storing of fuming and gaseous chemicals.

Irritating vapors that have been continually passing through lecture rooms and corridors will no longer be able to make their way into the nostrils of the students and instructors. Liquids of low boiling points which are usually explosive, will be stored in this room. Some other chemicals that are to be stored here are ether, benzine, carbon disulphide, fuming nitric acid, fuming sulphuric acid, and explosive chemicals such as metallic sodium, phosphorous and potassium. The walls and doors are of such strength that it would take a considerable explosion to blow them out of place.

Electricals Have Interesting Talks at A. I. E. E. Smoker

TALKS on opportunities with big companies, smokes, and business marked the first meeting of the A. I. E. E. student branch on Tuesday evening, October 4, in the Minnesota Union. Following the informal dishing out of cigarettes and cigars to which all helped themselves plentifully, Marcus Fiene, instructor in electrical engineering, reviewed his summer of work on a special refrigerator test problem with the General Electric company.

In his talk Fiene said, "I can't stress too much the spirit of cooperation with which the company views new students. They permit a man every effort to find his place, and if he only keeps on the lookout he will soon find himself in the place he wants to be." Fiene succeeded in developing during the summer a practical adaptation for the taking of indicator cards on electric refrigerator compression cylinders, a thing that had never been done before.

Supplementing the spirit with which

(Continued on page 98)

WHICH IS RIGHT?

A right-handed man named Wright in writing "write" always wrote "rite" where he meant to write "right."

If he'd written "right" right Wright would not have wrought rot writing "rite."

AFTER THE CLASS SCRAP

First Engineer's mother: "My son was in the fight yesterday and had to have six stitches."

Second Engineer's Mother: "Faith and that's nuthing. When my son was brought in, the Doc says, 'Has anyone here got a sewing machine?' "

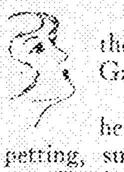
First Engineer: "Why was it so hard for Paul Revere to complete his ride?"

Second "Do": "Because he passed lots of houses where they'd forgotten to pull down their shades."

Freshman: S'matter? You don't expect me to stop cheating, do you?

Prof.: Certainly not, but you know that you're not supposed to smoke during an exam.—*Okla. Whirlwind.*

ILLOGICAL



St. Peter was interviewing the fair applicant at the Pearly Gates.

"Did you, while on earth," he asked, "indulge in necking, petting, smoking, drinking or dancing the Charleston or Black Bottom?"

"Never!" she retorted emphatically.

"Then why haven't you reported here sooner? You've been a dead one for some time."

Engineer: Can you draw?

Sweet Young Thing: A little. Why?

Engineer: Then draw a little closer.

"Triplets," announced the nurse to the proud father.

"Really?" he said. "I can hardly believe my own census."

JUST BETWEEN CIVILS

"Hard as concrete, you say?"

"Yeh, fact is, I took her for a walk."

The pathetic part about the Engineering School at Minnesota is that some of the final exams are final.

Explosion!—no, just Moffett hollering—lookers—these damn Chemists—fight to the lockers—between that big boso's legs—climb into my coveralls—underwear shows, but you're an engineer—chew the fat with other late arrivals—everybody gone—Harry!—wink—Rogers—"heard this one?"—work—time out—back to work—end of hour—see coeds parade through P. O.—can't see their faces as well as their legs—Moffett lumbers through—he gives us a deaf and dumb yell—back to work—ruined a piece—bum lathe—start another — going fine — what? — quitting time?—washing—the liquid lye takes off the skin but leaves the dirt—borrow some soap—clean?—who cares?—who threw that towel?—sock!—Ye gods, another day!

Junkman: Any rags, papers, old iron?

Grad. (angrily): No, my wife's away.

Junkman: Any bottles?

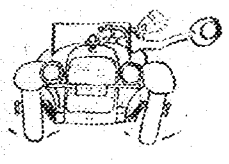
Mike (who had a very nasty fall from a roof): "Thank hiven Oi don't belave it's broke."

St. Pat.: "Phwat, yer neck, Moike?"

Mike: "Neck! No begorra. The bottle o'whiskey in me trousers pocket!"

Englishman (at plane crash in a Scottish village): "Give that aviator some air."

Suspicious Native: "Give him some yourself."



According to the report that the Mechanicals have received, the new Ford car will be able to make 70 miles an hour. Does anybody know whether this 70 is straight ahead or up and down?

THE WHATZ WHAT

Dope That All Freshmen Should Have on the Fraternities

Alpha Chi Sigma—They have invented some sort of a chemical for rushing; it is understood that this chemical hypnotizes the innocent rushees and leaves a wonderful opening to put a pledge pin on his lapel. For particulars see Pat. Butler.

Alpha Rho Chi—They have a new house, which reminds me of the remark made by Glynne Shifflet to the effect that it certainly is funny how many freshmen architects can be convinced that a spectacular house with sick looking men is better than a sick looking house with spectacular men.

Kappa Eta Kappa—Just a new fraternity at Minnesota, but oh my! They do not seem to have any trouble pledging the prominent engineers. Ask Hoover, he knows.

Scarab—Not such a large group, but as Homer Tatham says, "It is a collection of the Elite."

Sigma Rho—Every miner knows this group. Each freshman miner gets an invitation that reads as follows: "If you ever need fraternity connections while in college, come and see us, we will be glad to pledge you."

Theta Tau—George Thwing has been heard to make the following statement: "Theta Tau is not interested in politics; you will never see any of our men in school activities or running for school offices."

Triangle—Last year the editor stopped in at their spring formal, and to his amazement found only three couples dancing. He knows nothing of the size of the fraternity, but wants to ask the following question: "If there are more than three members in a Triangle, what were they doing that night?"

SHE KNEW

"If I stole fifty kisses from you what kind of larceny would it be?" asked the young man.

"I should call it grand," sighed the sweet young thing, without a quiver of an eyelash.—*The Trouble Shooter.*

The
MINNESOTA TECHNO-LOG
University of Minnesota

Education for All

SAY, Johnny Engineer, have you ever stopped to think that you are but one of 1,533 persons studying in the technical colleges? Quite a few, eh?—but wait a minute.

Do you know that in addition there are 749 students registered in the evening school courses? "Why," you say to yourself. "The evening school registration is one-half of the day school registration." You are right. It is.

Five nights a week evening courses are held in the engineering buildings, and they are well attended. To the person who hasn't been over to school at night an evening visit is a revelation. Persons, who for numerous reasons cannot attend the day school, can and do take up their learning in the evening school classes.

But what is the purpose of this editorial?

Simply to bring forth the largeness of this school of ours; simply to show that the day school is but one part of the vast college of learning. Neither the night or day students have given each other much thought. Each has thought only about his own sphere of action. Let us realize, however, that we are all engineers working toward a common end.

Selfish Motives

IN the rush of outside student activity a student is prone to forget that he is not the most important thing in this old world. Yet, he often begins to go about the campus letting things await his pleasure, and he tends to forget that his own benefit in extra activity is subordinate to the purpose of the organization or project upon which he is working.

An old mathematical expression, "a part is never greater than the whole," is a truth that will cause such a man a little thought when he reaches this stage of his superiority complex. If he would but sit in his room and mull over this thought, he would realize that his work instead of being for his own personal glory should be for the honor and value of the project on which he is working. His work should be for the betterment of the enterprise. By taking such an attitude the student is likely to discover that in the end he has accomplished more and gone farther than he would have otherwise. For if a man begins to use people in organizations purely for his own profit and advancement they are sure to feel hurt and resent such use as injury. This in the end brings group resistance to bear against any and all things such a man attempts.

Not only is this true in school life, but all through life one meets up with the same tendency. It is a good thing to guard against. It is selfish motives versus cooperative principles.

Analyze Yourself

IT is the aim of personnel men of the large corporations throughout the country to place the right man in a position where he can best use his talents. This aim can usually be fulfilled, as far as the company is concerned, because positions of every kind are open, particularly for graduate engineers. Company representatives naturally try to help senior graduates find their places because it means money to the industrial concerns to have each man in his best branch of work.

However, to the student this problem of finding himself is vastly more important. His happiness and success in life depends on it. Realizing this a representative from one of the large industrial concerns said to seniors recently, "The average man who analyzes himself and the jobs offered will go a lot further toward attaining success than will the Tau Bete who jumps at the first job that comes along just because the salary may perhaps be a little higher."

Going further this representative described the successful man as one who completely made use of his best talents. He based success, not on the work accomplished or on material gain, but on the completeness to which a man found himself.

Usually around the senior year a student becomes quite thoughtful about his future work. He knows that it pays to give it much thought. Strange to say, during the junior, sophomore and freshman years this subject is apparently given little concern. However, the underclassman who has thought over such matters is just that much to the good.

Flying Collegians

ANOTHER intercollegiate sport looms on the horizon! Announcement has been recently made that Grover Loening, president of the Loening Aeronautical Engineering Corporation of New York City, has set aside a prize fund of $5,000 to be used in making annual awards in an intercollegiate flying contest to be held each year among aeronautical students representing American Colleges.

Universities are already participants in many types of sports, from golf and tennis to the popular sport of football. However, this new proposition would provide for the engineering students a particularly interesting type of sport. The exact nature and rules of these contests have not yet been announced, although contests and awards are to be executed according to rules and regulations yet to be set down by the National Aeronautical Association.

As something entirely new in college sports it seems interesting, and it is likely to prove valuable. It involves engineering principles which no other collegiate sport does. However, largely the object of the prize is to develop "air-mindedness" on university campuses. We look forward to the day when the college racing plane entry will compete with the football star for front page newspaper publicity.

Campus Paths

AGAIN we have a winter, and again there are strewn about the engineering campus the ugly unpainted iron fences. Each year the same thing happens—first the snow and then the fences.

But before the fences come we have new paths. Dirty, dingy paths that stretch across the white snow in hard-packed, crisscross lines that resemble the outline of some giant futuristic sketch. And then overnight we have the ugly fences.

Why is it that with the first fall of the snow all memories of the familiar walks seem to flee the minds of a certain group of students? The walks still remain, but to those students they are lost, buried deep under the slightest fall of snow. These walks are the result of much planning. They are for the use of the students and visitors. They beautify the engineering campus.

The crude, low iron railings do not. They are a symbol of thoughtlessness. They would not be needed if a little consideration were used on the part of students. When a student cuts across one hundred feet of snow-covered lawn to save time in getting to a class, we wonder if that time saved is usefully applied. From an observation of the average student in the Engineering College there is little ground to consider that time is always applied as it should.

Being late to class is bad, but has not yet been classed as a cardinal sin. These dirty, crisscross smudges on the campus are worse. They tell the world of our thoughtlessness.

FACULTY SKETCHES

FRANK B. ROWLEY

WHEN he is not engaged in working in the laboratory, Frank B. Rowley, director of the Engineering Experiment Station, may be found on the golf links, as he is an ardent golfer. From the illustration we gather we might find him out in the wilds of Minnesota shooting ducks. Then too, he usually spends his summers at his cottage on Cass Lake, where he can exercise his penchant for fishing.

Professor Rowley was born on April 3, 1882, at Evansville, Wisconsin. He received his early education in the schools of Evansville and in 1901 he entered the University of Wisconsin where he studied mechanical engineering.

Following his graduation in 1905 he spent a year in graduate work and received his M. E. degree in 1906. After one year of practice he came to the University of Minnesota to take a position in the drawing department. In the year 1915 he was appointed an assistant in the experimental engineering department. Later he was made an associate professor, and in 1920 he was appointed to the position which he now holds. He has recently completed his twentieth year at Minnesota.

In addition to his work at the University, Rowley has been acting as consulting engineer for the securities division of the Department of Commerce since 1916. In 1918 he went to Plattsburg training camp at Plattsburg, New York, where he became an instructor in automotive engineering with the rank of Captain.

Rowley's particular field is heating and ventilating engineering. Among the various items of his recent professional practice in this field are the development of radiators for a large manufacturer of heating equipment; the development of insulating materials; and the devising of acceptance tests on power plants, paper drying equipment, and on the new incinerator plant for the City of Minneapolis.

It is interesting to note that the American Society of Heating and Ventilating Engineers has adopted for heat transmission tests the apparatus that has been developed at the Experiment Station under Rowley's direction.

Rowley is at present serving on several university committees and holds office in several of the many clubs and societies of local and national scope to which he belongs. A few of the organizations which claim him as a member are Theta Xi, Sigma Xi, Professional Men's Club, Midland Hills Golf Club, Minneapolis Institute of Arts, American Society of Heating and Ventilating Engineers, American Society of Mechanical Engineers, Minneapolis Engineer's Club, Minnesota Federation of Architectural and Engineering Societies, Pi Tau Sigma, the Scottish Rite Masons, and others. He has been very active in all of these organizations, and has served on many committees, being an officer of a number of them.

An Engineer for President

GRADUATE engineers enter every field of endeavor, where they usually succeed extremely well. Especially do engineers succeed as industrial executives. Since executive management depends so much upon the use of engineering materials, this is no doubt the proper position for the engineer. Some people claim that the really great executive is a thoroughly qualified engineer.

It is the opinion of many that an engineering course of some kind is just the basis for later work of any type. The type of training and the general fundamentals are the best possible for business training.

As an engineer and an executive none could be better than Herbert Hoover, present secretary of Commerce, and much talked of candidate for president. He has demonstrated his executive powers to the public through his sure, business like, and rapid methods of accomplishing his purposes.

To the people of the country, Hoover is a most popular figure. There never was, it seems, a man more fitted for the position of president than is Hoover. Although Hoover has held numerous governmental positions of importance, he has never run for a political office or cultivated a political following. Such procedure is unheard of for a possible presidential candidate. The people have confidence in him. For 18 years he has carried out engineering work in the principal parts of the world, coming back to United States as one of the most informed and capable men in the country. He is a leader in the engineering profession, and he is a leading executive. He should go a long way in a run for President.

Every day the engineer has new fields opened to him. It is reported that a synthetic rubber has been developed, soon to be placed on the market. This was announced at a meeting of the German Chemical Manufacturers' Association at Frankfort-on-Main. A new catalyzer has been found that simplifies the uniting of the elements of rubber found in coal tar.

When the super magnetic metal, permalloy, was discovered by G. W. Elmer in the Bell Telephone laboratories the company demanded an explanation. For many years it had been thought that pure soft iron had the highest possible permeability, and then permalloy was discovered. "Why hadn't it been discovered sooner?" the company asked.

Now, it is predicted that much research will be spent on the development of an entirely new magnetic material.

Around the World With Our Alumni

Architects

'25—Dean W. Rankin is employed by the Telephone company at Chicago. Dean right now is engaged in inspection work on new buildings being built by the company. He likes his work real well as he says it feels great to be out of doors a good share of the time.

'26—O. Stageberg was engaged during the summer and fall in the U. S. Engineer's office on flood control work.

'27—Alva Stanley Bull is now with the Insulite company, 1100 Builders Exchange, Minneapolis, working on insulation engineering. He says that the Builders Exchange Coffee Shop is a good place to find the alumni at noon.

'27—Paul Havens is teaching at Bradley Polytechnic Institute at Peoria, Illinois.

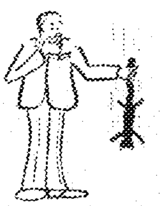
'27—Lawrence B. Anderson, former art editor of the TECHNO-LOG, has a teaching position at the University of Virginia.

'27—Charles R. Barnum, who is now teaching in the College of Architecture at the University of Michigan, is expected to return to the campus for homecoming.

Chemists

'24—Irvin Lavine, who received his Ph.D. in chemical engineering last year is now assistant professor at the University of North Dakota. It was erroneously reported in the October issue of the TECHNO-LOG that he had received an instructorship. There is much indignation.

'25—A. M. Edmunds is now known as a big "cathartic" man from the West although some insist that he is a physicist. He is superintendent of the epsom salts plant of the Dow Chemical company. He visited the chemical engineering department at the university this summer.



'26—E. Sverdrup did graduate work last year and received his master's degree last June. He is now working for the U. S. Rubber Reclaiming company of Buffalo, New York.

'27—Clifton Carlson and John Beal, who obtained their degrees in chemical engineering last June, and A. B. Algren, a '27 mechanical engineer, have been appointed research fellows in the Experimental Engineering Laboratories. They will work on building insulation and heating and ventilating problems. The fellowships were created by the American Society of Heating and Ventilating Engineers.

'27—J. Howard Arnold, James Holst, and Lew W. Cornell have positions as assistants in the School of Chemistry and are doing graduate work. Kenneth Maehl is doing laboratory work in the ore testing laboratory at the Bureau of Mines.

Civils

Roger Merritt Hole, a student here for three years, '15 to '18 has been heard from in South America where he is running a preliminary survey for a highway through the rough mountain country in Columbia. Hole left the University of Minnesota to graduate from Purdue University in 1920. Returning to this part of the country in 1920, he worked with the sewer department of the City of Minneapolis, and then with the state highway department. In '21 and '23 he was with the Minnesota Utilities company, and since then has been working in the South American countries on railroad and drainage projects.

'15—H. B. Christianson recently has been promoted to the position of division engineer with the C. M. and St. P. railroad. He now has headquarters at Sioux City, Iowa.

'19—George A. Sawyer is now assistant supervisor in charge of maintenance engineering and construction work on the Pennsylvania railroad. He is stationed at Canton, Ohio.

'22—Loring S. Slade was married to Miss Margaret Schweiger on November fifth at Moose Lake, Minnesota. They plan to make their home in Minneapolis.

'22—T. S. Paulsen drove to Minnesota for Homecoming and spent some time visiting the civil department. Paulsen recently resigned his position as chief draftsman for Huff and Roberts of Miami to become superintendent of building construction at Harvard university.

'24—E. T. Bergquist has resigned his position with the Minnesota State Highway department and is now located in Duluth.

'24—H. W. Gillard is manager of the Simplex Ejector company located at 2528 W. Madison street, Chicago. "Herb" generally gets around to every meeting of the engineers and greets the boys.

'25—The radio bug has bit another. It happens to be E. I. Winkenwerder. "Wink" is with the Acme Wire company and makes a specialty of taking in all the radio events.

'25—Norman R. Moore has recently been transferred to New Brunswick, New Jersey, where he is assistant supervisor for the Pennsylvania railroad.

'25—U. G. Ohman has been a junior engineer in the U. S. District Engineer's office since his graduation. He is now engaged in construction of the Portage Lock on the Fox river, Wisconsin.

'25—Conrad Cooper made a business trip to the northern part of the state and with his parents and youngest brother dropped off for a short visit at Professor Zelner's summer cottage on Norway Beach, Cass Lake.

'26—Burton Juell, 303 No. Grove Ave., Oak Park, Ill., is now with the Public Service company of Northern Illinois as an engineer in the distribution department. He says that many of the old grads can be found at the Chicago Engineers' Alumni Club.

'26—Ed. Young came through Minneapolis on an auto tour which included the Upper Peninsula of Michigan, Duluth, and his home at Marble. After visiting friends here, he went to visit Wisconsin and Chicago Universities. He has held the position since his graduation of junior engineer with the U. S. Engineers on the Great Lakes.

'26—Thomas H. Comfort, who is now with the St. Paul Structural Steel company in the capacity of contracting engineer, represented his firm at the Northwestern Welding conference held at the University of Minnesota under the auspices of the mechanical engineering department on October 20-21. Mr. Comfort was married to Miss Dorothy A. Hermann on June 30.

'26—R R. Kelly is designing structures for the Concrete Engineering company of Chicago. This company has completed the design of some of the larger buildings now under construction. Ray was chairman of the Minnesota Engineers' Club for the month of September and put things across in great shape.

'27—C. K. Price and Henry Norman have been with the U. S. Engineering department since graduation. They now hold the positions of inspectors on breakwater construction. Price is stationed at Frankfort, Michigan, and Norman is at Milwaukee.

'27—Kenneth N. Clark is now employed by the Pennsylvania railroad at Chicago. He is living with Elmer Lawson, who left Minnesota after his sophomore year to continue his course in civil engineering at M. I. T.

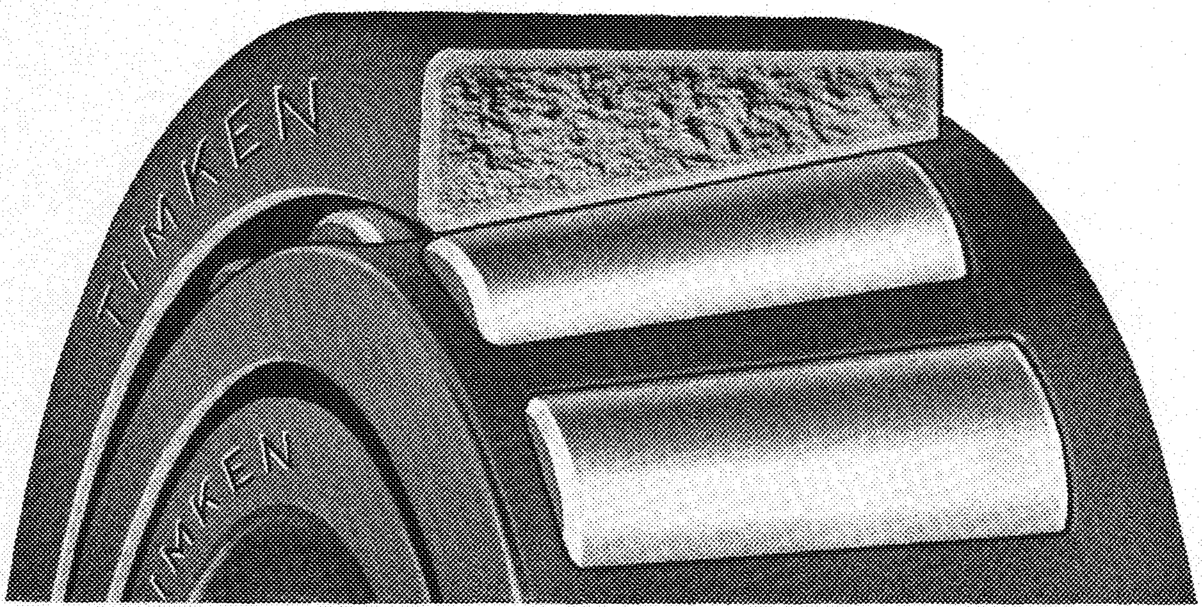
'27—Fred C. Tashe, who has been working with the U. S. Army Engineers at St. Paul, is now connected with the budget department of the Northern Pacific railroad at St. Paul.

'27—Douglas M. Campbell is taking a year's training as an aviator in the U. S. Naval Reserve. He is attached to VO Squadron 5S, an airplane observation squadron of the scouting fleet, located at Hampton Roads, Va.

Electricals

'01—Jake Danner, who has been connected with the Western Electric company since receiving his degree of E. E. from Minnesota, was appointed during the summer to the position of superintendent of installation work for the western half of the country. The position entails the responsibility of replacements and additions of central office equipment for the Bell System in this section of the country. He is located in Chicago, close to the company's big works at Hawthorne.

'07—Fred M. Williams was recently made general installation engineer of the Western Electric company with his headquarters in New York City. Mr. Williams started with the Western Electric company as a student at its factory in Hawthorne, Illinois, in 1909. He has held various positions, becoming in 1923 assistant superintendent of equipment engineer-



In all Machinery there is no place where bearing accuracy is more vital than in machine tool spindles. On the spindles of leading makes of machine tools there are Timken Tapered Roller Bearings.

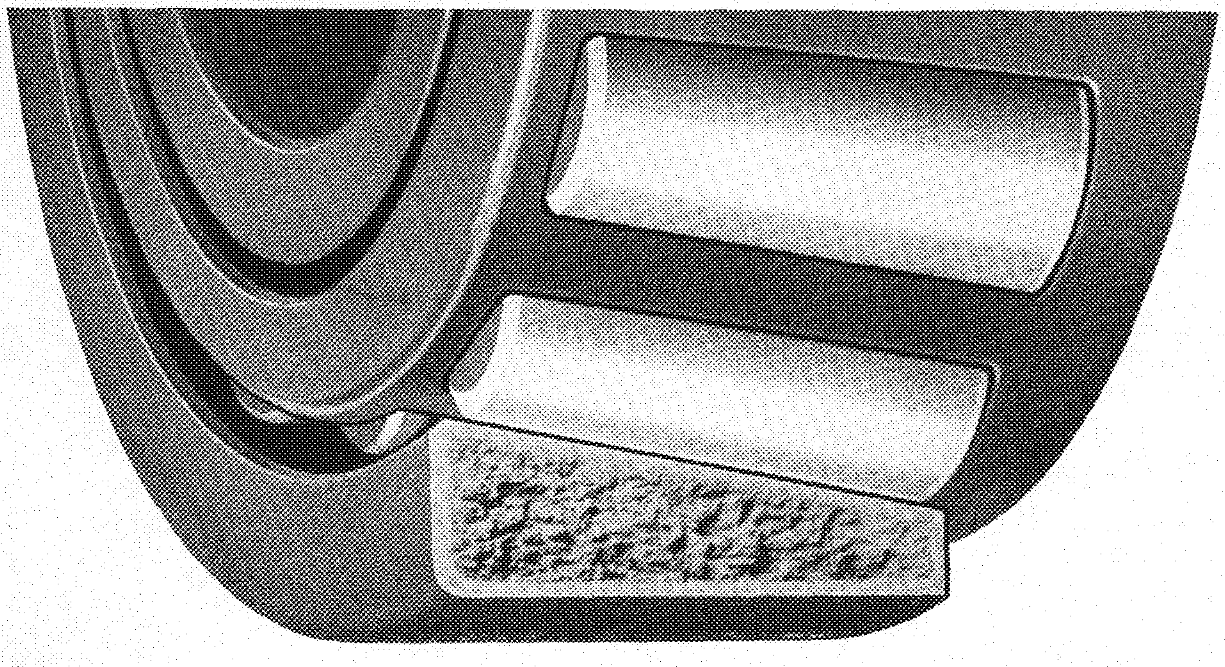
In all Machinery there are few bearing applications in which the stresses approach those that are typical in steel rolling mills or in cement mills—a million pounds—two million pounds—and more! Many of the great manufacturers in these lines are using Timken Bearings to achieve certainty and speed of production never known before—at the same time reducing power costs as much as one-half!

The durability and the permanent precision inherent in Timken Bearings are permitting all Industry to take advantage of anti-friction economies. Where anti-friction bearings were once impossible because of the severity of the requirements, Timken Bearings are effecting the greatest improvements in cost and production.

Modern engineering in every phase is bound to be more and more concerned with Timken Tapered Roller Bearings.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* BEARINGS



ing. This work he has recently relinquished to assume his new duties.

'22—John E. King is in the equipment engineering department of the Telephone company at Chicago. John is the proud father of a 10 months old baby.

'22—A. G. Olson is assistant district engineer of the Public Service company at Evanston, Ill. This company sells gas and electricity to quite a few large customers and many times problems arise that are quite serious from an engineering standpoint.

'23—Winifred W. Russell is a proud papa of a baby boy born about October 1st. Russell is one of the "Bell Boys" in the transmission engineering department of the telephone company at Chicago.

'23—C. R. Zimmerschied, who is now with the Electric Machinery Manufacturing company of New York, visited the electrical department last month. He drove to Minneapolis with Mrs. Zimmerschied and their three months old son.

'23—Russel O. Nash severed his connections with the electrified mountain division of the Chicago, Milwaukee, and St. Paul railroad to take a position in the Electric Railway department of the Westinghouse company at Pittsburgh. A set of twins arrived at the Nash home a short time ago.

'23—Adrian A. Kearney is with the Northern States Power company in the sales department. He was in charge of sales at St. Cloud.

'23—Walter F. Kannenberg has been working with the research department of th Bell Telephone Laboratories at New York City. Here he has spent considerable time on the development of a new automatic pilot channel, which the telephone company is developing for purposes of gaining control on carrier telephone toll circuits. He has written to Professor Springer, requesting information about the degree of Electrical Engineer, which cannot be taken till after a man has been out of college for five years. He is now residing in Lynhurst, N. J., where on the second floor of his home he has a veritable machine shop, with lathes, drill presses, and grinders.

'24—R. H. Tunell who is now with the Union Switch and Signal company at Wilkinsburg, Pennsylvania, has recently returned from an extensive trip in South America. During the seven months of his tour he visited nearly every country in South America.

'24—Charles T. Skarolid is supervisor of Foreign Wire Relations, General plant department of the Northwestern Bell Telephone company instead of as listed in the alumni directory for June, 1927. "Chuck" can be reached at 1303 Telephone building.

'24—Harry S. Greigner was in charge of the development of electric truck transportation for the sales department of the Northern States Power company.

'24—Harvey Z. Sheekman is now employed by the Commonwealth Edison company of Chicago. Harvey has acquired a few hairs on his upper lip which he calls a mustache.

'24—At the Western Electric company, Hawthorne, Ill., one will find A. A. Waligoski, who is a "Checker" in the equipment engineering department. "Wally" spent his vacation this year at Camp Sheridan where he was an officer in the reserves.

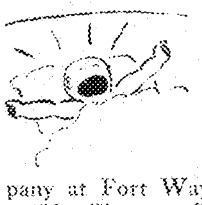
'24—Curtis R. Eckberg is with the telephone company at Chicago. Curtis is working on carrier current plans for the southern part of the state and during his spare moments he is attending night school at the Northwestern University.

'24—Joe Kater has acquired a Dodge car and when he is not rambling around seeing some of the boys he is working for the Sanitary District of Chicago.

'24—Fred E. Krause is a field engineer for the Public Service company at Maywood, Ill. Fred is kept pretty busy rambling around to see that the public is getting 100 per cent service. In addition he is inspecting and laying out extensions to the present power system.

'24—Murray Lanpher has moved from Chicago to Davenport, Iowa. Murray is a sales engineer with the Westinghouse Electric company, and would like to hear from any other Minnesota engineers in or around Davenport.

'24—Frank Appleman who is an engineer with the Illinois Bell Telephone company spent a few days visiting his old friends in Minneapolis. He can be found in Room 1404, 212 W. Washington St., Chicago.



'25—Word comes to us that Philip E. Richardson has become the proud father of a baby boy. Richardson is in the sales office of the General Electric company at Fort Wayne, Indiana.

'25—Clarence Tyberg was married in August to Miss Bertha Schreiber who was formerly a Minnesota coed ('26).

'25—C. R. Tunell has accepted a position in the D. C. engineering department of the General Electric company.

'25—Gus Adolph Johnson was married in Minneapolis on July 8 to Helen Townsend. They will be at home after September 1 at 2719 North 49th street, Omaha, Nebraska. "Gus" and Helen took a trip to the Black Hills on their honeymoon (Sylvan lake by moonlight is very beautiful). "Gus" is quite a golf enthusiast, and the boys have been trying to tell him that his golfing days are now over. It appears, however, that Mrs. Johnson plays a good game of golf too.

'26—Lawrence T. Robinson has been transferred to the Boston sales office of the General Electric company.

'26—W. J. Carman is working on the future toll line growth to be installed by the Illinois Bell Telephone company. Mr. Carman has been engaged in this line of work since being transferred to the transmission engineering department several weeks ago.

'26—Paul Saulstrom has been recently transferred from Fort Wayne, Indiana, to Cleveland, Ohio. He is in the motor sales division of the General Electric company.

'26—Merle Dahl joined the ranks of the benedicts in September when he was married to Miss Cleo Smith of Battle Creek, Michigan. Dahl is now in Chicago in the capacity of installation engineer for the American Telephone and Telegraph company.

'26—In Germany as an exchange engineer in the railway engineering department of the Westinghouse company we find Hugo Hanft who is studying the methods and engineering of railways. He was sent to Germany on the 15th of September by the Westinghouse company, where he will study under a German branch of the concern.

'26—Welton V. Johnson is now an engineer in the Relay department of the Westinghouse Electric company at East Pittsburgh. He came back with a lot of praise for the electrical engineering course here at the University of Minnesota and told us that in 1927 that 10 per cent of the men went through the Westinghouse Engineering school at East Pittsburgh were Minnesota men.

'27—Robert Gibson, E. E. Swanson, H. B. Rogers, P. R. Lee, R. B. Robinson, H. F. Farmer, E. B. Berglund, Bertram Hove, and R. V. Malmgren are enrolled in the Westinghouse Electric and Manufacturing company's Graduate Student Course. At present they are located at the East Pittsburgh works of that company.

'27—Hubert F. Wehlitz, who is now working in Chicago, was married to Miss Maude Kimmell, 3405 Minnehaha avenue, on Friday, October 15.

Mechanicals

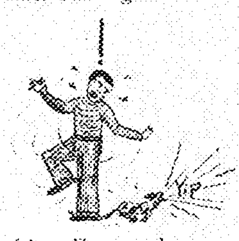
'26—Walter H. Pierce was married to Miss Margaret Wedge of Minneapolis on September 10. Mr. and Mrs. Pierce will make their home in La Salle, Illinois.

'27—Wilbur Chapman has taken a position with the Minnesota Mining and Manufacturing company of St. Paul.

'27—Carl D. Parten and Arthur M. Isaacson have been last heard from in Chicago. They enjoy the work with the Western Electric company there very much.

'27—Ralph A. Richardson took a position with the A. C. Spark Plug company at Flint, Michigan, but little has been heard from him. He must be enjoying himself.

'27—Jay R. Pike accepted the job that the General Motors company offered him last spring, and he is hard at work at Pontiac, Michigan.



'27 — Every now and then someone hears from George Vye, who is now taking up graduate work at the Sheffield Scientific School at Yale University on a fellowship. From what we gather, school work down there keeps a person humping as much as it does at the University. George is piling right into his studies, and we expect him to send us evidence of some marks when he returns home for Christmas vacation.

The Field House

(Continued from page 71)

score feet above the street astride a beam no wider than his foot, now guiding giant derricks with a finger's touch in their gyrating swaying as they swing steel into place—He is the *deus ex machina.* Again we must not pause, but breathlessly hasten lest all our available space be consumed; at any rate, in so doing we will be in style.

After the preliminary ground clearing, building removals, and similar preparations, the footings for our east end columns and arches are poured. We still naively say we "pour" concrete, when it has long been known that good concrete is not a fluid but a plastic mud. Perhaps we should not be so critical of our terminology; ofttimes the term we criticize describes more truthfully—let us proceed. The end columns are raised by the derricks and then braced by the end arch framing. This involves no great difficulty. Next comes the first arch rib. The tie underground has been placed. One-half of the rib is assembled on the ground then turned upright by the derricks. The lower pin must now be placed and it is found that this is very troublesome. So the manner of erection is changed. The two lower portions of the arch up to the knuckle are raised first and braced and straightened by block and tackle. Next the two upper portions are picked up by the derricks and inserted first into the joints at the lower end then raised or lowered until the crown pin holes align and allow the placing of the pin. The rib is braced against the end columns by means of the purlins using wire for temporary fastenings. Soon riveting hammers clatter and the bolts that hold the arch *pro tempore* are chiseled off and replaced by button-like rivet heads and points. The derricks are moved, more arches are raised and braced; the skeleton grows to look like some prehistoric monster's that the vultures have picked clean.

THE longitudinal bracing girders are inserted and riveted into place; the balcony cantilevers are put up. Then comes the placing of the roof. The steel deck sheets are raised one by one, hauled up with ropes to the roof levels. They are put in place and fastened. Hot asphalt is mopped upon the sheets and then in turn the Flaxlinum, roofing felt and slate covered felt go into place. The brick work starts and masons fling the "mud" in place, set the bricks and strike their joints; set their chalk lines that keep their joints true and level and move upward.

Scaffolding grows with the height of the wall until it is nine stories high! Windows and doors, balcony seats, heater platforms and the many sundry accessories and machinery are put in place as fast as possible. Cold weather is at hand and haste is economy. Finally the interior must be painted. A special formula that will give a light blue-gray color is adopted. This paint is very lasting and effective protection for the steel. The interior woodwork, hardware, fixtures and lights, together with the wiring, is installed, painted or otherwise finished. At the east end transformer rooms, locker rooms, lavatories are built with their attendant many plumbing, wiring, hardware and other details.

If the expression were not so trite I would be tempted to say that there are a great multitude of other details worth mentioning that are too "numerous to mention."

The Engineering Library

(Continued from page 69)

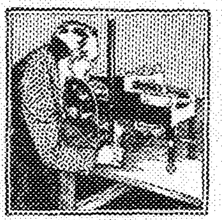
tee in 1894, the library was located on the second floor of the Mechanic Arts building. This room was also used as a drawing room having two drawing tables in it. The collection of books consisted mainly of the civil and mechanical engineering works. The physics, chemistry and electrical departments which were located in the Union had most of their books there. As each department developed and moved from one building to another it kept its own collection of books. The libraries were composed of the latest technical and general works, files of the leading periodicals, charts and other related material.

Shortly after the erection of the Main Engineering building two wings were added, the north one being for the engineering library. Most of the books of general nature and all new books were put in the library at that time although several of the departments felt inclined to keep many of their own books within the department.

THE present library quarters furnish a splendid home for a technical library. The main floor, where there is room for eight library tables of generous size, has well lighted alcoves on each side formed by open shelves of books. Above the main floor is a balcony which encircles the room. Here the walls are also covered with open book shelves. There are no windows on the balcony, but it is well lighted by a skylight which extends the length of the room. Below the main floor is the basement room which is arranged similarly to the main floor with alcoves formed by bookcases, each alcove having two windows in it. The books were fewer when the library was first

(Continued on page 92)

Today telephone cable, carrying hundreds of circuits, crosses Daniel Boone country on the way from New York to Chicago



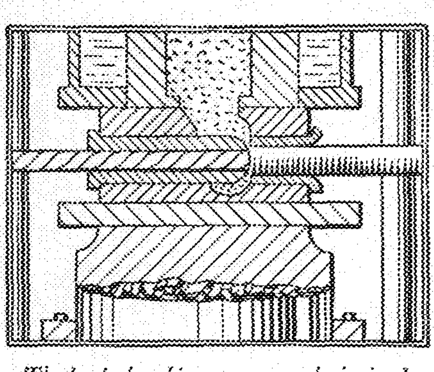
The alloy of lead and antimony which forms the rugged water-tight covering of this cable is but one development among many made in Bell Telephone Laboratories.

In actually building this line, Daniel Boones of telephony blazed a trail of poles and heavy cable through dense woods, over rivers and across five ranges of mountains.

Trail blazing in cable manufacture at Western Electric

ALL the trail blazing and pioneering work of telephony is not done alone in laboratory and field. Western Electric, as manufacturer for the Bell system since 1882, has done its share — for example in the cable shop, helping to make possible the New York to Chicago cable.

The lead press illustrates the practice of the engineers of this company continually to work out new types of machinery that will improve the quality of output and at the same time increase production. This ingenious machine turns out thousands of miles of lead-covered cable every year, with an efficiency far greater than was ever possible under the old laborious hand methods. It is the point of view which seeks the better way that enables Western Electric to supply the nation's ever increasing telephone demands.



The lead sheathing press revolutionized the cable covering process.

Western Electric engineers prepared for present needs long ago, and right now they are getting ready for the future. The men of this company are pioneers —opening up new country in manufacturing methods and blazing the trail to more economical yet more efficient production.

BELL SYSTEM

A nation-wide system of 18,000,000 inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

The Engineering Library

(Continued from page 88)

opened to students in 1913, as only the shelves on the main floor were used. Under the expert guidance of Miss Veblen, the present librarian, the engineering library has grown to over twenty thousand volumes, and it is now ranked as one of the best and most complete technical college libraries in the United States.

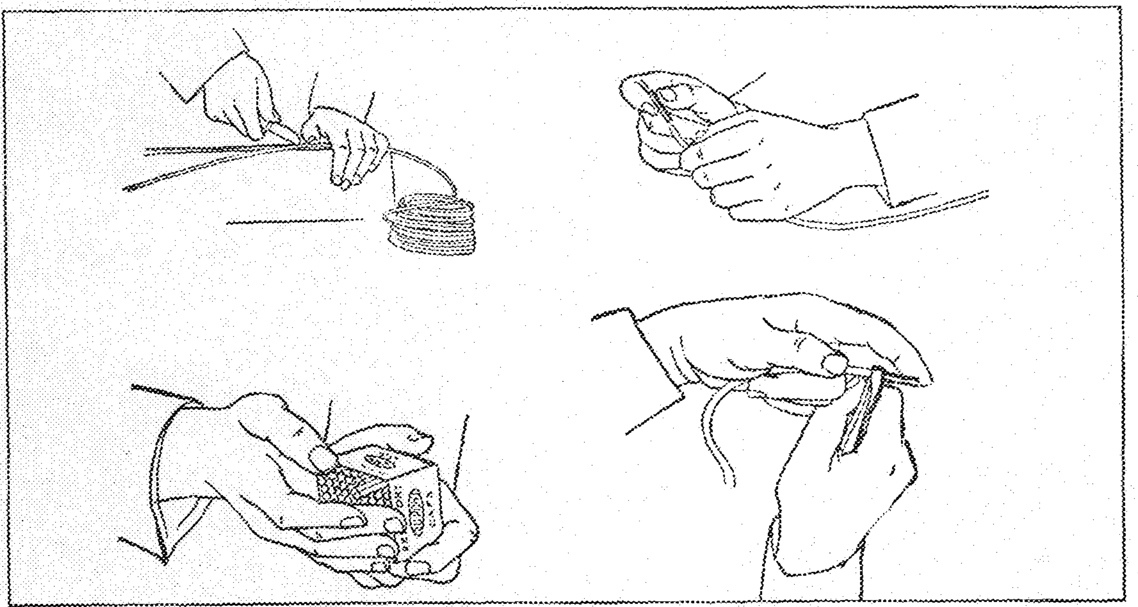
That the library has always been appreciated and used by the students is shown by the yearly reports. In THE MINNESOTA TECHNO-LOG for December, 1920, Professor Zelner has made a complete analysis of the use of the library by students during the period from 1913 to 1920. He has made a graph of seven curves which show the library attendance. Probably his most significant curve is the one which gives the average number of times each student uses the library during the college year. Mr. Zelner's values for the period 1913 to 1920 shows that on the average each student uses the library sixty-three times during the college year.

The policy of the University of Minnesota Library is to center all the departmental libraries of the College of Engineering and Architecture in the main engineering library. The final consolidation of the electrical and mechanical libraries, which had been previously kept in the departmental buildings, was made in June, 1924. At this time there were added over 2,000 books from the electrical department and about 2,600 volumes from the mechanical department. This brought all the reference books of the technical schools into one library affording the user of the library greater ease in finding material. A working collection of architectural books is kept in the architectural reading room on the third floor of the main engineering building. This collection is limited to the books that are used regularly by the students in the architectural department, and are put there for their convenience.

FROM time to time the engineer's library has been enriched by gifts from students, friends, and faculty members. Dr. Eddy, who was a former professor of mechanics, and Dean of the Graduate School, presented in 1919 a very excellent collection of over 700 volumes of mathematical and scientific books. In January, 1918, the Engineer's Club of Minneapolis donated 475 volumes. About 375 choice books on engineering from the collection of Professor Shepardson, former head of the electrical engineering department, were given the library by Mrs. Shepardson. Mr. E. P. Burch, a Minneapolis engineer, gave over a hundred volumes. Dean Leland has given the library many current periodicals and books. Harold Smith of the Engineers book store has been another contributor. THE MINNESOTA TECHNO-LOG gives the library their exchanges from twenty-one schools of the Engineering College Magazines Associated. Mr. G. L. Wilson of the Minneapolis Street Railway company has made many gifts to the library. A number of architectural periodicals have been received from V. F. DeBrauwere and H. W. Jones. Former Dean Shenehon, Professor W. R. Hoag, Mrs. James Forsythe, Mrs. J. J. Flather, Professor A. F. Meyer and many others too numerous to mention have made valuable contributions.

As stated before, the engineering library contains more than 20,000 volumes on engineering, architecture, and related subjects. The estimated value of

Making Primers



Lesson No. 2 of

BLASTERS' HANDBOOK

PRIMING a dynamite cartridge seems like a very simple job when you watch a professional blaster—a thrust into the cartridge, a blasting cap crimped onto the fuse and inserted into the hole, and the fuse tied to the cartridge with a piece of twine.

But each of these apparently simple steps requires experienced handling for the sake of efficiency and safety. Upon proper priming depends ***complete detonation, avoiding the pulling out of detonator, guarding against moisture, easy and safer loading of bore holes.*** There are two methods of detonating a charge—safety fuse and blasting cap or electric blasting caps.

Each step of the several methods of priming a cartridge is fully explained in classroom terms and clearly illustrated in Chapter Two of the *Blasters' Handbook*.

The entire Handbook, in fact, is one of the practical reference and study works found in the classrooms of leading technical schools, colleges and universities. Written out of the experience of du Pont field service men over a great many years and taken from all fields. Meaty, well arranged, and condensed into handy pocket size.

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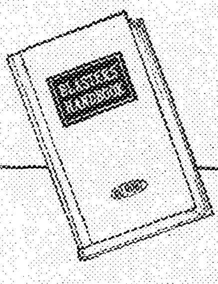

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Without cost or obligation on my part, please send me a copy of the "Blasters' Handbook."

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City .... State ....

the library has been put at approximately $75,000. It is very difficult to put an exact money value on a library because although many of the books would not command a high market value, they could not be duplicated because they may be out of print or of a limited edition.

The engineering library has many current periodicals which deal with engineering and architecture, receiving them from Argentina, Austria, Germany, England, France, Holland, Scotland, Sweden, Italy, Japan, Canada and the United States. These all make a large collection of the best engineering publications of the world. The library also receives the publications of the important engineering societies and institutions such as the American Societies of Civil, Mechanical and Electrical Engineers. These publications contain accurate and useful information contributed by the foremost men in all engineering lines. The engineering library also receives scientific bulletins from twenty-four colleges and universities including several universities in Japan and China.

Many general works and books useful to engineers are to be found in the library. Among these is the Engineering Index. This publication is an index of the latest engineering articles published in periodicals. It lists the title of the article under a general heading, gives the publication in which it may be found, the volume, page and a brief description of the article. There is also the Industrial Arts Index. This is much the same as the Engineering Index except that it contains articles of more general nature.

Other useful works to the engineer are the Statistical Abstracts of the United States which contain all general statistics of recent years on a very wide variety of subjects. For encyclopedias there are the Americana, Britannica, Century, Funk and Wagnall's, New International and the Machinery's. A Thomas Register of American Manufacturers gives the location and address of American manufacturers. The "World Almanac" and "Book of Facts" give a large amount of statistical information and facts. A "Crams Unrivaled Atlas" gives maps and geographical data of all the countries in the world. There is a "Who's Who in Engineering" and an "American Men of Science." They give a list of prominent men in engineering with short biographical sketches. A bibliography of engineering fiction tells of some very good stories dealing with engineering. There is also a valuable and complete collection of handbooks covering many subjects.

The engineering library uses the Dewey decimal system of classification. This classification divides all knowledge into nine main classes with a tenth class for general works. They are:

0	General Works	5	Natural Science
1	Philosophy	6	Useful Arts
2	Religion	7	Fine Arts
3	Sociology	8	Literature
4	Philology	9	History

For example, in the library there is a rare old surveying book published in 1765 during the time of George Washington. Its catalogue number is

En 526.9
F 65

The En tells us that the book belongs to the engineering library. The 526.9 gives the classification under the Dewey system. The F tells us from the list below that the book was published sometime between 1700 and 1799. The 65 tells us what year of that period it was published. The list of letters and the periods which they indicate are as follows:

A	B. C.	K	1840-1849
B	A. D. 1-999	L	1850-1859
C	1000-1499	M	1860-1869
D	1500-1599	N	1870-1879
E	1600-1699	O	1880-1889
F	1700-1799	P	1890-1899
G	1800-1809	Q	1900-1909
H	1810-1819	R	1910-1919
I	1820-1829	S	1920-1929
J	1830-1839		

A book published in 1927 would have the letter S and the number 7 under the classification number.

The library has a dictionary card catalog in which books are listed by author, subject and title all in one alphabet. This enables the classification number to be found very easily. After this is secured a chart at one side of the room shows where the books may be located. This chart shows that the bound architectural periodicals, government reports, and publications of societies may be found up on the balcony. The main floor holds the bulk of the library on open shelves where the reader may consult the books and browse around as much as he desires. The books are numbered from left to right around the room. At the left of the room are the current periodicals on open shelves. Many students and faculty members find the time to spend profitable and pleasurable moments in the perusal of these magazines. Sets of bound periodicals are kept in the basement room below the main floor. Most of these sets date for many years back and afford an immense amount of information for the research worker.

The engineering library is strengthened by its affilation with the Main Uni-

(Continued on page 98)

Steel Sheets that Resist Rust!

The destructive enemy of sheet metal is *rust*. It is successfully combated by the use of protective coatings, or by scientific alloying to resist corrosion. Well made steel alloyed with Copper gives maximum endurance. Insist upon

KEYSTONE

Rust-Resisting Copper Steel

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Keystone Copper Steel gives superior service for roofing, siding, gutters, spouting, culverts, flumes, tanks, and all uses to which sheet metal is adapted—above or below the ground. Our booklet *Facts* tells you why. We manufacture American Bessemer, American Open Hearth, and Keystone Copper Steel Sheets and Tin Plates.

Black Sheets for all purposes
Keystone Copper Steel Sheets
Apollo Best Bloom Galvanized Sheets
Apollo-Keystone Galvanized Sheets
Culvert, Flume, and Tank Stock
Corrugated Sheets
Formed Roofing and Siding Products
Automobile Sheets—all grades
Electrical Sheets, Special Sheets
Deep Drawing and Stamping Stock
Tin and Terne Plates, Black Plate, Etc.

Our Sheet and Tin Mill Products represent the highest standards of quality, and are particularly suited to the requirements of the mining, engineering, and general construction fields. Sold by leading metal merchants. Write nearest District Office.

American Sheet and Tin Plate Company

General Offices: Frick Building, Pittsburgh, Pa.

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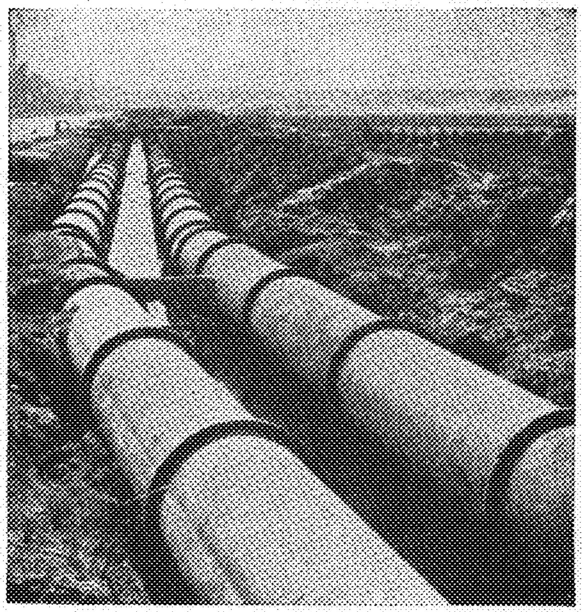
Chicago Cincinnati Denver Detroit New Orleans New York
Philadelphia Pittsburgh St. Louis

Pacific Coast Representatives: UNITED STATES STEEL PRODUCTS CO., San Francisco
Los Angeles Portland Seattle

Export Representatives: UNITED STATES STEEL PRODUCTS CO., New York City



Resists Corrosion

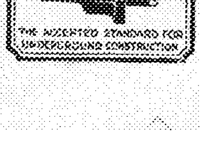
THIS picture, taken in the salt marshes near Kearny, N. J., shows two lines of 30-inch Cast Iron Pipe replacing pipe made of other material. The alternate exposure to the action of salt water and air is a severe test.

While the pipe shown in the picture is subjected to unusual corrosive influences, all underground pipe must be able to withstand corrosion to a greater or less degree. Cast Iron Pipe has this quality. It does not depend on its coating to resist rust; the material itself is rust-resisting. The first Cast Iron Pipe ever laid is in service today at Versailles, France, after two hundred and sixty years' service.

THE CAST IRON PIPE PUBLICITY BUREAU
Peoples Gas Bldg., Chicago

CAST IRON PIPE

Our new booklet, "Planning a Waterworks System," which covers the problem of water for the small town, will be sent on request



Send for booklet, "Cast Iron Pipe for Industrial Service," showing interesting installations to meet special problems

Electric Discharges *for* Petroleum Production

(Continued from page 74)

ment was the preparation, purification and analysis of the ethane used. The experimenters accomplished this as follows:

"The ethane was obtained from a tank, and was said to contain 10 per cent ethylene. We led it through bromine water and KOH solution, over solid KOH and P_2O_5, and condensed it with liquified ethane. The permanent gases were pumped off from the liquified ethane. The liquid air trap was then removed and connected to a small condensation trap connected to the reaction volume. We always had a larger amount of liquified ethane than was necessary to fill the reaction system to the desired pressure. The ethane was thus distilled from one trap into the other, and the process amounted to a fractionation. The reaction vessel was again pumped out while the ethane was still liquid, thus removing permanent gases to a further extent. Combustion with pure oxygen (from $KMnO_4$) gave the following results: Ethane calculated from CO_2 formed, 98.17 per cent; ethane calculated from O_2 used 102.30 per cent; average 100.25 per cent. We believe we used as pure ethane as can be produced without going to extreme methods of purification."

In conducting the experiments several different types of electric discharges were used in order to determine the effects of each. Accordingly, quoting the paper, "The first experiment was carried out by employing a large induction coil at 30 cycles. Since our object was to find out whether a reaction would take place at all, the secondary voltage and current were not measured. Liquid drops appeared in small amount, and the resulting gas phase was analyzed." With this type of electrical discharge there was left in the residue in addition to drops of oil, ethane, propane, butane and pentane gases.

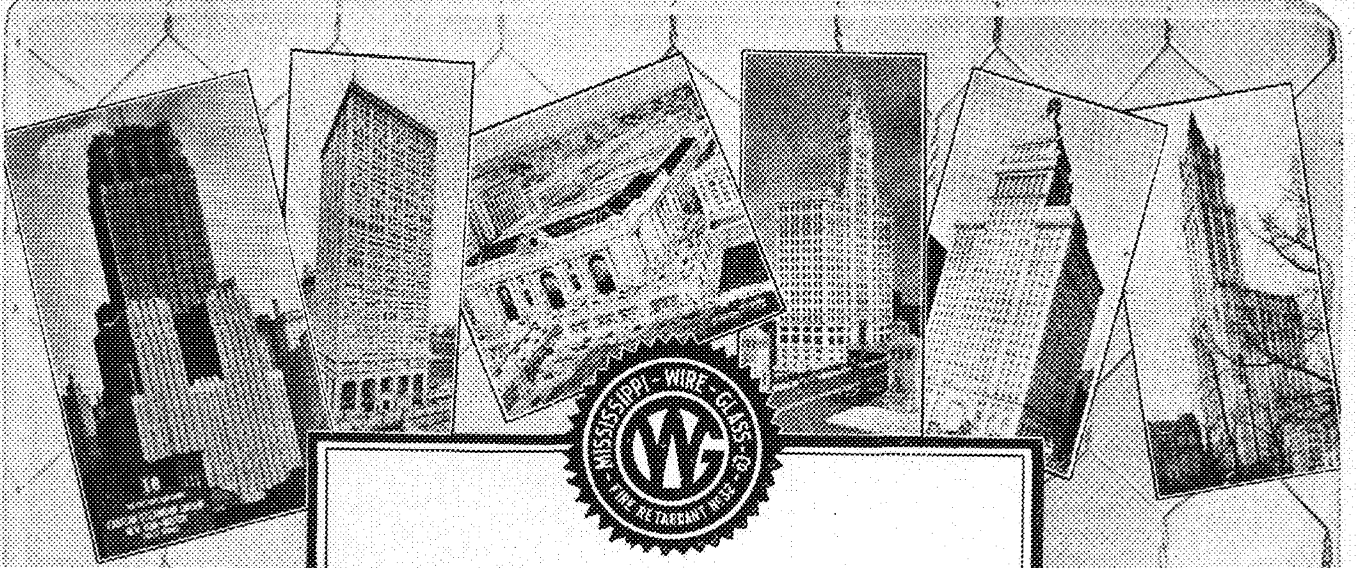
"WE next used a Thordarson transformer. With 12,000 volts on the secondary we again obtained decomposition," say the investigators. On this type of discharge drops of oil remained, and more varieties of gases were left in the residue.

The experimenters wanted to analyze the substance, but due to the small amounts of oil obtained some difficulty was experienced. So they ran experiments on a "production basis," and obtained a total of five grams of oil.

"From our previous experience we knew that the application of the discharge for a period of three hours would decompose most of the ethane. After each run the reaction vessel was pumped out and all the gaseous reaction products that would vaporize were pumped off. Only the liquid clinging to the glass walls of the ozonizer remained. It slowly ran into the condensation trap, but was subjected to the electric discharge during the next run. The liquid products formed initially were undoubtedly further changed by the discharge, for we observed many times that liquid rods formed by drops bridging the distance 1 mm. between the inner and outer walls of the ozonizer would gradually enlarge into ring-shaped structures filled with gas.

"It is evident that the liquid obtained would be a very high condensation product of ethane. While it appears that no other investigators have made a detailed study of ethane under the influence of silent discharge, ethylene has been so studied by several experimenters."

Although not all of the ethane gas used in the experiments was converted into oil, a good percentage was. On a



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total of 61 runs 38 per cent by weight of the ethane used was converted into oil. In different experiments the percentage of conversion runs as high as 44.4 per cent and 55 per cent conversion. This last value is close to the figure obtained by Dr. Lind when he converted into oil 56 per cent of the ethane reacted on by alpha ray bombardment from radon.

In concluding, the investigators say, "Since we had to manipulate the oil in our further research regarding its properties, we attempted to find out if it would absorb oxygen from the air. We placed 10 cc. of oxygen (NTP) overnight in the reaction vessel containing some liquid oil, but no measurable absorption took place. We concluded that the process of absorption is a slow one if it exists."

They found that upon heating the oil to 290 degrees Centigrade in an open test tube some distillation took place. The residue was darker in color although no extensive charring took place. In further experiments Drs. Lind and Glockler will try to fractionate the liquid oil and study the properties of the individual fractions. In further work it is also proposed to study the various hydrocarbons such as methane, propane, etc., under all sorts of electrical conditions and to analyze the reaction products.

This research is being carried out at Minnesota under a grant received from the American Petroleum Institute under the auspices of the central petroleum committee of the National Research Council, Washington, D. C. It has been largely through the efforts of Dr. Lind that Minnesota has been granted this research by the American Petroleum Institute.

Twenty Acres for Austin Athletes

(Continued from page 75)

to accommodate the cars of the spectators to the athletic events. Grounds to the north about the volley ball and basket ball courts will also be used for parking.

There are no plans for the erection of a fence around the field as the need is yet not felt for that expenditure of money. The orchard situated on a slight rise of ground in the southwest corner is to remain as the beauty spot of the entire athletic field, acting as a setting for the wooden stands as seen from the entrance.

In discussing his work on the design, Professor Zelner spoke highly of the cooperation of the Austin school board, and city officials. With the beginning of the fall term of school, Superintendent of Schools Nevlen, and Athletic Coach Sangster of the Austin schools took over supervision of the construction that is now going on at Austin. At present the indication is that the work on the various courts will be nearly complete by spring.

The Engineering Library

(Continued from page 94)

versity Library under Mr. Frank K. Walter, University librarian. Each department of engineering also has a representative on the library committee which supervises the spending of over eleven hundred dollars a year for new books for the engineering library. Professor Parcel of the civil engineering department is the chairman. The representatives are Professor Kirchner of the drawing, Professor Ryan of electrical, Professor Martenis of mechanical, Professor Brooks of mathematics, Professor Rowley of the experimental department, Professor Mann of the architectural, and Mr. Richardson of the rhetoric department.

Band Goes to Michigan

(Continued from page 73)

On the Michigan trip it was necessary to leave 30 members at home, but the 100 who went, outnumbered the Michigan band.

Engineers make up a large percentage of the membership of the band. As in past years, they cooperate with the management in maintaining the high standards of the organization.

Those from the technical campus who are members of the band this year are Rex S. Anderson, John H. Bachman, Francis R. Colton, Roy H. Comstock, Gordon Conrad, E. Lorenzo Fritzberg, Richard Furber, James E. Holst, Paul K. Honey, Lewis S. Miner, Floyd M. Nelson, Henry O. Ogren, Roswell F. Schaller, Justin E. Schradle, C. Theodore Skanse, Mirl C. Solberg, Esbern C. Sorensen, James E. Specht, Stanton E. Wallin, Le Roy Whitlock and H. Russell Williams.

Paul B. Nelson, electrical engineering graduate of 1926 who is now in Chicago, was manager of the band last year.

News from the Technical Campus

(Continued from page 78)

Fiene viewed prospects with a large company. W. A. Schweppe reviewed to the group his favorable experiences during his year with the student course of the Westinghouse Manufacturing company.

In the business part of the meeting announcement was made that Glendon Brown, and Professor Kuhlman are to be representatives to the regional convention of the A. I. E. E. which is to be held in Chicago late in November. Plans for future meetings of the local branch include a dinner meeting and inspection trip at a Minneapolis telephone exchange, smokers, movies, and prominent speakers. Joint meetings with the other groups are planned. It was also pointed out $100 was the first prize for papers submitted to the A. I. E. E. this fall. A paper on any electrical engineering subject may be turned in.

Committees as appointed by Brown to serve during the year are: board of control, John Kriechbaum, Glenn Williams, and a sophomore to be elected; membership committee, Sheldon Johnson, Leon Mears, and a sophomore; meetings and papers, Clint Hawkins, Ed Kueffer, and a sophomore; publicity, Lawrence A. Clousing, Donald Bohrer.

Engineers Are Appointed To Major R. O. T. C. Positions

AGAIN in the R. O. T. C. units here at the university the engineers have shown their excellence. Following the precedent of the last several years engineers again hold important offices. Richard Lindsay, sophomore electrical, has been appointed Cadet Colonel of the R. O. T. C. to succeed Stewart Bailey, who is an electrical engineering graduate of this spring. Gordon Harris, senior electrical, was appointed as Lieutenant Colonel.

Cadet Colonel Lindsay will lead the military ball to be given December 2, and he will also officiate at the annual spring formal inspection of the entire cadet corps. Gordon Harris is in charge of the arrangements of the dance.

Personnel Men Interview Electrical Seniors

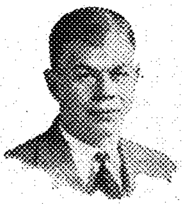
DR. ROBERTS, personnel man for the Westinghouse Electric and Manufacturing company on November 28 interviewed senior electrical students. The purpose of his visit was to pick men for the student graduate course which Westinghouse offers.

As Dr. Roberts interviews more than 1,000 students in various universities, Herbert Farmer, E '27, was sent as a forerunner in order to "speed up" the work by giving to the students general information.

That Minnesota has very good graduates and a very good engineering course is the opinion of the Westinghouse company. In the student graduate course of Westinghouse started last July, Minnesota had the largest representation of any engineering college in the country. Graduates from here are now distributed throughout the entire Westinghouse organization.

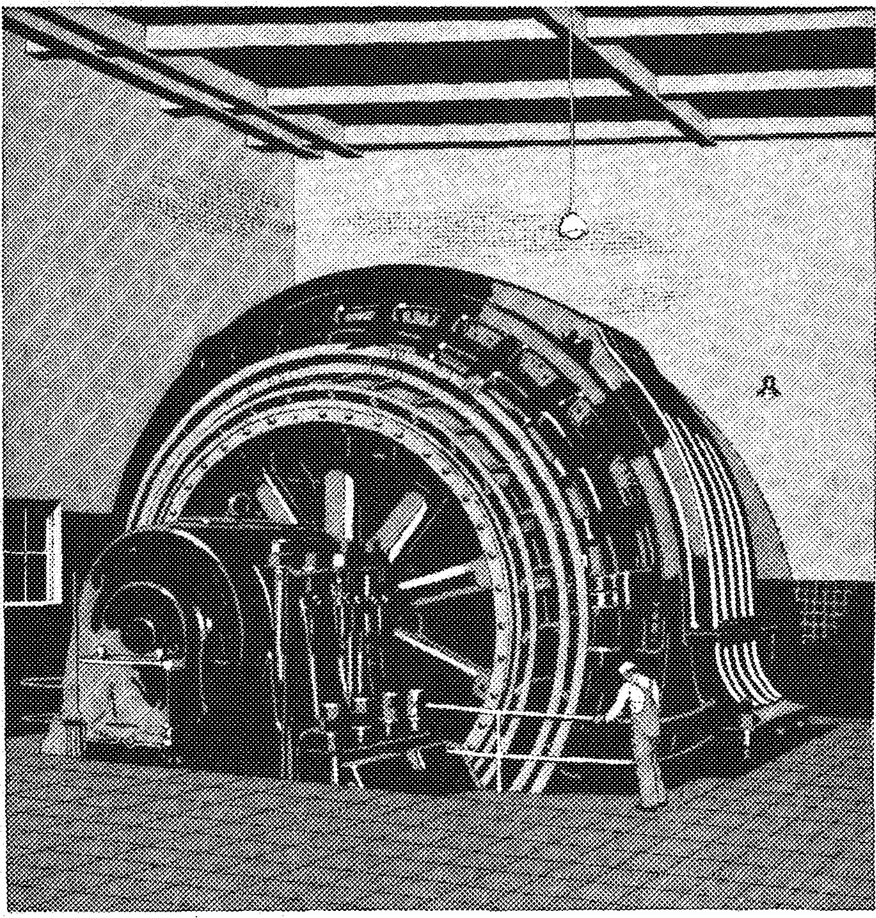
In the next few months representatives from the various large industrial concerns will interview the seniors.

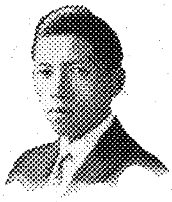
N. D. COOPER,
General Engineer,
University of Fla., '22



J. J. MELLON,
General Engineer,
Rensselaer '24

B. L. HAYFORD,
Switchboard Engineer,
Syracuse '22





A. P. DING,
Substation Engineer,
Oregon Agricultural '21

J. C. GILBERT,
Service Engineer,
Bliss Electrical '22

R. G. DAILEY,
Headquarters Correspondent,
M. I. T. '24

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

The Homestead Steel Mills

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

STAND on the hill-top near Homestead, Pennsylvania, and look out over the Carnegie Steel Company's vast works. Your eye falls on a huge new building, covering 30 acres. It is the structural steel department, and here electricity performs every mechanical operation in steel rolling from the soaking pits on through to the shipping department.

This Homestead electrification, predominantly Westinghouse, is one of the most notable in history—notable because of the number and size of the motors employed and notable because of new features of automatic control introduced for the first time.

This is a type of engineering that only an organization of the size and resources of Westinghouse can undertake. Achieving the stupendous, the never-before-undertaken, is not rare here. Hence young men of capacity, of enterprise, of genius, are offered much to challenge their imaginations and abilities.

In one unit of the new Homestead Mill is a reversing motor rated at 8,000 h.p. and 40 r.p.m. (pictured above), the largest single-armature motor ever built. This motor and all the mill accessories are controlled by two men. They maneuver steel ingots as heavy as 30,000 lbs. There is a total of 336 motors in the new mill, of which 49,000 h.p. are main roll drive motors and 50,935 h.p. are auxiliaries.

Westinghouse

Luca Della Robbia (1400-1482), the first of the famous Florentine family, developed to a point of artistic perfection the intricate technique of enameling clay.

Borrowing fire from Della Robbia

MASTERS of Art they were. Masters of enameling on clay. Their gems of modeling covered with brilliant colors are unequaled today. And the gifted craftsmen of Venice and Limoges have left us superb proof of their ability to apply enamel to metal.

That enamel can be something besides ornamental, that it can actually be useful, is a discovery and a development of this age of machinery and engineering. Step by step the art has become a science. Better metal, better glazes, better methods, and better heat—electric heat.

The glowing units of the electric furnace give a heat that is perfectly uniform and constant—vital factors if the enamel is to be smooth. And in the electric furnace there is no smoke to mar the glistening surface.

Such stories are legion. With electric heat as an ally, manufacturers offer us today hundreds of well-finished products. Even an army of men using Della Robbia's methods could not do this work at any cost.

General Electric engineers have applied electric heating to processes used for bath-tubs and jewelry, for cast iron and bread, for tool steel and glue pots. In the G-E booklet entitled "Electric Heat in Industry" you will get some idea of its range of application and of the possible value of electric heat to any manufacturing business.

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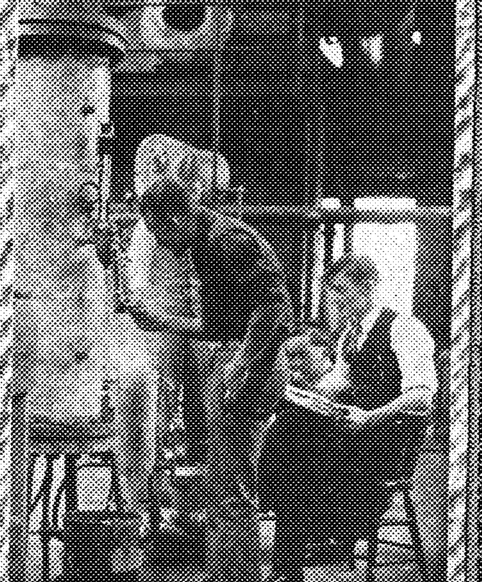
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

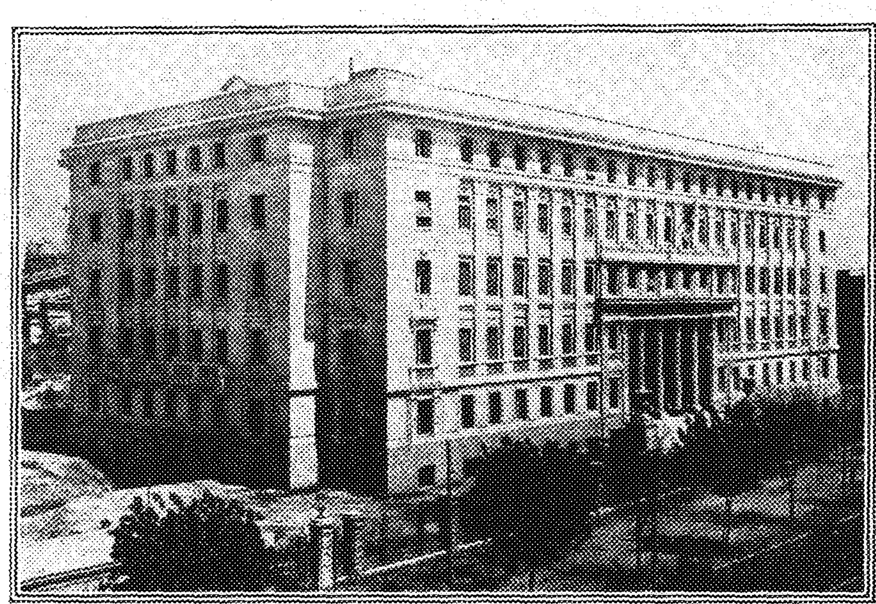
MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



HEAT ENGINES LABORATORY

Volume VIII JANUARY 1928 Number 4

Pharaoh Wrote Few Letters



POST OFFICE, CAIRO, EGYPT

Now during the tourist season, the mails out of Cairo are tremendously heavy. And no wonder! Everyone who travels in Egypt, who comes into contact with the most ancient of civilizations, must say something about his impressions to someone—even if he has hitherto been a lazy correspondent. He may send only a postal card showing the Great Pyramid with "X showing the spot where I ate my luncheon." But he must write something!

And since the discovery of the tomb of Tutankhamen, tourists have multiplied, impressions have been voluminous, and the mails have increased enormously. "Of course, you can't imagine it without being here, but I simply must tell you about....." And so on.

It is very lucky for the correspondents that with her wonders of antiquity, Egypt did not also inherit the ancient postal system. Only the Pharaohs and the great officers of state could indulge in the luxury of corresponding with a foreign country—and a letter from the King of Egypt to the King of Babylon might take months in transit. Some of these royal letters have come down to us. They are very long, full of elaborate salutations and important news—as if their writers considered their composition the event of a season.

All things considered, we may be grateful that the modern postal system of Egypt is what it is—efficient, orderly, up-to-date. Of course, the Cairo Post Office is equipped with Otis Elevators.

So with the advance of civilization, Otis, the symbol of twentieth century convenience, has been put at the service of the Pharaohs of Egypt in spreading their fame far beyond any worlds which they could even have dreamed of! The pyramid builders would, we feel sure, appreciate the marvel.

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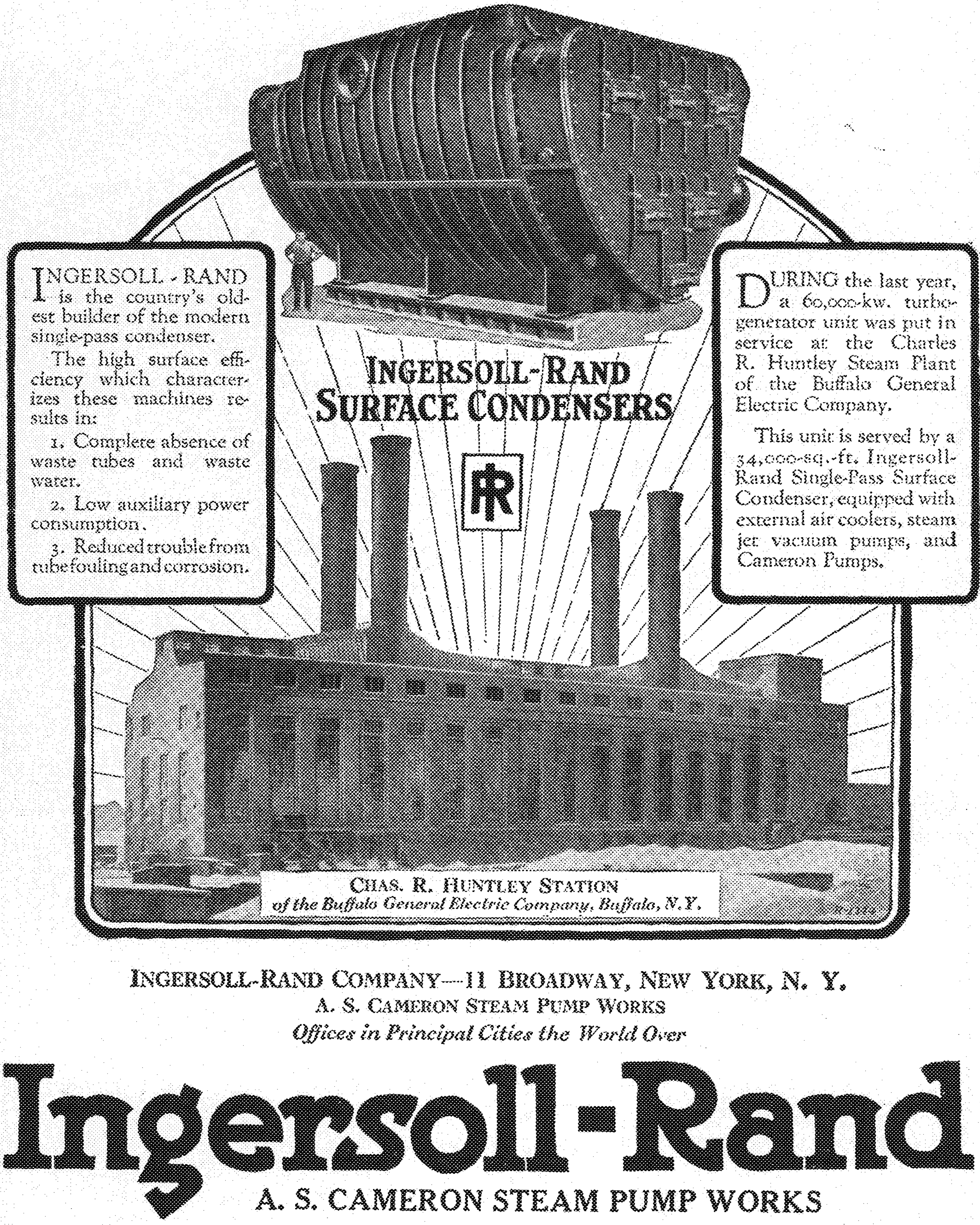
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TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

Published monthly from October to June inclusive, by the TECHNO-LOG *Association, composed of the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines of the University of Minnesota.*

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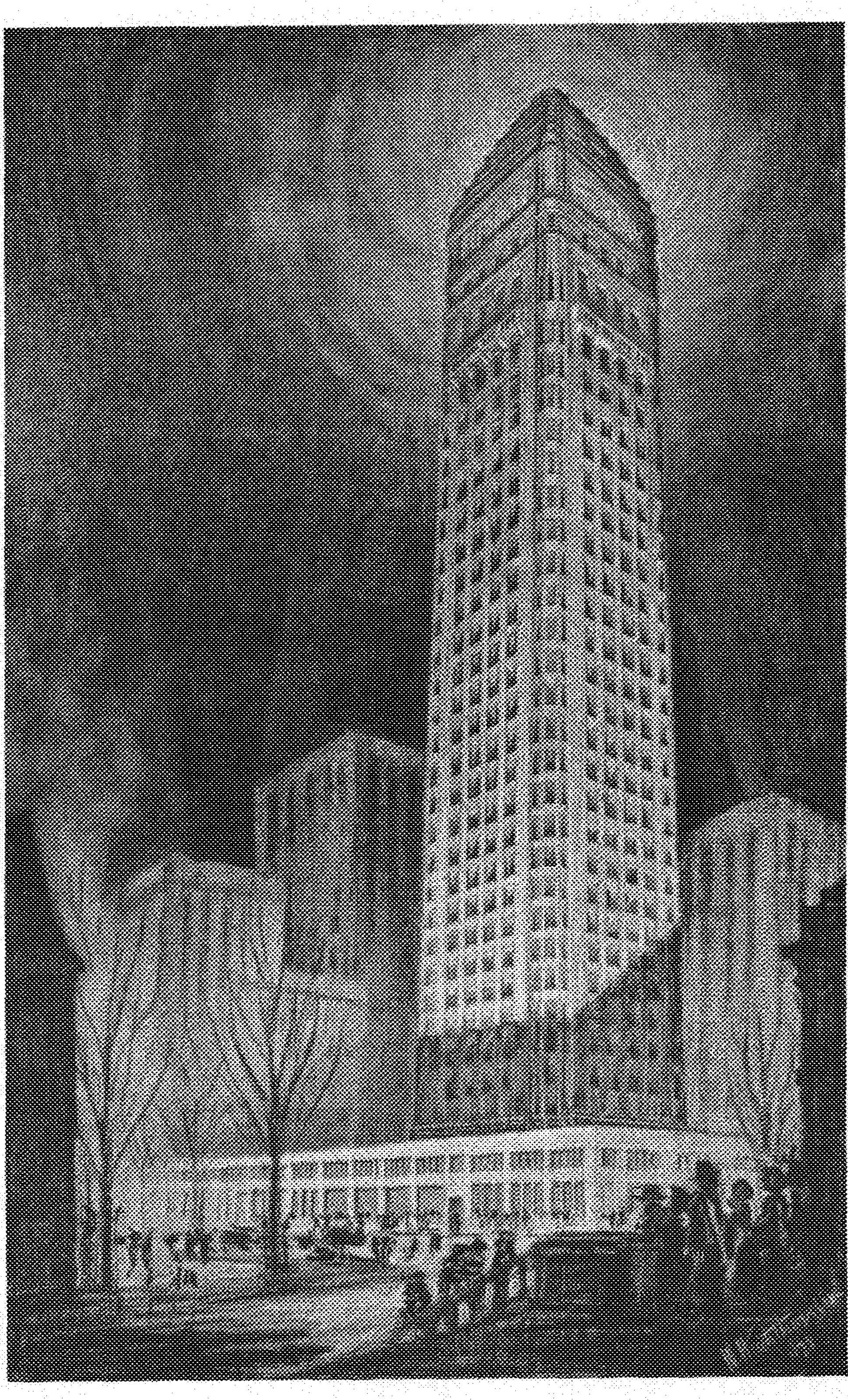


The Foshay Tower

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII JANUARY 1928 Number 4

Details of the Foshay Tower

This structure, now under construction in Minneapolis, is patterned after the Washington Monument. It is to be taller than any building in the Northwest

By Albert W. Morse, E. '29

ARCHITECTURAL features embodied in the design of The Foshay Tower, now under construction in Minneapolis, make this building of particular interest to the engineer.

Its unusual height of 30 stories, greater than that of any other Minneapolis building, or of any as yet announced, has a certain public appeal, and it is probable that The Foshay Tower heralds a period of construction to be characterized by a group of buildings which will materially alter the Minneapolis sky line.

In overcoming the problems which would arise from the design of a building of this type, the University of Minnesota has played an important part, since the men intimately identified with the work received their training here. G. R. Magney and W. H. Tusler of the firm of Magney & Tusler, Inc., the architects, are Minnesota men. Mr. Magney completed a special course in architecture and engineering in 1905, and Mr. Tusler graduated from the College of Science, Literature and the Arts. Leon E. Arnal, the designer of the building, is a professor of architecture at Minnesota. In addition to these men, there are about a dozen identified with the firm who are former students of the College of Engineering and Architecture.

The Foshay Tower is patterned after the Washington monument, and the tapering outside walls of the tower converge at the rate of about 4 inches to each floor, extending from the second floor to the roof. The architects considered that this was too great a taper to permit the running of the wall columns vertically, with an off set at splices, so they are built at an angle to conform with the outside walls. At the base of the tower the dimensions are 81 ft. x 87 ft., and the walls converge to a floor area of 59 ft. x 65 ft. at the base of the pyramidal roof.

To insure stability for so slender a structure, the footings were run to a depth of 62 ft. below street level, extending 12 ft. into rock, the last 8 ft. being below standing-water level. Borings were made at the center of each caisson excavation, so as to determine the structure of the rock ledge, and this in turn governed the construction of the caissons.

A coffer-dam was used in the excavation, and to accommodate the earth pressure which later is to be carried by the building, in addition to the wind pressure, provision had to be made against rather large shearing forces at the foundation. A horizontal system of trusses in the basement floor is intended to transfer these forces to the walls, and from there they will be taken to the foundation by means of vertical bracing.

Sub-basement excavation extends 50 feet below street level.

Provision for wind stress, occasioned by a rather large bending moment of the steel columns, was one of the chief considerations in the design of the tower, and after this had been provided for it was found that an additional provision for the dead and live loads was unnecessary. Columns and girders with especially designed wind-bracing features, including brackets at the ends of the girders to maintain rigidity, are intended to care for this wind stress, with the reinforced concrete floors acting as stiff diaphragms in resisting the tensional action caused by the wind.

Thirty pounds for each square foot of exposed surface is the wind requirement of the Minneapolis Building Inspector's office, and this is the equivalent of a 97 mile-per-hour wind. It is believed that the maximum wind velocity recorded by the federal weather bureau for this district is 76 miles per hour, the equivalent of about 15.5 pounds per square foot. Minneapolis is not in what is known as the tornado belt, which is liable to receive wind velocities up to 137 miles per hour, or about 60 pounds per square foot. A hurricane recorded for August 20, 1904, was the most recent one in this vicinity, and in these wind disturbances of a velocity of 100 miles per hour are rarely exceeded. It is believed that with the general requirements as specified by the office of the Minneapolis building inspector, any building so designed could safely withstand any storm which might occur in this district.

With the allowable unit stresses one-fourth of the amounts which would be necessary to cause failure of the building, it becomes apparent that 120 pounds per square foot wind pressure would be necessary to cause destruction.

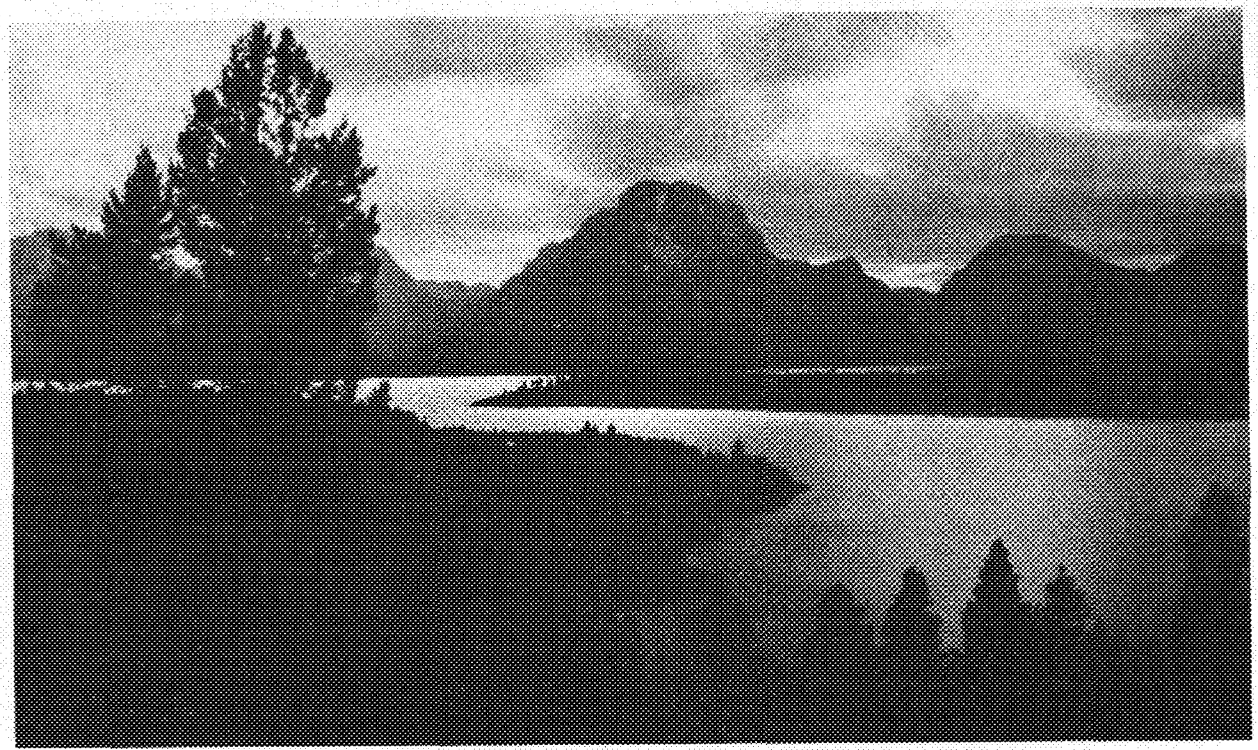
A further requirement of the Minneapolis Building Inspector's office is that overturning moment created by wind cannot be greater than 75 per cent of the stability moment of dead weight, and in the Foshay Tower this is 14 per cent.

LOADS varying between three and four million pounds are carried by the inside columns, which in turn are sustained by steel grillages built with steel slabs in the caissons. It is believed that the dead load carried by a column by far exceeds what uplift may be caused by wind, making unnecessary any anchorage to allow for this uplift after erection of the steel has been completed.

Specifications call for a reinforced concrete chimney, five feet in diameter, with the top at the point of the pyramidal roof, to be invisible from the street. This chimney, together with the elevators, stairway, toilets, janitors' closets and pipe space is to be carried up through the center of the building, thus insuring the maximum of light and air, with all office space on the outside.

It is planned to provide storage tanks in the basement, on the seventeenth floor and in the roof space for fire protection, with hose connections on each story. The tanks on the upper floors are to be supplied with city water by pumping.

(Continued on page 124)



JACKSON'S LAKE AT SUNSET

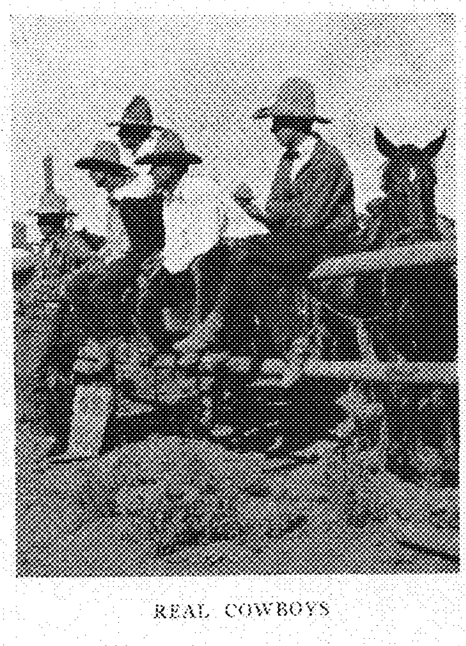
What Ho? Jackson's Hole!

By CHARLES E. PETERSON

Sketches and photographs by the writer.

LATE in June last summer the three of us—Perry Bean, Chief of Party, Francis Freeland, transitman, and I, rodman, drove a government Dodge truck up from Denver across the Wyoming desert into Jackson's Hole. The U. S. Bureau of Public Roads, District Number Three, Denver Office, was to operate six separate surveying projects in the Hole that season, and we were being sent out to supplement the parties already working there. It was noon of a cold wet day when we entered the mouth of the "Hoback" just below the K. C. Ranch. The air was damp and chilly, and the clouds hung low on the peaks about us. We wallowed through the slippery landslides for which this canyon is notorious—slides full of rock floating in mud slick as grease. The road skirts the feet of cliffs a thousand feet high overhanging the swift Hoback river, then swollen with the spring snow water from the hills about us. After some twenty perilous miles of rock falls and washouts on oneway curves, we reached the floor of that great isolated mountain valley, Jackson's Hole.

The early days in this part of western Wyoming were romantic times of pioneering and Indian fighting. It is more than a hundred years since the first adventurous whites entered this country which was then the favorite hunting ground for the roving tribes of Black Feet, Crows, Flatheads and other rocky mountain Indians. They were the hardy scouts and trappers of the fur companies. Such men as Jim Bridger, Kit Carson, John Hoback, Capt. Bonneville, Father DeSmet and General John Fremont were intimately connected with its early history. There was an abundance of valuable fur bearers, and a great trapping industry was built up with the trading center at the Green River Rendezvous. For several years the country was full of trappers and traders, but when beaver hats went out of style, about 1845, the business fell off. From that time cattle raising was the sole industry of a scant population, until the modern time of tourist travel. Now "dude ranches" are the principal industry. They are scattered here and there in favorable locations about the country and have become very successful. The country is a splendid place for recreation. It will become very popular when it is discovered in the general search for "summer playgrounds."



REAL COWBOYS

A GREAT sagebrush flat overhung by startling granite peaks—the Snake river meandering southward—great forests of pine, spruce, fir and aspen, full of big game—mountain lakes of romantic beauty—a country remote from railroads and cities—Jackson's Hole. On the west is the Teton Range and the Idaho line; to the north is Yellowstone Park; the east side is bounded by the peaks along the continental divide; and off to the south is the Green river slope running over into Utah. The whole valley, an area some fifty by sixty miles, is drained by the Snake river, which pierces the mountains off through a precipitous gorge to the southwest.

Jackson is the only town in the county, and claims a double distinction as metropolis and the seat of government. The office of the Bureau is located here, and W. H. Curwen, a Wisconsin man, is in charge. For several days we stopped here at the Crabtree Hotel, driving out to Hoback canyon every morning in an ancient and battered Ford. "Buzz" McCain, from Iowa Wesleyan, "chauffed" us out and back. What with getting the car cranked, we usually reached work about noon. Then it was time to eat, and we had dinner in the contractor's camp.

After eating, maybe a game of horseshoes. Then we walked out to the job. About four o'clock we hiked back and put the equipment away. Swimming was then in order. It consisted of hanging onto a branch and letting one's self down into the cold swift river water. It was recommended for "putting hair on your chest." When out and dry we cranked up the Ford and drove back to town. When there were no blowouts, we made the hotel just in time for supper. Evenings in this little tie-rack town were uneventful, and were passed by telling yarns around the stove.

One night there was a movie in town. I volunteered to play the piano during the show—it was Wallace Beery and Raymond Hatton in "We're in the Navy Now"—if I could get into the dance free afterwards. Somehow I got through the performance without any physical violence to myself, and finally the lights came on. The chairs were shoved aside by volunteers among the patrons, and the orchestra moved in. Whole families, from babies to grandfathers, ranged along the walls. It was someone's wedding dance, admission free!

THIS was my first contact with surveying in highway engineering. I had always supposed that highways were built by merely knocking tops off the hills and filling up the holes according to the contractor's fancy. I did not know that roads are designed in the drafting room from detailed data taken in the field. I do now. The Hoback canyon project would be a baptism worthy of any engineer. The line follows the bottom of the canyon through rock slides which drop into the river at a fearful angle. Any mis-step loosed an avalanche of rocks, and sent them clattering down into the rapids below. The Hoback canyon highway is a very expensive undertaking, and when completed will have set the Bureau's funds back several million dollars. The chief difficulty in the operations is digging out the slides: which seem to run endlessly. A large gasoline shovel was used for pioneering and handled the work very efficiently. The project is being built in sections. The present operations cover some two miles and are connected across the river to the old road by a temporary bridge.

We had the Fourth of July off. Most of the town went up to the K. C. Ranch to celebrate. In the meantime a heavy storm came up, there was another slide in the canyon and they had to stay up there. As for myself, I climbed a range of hills south of town, and observed my annual Fourth of July festivity by sitting on a snowbank. The country there is about 7,000 feet above sea level, and the snow stays late into the summer.

The next day we moved up to Moran in the north end of the hole. We packed up the truck with our sleeping rolls, cots, axes, stakes, instrument cases, and other equipment. We picked up two others who were to be with us the remainder of the season—"Peck" Miner, laborer, who was with the A.E.F. in Siberia, and "Chuck" Deloney, chainman. Chuck was a Mormon. About half of the people in the Hole are followers of the Church of the Latter Day Saints, though I did not discover this for a long time. They are just like other people. Chuck's father is in the legislature in Cheyenne.

We were pretty heavily loaded, and we drew lots to see who would sit in the back end and eat up the exhaust. The fumes in the back end of a Dodge truck are terrible. We had to take an old road along the base of the Tetons. The regular highway was closed because a bridge on the Gros Ventre river had been carried away in a flood three weeks before.

IN 1925 when the Santa Barbara earthquake shook the western states, the side of a mountain slid down into the draw where the Gros Ventre river comes down from the Continental Divide. It backed the waters over the timber and formed a sudden lake seven miles long and two hundred feet deep. This body of water persisted until last spring, but one morning the dam went out and so did everything else in the val-

PENCIL SKETCH OF JACKSON LAKE

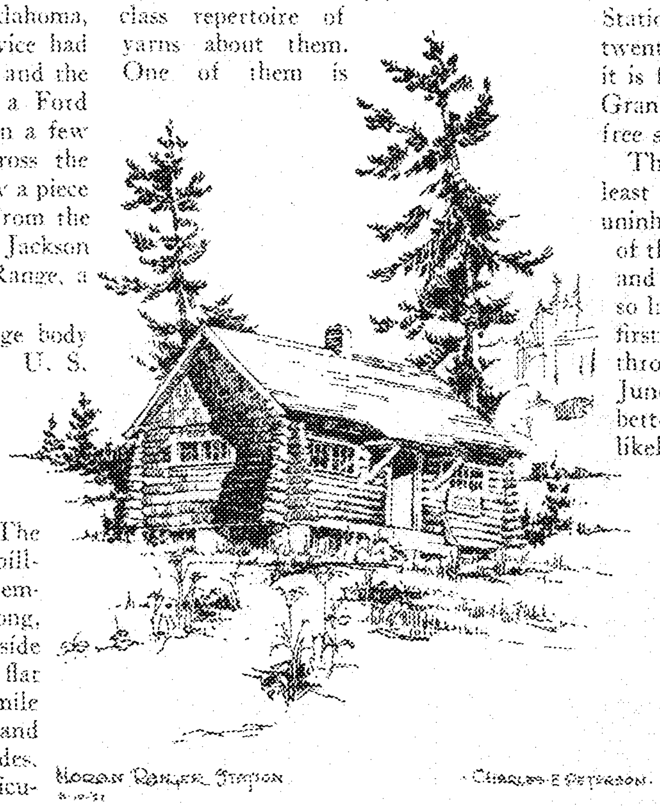
ley, including the little town of Kelly, four miles below. The natives had just been warned of this and only half a dozen were drowned, though all the ranches and bridges were swept away. Later, some wag posted the sign on the site, "HAS ANYBODY HERE SEEN KELLY?"

AFTER twenty-five miles of fording creeks and leaping sage brush we drew up at Moran Ranger Station. Here were two more men—Homer Gray, levelman, and William Boatman, rodman. Gray was from Gunnisson, Colorado, and formerly a student at Boulder; Boatman was from Tulsa, Oklahoma, part Indian. The Forestry Service had given the cabin for the summer, and the Reclamation Service loaned us a Ford touring car. The cabin is within a few feet of the main highway, across the river from Moran. It is as pretty a piece of log work as one can find. From the front door one can look across Jackson lake to the magnificent Teton Range, a splendid mountain panorama.

Jackson lake, naturally a large body of water was taken over as a U. S. reclamation project. A large dam was thrown across the end of the lake and the water level raised forty feet. The dam was begun in 1908 and finished in 1912 at a cost of $1,250,000. The water runs through a concrete spillway. The dam is an earthen embankment about half a mile long, reaching from a low hill on one side of the river off into a swampy flat on the other. For a third of a mile down, the river has been dredged and the debris banked along the sides. This stretch of the river, particularly below the dam, is full of trout, and carloads of them were pulled out last season. They average several pounds apiece. The largest trout I saw this summer was a "mackinaw" pulled out of the lake, which weighed twenty-two pounds—a good sized trout, but not the largest ever caught there. The natural supply of fish in this stream must be enormous, for though the stock has never been replenished the fish seem as plentiful as ever.

Moran is just at the foot of the dam. The town consists of Teton Lodge and its guest cabins, a small garage and store, and one frame house, around which are grouped a large assortment of barns and sheds. The hotel office is the social center of the place, by virtue of its easy chairs and cheerful fireplace. Here, too, is the local post office, open every day from seven in the morning till twelve at night, including Sunday, presided over by a cheerful little Theta from Utah. On one side is the "roughneck" dining room where we ate, and on another side the lobby where we were wont to dance of evenings.

Coming up to the camp late at night it was always nice to stop at the dam office and hold a session with "Cap" McDermott. He was the night watchman, and was usually found at this time reading Argosy, or something of lighter vein by the light of a gasoline lamp. "Cap" is one of the oldest of the old timers. He has done everything from running a locomotive on a Mexican railroad to visiting once in St. Paul. "Cap" has known most of the characters, good and bad of earlier days, and has a first class repertoire of yarns about them. One of them is



MORAN RANGER STATION

about the author and sportsman, Ed. Harrington. He was doing some carpentry for "Cap" when he disappeared one day. He was next seen when he held up eight Yellowstone stage coaches single-handed and got away with the loot. Some say Harrington was drowned shooting the Snake river canyon in a canoe. "Cap" says he was shot in a restaurant in Los Angeles. Anyway it makes an interesting story, and what more does one want?

Sometimes we went to dances at Jenny lake, or drove fifteen miles to Menor's Ferry for our laundry. Distances are long out there. Our mail was two days in getting to a railroad. Sometimes there would be a chicken fry or a marshmallow toast with a bunch from the Lodge. Once we had charivari out at a lonely ranch in the middle of the night, with a great noise of six-shooters and bells. The groom came to the door of the cabin. He had on a pair of slippers with luminous buttons on them.

Moran is located on an important highway junction. The road from Casper, Lander and other eastern points comes in over the Continental Divide on Twogwotee Pass at 9,000 feet, and drops down into Jackson's Hole uniting with the road from Rock Springs to the south and Idaho Falls to the west. The road then strikes off northward and crosses the gravel flats of Pilgrim Creek, skirts the edge of Jackson's lake, passing Leek's camp and the Flag Ranch and entering Yellowstone Park at the Snake River Station on the south boundary, about twenty miles from Moran. From there it is forty miles to West Thumb on the Grand Loop, and you are in the land of free steam, hot mud and one-way roads.

This South Entrance is at present the least used of the four, because of the uninhabited country it traverses, because of the imperfect conditions of the roads, and because the snow keeps it blocked so late in the season. Last summer the first Yellowstone flood did not break through the drifts until the 29th of June. The Hole country is becoming better known now, and it is not unlikely that in the future it will be taken into Yellowstone Park. With this in view the highways are being improved as fast as the funds are available.

The first afternoon out, we cross-sectioned on the Jackson Park 4 which is the six miles of highway just south of Moran. To the dear reader who does not know what cross-sectioning is, let me explain this strange and wonderful thing. The contractors who bid for these highway constructions bid on the price per cubic yard they will move the earth for, common excavation and solid rock being considered separately. Crude pre-estimates of the amount of yardage involved, a consideration of the kind of earth worked, the initial expense in establishing the equipment, and the cost of operating, are the main factors which determine the amount of the bid per cubic yard.

TO determine the area of the section of earth cut or filled at any one point on the line is the purpose of cross-sectioning. The center line has already been staked out and the grade marked on the stakes. Then the "catch points" of the cut and fill slopes are found by running up and down the side of the hill with a "slope board" and rod, arguing fiercely and batting the mosquitoes which would get under the nets we wore about our faces to keep them out. The results are

(Continued on page 122)

Beryllium—*Lighter than* Aluminum

Hard enough to scratch glass, malleable, of high tensile strength, a better conductor of electricity than copper; this article thoroughly describes this "new" metal

By RAYMOND E. KIRK
Associate Professor of Inorganic Chemistry.

"A NEW metal, as light as wood and stronger than steel"; so ran some of the recent comments on beryllium. And yet this "new" metal was discovered one hundred and one years before the discovery of radium and was isolated in the metallic form, although somewhat impure, just one hundred and one years from this new year of 1928.

HISTORY

THE emerald and various forms of beryl were known to all the ancient peoples. The emerald, or smaragd is described in the Bible as the stone which had the fourth place in the breastplate of the high priest of the tabernacle. The emerald is also mentioned in the writings of Theophrastus. Pliny waxes enthusiastic in his description of the emerald and suggests the existence of a close relationship between the emerald and beryl.

In the last years of the 18th Century the available analyses of the mineral beryl led the chemists of that time to consider it a calcium aluminum silicate. The emerald was thought to belong to an entirely different species of mineral. The analyses were from the laboratories of such eminent chemists of the day as Bergman and Klaproth, and were deemed conclusive. A famous mineralogist, Haüy, sometimes called "the father of modern crystallography" came to the conclusion, from crystallographic and other physical properties, that the beryl and the emerald were related minerals. He asked the chemist Vauquelin to analyze them for him. Vauquelin, in 1792, not only demonstrated the identity of the minerals but discovered along with the alumina another oxide, or earth, as he called it in conformity to the custom of the time. This oxide, which he called "la terre du béril" (i. e. the earth of beryl) differed from alumina in chemical properties. It could be separated from alumina by boiling the solution with potassium hydroxide; it was soluble in ammonium carbonate; it was not precipitated by potassium oxalate or by potassium tartrate; it did not form alums; and it gave salts which had a sweetish taste.

When Vauquelin, in 1798, published his findings in the "Annales de Chimie," he failed to suggest a name for the substance described. The editors suggested at the end of his article that the new earth be called glucine from the Greek "sweet" because of the sweet taste of the salts. Objection was at once raised to this name since other salts, notably those of yttrium, also give a sweet taste. Vauquelin reluctantly accepted this name; perhaps because of pressure from the editor of the "Annales de Chimie." But while Gmelin used the German equivalent "Susserde," the usual German practice became to use a translation of Vauquelin's phrase, "la terre du béril." Thus arose the word "Berylerde" and from it "beryllium." From "glucine" came the word "glucinium" which is also used to describe this element. In recent years the name beryllium seems to have gained in general favor and the long dispute over the name of the element seems almost decided by the court of final appeal—common usage.

The work of Vauquelin attracted wide-spread attention and many chemists attempted the isolation of the element. Among them was Sir Humphrey Davy of England who obtained an alloy of iron and beryllium by fusing the oxide with iron and potassium in a clay crucible. In 1827, the famous German chemist Wöhler produced the metallic element, in a very impure condition, by reducing beryllium chloride with potassium. A French chemist, Bussey, using the same method as Wöhler also prepared very impure metallic beryllium.

OCCURRENCE

IT has been estimated that beryllium comprises from 0.01 to 0.001 per cent of the crust of the earth. In very small amounts it may occur in nearly all rocks, since in most casual analyses it would be overlooked because of the ease with which it may be taken to be aluminum. The most usual mineral of beryllium is beryl, a beryllium aluminum silicate ($Be_3Al_2(SiO_3)_6$) which has about 13.5 per cent of beryllium oxide (BeO). Beryl may also contain varying amounts of the rare alkali metals rubdium and caesium. In the opaque form, beryl is found in large hexagonal prisms. Single crystals are known which weigh from one to two tons each. The less usual transparent forms are used as gems. The colors may be blue-green (aquamarine), yellow (golden beryl), blue, or red (rose beryl). The emerald is a bright green variety of beryl. It is said to owe its color to the presence of chromium.

The common variety of beryl is found in many localities in the United States. Deposits are known in the Black Hills of South Dakota, in Colorado, Alabama, North Carolina, Virginia, Pennsylvania and in nearly all the New England states. Very rich and extensive deposits are reported in Madagascar. The Vosges Mountains in France have well-known deposits, especially near Limoges where the streets are, by an ancient and much-repeated myth, said to be "paved with emeralds." The mineral is also found in Bavaria, Sweden, Ireland, Scotland and Cornwall (England). Beryl is the usual commercial source of beryllium despite the small amount of the element which it contains.

Other minerals which have been used as sources of beryllium include leucophane, gadolinite and chrysoberyl. Leucophane, a sodium calcium beryllium fluo-silicate ($NaCaBeF(SiO_3)_2$ contains from 10 to 14 per cent of beryllium oxide. Gadolinite carries about 10 per cent of the oxide of beryllium. It is a complex mineral consisting mostly of an iron yttrium beryllium silicate ($2BeO.FeO.Y_2O_3.2SiO_2$). In the United States it is found in Colorado and Texas. Single crystals weighing up to 60 pounds come from Barringer Hill in the last named state. It is also found in Greenland, Iceland, Sweden, Norway and in Silesia.

Chrysoberyl is the beryllium meta aluminate ($Be(AlO_2)_2$ which has from 19 to 20 per cent of beryllia. The transparent varieties are used as gems. They have a yellowish green color. Chrysoberyl is found in Brazil, Ceylon and the Urals in mica schists along with beryl.

The only commercially important mineral containing large amounts of beryllium is phenacite ("The deceiver"). This mineral is beryllium orthosilicate (Be_2SiO_4) which contains 44 to 45 per cent of the oxide. It is found in Colorado, Maine and Virginia as well as in the Urals, in the Vosges, in Switzerland and in Bohemia.

Among the minerals not commercially important at the present time but of interest because of their high beryllium content may be listed Bertrandite and Hambergite. The first, a basic beryllium silicate ($Be_2(BeOH)_2Si_2O_7$) contains from 40 to 43 per cent of the oxide.

Hambergite is a very rare basic beryllium orthoborate ($Be(BeOH)BO_3$). It is of interest only as having the highest known beryllia content, about 53 per cent. It is reported from near Langesund Fiord in southern Norway.

Doubtless many occurrences of beryllium ores are not known and will come to light if the element comes to have commercial importance.

Extraction

SINCE the numerals of higher beryllia content are all derived from primary ores such as beryl, the commercial production of the metal demands the use of methods of extraction from the primary ores.

Many methods have been proposed for the extraction of beryllium oxide from its ores. These methods may for our purpose be considered under two heads; first, alkali fusion and second, fluoride fusion.

In the first type of process, the powdered mineral is fused with an alkali flux such as potassium or sodium carbonates or the hydroxides of the same metals. It is a usual practice to use a mixture of several of these substances since, as it is well known, the mixture will melt at a lower temperature than any one of the components. The resultant melt is treated with sulfuric acid and heated until the first white fumes of sulfur trioxide appear. It is then extracted repeatedly with hot water. The beryllium, iron, aluminum and other metallic elements are thus taken into solution as the sulfates while the residue is primarily silicon dioxide. Excess potassium sulfate is added to the solution and nearly all of the aluminum is removed by crystallizing out ordinary alum ($K_2SO_4.Al_2(SO_4)_3.24H_2O$). The mother liquor from this crystallization contains beryllium sulfate, some aluminum sulfate, and the sulfates of iron, potassium, etc. Further purification is therefore essential. This usually involves the precipitation of the iron and aluminum as hydroxides, often by the use of various carbonates. Any remaining iron is removed by precipitation with hydrogen sulfide in alkaline solution. Beryllium can then be thrown down, usually as a basic carbonate, and the oxide obtained. The conditions must be very carefully regulated. Undoubtedly tremendous advances in the commercial extraction of beryllium from its ores may be expected when more definite information is available concerning the chemical behavior of beryllium compounds.

In the fluoride fusion method the reagents employed may be calcium fluoride (CaF_2), sodium fluosilicate (Na_2SiF_6), or ammonium hydrogen fluoride (NH_4HF_2).

Lebeau fused beryl with calcium fluoride and poured the molten mass into water. The resultant friable mass was extracted with sulfuric acid and evaporated nearly to dryness, to drive off silicon tetrafluoride. Some of the calcium was removed as calcium sulfate and the remainder separated along with the iron, coming down as the carbonate. Copaux fuses beryl with sodium fluosilicate forming sodium fluoberyllate (Na_2BeF_4) and sodium fluoaluminate (Na_3AlF_6). Hot water extracts the soluble beryllium salt leaving the insoluble aluminum salt as a residue. Pollok fuses beryl with ammonium hydrogen fluoride and extracts the soluble beryllium fluoride with hot water.

In each case further purification of the resultant solution is essential and often involves tedious and expensive chemical operations.

Metallurgy

THE two general methods for preparing metallic beryllium are, (1) chemical reduction and (2) electrolytic reduction. Wöhler first prepared the metal, in an impure form, by the reduction of the anhydrous beryllium chloride with postassium. At nearly the same time Bussey used the same method to prepare the metal. Sodium may be substituted for potassium. The expense of the potassium and the difficulty of preparing anhydrous beryllium chloride render this method an impractical one. However, in 1885, the English chemist Humpidge used this method to prepare the first beryllium of high purity (about 99.2%) and made very exact determinations of its specific heat at various temperatures. The double fluoride of potassium and beryllium, $BeF_2.2KF$ (also written K_2BeF_4), when heated with sodium yields metallic beryllium. This method was used by Gerhard Krüss in 1890 to prepare high-purity beryllium.

The Goldschmidt method, using finely divided aluminum as the reductant yields an alloy of beryllium and aluminum which contains about 10 per cent aluminum. The mixture must be heated above the melting point of beryllium.

Electrolytic reduction, which is the method now being used to make beryllium on a commercial scale, dates back to the work of Sir Humphrey Davy. Davy, who in 1807 and 1808, first isolated the elements sodium, potassium, barium, strontium and calcium by electrolyzing their hydroxides, and also attempted the isolation of beryllium. He heated an iron wire to redness by the current from a battery of one thousand plates and touched it to beryllium oxide slightly moistened and in an atmosphere of hydrogen. He thus obtained an alloy of beryllium and iron which he thought to be the free element beryllium.

In 1831, A. C. Becquerel reported the preparation of metallic beryllium by the electrolytic reduction of a concentrated solution of beryllium chloride with enough ferric chloride added to render the solution a conductor. The purity of the product is open to question.

Effective electrolytic processes, however, date back only to 1898 when Lebeau, noting that the fused simple halides of beryllium were nearly non-conducting, used mixtures of the simple halides with the double halides of sodium and beryllium. This method has recently been improved by Osterheld. A major difficulty in the production of beryllium by the electrolysis of fused salts is the fact that small flakes of the metal are formed which scale off and remain suspended in the molten mass of electrolyte where they are readily oxidized. The collection, purification and fusion of these flakes into a compact form is both difficult and expensive.

Stock and Goldschmidt working in Berlin claim to have obtained compact beryllium directly by choosing such a mixture of salts that the temperature of the electrolytic bath is kept above the melting temperature of metallic beryllium. A recent article by Stock describes the method in considerable detail. A mixture of three double fluorides of beryllium is used. Any one of these compounds vaporizes at a temperature below the melting point of beryllium (about 1285°C.). The mixture of the three may, however, be raised to 1380°C. An Acheson graphite crucible serves both an an anode and as a container. A water-cooled iron cathode is employed. The electrolyte is a properly-proportioned mixture of $NaBeF_3$ ($BeF_2.NaF$), $BaBeF_4$ ($BeF_2.BaF_2$) and $BaBe_2F_6$ ($2BeF_2.BaF_2$). A yield of 38 to 44 per cent of beryllium is claimed. The metal is freed from slag and oxide and cleaned giving a metal of high purity.

Similar methods are said to be used in this country to prepare metallic beryllium.

Properties

THE metal ranges in color from silvery white to steel gray and has a metallic luster. It is hard enough to scratch glass, but the pure metal is malleable, is easily forged and cold rolled and takes a high polish. Its low density is of special interest. The most recent values for the density are in the neighborhood of 1.64 although older values run as high as 1.8. The specific heat of the metal is high, changing with tem-

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Heat Changes in Cement During Setting

Substituting lumnite for portland cement in winter will probably cut cost of concrete construction through quicker handling of forms

By ARNE A. JAKKULA, C '26
Research Fellow in Department of Structural Engineering.

SINCE 1866, when Portland cement was first manufactured in the United States, its use has increased enormously, for in the decade of 1870-79 only 82,000 barrels were used while in 1927 its use had increased to approximately 170,000,000 barrels. Portland cement concrete alone and reinforced by steel bars or structural shapes is now one of the most widely used of building materials. One of the serious drawbacks to the use of Portland cement concrete has been the long time required for it to harden. Most concrete structures are designed on the basis that the concrete will have a compressive strength of 2,000 pounds per square inch at the age of 28 days. The compression test is usually made on 6 in. x 12 in. cylinders molded at the same time the structure, of which it should be a representative sample, is poured. This means that none of the forms or the supporting falsework can be removed for use in another part of the structure until the concrete has reached the required strength. This has meant a delay of from three weeks to a month depending largely on the air temperatures, low temperatures requiring a longer time for hardening than high temperatures. As the cost of labor and lumber and the desire on the part of the builder to earn dividends on his investment as soon as possible has increased, it has become imperative that this delay be eliminated.

Various means have been taken to increase the rate at which concrete hardens. Cement manufacturers have devised schemes to increase the rate of hardening of their product; various substances have been discovered and placed on the market whose manufacturers claim that its addition to the "mix" will produce quicker hardening; and finally entirely new cements have been discovered whose rate of hardening is such that the desired 2,000 pounds per square inch can be obtained in three days and even in 24 hours. The economy in time resulting from the use of these cements is obvious.

Some of these new cements are manufactured from the same ingredients as is Portland cement but greater care is taken in their manufacture. Greater care in proportioning, more rigid control, more thorough burning and finer grinding are the chief differences between the new and the old cements. Other of these new cements are entirely new in composition being called "high alumina cements" among these are: "Ciment Fondu", "Ciment Electrique" and "Atlas Lumnite Cement." The latter is an American product while the former are European products. Lumnite cement, as it is popularly called, is quite a bit finer than Portland cement. The percentage of residue remaining on a 200 mesh sieve is invariably less than 10 per cent while that of Portland cement is usually between 15 and 20 per cent. In color Lumnite cement is a dark, rather earthy-brown while Portland cement is usually gray. Numerous tests show that Lumnite cement concrete is as strong if not stronger in 24 hours than Portland cement concrete of the same ingredients is in 28 days.

Chemically too they are quite different as the following analyses show. These analyses are quite representative.

	Portland	*Lumnite*
Silica	22.0%	2.6 %
Alumina	7.5%	39.5 %
Iron	2.5%	15.4 %
Lime	62.0%	39.9 %
Magnesia	2.5%	0.73%
Sulphur	1.5%	0.21%

Because of its greater rate of hardening, the chemical action that takes place is much more intense, producing more heat. This heat phenomena is of great interest, for with the large amount of concrete work carried on in winter, contractors are faced with the problem of protecting their concrete from freezing during the hardening period. A concrete producing a large amount of heat during the early period immediately after placing is "self-protecting" to some extent and does not require the care that a concrete which produces but little heat requires.

It is well known that the strength of concrete is dependent to a large extent on the care it receives during the period following placing or during the "curing" period. The same methods of curing are not applicable to cements that do not act alike during this period.

It was, with these objects in mind that the following tests were run: namely, to find how a "high alumina cement" behaved during the hardening period. Lumnite cement was chosen because it was the only cement of this type available in this vicinity.

APPARATUS

THE tests reported in this article are divided into two parts: first, those tests in which the temperature of the specimen was measured; and, second, those tests in which the heat developed by the specimen was measured.

The tests under the first heading were run in a box. This box was made of ¾ inch white pine lined with 1 inch of flaxlinum as insulating material. It was heated by six electric light bulbs placed in the bottom, the intensity of which could be regulated by two rheostats arranged in series. Temperatures in the specimens, which were 6 in. x 12 in. cylinders cast in steel molds, were measured by three copper-constantin thermocouples placed in the specimen and a portable potentiometer pyrometer indicator with an automatic cold junction compensator. The insulated box was chosen so that any heat generated could not escape for that is the condition that exists in the interior sections of concrete because of its good insulating properties.

The tests under the second heading were run in a calorimeter. This consisted of two galvanized iron cans, one within the other, separated from each other by a 1½ inch layer of granulated cork. The specimen container, likewise of galvanized iron, rested on wooden supports within the innermost can and was surrounded on all sides by 1 inch of water. The rise in temperature of this water was measured by means of two accurate thermometers. The specimens were 6 in. x 12 in. cylinders.

RESULTS

THREE tests were run with cement from one batch and four from another. In these tests the cement and water were first heated to the initial temperature desired and then mixed and placed in forms in the box which, in the meantime, had been heated to the selected temperatures. When the temperature of the specimens had started to rise the lights were turned off. The lower temperatures were obtained by taking advantage of the cold weather during January, 1927.

In the first test the cement and water was heated to 130 degrees F. and before the mixture was placed it started to "set". As it was the first test run it was surprising to note the rapidity with which the temperature rose and to see

(*Continued on page 126*)

LEO E. OWENS

Leo E. Owens

A Publisher *and an* Engineer

Mechanical graduate of '11 is now publisher and part owner of the St. Paul Dispatch and Pioneer Press

IT was but a few years ago during the famous New York newspaper strike of 1923. Consternation was apparent in all of the newspaper offices of the city as it became evident that the daily papers could not be published. The papers faced financial losses. Prestige and past reputations for continued service were at stake. The New York World was no exception. Every pressman had gone out on strike. Its problem seemed impossible of solution.

"We simply can't publish a paper without pressmen," exploded one of the men. But—

"Bunk," said another of the group, "let's take a look at this mess."

With that, down to the pressroom he went. Perhaps he might have called to some of the office boys, "Come down to the pressroom; we're going to put out the paper." At any rate with a ridiculously small group of office boys and clerks he assembled a staff of amateur pressmen.

Plates for an edition were cast by the stereotypers and were waiting to be used. He had them taken to the presses; put them on himself. With the assistance of the "amateur pressmen" he ran the presses. For two days and two nights this man scurried about, now doing this, now that, now directing the men how to do certain things. Although the required number of papers were not put out and the papers were smaller than ordinary, New York was not without the World or the Evening World.

To the men who helped him on the presses this work was entirely new, but to Leo E. Owens, mechanical engineering graduate of 1911, this was old stuff. His whole previous training had fitted him for such an event, and the strike gave him an opportunity to display his rare knowledge of every part of the production of newspapers.

This was four years ago. Now Owens has come back to the Northwest, to the scenes of his boyhood days.

"Ridders With Owens Buy St. Paul Papers," is the headline which appeared in Editor and Publisher, a newspaper business magazine. "Dispatch and Pioneer Press sold by Blandin for $5,000,000." Nor is that all: Leo E. Owens is publisher of these two great newspapers.

Sitting behind a large flat top desk in a heavily carpeted room which is nicely though not ornately decorated, he directs two of the Northwest's large newspapers. A firm mouth marks his features. His face, yet unwrinkled, carries a look of force and evidence of hard work. He speaks slowly and is not hurried in his movements. He lights a cigarette, puffs it a bit, answers the telephone in a quiet, clear voice. Beneath his outward calm he has a mind alert and active. Picking up a magazine, he goes through a whole article in just a few minutes, observing every detail, and in true St. Paul style he remarks, "—and absolutely nothing is said of St. Paul. I can't see why—?"

YET Owens classes himself as an engineer in spite of his executive position. In fact he believes engineering is necessary to any executive, because an executive acts as an engineer in his direction of material things—that is in order to be successful he must do so. Owens' life is an example of the growth of this type of executive. The manner in which he has climbed the ladder of achievement is most interesting. It shows the way in which he has organized and combined an engineering education with practical experience and a natural executive ability.

Just 38 years ago Owens lay in a cradle in Eau Claire, Wis., while a proud father passed the cigars about to inquiring friends.

LIKE the average American boy he survived that dangerous age from about four to fourteen years old without losing any front teeth and without getting too many black eyes.

In 1906 at the age of 17, after graduating from the Eau Claire High school, his folks moved to Minneapolis, and young Owens worked in the mechanical department of the Tribune. Pouring molds in the stereotype department, running over and about the presses, and serving as a printer's devil gained Owens much practical experience. After a year and a half of work in the different departments of the Tribune, he registered in mechanical engineering at the University of Minnesota.

Nor did he give up his work at the Tribune in order to study at the university. Promptly at 12:30 he would leave the university for the Tribune building where he would work in getting the evening paper out. At 3:30 he would return to the university for the remaining classes of the day. Friday and Saturday evenings he would work late putting out the "Bull Dog" or early editions of the Sunday papers.

During this time he made good use of the more theoretical information he was gaining. Several minor improvements in design and construction of the equipment were made by Owens. When summer came the foreman had but simply to say, "Here, Owens, take charge of this press while Mike goes on his vacation," and it was done. So all through the summers Owens because of his ability was placed in charge of a different press as the respective press bosses went on their vacations.

The theoretical knowledge that Owens gained in the class rooms was thus combined with the more practical experience obtained in a newspaper plant. This early training has proved an invaluable foundation for the rapid development of a newspaper career. He was a good student at Minnesota, having never even a condition in a subject, although he was often forced to stay up late in the night to study for the morrow's lessons. Often he would come to class as remembered by Professor Martenis "with apparent drowsiness."

DESPITE the time taken up by his outside work, Owens had time to participate in a few activities of the student body. He was a member of the crack drill squad of 1910. This squad used to perform at the basketball games, the Military Ball and at other events on the campus. Owens was a member of Alpha Kappa Sigma, a local fraternity, which in 1920 became a chapter of Theta Xi.

Upon receiving his degree in 1911, Owens, thinking nothing of other fields of work, returned to steady employment in the mechanical department of the Tribune and was later given complete charge of the mechanical departments. Thus he worked steadily for six years until United States entered the war.

But even then his training did not stop him entirely from work. By special permission, while he was stationed at Fort Snelling, he continued to work at the Tribune.

However, a good man can't be kept down—

Owens became an officer in the Flying Corps, and was placed in complete charge of the construction of Rich Field, a flying field at Waco, Texas. This project involved an expenditure of $1,250,000. He directed here, for eleven months, work involving the leveling off of a mile square cotton field, changing the course of a road, building 16 hangars, a hospital, officers' quarters, administration buildings, storehouses, repair shops, kitchens, aero repair buildings, etc., as well as the building of roads, sewers, water systems, gasoline storage and supply systems.

Under this duty Owens was a ground officer, and so did not receive training in piloting of airplanes. However, an order came through stating that all ground officers should receive pilot training. Owens, who had been up in the air often before, was given instruction, and was just about to "solo" when he was ordered East, arriving at Mineola, L. I., just before the Armistice.

He then spent more time supervising unfinished work, and while doing this he came across another former engineering graduate who was engaged in the same work, Ezra Curry. They were discharged from the service late in December and returned home together on Christmas day. Owens was again ready to start his upward climb.

Back to newspaper work he went, but this time he worked on the staff of the Louisville Courier Journal as Manager of Production and as an assistant to the Business Manager. Here he stayed for several years until the desire for a broader experience in the newspaper world led Owens to New York City where he joined the staff of the New York World.

It was with the New York World that Owens had the opportunity during the newspaper strike to put to a practical test his experience gained during his college days.

As a recognition of his unique services during the tense hours of the strike, Owens was sent abroad to inspect the color gravure equipment which was then in the process of construction in France for the New York World. In Europe Owens also inspected the electric drive for the press, the drive being manufactured by the Siemen Schuckert company which is the German branch of the Westinghouse Electric and Manufacturing company. The press itself was manufactured in Alsace Lorraine, while the folding apparatus was made in Wurtzberg, Bavaria. Later under his direction this press produced the finest color gravure newspaper work that has yet been printed, a type of color printing which will soon be a feature of some of our largest Sunday newspapers.

AFTER his return from Europe Owens was made Manager of Production for the World in which capacity he continued till January, 1927. As production manager because of his practical and theoretical knowledge of newspaper production he made possible an additional yearly saving of between $250,000 and $300,000. Modern presses were recommended, designed and purchased. He introduced better stereotype equipment and the savings in wages more than paid for it. As a result of his engineering knowledge and practical experience he was able to see things that practical men of the trade could not. During the years spent on the World, the entire plant was converted from a totally inadequate and inefficient plant to one of the most modern and efficient plants in the country. Since leaving the World on January 1, 1927, Owens has advanced rapidly.

Owens joined the Ridder Brothers as General Manager of the New York Journal of Commerce Commercial when the Ridders purchased this paper on January 1. Now Owens' association with Ridder Brothers continues with the joint ownership of the St. Paul Dispatch and Pioneer Press, which was purchased by Ridder Brothers with Owens early this August.

IN the sixteen years that he has been climbing, Owens has fitted himself to come back home as a leader in the work he loves and for which he has been so well trained. His highest ambition has been realized, for his life ambition has been to publish a paper devoted to the great Northwest, the country of his boyhood and university days.

Owens says, "There is no part of the United States which offers such vast opportunities for growth as does the Northwest. As publisher of the St. Paul Dispatch and Pioneer Press an opportunity will be given to me to play a small part in the development of a greater Northwest. It is with a deep sense of satisfaction that I turn my eyes homeward."

Throughout all of his experience Owens has called himself a "newspaper engineer." To him engineering is something more than only a study of strict engineering principles. He believes the knowledge of engineering principles is fundamental to a good business executive, whether these principles are obtained in school or through experience. Also he says that a broad course in engineering should be stressed more.

Owens also believes there is a great field for the "newspaper engineer," a type of engineer who is now trained entirely by practical work. In view of his own success, Owens thinks this field has great prospects.

There have been many changes made in the St. Paul papers which Owens and his associates took over October 1. The physical appearance of the papers has changed, new and more readable type has appeared, the editorial content has changed, and an editorial policy, vigorous and militant, is evident.

The keynote of the announcement made the day the new owners took over the papers that "these papers will be violently partisan to St. Paul and the Northwest" seems destined for fulfillment.

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

Tintic Miner in Mexico Making Good

GEORGE HEZZELWOOD, '23 E. M., former Tintic Standard Mining company employee, who had much to do with establishing a world's record for fast drifting in that property, is getting along nicely with his work for one of the big Mexican mining companies, according to word sent to his brother, Morris Hezzelwood, of Dividend, Utah, recently.

Mr. Hezzelwood's work at the Tintic Standard attracted the attention of mining operators in all parts of the country and resulted in an offer for his services from a mining company located at Mapimi, Mexico. He went there last May and took with him a crew of miners from the "states."

It is stated that the job under way in Mexico will last for some time, the large tunnel, which is 8x 8 feet is to be driven several thousand feet. The first month after getting his crew organized Mr. Hezzelwood made over 600 feet of drifting. The work was speeded up through the successful use of a mechanical mucking machine similar to the one used in the Tintic Standard and electricity is available for the tramming of the waste. The second month the heading in the Mexican property progressed 650 feet and Mr. Hezzelwood and the members of his force state that they will not be satisfied until they make a distance of 800 or 900 feet in thirty days.

Minnesota Delegates Attend A. I. E. E. Convention

"VERY successful" is the official comment on the A. I. E. E. student convention held in Chicago on November 28, the first of its kind to be held for the Great Lakes District. Over two hundred students registered and a number of interesting papers were presented.

Two papers presented by Minnesota students ranked high and both papers will be submitted to the National Prize committee for the student prizes.

In a survey of electrical shows made by two students of the Michigan State college, it was pointed out that the electrical department of the University of Minnesota was the only one to combine a reception or party with their electrical show. This was considered an ideal arrangement.

A paper by Professor Jansky and Mr. Feldman was well received and with considerable interest. Professor J. H. Kuhlman, counselor for the Minnesota Student branch of the A.I.E.E., and Mr. Barton presented a paper on "The Vacuum Tube Rectifier." An unusual demand was made for copies of their paper.

Mr. Elliott attended the convention as the delegate of the junior electrical engineering class of Minnesota. This is the first time a junior delegate has been sent, and it was made possible by the large enrollment of juniors into the A. I. E. E.

Lost, Borrowed or Stolen

One rickety, antiquated, Underwood typewriter from the TECHNO-LOG *office in the Electrical Building. The frame is cracked; the keys don't write evenly: it prints in small type, and at the time of disappearance, it had a ragged ribbon in it. As a general outfit it was on its last legs, but it is a necessary part of the equipment of the* TECHNO-LOG *office. The staff sincerely hopes that the person who borrowed it will show his gentlemanly instincts and return it. Any knowledge of the whereabouts of the typewriter will be appreciated. If it was merely borrowed, and it is returned shortly, the borrower will be forgiven, but woe, woe, woe, and utter woe unto the thief if he does not return the typewriter. An infuriated* TECHNO-LOG *staff threatens dire action.*

Engineer at Oil Station Vanquishes Robbers

THE old fighting spirit has been shown again by a Minnesota engineer. On December 30, a few days before the big night, two huskies decided that they needed three gallons of gasoline and some spending money.

They picked a certain filling station at 518 East Hennepin avenue to do their business. Norman Paquin, a junior civil and the attendant, was told to put three gallons of gasoline in a Ford tudor. One of them handed him fifty cents and followed him into the station. Paquin thought it queer of the fellow to follow him so closely, and as he leaned over a table to make change the bandit hit him with a foot and a half length of steel pipe.

Paquin fell forward onto the table, temporarily unconscious. On coming to his senses he realized what was happening, and he turned to give fight before the cash drawer could be rifled.

The robbers, seeing that it was impossible to make a getaway with the station's money, fled, leaving the company eight cents to the good, and Norman Paquin one bump on the head to the worse.

S.P.E.E. Holds Dinner Meeting

LOCAL chapter of the Society for the Promotion of Engineering Education held the first meeting for the school year at the Campus Club on December 6. Members and their guests numbered thirty-five.

Professor Springer is President for the coming year; Professor Richards is Secretary and Professor Heisig is Chairman of the Program Committee. The subject for discussion was "Pre-College Training of Engineers" given by Mr. W. F. Webster, Superintendent of the Minneapolis Schools.

Pi Alpha, Art Fraternity, Stages Fifth Annual Ball in Polar Regions

ABOUT this time each year there occurs from this campus an excursion to some fantastic corner of the world or sidereal universe. These excursions have become known as the Jinx Ball, and the participants in order that they might not be recognized as strangers in a strange place must dress in costumes of the natives. On the night of Friday, January 27, there will take place the fifth annual excursion.

The Ball is under the direction of Pi Alpha, honorary art fraternity on the Minnesota campus. It is planned to have this year's excursion at the polar regions which were made so popular during the past year by American aviators. The Ball will be given in Minneapolis at a place not yet announced, and all of the requirements of the previous Pi Alpha Balls must be lived up to, that is, each person must come in some costume of the polar country.

Walter Huchthausen, vice president of Pi Alpha, is chairman of general arrangements. Glen Thompson, campus cartoonist, as decorator will bring the polar atmosphere to Minneapolis, and he has enlisted the services of all the members of the fraternity to help him construct icebergs, igloos, gigantic snow drifts, and like properties of the arctic regions.

Harold Ekman, architect and secretary of Pi Alpha, is handling the finances, and Charles E. Peterson, president of the society, is in charge of invitations and publicity.

Technical College students in Pi Alpha are Charles E. Peterson, Walter Huchthausen, Harold Ekman, John Davidson, George Burch, and Dudley Bayliss.

Arabs Start Work on Sixth Musical Comedy Production

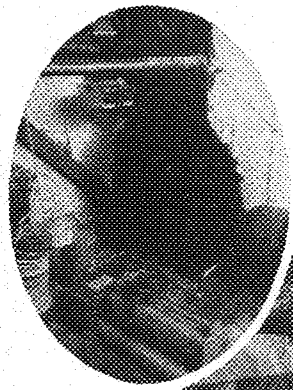
WITH the beginning of winter quarter, the Arabs, engineering college dramatic organization, started active work on the sixth Arabs' production.

Charles E. Peterson, chosen by the committee as the author for this spring's production, and Avner Rakov, composer of last year's music, are hard at work getting the musical score in shape. The entire plot has not been divulged, but it will probably take in some heroic desert scenes with handsome sheiks in brilliant, flowing robes pacing up and down in a golden twilight before the tent of a beautiful feminine captive.

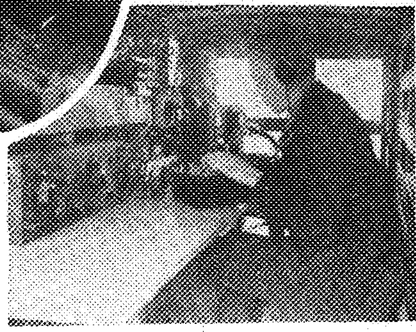
A story of heart throbbing Arabian love under towering palms in the midst of desert sand will be laid in the desert regions of Arabia.

Settings for the play are to be designed by Walter Huchthausen, who has them well under way. These settings are to far surpass those of last year's production, "Broadcast," which took the campus by storm, and was declared to have some of the best settings made at Minnesota.

Harold Ekman is production manager. Tryouts and practices are to be soon started. Singing is to be handled this year by Thomas Finnel. Other parts of the management now busy are: business, with Sheldon Johnson as business manager; stage manager, Rex Severson; costumes, Walter Juran; lighting, John Kriechbaum; properties, Paul Dahl; personnel, Gurdon Jones; and publicity, Lawrence A. Clousing, with William C. Hill.



Oval: The five meter transmitter and in the background the bakelite disc that automatically sends the signals.



Right: The portable receiver, with Boyd Phelps recording the signal strength of his own station.

Boyd Phelps, former Electrical Student, Conducts Experiments with High Frequency Currents

ANOTHER myth of popular radio has been exploded. It has been believed by some that bakelite used on high frequency transmitters of five meters or below "explodes and bursts into flames." Nothing is more false according to Boyd Phelps of Jamaica, New York.

Operating his own station, HAM-2-EB, on five meters, Mr. Phelps has definitely proved that bakelite can stand the intense strain placed upon it by high frequency currents.

Mr. Phelps in his tests rigged up an automatic transmitter, and a portable receiver installed in a motor truck. He then toured the country picking up the signals of his own station and recording the signal strength at different localities in the country. In this way a rather peculiar study of the effectiveness of the short wave transmitter was made.

Not only was the effectiveness studied, but also the problems of set construction were gone into very thoroughly.

His findings in regard to insulation were "except for the glass in the vacuum tube itself and one leadout insulator Bakelite insulation is used throughout my five meter transmitter."

Normally, the transmitter handles about a kilowatt, but for short wave apparatus tests, "powers five times this have been used on a normal frequency of 59,000 kilocycles without any sign of heating the insulation although I have had heavy conductors heat so that they become unsoldered."

He has constructed transmitters on as short wave lengths as one-half meters using bakelite insulation throughout.

Another novel study in the construction of transmitters was the use of an automatic sender. This was a bakelite laminated disk that, operated by a motor, provided a mechanical means of sending radio impulses automatically.

In the transmitter condenser construction, Halowax, a chlorinated napthalene product, was used in place of the ordinary wax. This product, because of its higher specific inductive capacity, makes the size of the condensers two-thirds the size of the paraffin-treated units of the same capacity.

Professor Boehnlein Has Pleasant Year of Study at Gottingen, Germany

STUDY in Germany is very pleasant according to Professor Charles Boehnlein, assistant professor in Mathematics and Mechanics. He returned this fall from a year of study in Germany having left the United States during the latter part of June in 1926. About a year and a half ago, following an enjoyable voyage he and his wife landed at Hamburg, Germany, and from there they went to Berlin and then to Breslau where Boehnlein brushed up on his German before starting to go to school.

As the special school in aerodynamics which Boehnlein attended began in October of that year, he with his wife had but little time to spend in sight seeing. At Gottingen, Boehnlein spent a year under some of the most famous mathematicians of Europe. Two of these, Professor L. Prantl, and Professor A. Betz have a world wide fame because of their knowledge of aerodynamics. This knowledge which Boehnlein has gained in Europe he is now using in his course in Aerodynamics which he teaches here at the University of Minnesota.

While in Europe, Boehnlein had an opportunity to study student life to quite an extent. Over there he says that students are placed much more upon their own responsibility.

He continued to study all through summer of last year, and when the summer term was completed there was little time left for side trips except for one which he and Mrs. Boehnlein made through the Rhineland while on their way to Hamburg where they boarded a steamer for home, arriving in New York on Labor Day of 1927.

Synthetic Gasoline to Be Fuel of the Future, Says Minnesota Man.

THAT the manufacture of synthetic gasoline will be a practical industry in the future seems a certainty to a Minnesota graduate, Dr. V. R. Kokatnur, consulting chemist of New York. Distilled as a byproduct of coal, a synthetic gasoline has much the same explosive properties of the petroleum product, and is much cheaper to manufacture.

Dr. Vaman R. Kokatnur came from Bombay, India, where he received his B. A. degree in 1912. He acquired an M. S. degree at Chicago in 1914. He came to the University of Minnesota to finish his education and in 1916 received his Ph D. in chemistry. For the past six years he has been consulting chemist at 52 E. 41st, New York City.

Joint Dinner Meeting On January 21

THE North Central Electric Association and The Society for the Promotion of Engineering Education will hold a joint dinner at the Nicollet Hotel on January 21. Dean Ruggles of Ohio State will be the speaker for the evening and will discuss "How Public Utilities Can Better Co-operate with the Educational Institutions of the Country." Members of the local branches of the A.I.E.E., the A.S.M.E. and the A.S.C.E. are invited to attend.

Naval Reserve Unit Expects To Receive Planes This Spring

THE Minneapolis Aviation unit of the Naval Reserve has announced that they will receive several planes this spring or summer which are to be kept permanently at a field close to Minneapolis for use by the flying officers of the Minneapolis Naval Reserve organization. These planes will be land planes. They will not be used for instruction purposes at the present time, and all students of the university who at the present time are taking up the aviation course that is offered by the Naval Reserve in cooperation with the university will this summer be sent to the established places for instruction.

The receiving of these planes is contingent upon the acquiring of proper facilities for the housing of the planes, Mr. McKay, commanding officer of the Minneapolis unit has announced. At present negotiations are being conducted for the use of a hangar on the Wold-Chamberlain field, but if this is not obtained, members of the Minneapolis unit have volunteered to build a hangar themselves.

At present there are about 12 engineering students taking up the ground school work that is presented in instruction classes every Thursday evening at the Naval Reserve Armory, on Calhoun Boulevard and Lake street. This work is a necessary requirement of student aviators before they are sent to Great Lakes for preliminary flight training. There is still opportunity for those interested to take the course this year.

CORRECTION

The Minnesota Techno-Log wishes to correct a statement that appeared in the December issue. The enrollment of the department of Chemical Engineering should be:

FALL QUARTER, 1927

	Fresh.	*Soph.*	*Junior*	*Senior*	*Special*
Chem. E.	58	44	37	21	....
Chem.	23	18	11	9	3

FALL QUARTER, 1926

	Fresh.	*Soph.*	*Junior*	*Senior*	*Special*
Chem. E.	41	49	28	18	2
Chem.	32	19	11	3	2

Professor Springer Heads Headlight Adjusting Committee

A COMMITTEE of which Prof. F. W. Springer of the University of Minnesota is chairman has devoted several months to study and research on automobile headlights. They have devised a plan to establish designated testing stations which will have a uniform, standard method of testing and adjusting automobile head lights so that they comply with the headlight laws.

Minnesota law does not require dimming lights. It is held, that safe driving requires light which will illuminate the road, but the law requires that the lamps be adjusted so that the main beam is directed downward onto the road and not into the eyes of approaching drivers.

The Motor Vehicle Light Advisory Committee, headed by Professor Springer and composed of men such as Assistant Professor Elmer W. Johnson and M. R. Boss, assistant director Dunwoody Institute, suggested that a school of applicants for appointment as automobile lamp adjusters be held at some trade school. This suggestion was adopted by the State Highway Department and a two day course for these applicants is to be conducted at Dun-

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Night Classes Month by Month

Demand Causes Extension Division to Offer Six New Courses

WITH six new courses being offered this coming semester in the engineering extension division, there is predicted one of the biggest attendances in the evening classes ever recorded on the engineering campus.

Probably the most interesting course offered is the one on commercial tests of petroleum. This course will be taught by Dr. E. P. Harding, associate professor of technological chemistry, and is taught Tuesday evenings at 7 p. m. in the Chemistry building. This is an elementary course dealing with the source and specifications of petroleum products, principally gasoline and oils.

Ray Sweet, former chief engineer of WCCO, will instruct a class in radio communication which will start Thursday, February 2, at 7:30 p. m. in the Electrical Engineering building. This class will deal with the calibration of wave meters, the principles of radio batteries, coils, and condensers used in radio. Another class is being offered in elementary electricity in the new Physics building this coming semester, and is instructed by Iwoa Fukushima, assistant in the department of physics. This course will be offered on Mondays.

In the mechanical department there will be a course in mechanical refrigeration under John E. Nicholas, of the department of mechanical engineering of the university. Friday, February 3, at 7:30, is the time scheduled for the class to meet.

Another class on the campus will be one in cost estimating with Professor Robert W. French as the instructor. Actual building costs will be studied, and methods of calculating quantities of excavation will be made. No knowledge of advanced mathematics is required in the course according to Mr. French, as the calculations involve only common arithmetic.

Off the campus there will be a new class in production factors which is to be conducted in the Midway Y. W. C. A. building. This class will be taught by Professor S. C. Shipley starting Tuesday evening January 31 at 7:30 p. m. The course covers all economic principles and practices, the tools and equipment, that are used in large scale production.

Concrete courses will be continued, one of which under Mr. Wise is in reinforced concrete, and the other one is in elementary work.

Gleaned from the Technical Press

Summaries of engineering articles—developments—inventions—items of interest

Fuel Burning Stations Increase Over Hydro-electric Plants

IN 1927 more than 46,000,000,000 kw. hr. was generated in fuel-burning stations of the light and power industry and 29,000,000,000 kw. hr. in the hydro-plants. For several years more than 60 per cent of the energy used has been generated from fuel, and this percentage is apt to increase in the future. Economic, political and engineering handicaps to waterpower development become greater each year; because of these handicaps and because of advantages possessed by fuel-burning stations, it becomes increasingly difficult to find economic justification for large water-power and transmission projects in localities distant from load centers.

Airplane Safety a Problem of Engine Design and Loading

RECENT developments in the field of aeronautical engineering have increased the factor of safety of airplane flights so that in the last two years out of the 377 crashes that occurred in the U. S. Navy less than one-quarter of them were caused by power plant failure.

Before this year at almost every crash the verdict of the investigators was "Power plant failure." That has been the explanation of the failures in the trans-oceanic flights, but of the two that we know anything about—the case of the Dallas Spirit and the forced landing of Ruth Elder—the failure of the engines was not the primary cause of the landings. Also out of 29 fatal crashes that cost the U. S. Navy 43 lives only one was due to the fault of the power plant. This must be considered in view of the fact that 67 different types of airplanes and seaplanes are used, and that there are 12 distinct types of engines under the guidance of 800 commissioned and enlisted pilots. In total there were 15,000,000 miles flown by the Navy during the two years, July 1, 1925, to July 1, 1927.

But there seems to be another factor that causes the failure of so many planes. This factor can be found in the problem of weights. How much should an airplane engine pull per horse power? There is a fairly well defined *upper* limit of the power loading, or total weight that can be carried per unit of power, which has been set at 25 pounds per horsepower. Lindbergh's plane fully loaded weighed 23.6 pounds per horsepower, Byrd's 22.5, Chamberlain's 24.5, and Lt. Comdr. Davis' 25 pounds per horsepower, and they all had trouble in getting off, especially Davis, who crashed.

Power loading has had a parallel development with the growth of flight safety. The Wright Brothers' first machine was loaded in the neighborhood of 50 pounds per horsepower, and the safety of the early machines is well known. Today the power loading is in the neighborhood of 20 pounds. This lowering of the power loading has not been just a coincidence, for it was found early that the heavier a machine was in proportion to its power, the more chance it had of crashing at low altitudes, one of the greatest sources of fatalities today.

The adoption of the air cooled engine has to a great extent lessened the dead weight of a plane and has allowed for greater efficiency in plane operation because of the increased "live load" space. In the past it has been the engine that has borne the brunt of the struggle to reduce the dead load on the plane. In the future it will be the wing and body construction that will be called upon to take its share in making the plane safe for the air.

Greater Value Is Feature of the 1928 Motor Car

IN 1928 the average car has a long, low appearance in marked contrast to the high vehicle of "horseless carriage" days. Engine details have received careful attention. Bearings on crankshafts are increasing in number and size. Cylinder bore, stroke and compression are increasing and stock cars of 100 h. p. or more are neither uncommon nor high in price as compared with a few years ago. Almost without exception and regardless of price, the horsepower and speed have been increased over last year. Even the smallest of cars are now rated at 60 miles per hour or over.

Semi-floating rear axles predominate. There is a tendency to a wider tread so as to increase the width of the rear seat cushion. Four wheel brakes are now universal, with the internal brake predominating. Hydraulic brakes now have automatic compensation for expansion and contraction of liquid. Some mechanical brakes are now using an enclosed cable, while the vacuum brake has been adopted by one builder. Disk, wire and wood wheels are being made to inter-change on the same hubs and are carefully balanced. This and frame reinforcement are helping to reduce shimmying. Steering gear ratios are higher and columns are adjustable, as are the driving seats in some cases.

When one sees the accessories that are now regular equipment even on cheap cars, it is hard to realize that windshields and head lamps were once extras.

Engineers Take Important Part in Promotion of Public Health

THAT engineering plays a big part in the United Public Health Service is not very well known. But without the service of the engineer there could be little done in certain branches of protective measures that were taken last year to protect the people. Not only of the United States, but of the world in general.

The health conditions of the world last year were better than ever before, according to the report of the United States Public Health Service. In this report there was a statement concerning the late typhoid epidemic at Montreal, Canada, where United States public health engineers investigated the water supply and recommended certain changes.

Ships were fumigated and diseases and rodents prevented from entering the country through the efforts of the engineers.

Flood problems were surmounted by the health engineers, and the Florida repairs were under the direction of the engineering corps of the Public Health Service.

Stream pollution was stressed in the work last year, and great progress was made in the problems of sewage disposal of municipalities on the coast and small inland bodies of water.

Effect of Smoke and Clouds on Daylight Is Studied

SMOKE in the atmosphere brings about a very great lowering of the daylight, a study of the decrease of light by smoke, now being made by the United States Public Health Service in New York City, at the lower end of Manhattan Island, where the air is very smoky, shows an average loss of daylight due to smoke in January, on sunny days, is 42 per cent at 8 o'clock in the morning, and is 18 per cent at noon. These amounts of loss decrease as the year advances. The loss is greater early in the

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Around the World With Our Alumni

Architects

'14—George Fraser, who in a National Competition won the Roman Prize in Architecture in 1924, is now spending his third and last year in the American Academy in Rome. Mr. Fraser left Rome in October for Leptis Magna in Tripoli for the purpose of obtaining measurements and data for making an architectural restoration of the Roman baths recently excavated there. A report from the Academy states "His experience was entirely unique. While there he had the good fortune to live with the Italians directing the excavation. These people aided him in every way to obtain the data necessary for his reconstruction. For instance, they even went so far as to assign laborers to excavate certain parts of the baths still untouched. Now he is back in Rome and already at work on what will be the first architectural restoration made of these recent excavations."

'23—Clarence H. Luedeman has severed his connection with Holabierd and Roche of Chicago, and is now living at 63 Thornton Avenue, Youngstown, Ohio.

Chemicals

'12—Paul H. M. Brinton, who was for several years professor and head of the department of analytical chemistry of the School of Chemistry until his resignation last June, is now living at Pasadena, California. Dr. Brinton is now devoting all his time to private research in his laboratory at Pasadena.

'25—Lester Johnson, who held a fellowship in the engineering experiment station last year, visited the School of Chemistry recently. He is doing chemical engineering work for the Roesller-Hasslacher Chemical company at Perth Amboy, New Jersey.

'26—Allen S. Smith recently completed a year of work toward his master's degree at the University of Louisville, and is now working on sodium nitrate for the Atmospheric Nitrogen corporation at Syracuse, New York.

'26—Edward F. Sverdrup and Irvin Lavine visited the School of Chemistry during the Christmas holidays. Sverdrup is working for the U. S. Rubber Reclaiming company in Buffalo, N. Y., and Lavine is an assistant professor of chemical engineering at the University of North Dakota.

'27—William Ohlweiler, who graduated in December, has taken an engineering position with the dyestuffs division of the E. I. Dupont De Nemours company.

Civils

Civil Circular Letter

EXPERIMENT NO. '27

Object of Experiment

To discover what relation exists, if any, between a passing grade in Statically Indeterminate Structures and the distance traversed by civil engineering graduates after the acquisition (for a consideration) of a non-skid, fool-proof diploma (University of Minnesota model).

Apparatus

Forty-nine so-called engineers, whose natural tendencies vary from the acute matrimonial to the simple alcoholic as a converging series.

General Conclusions

(a) That the Minnesota Hiway Department has replaced 229E as the favorite loafing place of CE '27.

(b) That, judging from all present indications, the class will be 99.44 per cent married seven weeks before Larry Johnson forgets the difference between an Imhoff tank and the binomial theorem.

Field Notes

Offhand, it appears that the first migration was in favor of hiway departments with railroads following as a close second. Several of the boys have been spending a period of watchful waiting with the Minnesota Hiway Dept. before striking out. Ray Edlund is one of these. He is not certain what his best line is but all appearances point to blondes.

Among the disciples of James J. Hill is Kenny Clark, who has evidently grabbed off a he-job with the Pennsy. He says, "We are preparing for three inspection trips; by the general manager, by the board of directors, and by the president of the road. It doesn't matter to us whether it is day or night, we keep right on working, getting an occasional two or three hours of sleep." And then he gets onto the subject of stenographers, which is a dead give-away.

Fred Teske spent a summer alternating between work in the Dean's office and work with the U. S. Army Engineers on flood control, but is now located with the N. P. where he and Russ Riedesel with a few more Minnesota graduates of an earlier vintage keep the bridge department going. All is not grief in the railroad game evidently, for Russ was granted a ten day leave with passes to Portland, Oregon, early in September.

"Christy" had a very profitable summer in more ways than one. After spending practically all summer in the United States Engineers' office in St. Paul, he was sent to Cincinnati to work on the design of the Hastings, Minn., lock and dam. Realizing the folly of leaving his girl behind in the vicinity of unattached members of the class such as Gus Brohaugh, he immediately got married and took her along.

Tent 6 evidently didn't break up entirely as Roy Kastner and Einar Pearson kept up bachelor apartments for most of the summer in Peoria, Ill. Kas is with the Ill. State Hiway Dept. where he is classed as an experienced grade designer, and expects to be with them until Spring at least. Einar is with the U. S. Engineers and has been taking soundings and doing instrument work.

Another infamous combination was composed of "Nick" Preus and "Hank" Norman, who were working for the U. S. Engineers in Milwaukee where they started out plotting hydrographs and soundings, with some design work mixed in. They were divorced during the summer, however, when Preus was sent to Frankfort, Mich., for inspection work on a breakwater job. Norman spent the summer inspecting on the construction of a breakwater at Milwaukee.

A few of the class were evidently afflicted with either a desire for the wide open spaces or a great and consuming thirst, judging by their destinations. The most subtle in choice of location was by John Borrowman, who is with the Minn. Hiway Dept. at International Falls.

John Marcroft wasted no time in sailing for Guantanamo Bay, Cuba, where he is working at the U. S. Naval Station as a civilian engineer. Life in the West Indies is pepped up by occasional visits to Caimanera and Santiago, where one-cylinder Spanish is the "Open Sesame."

Campbell and Luethi have taken advantage of their commissions in the Naval Reserve by taking a year's active duty with the Aircraft Squadrons, U. S. Fleet. Doug is with Observation Squadron 5 and is attached to the USS Florida, Scouting Fleet, while Luethi is with Observation Squadron 2 and is based on the USS Idaho, Battle Fleet.

There is a certain matter that seems to call for class action at this point. Briefly, the matrimonial situation seems to be sadly out of control. Vital statistics regarding this condition indicate that whereas only three since last June have definitely fallen from grace, several more are slipping fast. Christy, Rosing and McDanield have all taken on added responsibilities, and if certain rumors emanating from the St. Paul office of the Hiway Dept. can be relied upon, several others are in danger of a similar fate.

CARL F. LUETHI,
Class Secretary.
USS Idaho, San Pedro, Cal.
(Until July 1, 1928)
or, 3849 2nd Ave. So., Mpls.

'08—Henry K. Dougan has been promoted from his position as assistant valuation engineer for the Great Northern Railroad to assistant general auditor of the same road with headquarters in St. Paul.

'15—Leonard E. Ott is now superintendent for A. Guthrie and Company, Inc. He is at present in charge of the construction of a 7,000 foot tunnel being built for the Illinois Central Railroad at Ozark, Illinois.

'18—George Sawyer, is now located at Canton, Ohio, as supervisor for the Pennsylvania Railroad.

'20—F. A. Dever has been transferred from Buffalo, N. Y., to Dennison, Ohio, where he is assistant supervisor for the Pennsylvania Railroad.

'20—Carl E. Lebuck is now sales engineer for the General Fireproofing company. He is in charge of the Minneapolis district.

'22—O. A. Soutland, who is manager of the Fargo Foundry and Bridge company, was on the campus recently.

'22—C. R. Croy is now spending his time as City Manager at Chippewa Falls, Wisconsin.

'23—L. S. Mitchell, who was a varsity fullback in 1922, returned to Minneapolis this fall for a two weeks visit with his family and friends. He is fat and says that he is getting fatter. Upon being asked if he were married, his answer was a very emphatic NO. He heads the L. S. Mitchell Construction company at Walterboro, South Carolina.

'24—Philip L. Bergquist has resigned his position with the car service department of the Great Northern Railroad and has accepted a position with the Weyerhauser Lumber company. He expects to be located at Des Moines, Iowa.

'24—P. L. Larson can be reached in care of Deen and Yarborough at Jacksonville, Florida. He has recently been promoted to general superintendent of that company. He is the proud parent of a baby girl, and we understand that he has become a regular shiek.

'25—O. M. Skrokrud is now junior engineer in charge of breakwater construction in Milwaukee Harbor for the United States District Engineers. He has offices at 406 Federal Building, Mil-

'26—J. Ralph Hoffmann is a civil engineer for the Chicago, Milwaukee and St. Paul railroad at Milwaukee. He is doing surveying and inspection work. He was formerly stationed in Minneapolis.

'27—Stanley D. Lund has accepted a position as sales engineer with the Genfire Steel company. He moved to the office of the company at Youngstown, Ohio, on January 1, 1928.

'27—Clarence C. Lande, who graduated in December, is now in the engineering department of the Kimberly-Clark company, a paper manufacturing firm in Kimberly, Wisconsin.

Electricals

'98—Charles C. Gilchrist has become assistant superintendent in charge of factory planning, at the Hawthorne works of the Western Electric company in Chicago. Mr. Gilchrist, shortly after starting work for this company as an engineer at Chicago, was transferred to New York and then to Europe where he became assistant general shop superintendent with offices first in Antwerp and then in London. He returned to this country in 1913 to become assistant superintendent of manufacturing, and later operating superintendent. After engaging in special plant studies, he now heads the work of fundamental factory planning.

'98—Adolf Wagner, who is with the H. T. Electric company of Indianapolis, can be reached through Box 816, Indianapolis, Indiana.

'09—Clovis M. Converse recently resigned his position with the St. Paul Electric company and is now permanently located in Chicago as sales engineer for the G. & W. Electric company.

'21—Ludvig C. Larson visited the campus during the Christmas vacation. He was married in August, 1924, and is now an instructor in the department of electrical engineering at the University of Wisconsin.

'22—L. M. Ellestad has been transferred from transmission engineer in the chief engineer's office of the Northwestern Bell Telephone company at Omaha, Nebraska, to transmission engineer, department of operating and engineering of the American Telephone and Telegraph company of New York. Mr. Ellestad has been supervising interference, electrolysis, and foreign wire relations work for the N. W. company. In his new work, his time for a year or so will be divided between Los Angeles and San Francisco, where he will be in charge of an engineering project for the A. T. & T. Co.

'23—W. F. Kannenberg is now working for the Bell Telephone Laboratories, Inc. He writes that he is going to go on a field trial between Chicago and Denver for the company soon. He expects to visit the Technical campus sometime during the spring.

'23—C. L. Sampson has been transferred from the position of interference engineer in the Minnesota division of the Northwestern Bell Telephone company to that of transmission engineer in the chief engineer's office of the Northwestern company at Omaha. Mr. Sampson will fill the position vacated by Mr. Ellestad. "Cliff" drove from Minneapolis to Omaha about the first of December, and he says that although he found plenty of snow in Minnesota, he didn't find any south of Sioux City, Iowa.

'25—H. D. Cameron has recently resigned his position with the Public Service company of Northern Illinois. He visited the campus recently, and expressed his admiration for the great general improvement in the equipment of the electrical department. Harry lives at Shell Lake, Wisconsin.

George Patchin, ex-engineering student and School of Business graduate, who will be remembered on the engineering campus for his work in helping found the Arabs and producing their first three musical extravaganzas, is the proud "papa" of a nine pound baby boy, George Lowell, Jr., who arrived December 16.

The Patchins are living at 820 Savannah Avenue, Wilkinsburg, Pa., where George is selling Minnesota's own products for the Pillsbury Flour Mills.

'25—Grant C. Nierling, who has been employed by the General Electric company as a student engineer since December, 1925, has been transferred to the International General Electric company. Mr. Nierling's home is in Jamestown, N. D.

'26—Lawrence T. Robinson is still with the General Electric company at Schenectady, New York. It was erroneously reported in the December issue of the TECHNO-LOG that Mr. Rob-

(Continued on page 124)

The
MINNESOTA TECHNO-LOG
University of Minnesota

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Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

Technical College Students

ARE you behind the TECHNO-LOG *heart and soul? Do you really want it to represent the whole student body, and be the means of mirroring in an active way the spirit and enthusiasm of the technical students? Do you really want to see your college have a successful publication that will rank with the best technical college magazines in the country? Do you want to have your school become known as it should among the larger universities as a result of its Technical College publication? Do you want to have your publication mean more to you as students of the school?*

Within the next few weeks the TECHNO-LOG, *the* TECHNO-LOG *Board, and the Technical Commission will place before the students a plan whereby the* TECHNO-LOG *may be placed on a truly sound basis, and whereby a truly representative magazine may be produced. We of the* TECHNO-LOG *Staff cannot believe but that you are behind your college publication, and we believe that you will prove this. Whether this plan succeeds or not depends entirely upon you. Students, you are the persons who will decide.*

Engineers in the Municipality

"WANTED: a city manager, preferably an engineer with municipality experience."

How many times in the last few years have items like this appeared in the professional journals? The city and village governing bodies are just now waking up to the fact that an engineer is the logical man to control a progressive municipality.

It is still true that there are corpulent political bosses sitting at their desks in the city halls, pulling strings to make things go "right," but behind this there is the solid fact that the engineer is the man who maintains the efficiency of those governments. He is the man who controls the traffic, regulates the street lighting, constructs the sewers, solves the increasing problems of the city's health, yet keeping the expenditures of the municipality within the bounds of reason.

Probably the biggest problem that a municipality has to face is the protection of the life of its pedestrians. This means a logical regulation of traffic in congested areas, and therefore a change in the present antiquated code. The only man fit to handle this important problem is one who can see into the future, conquering the problems before they arise—therefore the engineer.

Also, there are the problems of health, city expansion, and growth. Without the wisdom of the experienced engineer these problems would remain unsolved in the larger cities, and there would be congestion and the accompanying loss of life, a condition that is found in so many of the Old World metropolises.

If then, there is any argument that engineering as a profession has become crowded, all one has to do is to consider the service that a competent engineer can render to the community in which he lives.

Professional Pride

JUST the other day in the East there died a lawyer who had dedicated his life to his profession. He had given much to the science of Law, and had in return received but a modest income.

Newspapers had published accounts of this because it was so exceptional. Yet, how many engineers have given to their chosen life work the utmost of their skill and cleverness, and received but little, materially, in return?

There have been untold numbers; some in the fastnesses of the jungles; some on the barren tops of high mountains; and others down in the blackness of the earth. The works of engineers have been manifest, but their names have been forgotten. Still the engineer continues to work, and it is hard to determine just why. He will labor unceasingly at his work even though he knows there is no great material reward. He will undergo great hardships to accomplish that which he has set out to do in order that the work may be well done. The engineer who receives but a modest income for a life dedicated to his work is no exception—the world just doesn't hear about him.

Why Not Think?

IT is said that above the door through which men must pass to reach Mr. Edison there are these words, "A man will resort to almost any expedient to avoid the real labor of thinking."

A professor from an eastern college in commenting on this phrase said, "A good many times the expedient resorted to by college students is a trinitarian artifice, skim, cram, and bluff." He goes further than this and in order to make clear what he is talking about he defines thought. "Thought," he said, "is the comparison and correlation of ideas."

This man wades right into the modern college students giving them little credit for their hard labor. To the college student who seems to be satisfied with simply knowing the subject this professor comes right back and says, "There is a vast difference between knowing facts and understanding facts." He found that in the mathematics classes the students were trying to remember a formula instead of thinking in terms of common sense—it was so much easier.

Much of this is only too true—how we hate to think. Psychologists tell us that our natural aversion to thinking or study is the cause of our going to sleep when we study. Our minds do not want to think and in order to get out of it, they make the body go to sleep. Thinking then resolves itself into a matter of will power. To the student who will, goes the knowledge and understanding. To those who give way to the natural instincts of nature come the practises of skimming and bluffing.

Yet in spite of its apparent hardness, real thought is a labor saver. It saves time. The development of this ability to think is one of the main purposes of college and university study, and there is no better place to develop this ability than in the Technical Colleges.

Rah! Arabs

THERE now exists on the campus a technical student organization that is without parallel throughout the country. It is the Arabs Dramatic Club. As an organization they are unique. They write their own plays, compose their own songs, design and construct their own scenery, and all characters, even the feminine characters of the plays, are acted out by engineering men students. Everything that goes into the play is the product of the local genius of the technical students.

Every person is eligible to try out for the Arabs Dramatic Club. It is something that every student should strive to be a member of. It makes no difference what your special qualifications are, there is most likely a place for you in this organization in which you can help, and in which the training will be of help to you. Such an organization is of great benefit to the Technical Students. It provides a means of development along lines which a crowded curriculum all but chokes out. It gives the engineer an opportunity to give vent to that spark of originality and musical talent with which he is usually plentifully equipped although unknown to many people.

Soon action will start on the production that is to be presented this spring. Tryouts will be held, and the practices will start. If you have a hankering to sometimes give voice to a popular song, be sure and try out. Last year the Arabs production was one of the most successful campus productions during the year. The production this spring promises to be even better. The Arabs are an organization of which the Technical Colleges can be proud. The experiences and pleasures that accompany the producing of a successful musical comedy are something that alumni write back to the TECHNO-LOG about. Such things are the ones remembered after graduation.

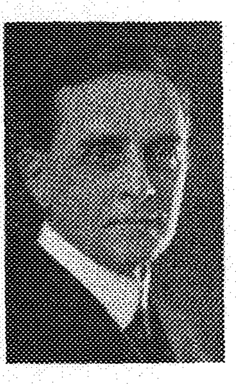
The Physics Building

THE new Physics Building is now in use, and it promises to be one of the outstanding centers of research on the University of Minnesota campus. The closeness of the building to the engineering buildings will be of great help to engineers. Because of the actual physical closeness of the two buildings, the subjects of engineering and physics will tend to be drawn closer together.

Figuratively speaking, engineers are always digging into the corners of the world to see if any cobwebs have been left there. In other words they are always looking at problems with a view to experimentation. In the new Physics building there are innumerable places in which to experiment. The student whose mind is always asking "Why is this true and if it is true, what comes next?" may now experiment to his satisfaction.

There exists no very great difference between the engineer and the physicist. Both are experimenters by nature. In the physics building there are many small rooms in which experiments can be conducted, and the larger building will tend to promote this side of our physics course to a greater extent. It is a wise thing for the engineering student to realize the value of his physics courses. In the large industrial concerns physicists work side by side with the engineer in designing and constructing apparatus. Research is built up on the fundamental laws of nature, and an engineer well informed on these is well equipped to go into research, and into the manufacturing industries.

Faculty Sketches



WILLIAM E. BROOKE

A MAN whose beliefs in the realm of music have aroused a great deal of discussion among musical authorities and critics, while his ability as a player of the bassoon has held him a place in the Minneapolis Symphony Orchestra of which he is a charter member—that is one side of William E. Brooke, head of the department of mathematics and mechanics. He can play with ease almost every type of instrument used in the Symphony Orchestra. Yet as a mathematician he excels; he has written text books on the subject that are now in wide use; and he teaches the subject of mathematics with great clearness.

Born in the little town of Minier, Illinois, on October 7, 1870, William E. Brooke was there but two years when his family moved to Ashland, Nebraska, where he was educated in the public schools. Entering the University of Nebraska after graduation from high school, "Billie" Brooke graduated in 1892 and took his master's examination in 1896 after teaching mathematics in various Nebraska schools. It was in 1896 while teaching his favorite subject of Mathematics at the University of Nebraska that Professor Brooke established a friendship with General Pershing. The only professional engineering work that Professor Brooke owns up to was done prior to his teaching at the Nebraska university when he spent some time surveying for the Burlington Railroad through the states of Nebraska and Wyoming.

The year 1897 saw the beginning of the serious career of Professor Brooke as a teacher of mathematics when he took a position in the Omaha high schools. That same year he married Helen Frances Langer of Omaha, staying in Omaha until 1901 when he came to Minnesota to take a position as instructor of mathematics in the Engineering College.

From 1901 Professor Brooke has taught continuously at the University of Minnesota with the exception of a sabbatical leave in 1908 when he studied in Europe under several noted professors of mathematics.

The hobbies of Professor Brooke are either very few or he is very modest in his accounting of them. The outstanding one is attempting to teach freshmen the fundamentals of algebra; another is music; others are lending a helping hand to anyone wanting mathematical information. Professor Brooke is noted for his text in trigonometry which he and Doctor G. N. Bauer wrote as corroborators. This year both he and Mr. Wilcox are planning to publish a text on mechanics which is now in the process of being finished.

Several societies claim Professor William E. Brooke as a member. He is a member of: American Mathematics Society, Circolo Mathematico di Palermo, Deutschen Mathematiker Vereinigung, Society for the Promotion of Engineering Education, American Society of Mechanical Engineers, Minnesota Engineering Society, Sigma Chi, honorary member of Tau Beta Pi and Triangle, and a fellow of the American Association for the Advancement of Science.

Beryllium—*Lighter than* Aluminum

(Continued from page 10)

perature up to about 450°C. where it becomes constant at 0.62.

Beryllium has a very high tensile strength; a very remarkable fact when viewed in the light of its possible structural uses. A recent value for the modulus of elasticity of beryllium is 30000 kilograms per sq. mm. as compared to 22000 for nickel and 20000 to 24000 for steel. Even more illuminating is a comparison with the tensile strengths of other light metals; the corresponding modulus for magnesium being 4,000 to 5,000 and for aluminum about 7000 kilograms.

Another very interesting property of beryllium is its electrical conductivity which is even higher than that of copper, approaching that of silver. This combination of high electrical conductivity and high tensile strength suggests many possible uses.

The metal oxidizes slowly and superficially in moist air although not so rapidly as does magnesium. The oxide so formed serves as a protective coating to prevent further corrosion. If the powdered metal is heated in the air it burns with a brilliant flame giving the oxide. It does not act on water or steam even at a red heat. The metal combines with fluorine, chlorine and bromine to form the corresponding halides but does not combine with iodine. In the electric furnace it combines with carbon, with boron, and with silicon.

Beryllium reacts with hydrochloric acid liberating hydrogen. Concentrated sulfuric acid yields the sulfate and sulfur dioxide while the dilute acid gives the sulfate and hydrogen. Even at elevated temperatures there is little action noted with concentrated nitric acid. Dilute nitric acid acts slowly giving the nitrate and nitric oxide. The metal dissolves readily in solutions of sodium hydroxide and potassium hydroxide liberating hydrogen and forming beryllates (K_2BeO_2, Na_2BeO_2).

Uses

THE extended use of beryllium awaits its production at a reasonable price and continued investigation of its properties. It seems reasonable to assume that the history of aluminum will be, in part at least, repeated and that the metal will be reduced in price as increased use lends impetus to the search for improved methods of extraction from the ores and cheaper ways of producing the metal. Just as the price of aluminum fell from about $600 per pound to $10 in eight years and then from $4 per pound in 1886 to 18c per pound in 1914; so the price of beryllium has already fallen from a purely artificial price of $425 per ounce in 1914 to about $120 an ounce. Even this must be considered an artificial price. German quotations list a price of about $40 per ounce.

A very promising field for the use of beryllium is in the production of alloys. Many of these alloys have been formed and a start made in investigating their properties. Among the most important alloys are those of aluminum and beryllium. These two light metals alloy in all proportions giving very hard and extremely strong alloys. An alloy of 90 per cent aluminum and 10 per cent beryllium has a density of 2.5 and has an extremely high tensile strength. Beryllium has been added to aluminum-calcium alloys to make a tougher, more malleable material.

An alloy with a tensile strength and toughness equal to that of bronze may be made from 85 per cent aluminum, 10 per cent beryllium and 5 per cent copper. Alloys with up to 25 per cent lithium have been made. These alloys have densities as low as 1.5. They are said to oxidize superficially after which the coating of oxide protects them from further corrosion. They should be extremely interesting and may prove of great value.

A recent article describes a new beryllium-magnesium alloy. This alloy is very light and yet has a high tensile strength.

The alloys of beryllium and copper have been studied at some length. They possess very unusual electrical properties and offer many advantages in the making of scientific instruments. They have excellent resonant qualities and are used in the production of musical instruments. With beryllium at a reasonable price they would be useful for high strength conductors. Their high tensile strength would make them of value in many ways.

Alloys with silver, iron, chromium, molybdenum, tungsten and other metals have been produced.

Chemistry

IN its compounds, beryllium acts as a bivalent element. Its compounds resemble those of aluminum and of magnesium. In general the chemical actions of beryllium compounds may be rationalized by thinking of the element as between magnesium and aluminum. Its compounds exhibit properties which indicate that the element is less basic than magnesium and more basic than aluminum.

Despite the fact that the chemistry of beryllium has engaged the attention of many eminent chemists for over a century, much remains to be learned about the element and its compounds. It seems likely that the present interest in the commercial possibilities of metallic beryllium will further stimulate investigation of this old-"new" element and add greatly to our knowledge concerning it.

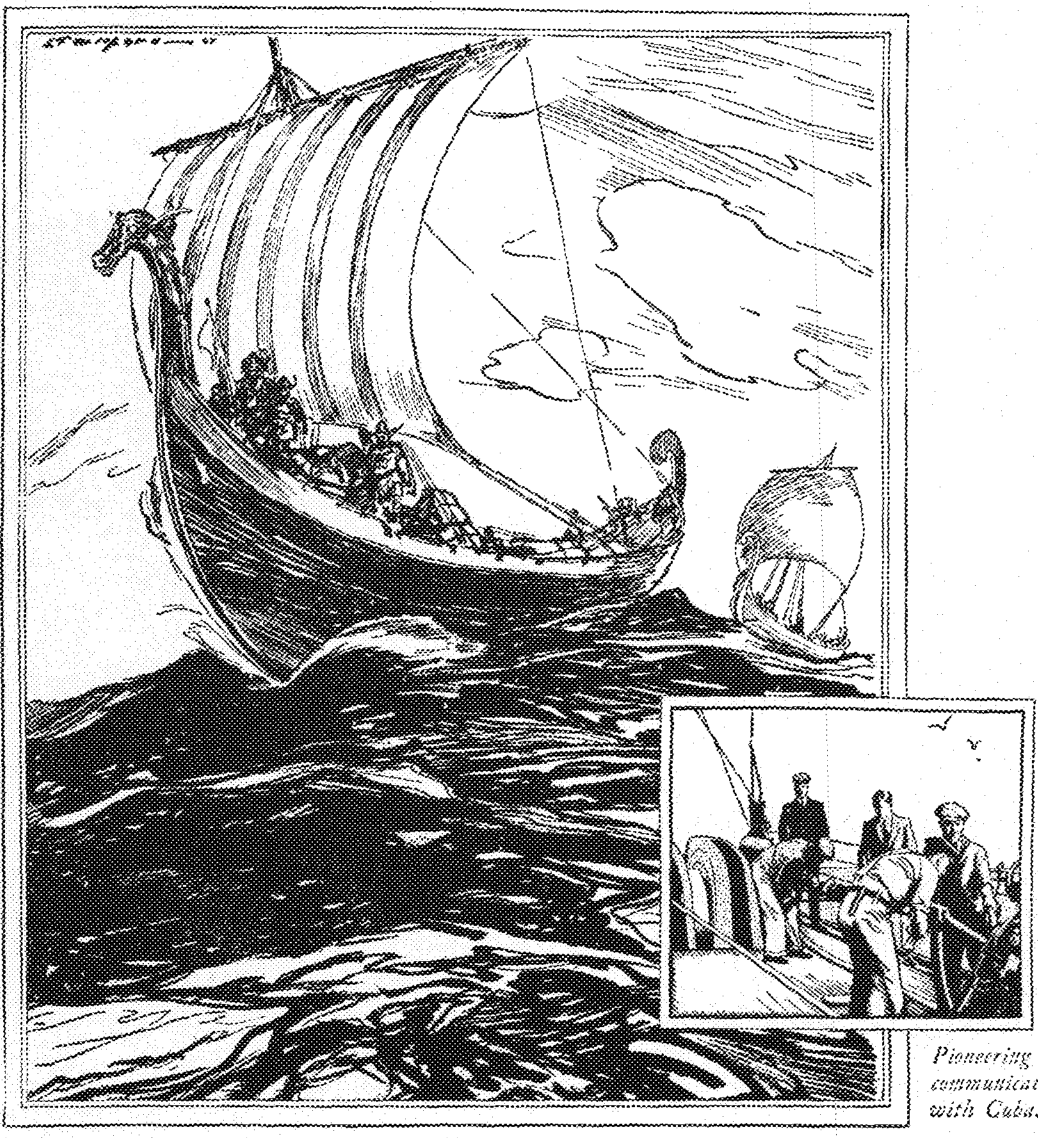
What Ho? Jackson's Hole!

(Continued from page 108)

recorded in a note book. Later, from the data taken, the cross section areas are computed in the office and the prism quantity is found by multiplying this figure by the distance between the points chosen. This is computed by aid of a slide rule and is one of the most tiresome things I have ever done. When all the figures have been checked several times, the data and results are copied on form sheets and sent into the district office. Here the calculations are rechecked on a Monroe calculating machine. If there are mistakes, the sheets come back to you marked in red. This is very bad.

When the cross sectioning was completed, the eighty foot right-of-way was marked for clearing by blazing the boundary trees. Then reference points were laid out to enable us to reestablish certain points after the stakes had been lost during construction. When the culverts had been staked out, the project was ready for construction. The Morrison-Knutson company of Boise, Idaho, was awarded the contract, and work began in August. During construction, it is the duty of the surveyor to flourish the big roll of blueprints and go up and down the line seeing that the road is being built according to specifications.

And then there was *Moran North* and *Moran East*, both location projects for which we ran preliminary lines. *Moran North* starts on the dam crossing where *Jackson Park 4* leaves off. From the dam to a gravel bench on the north the line crosses a full mile below a swamp, and is an awful mess to locate in. Beaver dams back up the water and the willows



Pioneering cable communication with Cuba.

grow about eight feet high, dense and whiplike. Through this thicket we had to chop a swath four feet wide with knives, hatchets and machetes. It was monotonous work — something like breaking rock, and we had to stand in water most of the time. We crossed several of these swamps and used to see moose there every day—big black bulls with their wide flat horns and beards, or cows with their calves at their sides. They would sometimes come stomping through the thicket and burst on us suddenly, which was startling to say the least. After some five miles this line joins the old road, cutting off about three miles from the present route.

Moran East starts in front of the Elk post office on the Twogwotee Pass road and follows closely the old road, below a low range of hills and roughly parallel to the Snake. The present road is narrow and full of sharp turns. And the grades are steeper than need be. The line passed many groves of quaking aspen, whose wood is very soft, and lots of fun to cut down. Other interesting features of this line were a dead horse and a dead cow which smelled vile. In one place we came close to a small private cemetery. The Chief Ranger told us later how a lady came to him with tears in her eyes and told him how "those engineers" were going to run a road right across their graveyard. After the line was laid out we took contours on the Pacific creek crossing, and mapped the property lines, fences, and other landmarks. We also did some rough cross sectioning here and took photographs. The data for these two latter projects will be examined in the office and the cost roughly estimated. Then the matter will be tabled until the budget permits the final survey and construction.

By this time it was late in September, and I could hear the old alma mater crying for me to return for another year. So I dutifully packed my roll and started back. We drove down to Rock Springs, and took the night train for Denver. The country was at its most beautiful when I left—the aspens were bright yellow, and the underbrush red—everything a blaze of color. But the snow was creeping down the sides of the Tetons, and it would not be long until nothing but snowshoes could move in Moran.

Details of the Foshay Tower

(Continued from page 105)

and are designed to care for any fire which might ordinarily occur in the building. Fire apparatus may pump water directly to the various floor hose connections. It is planned to carry this system up as the construction progresses so as to have protection against fires during the erection of the building.

Cold and hot water for use by tenants is to be provided in storage tanks situated in the roof space and at a lower point.

It was originally intended to have 28 stories, but two were later added, bringing the building, as planned, 450 ft. above the ground, and 500 ft. above the caisson footings, making the tower about 200 ft. above the First National-Soo Line building, and 50 ft. higher than the ball at the tip of the city hall flag pole.

Provision is made for a spectators' gallery at the base of the pyramidal roof, with an inconspicuous grilling installed to prevent people from jumping. The word, "Foshay," in letters 10 ft. high, on each of the four sides, will be illuminated at night, and it is believed that these signs will be visible at 15 miles, and legible at one-third that distance. A revolving beacon at the peak of the roof, which will be visible in clear weather for 20 miles, will serve as a guide to aeroplanes.

The system of flood lighting proposed calls for the concentration of rays at the foot of the tower, with a gradual building up of light until it reaches the roof. Then the entire roof is to be illuminated, and shortly afterwards all the lights are to be turned off with the exception of the word, "Foshay".

Excavation for the tower was started about August 1, 1927, with the pouring of concrete footings underway about November 1, and it is believed that the building will be completed on November 1, 1928. On December 31, 1927, the steel was in place up to and including the basement level.

Rental will be available to general types of business and professional men, with the exclusion of dentists and doctors, who would require special plumbing. A basement garage will accommodate about 300 cars.

The architectural firm of Magney & Tusler, Inc., is of long standing. Mr. Magney established his own architectural office in 1911, and in 1917 when Mr. Tusler entered the firm it was incorporated. Mr. Arnal was taken in as a partner in 1920.

Around the World With Our Alumni

(Continued from page 119)

inson had been transferred to the Boston sales office of the General Electric company.

'27—E. B. Berglund, H. F. Farmer, Bertram Hovey, P. R. Lee, and C. E. Swanson are entered in the Engineering School conducted by the Westinghouse Electric and Manufacturing company at East Pittsburgh, Pa. C. E. Swanson was at his home in St. Paul during December.

"Bill" Weibler, '08, "Gus" Johnson, '25, John Walifred, '20 M. E., and C. W. Teal, '24, have taken up bowling this winter and are bowling in the Northwestern League in Omaha. It will probably be the better part of valor to suppress the scores, although we must admit that Weibler has been shooting some 200 games.

Mechanicals

'25—Folmar I. Bjette is now a district engineer with headquarters in Boston. In a recent letter to our Omaha correspondent, Mr. C. W. Teal, E. '24, he wrote: "I have just completed some commercial tests at Tech (M.I.T.)—the profs, students, and all are a dandy set." In referring to the Arabs he says, "That hankering to get back into the leopard skin—or as a chorus girl—or as some vicious cannibal—comes right back again. To sing fancy melodies—to crow—to try to be graceful—aye, there's the rub. I often wonder how the Arabs are going now." He is living at 16 Lancaster Street, Cambridge, Mass.

'27—J. Edwin Coates recently left his position with the Minnesota Mining and Manufacturing company in St. Paul, and is now working for the government at Dayton, Ohio. He is in the Army Air Service at Wright Field in the capacity of propeller testing engineer. He says, "Anybody desiring permanent rest should work for the government."

'27—Dimon A. Roberts is a material testing engineer for the Army Air Service at Wright Field, Dayton, Ohio. Before going to Dayton he worked for the Bros Boiler company of Minneapolis.

'27—Wilbur J. Chapman is assistant maintenance engineer at the Minnesota Mining and Manufacturing company of St. Paul. He was formerly with the Northern States Power company.

Mines

'12—That George L. Harrington is

(Continued on page 126)

Heat Changes in Cement During Setting

(Continued from page 111)

steam issuing from every crevice in the box. On opening the box it was still more astonishing to see the excess water boiling merrily on top of the cylinder. In the seventh test the temperature as indicated by the thermo-couples was below the freezing point of water, but evidently there was enough free water to start the action for the specimen reached a temperature of 223.2 degrees F. The water-cement ratios were as follows:

Test No.	w/c	Test No.	w/c
1	.465	5	.406
2	.436	6	.406
3	.439	7	.406
4	.406		

In three tests with Lumnite cement with the following mixtures, neat, 1:1, and 1:2:4, and the respective water ratios .406, .475 and .800, the temperatures around the eight hour mark rose to the maximum. There was a very slight rise in the 1:2:4 mix after the ninth hour, and it remained constant for some time. Of the others, the neat mix rose as high as 281 degrees Fahrenheit, and the 1:1 mix reached 184 degrees.

After the eighth hour the temperature of the lumnite mix dropped quite suddenly until at twelve hours after setting the temperature was 161 degrees. Even this was high above the temperature of the Portland cement mix which reached the maximum temperature after ten hours of setting of 99 degrees.

In all these tests the readings were continued until the temperature of the water had started to drop, but since the specimens were still generating heat which was dissipated by radiation, their heat curves continue to rise. Readings were taken every fifteen minutes.

Conclusions

WHILE the tests run are not large enough in number to justify any sweeping statements as to the behavior of Lumnite cement during setting, the following conclusions are supported by these tests:

(1) When the specimens are made of neat cement of average consistency and are confined so that the heat generated cannot escape, a temperature over the boiling point of water can be expected due to the chemical action of setting and hardening.

(2) A decrease in the richness of mix decreases this effect.

(3) The Lumnite cement specimen reached a temperature of over four times that of a similar portland cement specimen.

(4) The rise in temperature with Lumnite cement takes place very suddenly. In every instance a rise of over 100 degrees F. took place in approximately 15 minutes.

(5) The effect of high initial temperature is to cause quick setting with Lumnite cement.

(6) In all cases for the same mix and the same water-cement ratio, the specimens composed of Lumnite cement generated over two times as much heat as a similar specimen of portland cement.

(7) At temperatures below 80 degrees F. the temperature of concrete composed of Lumnite cement will start to rise in about five hours.

It is obvious from these tests that Lumnite cement concrete could be used to advantage in winter construction because of the large amount of heat generated. It is also apparent that Lumnite cement concrete must be cured differently than Portland cement concrete because of its radically different behavior during this period.

Around the World With Our Alumni

(Continued from page 124)

enjoying his work as a geologist for the Standard Oil company in Argentina can be seen from the following excerpts from a recent letter to the Techno-Log. He writes: "This place is not quite in the jungles, though it is one of the places that might be listed among the great open spaces where men are men and women are scarce.—I have been in northern Argentina and southern Bolivia nearly eight years, the last year as the company's resident geologist doing subsurface and every other kind of geologic work. The roads are good enough to average 1,000 kilometers a month—making easily in a day what took us some fifteen days in 1920. We occasionally have to push across some sandy quebradas, and the we regret the 'good old days' when we rode the hurricane deck of a mule.—

"My office is a 'Close to Nature' tent with a fly, and I strongly suspect that our surroundings here are not greatly different from what one might find in a center of 'wildcatting,' in the States."

News from the Technical Campus

(Continued from page 116)

woody Institute, Minneapolis, January 23 and 24. Also, an evening course for applicants will also be given at the Dunwoody Institute beginning January 31 and continuing until the equivalent of two full days instruction is given. As soon as a sufficient number of adjusters have qualified, the State Highway department will begin designating lamp adjusting stations, and they will be prepared to put into effect the provisions of the 1927 law for the testing and adjusting of head lamps.

The Engineering College Hockey and Basketball Teams Start Play

STARTING the athletic year with eight basketball teams, the Engineering College has shown more spirit in the game than ever before. Even with this many teams entered, there is room for others and Charles Hendrickson, the student athletic manager, has issued a call for more teams.

With eight teams in the engineering league, Mr. Smith of the intramural department will give medals to the wining team members. The play in the tournament starts January 30 when the games will be played in the Minnesota Armory, or in the new field house from 7:30 to 8:00 each evening.

A call for more hockey enthusiasts has been sent out by Lloyd Russ, who has charge of the engineering organization.

Teams wishing to enter the basketball and hockey tournaments should see Harold Shannon, who is serving as athletic manager until Charles Hendrickson returns from an illness.

Chief Operator of WLB Leaves to Work with Dept. of Commerce

TWO days after he had received notice of his new position Lloyd V. Berkner, Ensign in the Naval Reserve, and former chief operator of WLB, was on his way to Washington, D. C., to accept a position with the Bureau of Lighthouses and Docks of the Department of Commerce. He was also taking graduate work at the University of Minnesota, and was in charge of the amateur radio station when he left.

With the Department of Commerce he will work on the installation of radio beacons for the air mail service, and at present he is working on an air mail route in Florida. This work involves both the knowledge of radio and the ability to pilot an airplane in which capacities Berkner is well fitted, having taken up the aviation course offered by the Naval Reserve Unit of Minneapolis, and having a wide experience in radio.

Television Is Explained to Students in Lecture

THAT television, the science of seeing, instantaneously the happenings at some distant point, is a practical and possible thing was demonstrated in a lecture before the student body in the Main Engineering Auditorium by Dr. J. C. Perrine of the Bell Telephone Laboratories.

Taking a photograph and passing a beam of light over its surface by means of a system of dots punched in the form of a spiral in a revolving disk, Dr. Perrine showed how, in practice each minute area of the subject was subjected to a beam of light. This beam of light after having struck the subject was reflected into three very delicate potassium photoelectric cells which transformed these light rays into electric currents of varying intensities in proportion to the intensity of the reflected light beams.

"These electric currents," said Dr.

Perrine, "must be amplified one hundred million, million times before they can be sent for long distances over the wires."

At the receiving station the currents are again amplified and sent through a long, bent tube having on the outside 2,500 tiny bits of tin foil. This tube is bent into fifty horizontal layers, each layer having fifty of these bits of metal stuck on the outside of the tube. Current from the amplifier passing through the tubes causes these bits of tin foil to glow with a pinkish light, and with varying intensities according to the strength of the current in the tube. As these glowing strips of metal send out their rays of light, there is a disk revolving at exactly the same rate of speed as the one in the sending station, that interrupts these rays before they can be seen by the audience.

As these rays pass through the holes punched in the revolving disk they form a picture on the screen.

Club of Signal Corps Men Is Established

IN order that fellowship among the Signal Corps men may be promoted there has been established during the fall quarter the Signal Club composed of men selected from the Signal Corps R.O.T.C. organization. The club was organized with 12 charter members, one alumni adviser, E. R. Summers, instructor in electrical engineering, and one honorary member, Captain W. B. Persons.

Men who are charter members are Carl E. Swanson, Captain of the club, Clinton Hawkins, First Lieutenant; Maynard Briggs, Second Lieutenant; George Wier, First Sergeant; Arthur Braaten, Melnor Rudser, Rudolph Bierwagen, Jack Ginnaty, Conrad Gran, Leon Mears, Anton Korba and Francis Mayer.

Sophomore Electrical Awarded Highest Scout Scholastic Honor

RECEIVING the highest scholastic honor that is given a member of the Boy Scouts of America, William F. Thompson, sophomore electrical of the Engineering College, has been awarded the $100 scholarship award of the Harmon Foundation of New York City for region No. 10. This region is comprised of Minnesota, North and South Dakota, and eastern Montana.

This award is given only to eagle scouts who show extraordinary service to the community. Bill, it seems, is one of the highest ranking scouts in the country, having the eagle badge with palm.

Gleaned from the Technical Press

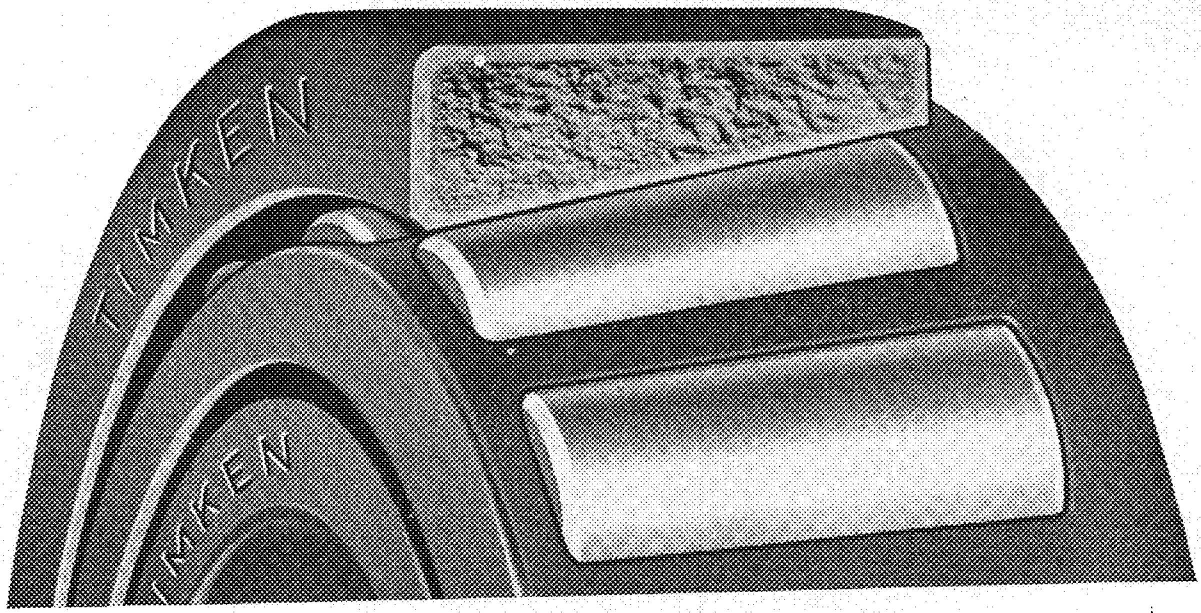
(*Continued from page 117*)

morning or late in the afternoon, and least at noon.

Loss of daylight is not the only evil resulting from the presence of smoke in the atmosphere; smoke also cuts out to a much greater extent the ultra-violet rays which are so necessary for good health.

The amount of light reaching us at different times of the day, at different times of the year, and under different conditions of weather is of interest. Records of daylight in Washington, D. C., have been made since July, 1924. These records show that at noon on a bright day in midsummer the illumination seldom exceeds 10,000 foot-candles. In midwinter at noon on a bright day, it seldom exceeds 3,500 foot-candles. In December the average illumination on cloudy days was found to be about 23 per cent of that on sunny days. In June this ratio was about 26 per cent.

Great variation in daylight takes place when small clouds pass over the face of the sun on a clear day. In such cases the light may fall from 9,000, or more, foot-candles to 3,000, or less, in one minute's time.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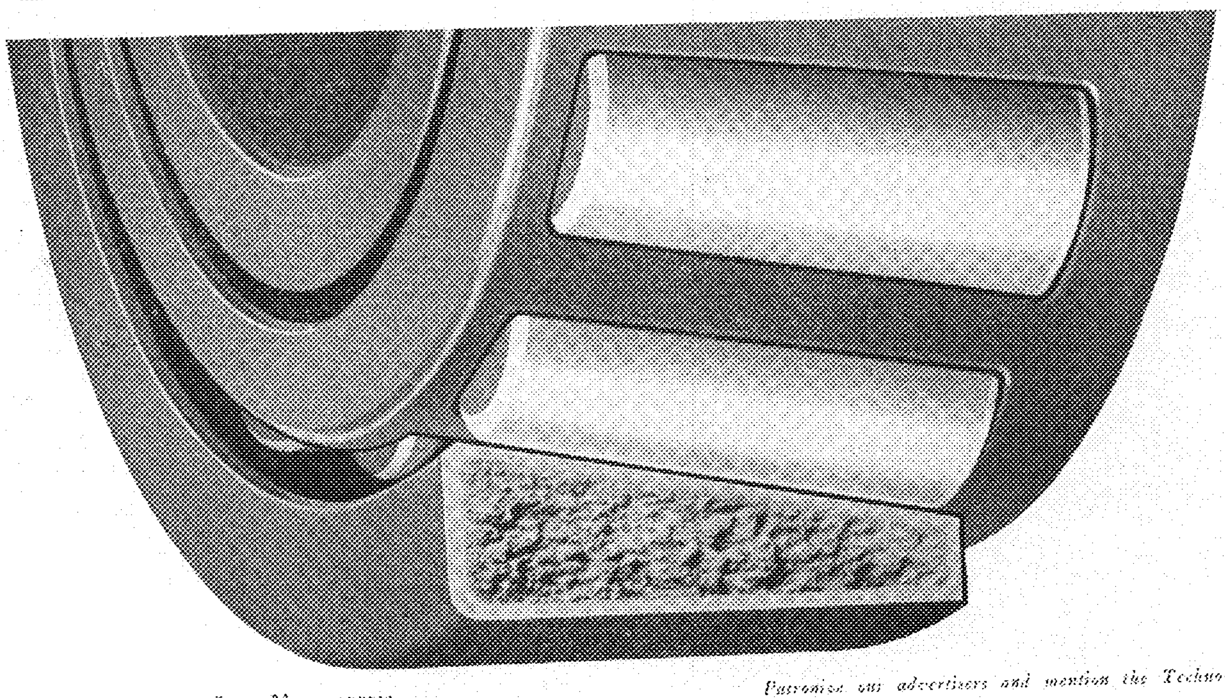
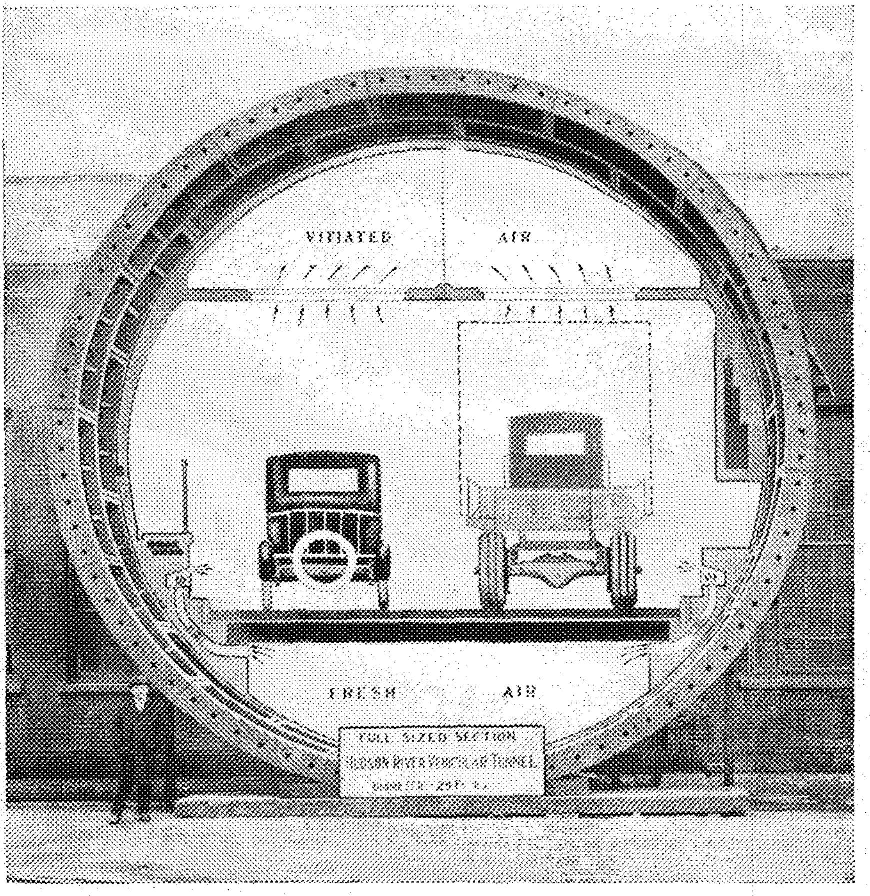


R. E. BEDWORTH,
Salesman,
Yale, '17

L. P. MAXWELL,
Head Design Engineer,
Missouri, '19

M. I. RUBEL,
Ass't Design Engineer,
Institute of Technology,
Vienna, Austria, '21



H. H. RUGG,
Design Engineer,
South Dakota
School of Mines, '16

R. De CAMP,
Engineer,
Montana, '17

J. E. WALTER,
Contract Administration,
Carnegie Tech. Ex '25

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

The Holland Tunnel

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

THE HOLLAND TUNNEL is one of engineering's greatest triumphs, because—

—it is twice the size of any tunnel ever bored beneath the bed of the Hudson River.

—it is over a mile and a half long.

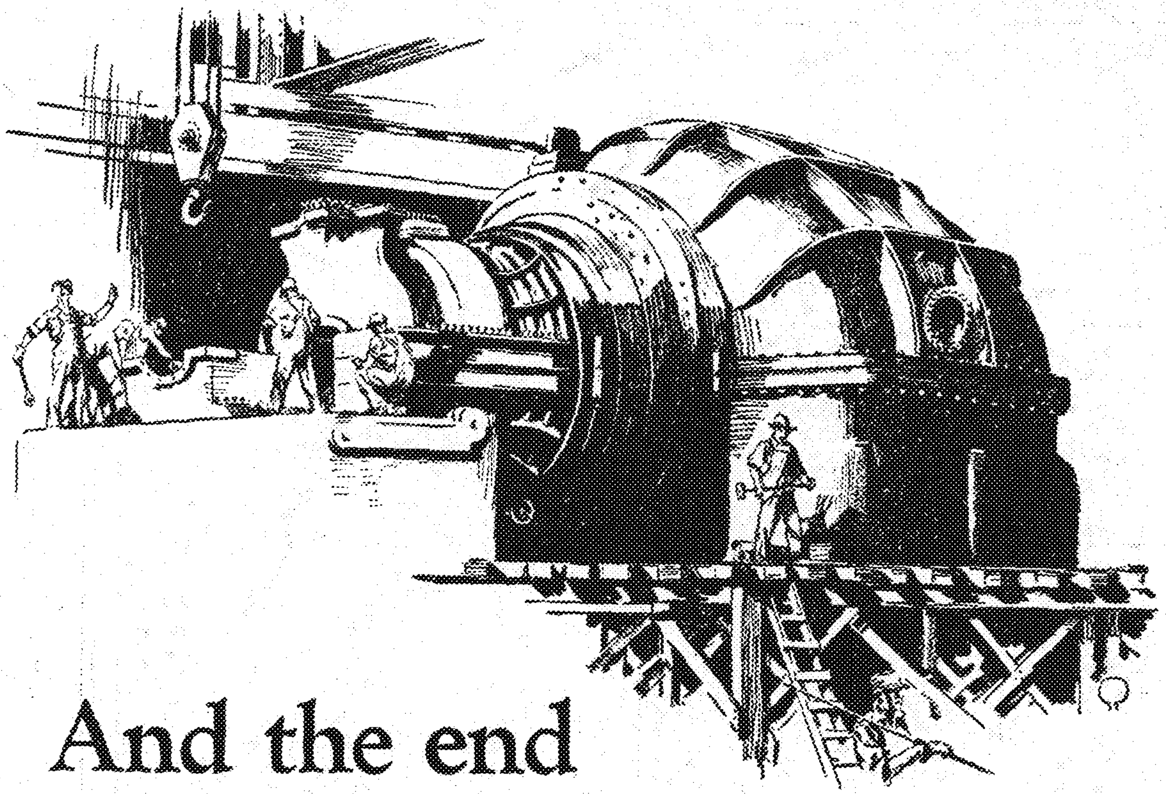
—it is designed for automobiles to use.

Because they generate poisonous carbon monoxide gas, motor cars create an entirely new need for tunnel ventilation. Yet even when the Holland Tunnel is filled to capacity and 2000 motor cars are passing through it in each direction, the air is fresh and pure.

This is a type of engineering undertaking with which young men in an organization of the size of Westinghouse frequently are brought into intimate contact. Opportunities to work on the stupendous, the never-before-undertaken, are not rare here. Hence young men of capacity, of enterprise, of genius, find much to challenge their imaginations and abilities.

A battery of 56 fans driven by Westinghouse motors pump fresh air into, and foul air out of, the Holland Tunnel. Twenty-eight more Westinghouse-motored fans are a reserve. Westinghouse planned the lighting system in the tunnel; also the system of remote control.

Westinghouse



And the end is not yet in sight

In the year that many of today's college students were born, a new child—the steam turbine—came into the industrial world. Its birth was celebrated by the installation of a 5000-kw. unit, in 1903. In 24 years the turbine has grown to giant size, with a 165,000-kw. unit to go into operation in 1928, and a 208,000-kw. unit under construction.

Experienced engineers have made outstanding contributions to its development—making possible these tremendous units. A young engineer, only a few years out of college, has by "flow casts" enabled designers to visualize the flow of steam through the intricate passages within the turbine. This has resulted in an improved design of nozzles and buckets. Others have eliminated the causes of resonant vibration and have made possible the production of units which operate at 1200-lb. pressure and 750 degrees F.

Greater power plant efficiency is being obtained by the extraction of steam from the turbine at different temperatures to heat feed-water on its way to the boiler, and the economies of the mercury vapor process indicate a new range of possibilities.

Rome wasn't built in a day, nor was it built by one man. The power plant, which now delivers a kilowatt-hour of electricity for one-third as much coal as it took a quarter-century ago, is the combined achievement of many engineers working not only on turbines, but on generators, boilers, and the many auxiliary devices. These men have helped to give the world a new force. Progressive leaders in all fields are calling upon electricity for ever-widening services—and the end is not yet in sight.

This monogram identifies the accomplishment of General Electric scientists and engineers. You will find it in power houses, on small motors in the home, on powerful electric locomotives, and in the electrified factories of modern industry.

174-15DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

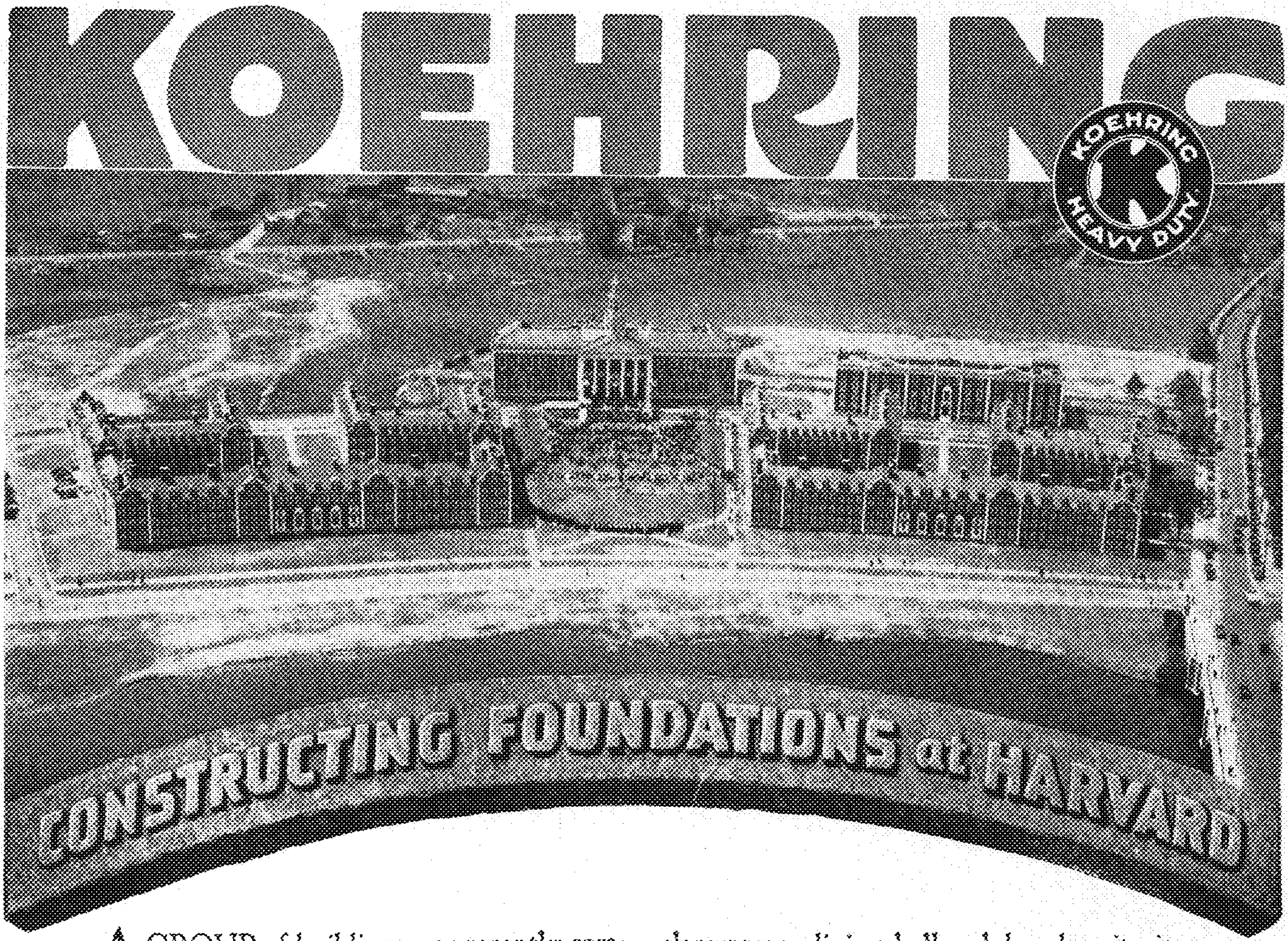
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

SWEATING AT THE FORGE

Volume VIII FEBRUARY 1928 *Number 5*



A GROUP of buildings was recently completed in Cambridge, Massachusetts, for the Graduate School of Business Administration, Harvard University. The group was planned as a unit and developed in accordance with a definite idea that buildings and grounds could and should help in education, and that personality could be brought out in an atmosphere of quiet and good taste appropriate to an old university.

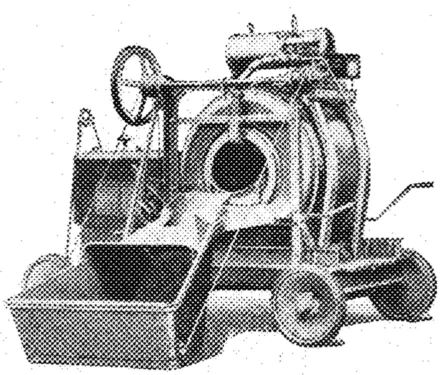
Included in this modern school of business are specific buildings for adminstration, classrooms, dining halls, clubs, dormitories, library, recreation, business research, and professors homes. The total cost of all of these as illustrated in the above picture was approximately $5,000,000.

Four Koehring Heavy Duty Mixers [two No. 10S and two No. 14S mixers illustrated below] were used in mixing the concrete for the foundations. With the Koehring re-mixing action it was assured that every foot of concrete wall would be uniform and of dominant strength.

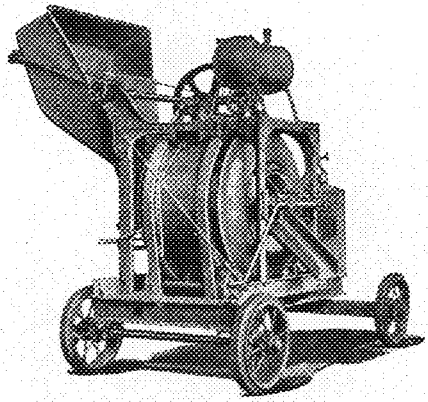
KOEHRING COMPANY

MILWAUKEE, WISCONSIN

Manufacturers of Pavers, Mixers — Gasoline Shovels, Cranes and Draglines.



The revised edition of "Concrete — Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, is now ready for distribution. To engineering students, faculty members and others interested we shall gladly send a copy on request.



THE MINNESOTA

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VOLUME VIII MINNEAPOLIS, MINN., FEBRUARY, 1928 NUMBER 5

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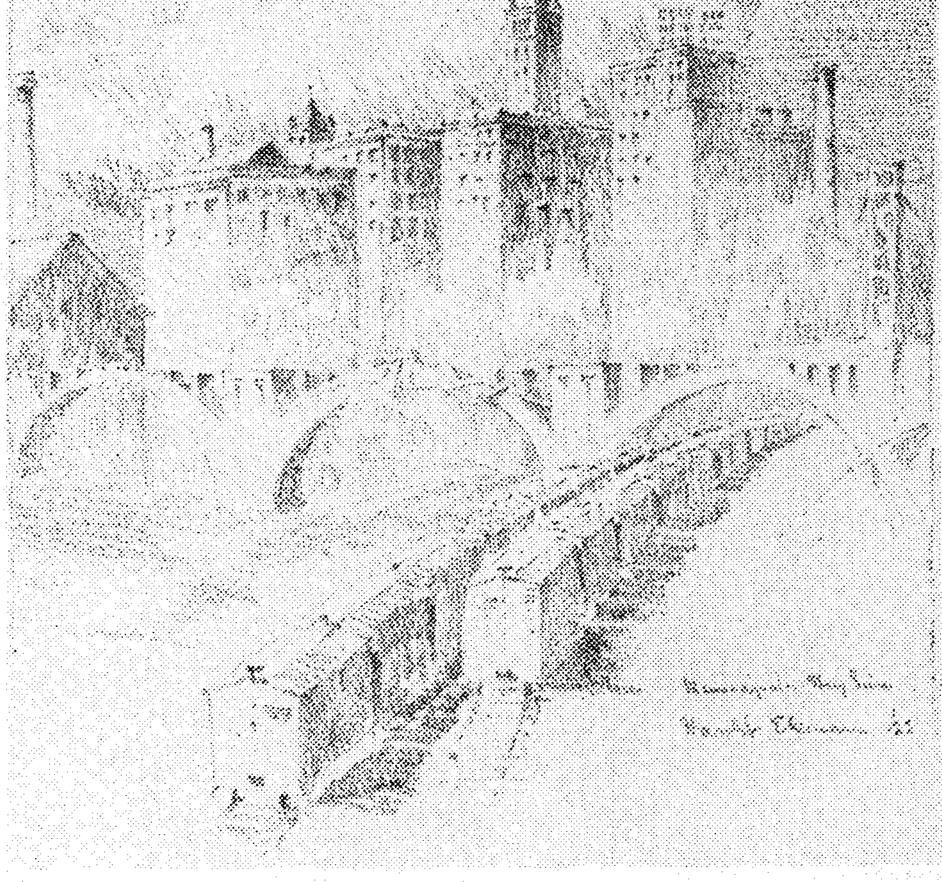


Minneapolis Sky Line

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII — FEBRUARY 1928 — Number 5

"He's a crusty old codger, but I got by ace high with him just because I . . ."

What I Would Do *If* I Were Going Through the University Again

By CLARENCE W. TEAL, E. '24

Managing Editor of the Minnesota Techno-Log During 1923-1924

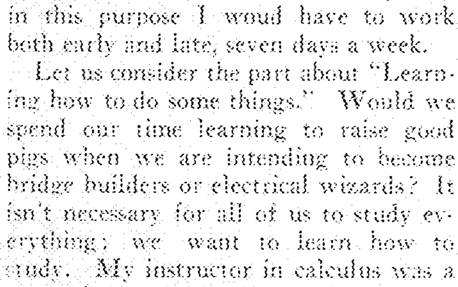
ABOUT a year ago a young friend of mine just entering the University asked me what I would do if I were going through again. Now if he had asked me how to get through and also have a good time I could have answered readily, but when he got down to brass tacks and asked me what I would do if going through again, why that was another matter. All of us have our little gestures which we delight to display before the undergraduate, such as: "Now, you'll probably get Professor X for math. He's a crusty old codger, but I got by ace high with him just because I . . . ." But when a younger man asks you point blank what you would do if you had another chance he's appealed to that code of yours that calls for the best answer you can give him.

Not because what I would do will be of any more benefit to the reader than what John Jones would do, but rather because John Jones hasn't already said what he would do next time, I'm going to lay our my hundred per cent perfect program.

Everyone knows that 99 44/100 per cent of us attend the university in the pursuit of happiness. We camouflage the main idea by broadcasting the fact that we're going to store up a lot of theories and engineering knowledge, etc., etc. When you get down to rock bottom, what we really want is to learn how to do some things, where to find how to do other things, and how to get the other fellow to do still other things either with us or for us. If I were going to the university again, these are the three things I would try to learn, but I'm convinced that to succeed even fairly well in this purpose I woud have to work both early and late, seven days a week.

Let us consider the part about "Learning how to do some things." Would we spend our time learning to raise good pigs when we are intending to become bridge builders or electrical wizards? It isn't necessary for all of us to study everything; we want to learn how to study. My instructor in calculus was a man who knew his subject and made us work problem after problem. He knew, of course, that we would forget it all in a couple of years but that's beside the point. Even though we never cracked a book for a dozen years he knew we had learned to work calculus for ourselves and that we could master the subject again after a little review. (I've had occasion to prove this, too.)

Learning to study isn't listed in the curriculum but it's what assures you a career. (So they still tell me.) Many a man has tried to put in the study on



"—99 44/100 per cent of us attend the university in the pursuit of happiness."

each course that the professor has recommended, but as Al Greene (He's Minnesota's Abe Martin, E '24, and recent publisher of the Knut Book) has so aptly remarked, "There just ain't more than 24 hours in a day and a fellow really should sleep two or three of those."

Learning to cover the ground easily and rapidly is something that every man has to develop for himself. For my part, I find it a lot easier to grasp something when I'm engaged with enough work of various types to keep my mind fresh and active. "The more one has to do, the more one can do and the greater the incentive to do it well." Too much time creates a sluggish worker and this type of engineer is not in demand.

"Learning how to do something" is nothing more than learning how to study and work out the information you desire. The moment I reached the point where I could sit down and proceed to untangle a knotty problem and then set it up again in logical sequence, then, and then only, would I consider that I had reached a definite starting point in my education.

IF you have no objection we'll just take a little detour here and talk about that lost art of choosing one's instructors. If I were starting my training anew I should certainly demand (Of course that might be as far as I'd get) the chance to pick my own instructors. When we want to learn something we go to a man who not only knows the particular subject, but one who can make it clear and logical and who doesn't leave us with a confused and hazy idea of the salient features. Choosing our instructors this way would relieve the dean a lot too, because it would make it easy to dispense with waste timber in the teaching staff; they wouldn't have anything to do anyhow. Take a case closer home. If you are ill do you call in just any doctor or do you call one who you feel is fully qualified to handle your special case? Do I make the analogy clear?

NOW to come to my second point. We are learning how to study and how to do things for and by ourselves, but have we been making a mental index of the side roads and green fields along the route? Some day the boss will say, "John, I wish you'd work this out and draw up some tentative plans for us." The problem in hand may be entirely foreign to us, but if we took careful notes along the way we'll be able to consult our mental card index and know just where the particular side road or green field lies. Once back at the side road we can venture from the broad highway into the special field of our problem where in time ripe grain may be harvested.

The making of a comprehensive index is not an easy task. One must start every course expecting to find a great adventure just over the next hill. One writer says that we must "enter every course with the conviction that it is to become a life hobby." Of course all subjects won't merit such an application, but there are some in the pursuit of which we will still be enjoying rare experiences thirty and forty years later. It is this enthusiastic pursuit in which we do something more than called for in the book, in which we read between the lines, that we most easily build up our index. Woodrow Wilson once said: "For my part I want to have to carry as little information in my head as possible—just as I want to forget the figures in a column whose sum and result I have ascertained and want to keep. I must scan information, must question it closely as to every essential detail, in order that I may extract its meaning; but, the meaning once mastered, the information is lumber. It is enough to know where to find it, for corroboration, for illustrations, etc. Of course one can't make himself familiar with facts for such purpose without remembering some of the more essential of them; but it is sheer, barren, ignorant waste of energy to try to remember a fact for its own sake. It is like eating for the sake of eating."

The other day I ran across two descriptions, one of learning and another of schooling. Here they are: "Learning is gracious, joyous and unending. Schooling is fretful, laborious, and anticipates completion." One can obtain either at a university, but it's up to the individual as to which he will choose.

Some people seem to be of the opinion that learning stops the moment you close your books and leave the lecture hall or study room, but I cannot agree. I like to think of the five questions a certain business man asks the college graduate:

1. Can you play the game with your fellows fair and square?
2. Do you know team work?
3. Can you stick until the game is won?
4. Can you think a problem through to its right conclusion?
5. Can you learn in the class room as well as in the field?

You'll notice that questions four and five deal with what we learned in the class room and that the other three are based on your extra curriculum activities. The business man, in other words, wants to know if you have learned how to study and to think straight, and, if you have, he still wants to know if you can enter into the game of life and "Carry on."

NOW as I look back there was only one place where one could learn to "Carry on" and that was in the field of extra curriculum activities. There are athletics, journalism, dramatics, class organizations, religious organizations, literary societies, and a score of others. Active participation in any one of these will furnish the laboratory in which we can investigate the various parts of this "Carry on" and learn how to get the other fellow to work either with us or for us.

If I were in college again I'd go in for some major sport and I'd stick with the one I found suited my ability the best. Sports like football, basketball, hockey, and track build up the body as well as develop the other characteristics to which our business man referred. As long as a fit body is such a big factor in the mental attitude of the average man, he who ignores his physical development cannot consider his educational program well developed. Of course I wouldn't deign to say that all students should take up a major sport, because they may not be physically fit, but they can at least take some kind of gymnasium work.

From other activities, I would choose journalism, dramatics, or debating. I have always believed the average engineer to be shockingly ignorant of the correct use of our English language and I know that he cannot express himself clearly or convincingly before an audience. The speaker who is often an authority on his subject and can prove by mathematics, charts, and experiments that his results are correct, is a total loss when he tries to impart this information to a group.

Journalism helps one to learn to express his thoughts clearly, concisely, and without waste of time. It brings the student into close contact with others and gives him a cross section of life that is hard to obtain in any other way. At the same time, college journalism gives the embryo engineer a bit of practical training which from a business standpoint should be of great value to him after graduation. Also, as we have always heard, if the engineer has to make reports from the moment he enters college until he retires from the profession at a ripe old age, it would seem that a knowledge of newspapers and article writing technique might prove helpful.

RECENTLY I've listened to two distinguished engineers, both of whom are authorities in their particular line. The first speaker gave a very clear, comprehensive talk on a technical subject with which none of his audience were familiar. He developed his subject chronologically and in simple English so that all were able to follow him. Needless to say, everyone there felt that he had spent a profitable evening. The second speaker also spoke on a technical subject, which to all intents and purposes was not as complicated as the first, but he rambled from one point to another, his manner was unconvincing and he left only hazy pictures with his audience. What had been heralded as an excellent lecture turned out to be a dud, simply because the engineer hadn't marshalled his material so that he could make effective use of it and because he didn't say what he did have to say in a convincing manner. The point I wish to make is that we need far more public speaking and debating than that which comes with the usual engineering course.

Debating sharpens the wits, teaches one to talk convincingly and logically, and if practiced enough should make one at ease before any audience. Public speaking classes help along this same line and in my opinion should be a part of the required curriculum in the engineering college instead of an elective course in some other college. Dramatics also help to make one at ease before an audience although I must admit that I participated in dramatics merely because I liked and enjoyed the work.

Minnesota engineers have an excellent opportunity for testing their creative abilities, initiative, business ability, resourcefulness and sticktoitiveness in the Arabs. There has never been a club on the engineering campus which offers more opportunities in the way of an extra curricula activity than does this club with its play writing, music composing,

(Continued on page 162)

Mr. K. J. de Juhasz, Inventor of Indicator

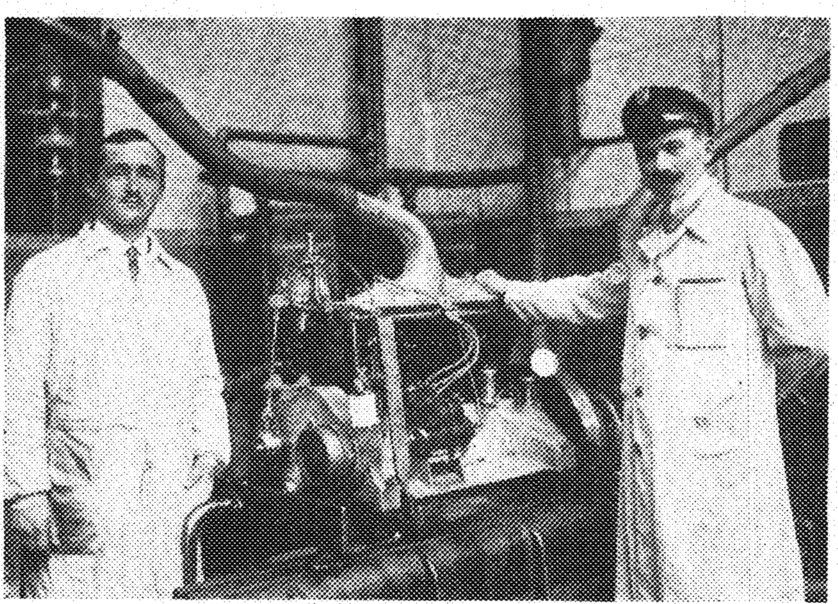
New instructor in mechanical engineering this fall, was a British prisoner during the war, and victim of famine and communism in Hungary

MR. K. J. DE JUHASZ, citizen of Hungary, prisoner in a British internment camp during the war, traveler of Europe, and inventor, has this fall become an instructor of gasoline engines in the mechanical department. The few years of his life have been filled with experiences more varied and more different perhaps than any other member of the university faculty has ever had.

As an inmate of the British internment camps, those stuffy, overcrowded, unhealthful prisons where civilians of the enemy were kept during the war sometimes losing their minds and health, Mr. de Juhasz conceived in principle and roughly designed a mechanism for measuring the instantaneous pressure in a gasoline motor cylinder. In Hungary upon his release from prison at the end of the war he witnessed communistic uprisings, and he saw people of his native country killed in the strife. He was separated from his parents and could not see them even after the war had ended. When people walked the streets of Budapest with sunken cheeks and hollow stomachs—when only those who had a certificate could get food—he was there. He has worked for manufacturing concerns of Germany, Italy, England, and France. He has taught at the Budapest Technical College in Budapest, Hungary—and now he has realized a great ambition. He has come to America to teach.

His invention while of a very specialized nature is a thing that is of quite some importance to automotive engineers. In testing automobile motors in order to study efficiency, designers must know what pressures exist in the cylinders during the cycle. These pressures are graphed on a small piece of paper by indicating devices.

Although there are other types, Mr. de Juhasz's indicator takes from 10 to 20 seconds to record a card where the old style indicator took but a fraction of a second. It makes a diagram from not one, but a thousand cycles. To accomplish this retardation, Mr. de Juhasz placed between the cylinder of the engine and the indicator proper a sort of slip valve whereby the engine cylinder and the indicator valve are placed in communication for a very short fraction of each cycle. The piston of the indicator will then assume a position which permits registering the pressure on the diagram. By changing the phase relation between the indicator valve and the engine crankshaft, a complete diagram of the engine cycle can be drawn, and the effects of inertia of the indicator moving parts practically eliminated.



DE JUHASZ INDICATOR AS INSTALLED AT BREMEN, GERMANY
This picture was taken in 1923 at the Hansa-Lloyd plant at Bremen where Mr. de Juhasz (left) did some research work. The assistant wears a cap as a sign of his profession.

This invention, upon which Mr. de Juhasz has spent much thought during the lean, long hours in a prison camp, has changed his whole career, and he says, "Had I been able to foretell the sleepless nights, countless hours, and money that I have now spent on this invention, I would never have undertaken it. It is perhaps fortunate that we can't see ahead."

INTERESTING, intelligent, well versed in his profession and filled with memories of unforgetable experiences—that is Mr. de Juhasz. He is rather short, but well built, having clear and finely formed features. A little mustache and black hair set off a round face. His life has been most interesting.

He was born in 1893 in Csap, Hungary. At that time Hungary was about the size of Minnesota. After graduation from high school he attended the Budapest Technical College, taking mechanical engineering. He graduated in 1914 with a scholarship of two months' study in England.

LITTLE did he realize what was in store for him. His arrival in England was two weeks before the war was declared, and the two months' stay in England turned out to be five years. Enclosed in a camp about the size of Northrup field he lived in a tent. It was during the winter season, and as there had been little time for preparation, the British government had done little to care for the prisoners—poor bedding, water from above and below, no heat, few clothes.

During the first two and one half years there was enough food for everyone, but with the increasing effectiveness of the German submarine blockade, food became scarce. "They gave us just enough food to hold body and soul together. Many times it became so cold that we forgot we were hungry, while at other times we were so hungry, we forgot we were cold.

"Our daily greeting in camp used to be, 'How long yet?' We didn't know how our families were; our mental anguish was so great that many became insane. We looked eagerly each day for the daily paper. We couldn't study; conditions were too crowded, and there was nothing to study. We slept in bunks three high, about twenty people to a room. Time just hung heavy on our hands."

As time went on the camps became less crowded, and some books were obtained. Camps of about a thousand people built up internal organizations of

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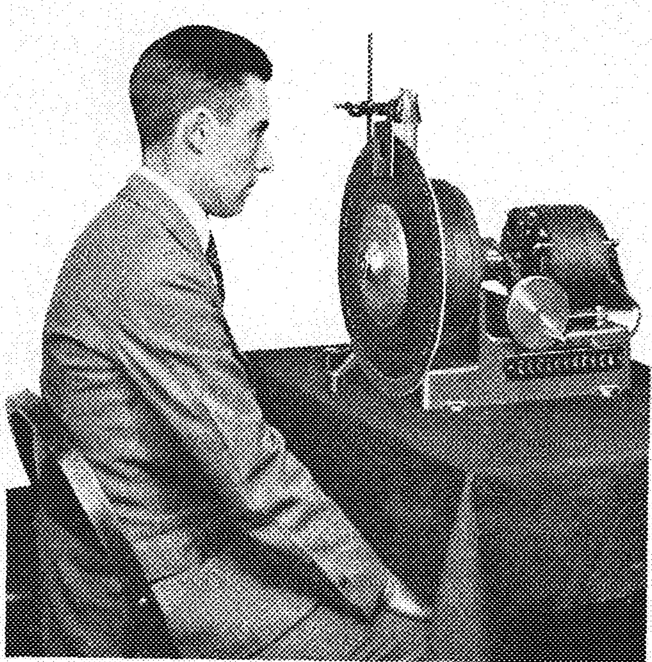


ILLUSTRATIVE RECEIVING APPARATUS

FIGURE 5: A neon lamp illuminates a series of small apertures; as they pass the field of view the observer sees an image in the frame.

Television

A description of methods and apparatus used by communication engineers in finally realizing dreams of "seeing at a distance"

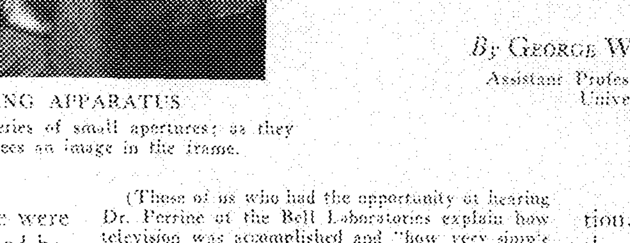
By GEORGE W. SWENSON, E '17, EE '21
Assistant Professor of Electrical Engineering, University of Minnesota.

SOME five or six years ago we were startled by the news that it had become possible to transmit a still picture from New York to Chicago in a few minutes. To further substantiate the news item, the papers printed copies of such pictures on their front pages. They were not perfect photographs, by any means, but it was possible to distinguish the subject matter. Since then we have heard little about this new invention of picture transmission, but there has been slow and sure improvement in this art until now pictures sent in this way cannot be distinguished from an original print, except with a high power microscope. We are informed that this service is now available between New York and eight large cities in the United States and that it is sufficiently patronized by the public to make it self-supporting.

About a year ago we learned that it was now possible to sit in one's own home and in a few minutes converse with anyone in the British Isles who had a telephone; thus spanning the great Atlantic ocean and possibly thousands of miles of land. This new service is still in the experimental stage and certainly is not yet on a paying basis, but there is little doubt that it will be a commercially profitable venture before long.

Late in the spring of 1927, we were again startled by the announcement that apparatus had been developed and perfected to the point where it was possible for two persons, at Washington, D. C., and New York respectively, to hold conversation over a long line and at the same time see each other and observe each other's facial expressions. In the same demonstration television was also accomplished by radio from Whippany, New Jersey, to New York.

(Those of us who had the opportunity of hearing Dr. Perrine of the Bell Laboratories explain how television was accomplished and "how very simple it was," were impressed with the fact that it could be so readily explained. Those, however, who have studied the articles published in the Bell Journal on this subject appreciate how much money, energy, and perseverance were expended in solving the innumerable problems which presented themselves on every hand. Pictures are published through the courtesy of the American Telephone and Telegraph company.—AUTHOR.)



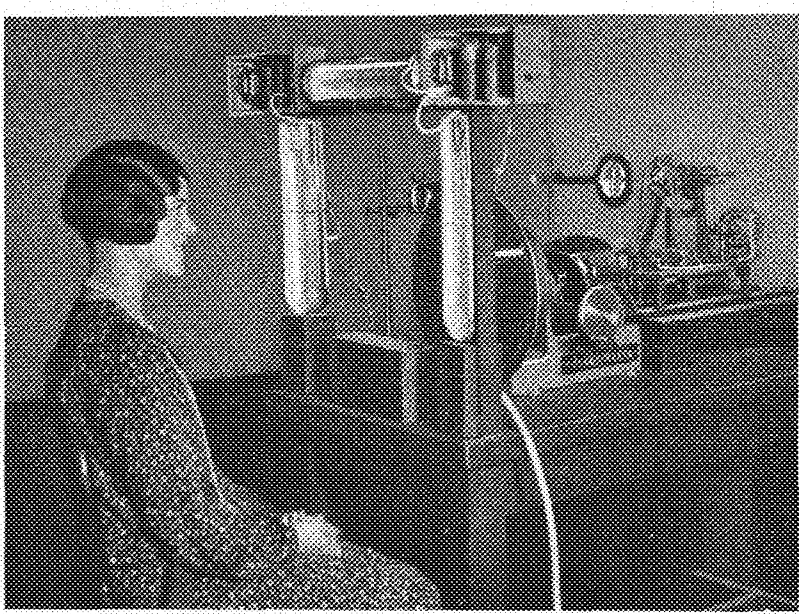
SCHEMATIC DRAWING OF TRANSMITTER

FIGURE 2: Light from a single source is projected as a moving spot on the subjects.

While research and development work toward the refinement and perfection of television will go on for years, enough has already been accomplished to show that it will, very probably, have a place in the field of distance communication. Just what the ultimate uses for television will be can only be left to the imagination. Whether it can ever advance to the point where athletic contests, pageants and other spectacles can be seen at great distances can only be suggested as possibilities until more is known and discovered about the various elements of television.

THE general principles underlying television are in no sense new. In other words, it has been known for a long time how television could be accomplished, but it was quite another thing to realize it practically. Some of the elements essential to success could not be developed before general science was further understood. We are, therefore, indebted to the Bell Laboratories for making such new discoveries as were necessary and for so coordinating the various phases of the problem as to make television so soon a reality. In his conversation with the President of the American Telephone and Telegraph company on the occasion of the first demonstration of the invention, Mr. Hoover said "We have long been familiar with the transmission of sound. Today we have, in a sense, the transmission of sight for the first time in the world's history. I am glad to welcome television as the latest product of scientific discovery. It promises that where the voice has led the way over the telephone wires, the eye will ultimately follow. Washington and New York are today not only within earshot of each other, but within sight as well."

An analogy may be drawn between television and telephony by which we may all better understand the principles. In a telephone conversation the sounds of the voice are made to actuate a diaphragm on the transmitter, which, when it vibrates, compresses and releases the pressure on the carbon particles in the carbon cup. This changes the current in the primary of an induction coil from a steady current to a pulsating one in accordance with the nature of the sound. The variation in air pressure or vibrations which we interpret as sound are then converted into variations of current which can be transmitted over a wire line or by radio. It is essential that the current variations follow faithfully the sound vibrations and that these current variations be transmitted over the line intact and that nothing be added to or subtracted from them in the transmission. In television, we wish to transmit variations in light, which can be done if we have some device that will change light intensity variations into current variations. In order to do this faithfully and without too much lag in action, the potassium hydride cell was chosen because it gives comparatively large current changes with changes in light intensity and returns quickly to its initial state when the agitation is removed. For greatest sensitivity with this cell, it was found necessary to make it large and to present a large area of photo-sensitive surface to receive the reflected light from the object. Fig. 1 shows the construction of one of the three cells which were used in the transmitting device. The ruler below shows that it is fourteen inches long and presents a sensitive area of forty square inches. These are the largest photo-electric cells that have ever been built.



ILLUSTRATIVE TRANSMITTING APPARATUS

Figure 3: Light from the arc is condensed on the disk which carries a spiral of pin holes. The light is then projected as a moving spot on the subject

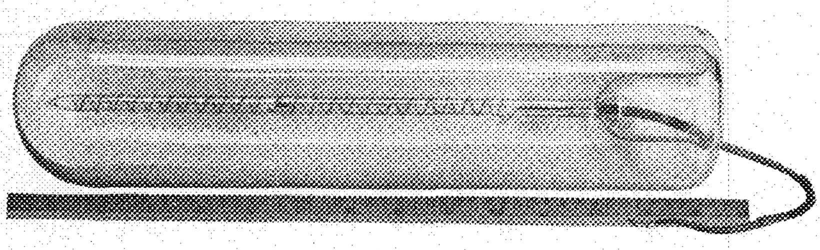
TO secure sufficient picture detail at the receiving end, it was decided to consider the picture as divided into 2,500 small areas or spots, each of which might have a different shade, or reflection coefficient. If the picture or subject were in a square frame, there would be fifty rows of fifty elements each. It was further found, that if a picture were repeated or interrupted at least 16 times per second on a screen, that the flicker was not objectionable and because of physiological and psychological effects, the observer was not conscious of the series of changes and repetitions, but simply saw the picture as a whole. We find from the above, therefore, that transmission systems must be capable of transmitting faithfully from 0 to 40,000 changes in current per second for satisfactory television.

The method adopted for scanning the object is illustrated in Fig. 2. A disc mounted on a rotating shaft has holes drilled near the periphery in such a way as to form a spiral. The hole nearest the edge scans a portion of the object near the top or bottom of the frame and the last hole, the opposite side of the object. The intervening holes cover the space between the two extremes. Since the view is divided into 50 such lines, there must be fifty holes in the disc. A very strong light is placed on one side of the disc and is focused through an optical system on the object at some point which represents one of the 2,500 parts into which the view is divided. What individual spot on the view is illuminated at any particular instant depends on which hole in the disc is in line with the light beam, and its position in the frame. The frame in front of the disc limits the size of the view to be scanned. As the disc makes one revolution, the light beam is thrown on all parts of the view in rapid succession and will give one complete picture. In order to allow for changes in position or facial expression of the object, it must be scanned at least 16 times per second and the disc must rotate at the rate of 16 revolutions per second or 960 r. p. m.

The above method of scanning was chosen because it was found that by placing the photo-electric cells near the object and on the opposite side of the disc from the light source, that sufficient reflection could be obtained from the rapidly moving spot of light to effect the proper change in the photo-electric cells necessary for sufficient current changes. It was found that if the photo-electric cell had been placed at the opposite end of the optical system from the object, that it would be necessary to illuminate the object with a light of 16,000 candlepower at a distance of four feet which would be extremely uncomfortable for a person. It was discovered, however, that the rapidly moving, high intensity spot of light passing across the face in a dark or semi-dark room could scarcely be noticed by the person being scanned.

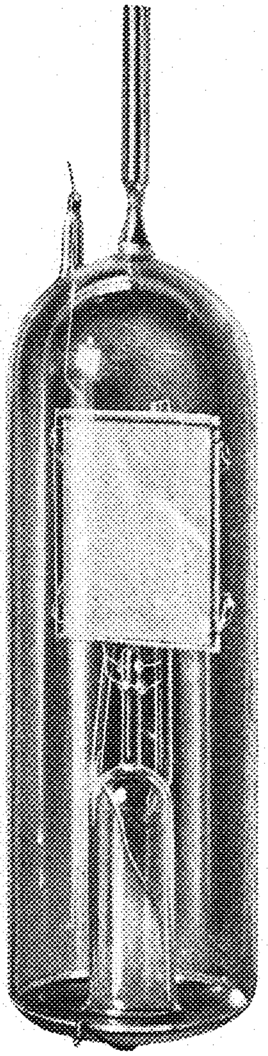
THE arrangement of the disc and driving motor, the photo-electric cells, the arc lamp, the optical system and the subject being transmitted is shown in Fig. 3. It will be seen that the beam from the arc lamp is condensed to illuminate the area traversed by the moving holes within the frame. The holes, as they pass over the elements of the view in succession, throw this small spot of light on each of the elements. The reflection of light from each element in turn reacts on the photo-electric cells and causes whatever change in current is necessary to represent the relative brightness or shade of that particular spot.

After apparatus is available for changing light variations into current variations, these current variations can be transmitted over a pair of metallic conductors to the receiving station just as in a telephone conversation. The changes in current produced by the photo-electric cells are very feeble, however, and need a great amount of amplification before



LARGE PHOTOELECTRIC CELL

Figure 1: The cell presents 40 square inches of photo-sensitive surface to receive light reflected from a subject. There are three of these cells.



NEON RECEIVING LAMP
FIGURE 4: The rectangular cathode is covered by a uniform layer of glow that varies with current.

being sent over the line, both to allow for line losses and in order to keep the transmission level high above interference current levels which would tend to blurr and distort the picture. Special vacuum tube amplifiers were developed to amplify these weak currents without distortion. The line characteristics were artificially compensated so as to transmit faithfully and without distortion the 40,000 changes or 20,000 cycles per second. This was accomplished with equalizing networks arranged to maintain the same characteristics with varying weather conditions and with phase correcting networks to insure the arrival from the transmitting end of various frequency currents in very nearly the same period of time. The details of these networks involve a technical discussion of such length that they would hardly be of general interest in this article.

IN telephony the variations in current transmitted over the line, which correspond to variations in sound, are reconverted to sound by the receiver as we know it on the telephone instrument. The variations in current are passed through a pair of small coils in the receiver. The varying current causes a varying magnetic flux to be set up which reacts with the flux from a permanent magnet. The steady magnetic field from the permanent magnet tends to hold the magnetic diaphragm flexed toward the pole pieces. Any increase in the total flux tends to pull the diaphragm closer and any decrease tends to release it. As the current in the coil changes, it produces vibrations in the diaphragm which are transmitted to the air and again produce sound. If all the converting apparatus and transmission systems were perfect, the reproduced sound would be exactly the same as the original sound. The fact that we can go so far beyond recognizing actual words as to distinguish between voices indicates that progress has been very satisfactory along this line, and hardly justifies what was recently published as a joke in a national magazine. A man was shown reading the headlines regarding the television demonstration and remarked to a friend "I see by the paper that we are now able to see by telephone." The friend answered, "Yes, but I suppose it is too much to expect that we shall ever be able to hear over the telephone."

Just as in the telephone we must be able to convert current variations into sound at the receiving end, so in television we must be able to convert current variations into light variations. Here, again, we make use of a scientific fact which has long been known. An air tight glass tube filled with a rarified neon gas and provided with electrodes will, when connected to a high potential, give a glow discharge the brilliancy of which is exactly proportional to the potential applied. Such a device is called a "neon tube." Fig. 4 shows the construction of one type of neon tube. When the two electrodes are separated by about one millimeter and when the gas pressure is just right, the glow discharge develops on the outer surface of the cathode or negative plate and gives off a uniform glowing light. This device can then be used to convert the amplified current changes to variations of brilliancy.

To arrange the changes in light in the same order at the receiving end as they were produced by reflection at the transmitting end, it was found that another disc exactly like the one at the sending end must be used to scan the light changes on the cathode of the neon tube. If the neon tube is placed behind the holes in the revolving disc and the observer in front of the disc, the latter will see the object at the transmitting end as a series of rapid changes of small areas of light. But because the eye and brain cannot follow these rapid changes, the observer will be conscious only of the view as a whole and any motions such as facial expression or movement of the lips when talking. Fig. 5 shows the arrangement of the observer, the disc and the neon lamp at the receiving station. It is very necessary, however, that the two discs run at exactly the same speed and that the holes in the discs have exactly the same position in the frame at any given moment. This is accomplished by the use of synchronous motors of special and interesting construction.

THE motors used for synchronizing the discs, as seen in Figs. 3 and 5, are 240 pole motors. Farther back on the shaft is a direct current motor for carrying the steady component of load. As the motors might get into step in any of the 120 angular positions, it is necessary first to get an approximate synchronization by means of a two pole motor. The armature of this direct-current motor is tapped at opposite points and the leads brought out to slip rings making a 2 pole alternating-current machine. This provides a means for getting the two discs into the proper phase relation with each

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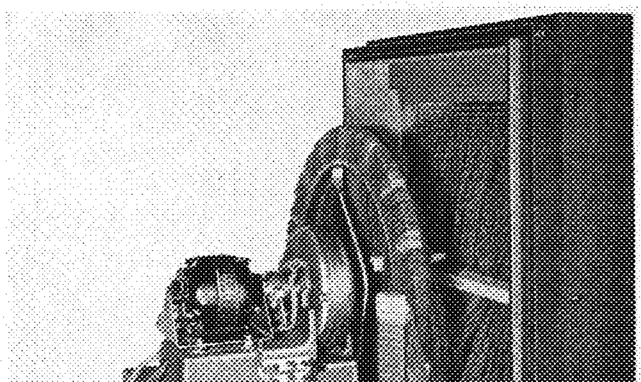


DISTRIBUTOR AND WIRING
FIGURE 6: High frequency current is distributed by 2,500 wires to successive electrodes of the grid from a high speed distributor.

Lignite Fuels of North Dakota

Extensive mining operations are taking place among large deposits; continuous development work is placing this coal before the people of the Northwest

By Irvin Lavine, Ch. E. '24
Assistant Professor of Chemical Engineering, University of North Dakota.

IT has been estimated that when Columbus discovered America, the State of North Dakota had 600,000,000,000 tons of lignite fuel, which at that time was not worth five cents. The development of this vast deposit has opened, however, a potential storehouse of more wealth than all the gold Columbus saw in his dreams.

Some years ago, the late Dr. Earle J. Babcock (B. S. '89), Dean of the College of Engineering at the University of North Dakota, wrote "North Dakota is fortunate in possessing an enormous supply of fuel in the form of lignite coal; and this is going to prove one of the greatest inducements this State has to offer for the establishing of industries . . . In the future our fuel and clay resources are destined to form the basis for a development which will gradually convert North Dakota into a rich mining and manufacturing as well as agricultural state." With this insight for the future Dean Babcock started a series of research problems on lignite. This work is being carried on and elaborated upon by Dr. A. W. Gauger (B. S. Chemistry ('14), Director of the School of Mines, University of North Dakota.

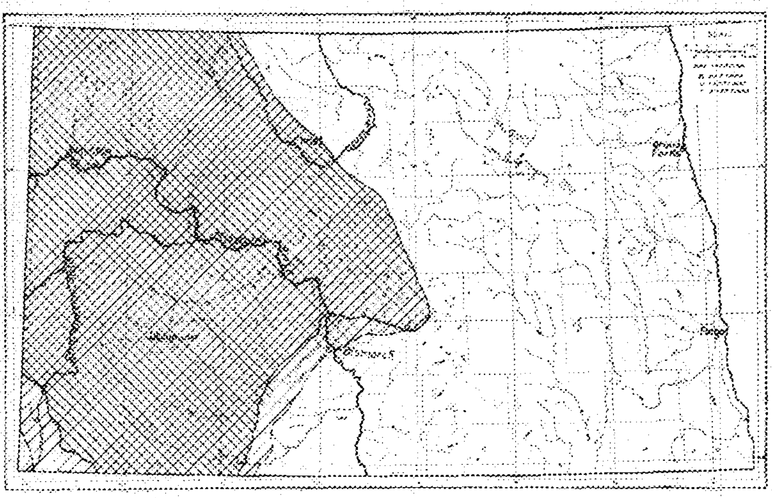
The Extent of the Lignite Beds

THERE are approximately 28,000 square miles of workable lignite beds, these beds being confined to the western half of North Dakota (see Fig. 1). Minnesota has no lignite deposits, being rich, however, in peat deposits. The interesting relationship of lignite to peat and other fuels, as well as its industrial value, makes the subject of lignite one of mutual interest to those of us in the northwest.

The coal fields of North Dakota are part of a much larger area which covers most of eastern Montana, and extends north into Saskatchewan and south into Wyoming. The greater part of the lignite, according to Dr. A. G. Leonard, state geologist, is of Tertiary age, and is thus geologically quite young, very much younger than the bituminous coal of Pennsylvania and the Mississippi valley states. It is because it was formed in comparatively recent times that the coal of this region is lignite rather than bituminous.

In the last State Coal Mine Inspector's Report (State of North Dakota, 1926), the following summary is given:

	1926
Number of mines in operation	263
Underground mines	176
Stripping mines	87
New mines	59
Mines closed and not operating	35



MAP OF THE NORTH DAKOTA LIGNITE BEDS

Figure 1: This State has approximately 28,000 square miles of workable lignite beds, most of which, as shown by the dark area, are confined to the western portion.

VALUATION

	Production in Tons	Valuation	Local Tons	Shipped Tons
1908	320,742	....	....	....
1913	495,320	....	....	....
1918	813,000	....	....	....
1923	1,435,603	....	....	....
1925	1,357,408	$2,601,807.47	321,166	1,036,232
1926	1,385,362	$2,628,067.12	336,905	1,048,457

This table shows clearly that lignite mining is coming into its own; at the present time North Dakota is producing approximately 60 per cent of its own fuel consumption. The future, no doubt, will see increased activity along this line.

Origin of Lignite Deposits

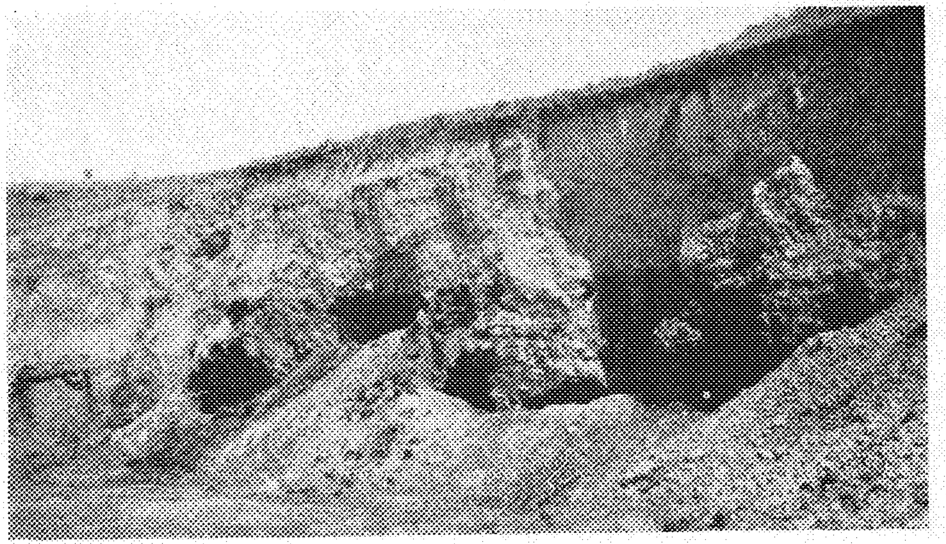
RECENT microscopic studies of thin sections of North Dakota lignite have furnished interesting information regarding the materials composing the coal, and the kinds of plants which have accumulated to form the deposits. Lignite consists largely of woody material, including trunks, stems and branches of trees, these comprising about 75 to 85 per cent of the whole mass. With possibly one exception the trees entering into the formation of the lignite are coniferous varieties related to the Sequoia (the big tree of California), cypress, juniper and arbor vitae, together with some firs and spruces.

Lignite of North Dakota is for the most part of a brownish color, though in some of the beds it is black and lustrous. It is generally conspicuously woody in appearance and exhibits clearly the grain of the wood. It breaks or splits readily along the grain, but is broken less easily in any other direction. Portions of flattened trunks and branches are often found in the lignite, looking not unlike the original wood, except for the brown color. An individual bed is frequently more woody in some portions than others, being made up of alternating layers of tough, brownish lignite, and a black, lustrous, brittle material.

The lignite beds vary in thickness from a fraction of an inch to 35 feet or over. Beds 6, 8 and 10 feet thick are common, half a dozen are known which have a thickness of 20 feet, and there are some with a thickness of 35 feet. The individual lignite beds vary in thickness from place to place, and where traced for any considerable distance the seam may grow thinner and finally pinch out entirely. Again, a thick bed of lignite may be split up into several by clay seams or clay partings, so that a single bed in one place may be represented a few miles distant by three or more beds. Figure 2 shows some of the lignite deposits of North Dakota. In some of these deposits the lignite is found with only a small layer of overlying clay and sand. Other deposits are overlaid by much greater depths of these materials.

Burning of Lignite Deposits

DR. LEONARD states that many of the coal beds have burned out extensively and very few of the thicker ones have wholly escaped burning. Spontaneous combustion has no doubt been the chief cause for this burning, although negligence on part of man may have con-



LIGNITE BED WITH OVERLYING CLAY AND SAND

FIGURE 2: Lignite is sometimes found with only a small layer of overlying clay and sand. Beds of 6, 8, and 10 feet thickness are common, and some have a thickness up to 20 and 35 feet.

tributed also. This burning of the coal beds has been going on for many thousands of years. Once started, the fire slowly smoulders and works its way back farther and farther from the outcrop, the overlying clays settling down as the coal is consumed, and the cracks thus opened admitting fresh supplies of air.

The heat of the burning lignite has baked and changed the overlying clays, and either burned them to a red or pink clinker or entirely fused them into slag-like masses. These clinker beds often have a thickness of 30 to 50 feet and are a very conspicuous feature of the bad lands and upland prairie of this State.

Chemical Composition

LIKE any other fuel, the lignites of North Dakota vary according to the locality from which they are derived, not only in chemical composition but in physical structure as well. In order to obtain a true average chemical composition of the lignites from the various workable mines, representative samples from these mines are taken each year under the supervision of Dr. A. W. Gauger, Director of the School of Mines, University of North Dakota. A proximate analysis, which consists in the determination of moisture, ash, volatile matter (carbonaceous material easily driven off as a gas by heating), fixed carbon (not easily driven off by heating), and heat value expressed in British Thermal Units per pound of fuel, is made on each of these samples. The results obtained are tabulated and kept from year to year. It might be well to state that very accurate results are obtained by modified methods of procedure adapted to proximate analyses of lignites.

The following table will give a fairly good idea of the composition of North Dakota lignite, these values being compared with those of bituminous and anthracite coals.

	Lignite	*Bituminous*	*Anthracite*
Moisture (as mined) about	36.0%	5%	3.5%
Volatile Matter, about......	27.0%	35.%	1.5%
Fixed Carbon, about........	30.0%	50.0%	80.0%
Ash, about......................	7.0%	10.0%	15.0%
Heating Value (B.t.u.) about	6,000-7,000	12,000-14,500	13,000-14,000

We may also compare these fuels by values obtained from another method of analysis known as the ultimate analysis. In this, determination of the percentages of carbon, hydrogen, oxygen, nitrogen, sulfur, as well as ash and moisture in the coal are made.

The following table of ultimate analyses are based on the dry ash free basis, using approximate average values.

	Peat	*Lignite*	*Bituminous*	*Anthracite*
Carbon	55.0%	68.0%	85.0%	94.0%
Hydrogen	6.0%	5.5%	5.0%	2.5%
Oxygen	36.5%	24.5%	7.0%	1.5%
Nitrogen	1.5%	1.0%	1.4%	1.0%
Sulfur	1.0%	1.0%	1.6%	1.0%

A study of the two tables indicates that lignite is characterized by (1) high moisture content and consequently low heat value as mined, (2) by high oxygen content in proportion to carbon, (3) by medium volatile matter content, (4) by rather low sulfur content.

When freshly mined lignite contains a high per cent of moisture which, if allowed to rapidly evaporate, by exposure to sun and wind, causes a tendency of the lumps to split and check into rather small pieces. This characteristic can be minimized if the lignite is stored in a basement or under suitable storage conditions.

One of the most objectionable impurities existing in many fuels is the high sulfur content. It is undesirable for almost all purposes for which coals may be used. The rather small sulfur content of North Dakota lignites is of a decided advantage.

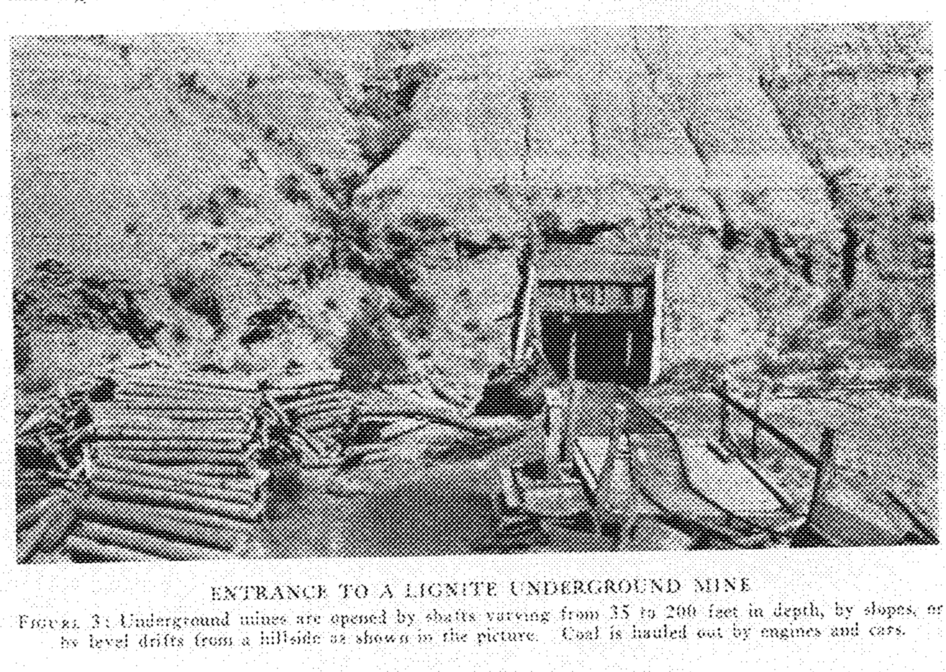
Although the quantity and character of the ash varies in the lignite from different mines, generally, North Dakota lignites are low in ash and very free from earthy materials, as revealed by chemical analysis. The following table giving values of the chemical analysis of the ash from a lignite was taken from the chemical analyses of fifty different lignites.

ANALYSIS OF ASH

	Highest Value	*Lowest Value*	*Average of 50 samples*
Silica (SiO_2)	48.00%	0.00%	20.64%
Alumina (Al_2O_3)	39.21%	4.38%	13.83%
Iron Oxide (Fe_2O_3)..	66.10%	1.97%	10.02%
Calcium Oxide (CaO)	60.00%	7.76%	26.84%
Magnesium Oxide (MgO)	19.04%	1.38%	7.25%
Sodium and Potassium oxides (computed as chlorides)	43.95%	2.32%	12.63%
Other constituents......	23.95%	0.23%	8.99%
Fusion temperature of ash in degrees F.....	2440	1930	2229

History of Lignite Mining

DR. LEONARD in Bulletin 4 of the North Dakota Geological Survey states, "Lignite has doubtless been mined



ENTRANCE TO A LIGNITE UNDERGROUND MINE

FIGURE 3: Underground mines are opened by shafts varying from 35 to 200 feet in depth, by slopes, or by level drifts from a hillside as shown in the picture. Coal is hauled out by engines and cars.

and used in western North Dakota by ranchers and others since the earliest settlement of that region, but the earliest mining of which there is any record was carried on by the Northern Pacific Railroad, which operated mines along its line as early as 1884. The mine at Sims was worked for many years and in 1888 there were two shipping mines, one at New Salem and another at Dickinson. By 1894 the number had increased to eight, and in 1900 the large Washburn mine at Wilton was opened. Several years prior to this the mines in the vicinity of Kenmare began operations."

Ever since the earliest of these times, lignite mining has played an exceedingly important role in the economic status of North Dakota. The early predictions of the late Dean Babcock are slowly but surely being realized.

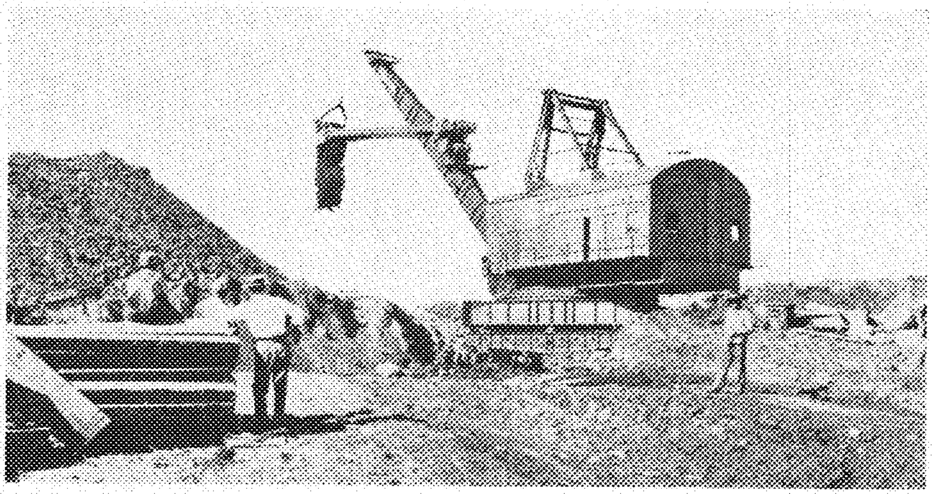
On October 20, 1927, North Dakota's most recent, and one of the greatest, industrial ventures ever launched in the state was announced to the world. The new Truax-Traer Coal Company Mine, situated southwest of Velva, North Dakota (near Minot), was opened and is now working on a large production basis.

This new lignite strip mine, which is one of three operated by the company, is the largest in North Dakota and was started with an investment of $1,000,000. This investment is well worth noting for it shows the faith this company has in the future of this state.

Eleven hundred acres of land, which boring tests have proven to contain twenty-eight thousand tons of lignite per acre, are included in the property. It is estimated that on the basis of 400,000 tons annual capacity, there is sufficient lignite in the field to keep the mine operating for a period not less than seventy-seven years and perhaps many more.

Mining Methods

NORTH DAKOTA lignite has been recovered by both underground and stripping operations, but within the last few years there has been a large increase in the tonnage produced by stripping methods. Underground mines are opened by shafts varying from 35 to 200 feet in depth, or by slopes and level drifts from a side of a hill (see Fig. 3). In the former hoisting is necessary. In the latter, the coal is hauled out by electric or gasoline locomotives, or in case of the smaller mines, by horses or mules. As a rule the mines are developed along a double entry system although a few of the smaller operators use the single entry. In both cases the room and pillar method of mining is used. The width of the room and pillar depend on the local character of the roof, thickness of the coal vein, and the floor material. The rooms vary from 10 to 24 feet in width, and the pillars from 9 to 21 feet. Entries are driven as narrow as possible to reduce timbering expense and render the work as permanent as possible. Beds over seven feet thick may be worked with a comparatively small amount of timbering by leaving a coal roof, this, however, depends on the thickness of the coal left, its firmness, and the absence of vertical cracks and cleavages. In many cases no timbering whatever is done in the entry work where it is possible to leave three feet or more of roof coal. A single row of props and caps are all that is necessary in the rooms, and as they are worked out, a large percentage of the props can be recovered to be used over and over, and the timbering expense is thus reduced to a very low figure. Underground the coal is either under cut or "shot from the solid." Shooting from the solid, according to Professor L. P. Dove, does not appear to injure a lignite mine due to the toughness of the coal and the roof of the lignite left.



ELECTRIC SHOVEL AT VELVA, N. D., LIGNITE FIELD

FIGURE 4: This has a dipper of 8 cubic yards' capacity on a boom 90 feet in length with 65 foot dipper sticks. It is used to remove the overburden from the lignite vein.

Lignite has been removed from strip pits since the state was first settled. Horse and scrapers were employed in favorable locations where a coal bed could be easily reached from a valley or other natural exposure. No extended or consistent attempt was made to strip large areas. Increased thickness of overburden soon ended these small scale attempts.

Of late, lignite mines have been attacked by modern huge steam and electrical shovels or draglines comparable in size and scope to those used in the older bituminous fields. At the Velva field of the Truax-Traer Coal company an electrically operated shovel is used to remove the overburden from the lignite veins. (See Fig. 4.) This electrically operated shovel has a dipper having a capacity of eight cubic yards on a boom 90 feet in length, with 65 foot dipper sticks.

The mining method used at the Velva mine consists in first stripping the overburden and then in filling tram cars with the lignite. These tram cars are then transported over a narrow gauge railway to a huge tipple that was built at a cost of $80,000. Here the coal is dumped from the cars by a rotary dump which turns the car upside down, making a complete revolution without uncoupling the car from the one next to it in the train. There are ten cars per train.

The coal then passes into a hopper which has sufficient capacity to allow the dumping of several cars. The bottom of the hopper forms a reciprocating feeder which gives an even flow of coal either to the conveyors or to the crushers, where the larger lumps are crushed to desirable size.

After leaving the main conveyor the coal passes onto shaker screens where it is graded into the different sizes for the market. The larger sizes pass onto picking tables where impurities are removed and are then loaded into the cars. The small sizes pass to a rapid shaker screen, where they are further graded and sized, and then are loaded on cars for shipment.

Lignite as a Fuel

THERE is a prevailing, but erroneous, notion amongst many people that lignite is a very undesirable fuel. The many experiments conducted at the School of Mines, University of North Dakota, as well as the warm reception given to its use as a fuel, domestic as well as industrial, by the people of this state, has conclusively proven that lignite can be successfully used. Dr. Gauger in the University of North Dakota Departmental Bulletin, No. 9, January, 1926, says: "In spite of its relatively high content of volatile matter, lignite lacks the properties of fusing and caking in the

(Continued on page 152)

The
MINNESOTA TECHNO-LOG
University of Minnesota

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Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

National Research Council

THE satisfaction gained from knowing that time spent solving difficult problems both in the classroom, and in the laboratory and field, has not been spent in vain is probably the greatest satisfaction a man gets out of life. The reward may be material, or mythical, but if there is that in it which compensates the man for the time spent in long hours of study and thought, then that reward is good enough.

Doctor Samuel C. Lind, director of the School of Chemistry, and Professor Fred C. Lang, associate professor of highway engineering, both of the Engineering College have been placed on the National Research Council, a cooperative organization of the scientific men of America.

The placing of these two men on this council was announced together with the names of eight other members of Minnesota faculty. Doctor Lind has been made a member of the Editorial Board for Publication of International Critical Tables, while Professor Lang has been placed on the Committee on Character and Use of Road Materials. These two men have long been authorities in their particular branches of engineering.

Founded in 1916 by the National Academy of Sciences at the suggestion of President Wilson, the council is organized for the purpose of bringing together scattered scientific work, and assisting in coordinating scientific attack in America on large problems in all line of scientific activity.

Men placed on this council are those most eminent in their profession. They have taken upon themselves a great deal of effort and work in the field in which they are successful, and it is most fitting that their work should be recognized.

Engineers Need Public Speaking

MANY an engineering student's idea of perfect torture is standing before an audience and trying to tell that audience a few connected thoughts.

In the curriculum of the College of Engineering there are a few courses in public speaking, but these courses are elective. Both winter and spring quarters there are a few students who, realizing the importance of public speech register for these elective courses, and reap a benefit. These are the only ones who get the benefit. There should be more.

It is often the duty of an engineer, as the leader of the progressive thought of his community to stand before an antagonistic group and present his case in the best possible way. It is then that ability as a public speaker is necessary.

Although there are a great many required subjects in the engineering course, one that should be added to the list is public speaking. The time spent in fostering within ourselves the feeling that we can stand before an audience and not feel the need of knee braces, will return more dividends in the future than we can count.

Employment Bureau for Engineers

THE technical campus needs an all-engineering employment bureau. Up to this year nothing was done to remedy a situation often tragic to the senior, but this fall a few enterprising, mechanical engineering seniors organized the first student employment bureau on the engineering campus of the University of Minnesota.

So far so good. But why stop there? Why can't there be an all-engineering employment bureau with the mechanical organization as the nucleus?—one that would include all of the engineering schools and departments?

Not only would this bureau be for employment, but it could render most valuable service as a personnel department. Here the purpose would be felt by the undergraduate who is often in need of guidance. This service to the undergraduate would probably be the most valuable part of the bureau in that it would show the way to men who enter an engineering college with no clear purpose of life before them.

Our University and Aviation

COURSES in aviation have been slow in development at the University of Minnesota. Since the war when aviation received such a boost, many schools have arranged very thorough courses upon the many subjects pertaining to airplanes. They have built laboratories in which to carry on experiments. For the most part, of course, these laboratories were the result of federal financing during the war. Minnesota was not so fortunate, and it is easy to see why aviation as a course has been slow in developing here. However, it should not continue to be so, and every indication points that it will not.

In connection with the Naval Reserve the university is now offering a simple course in the study of the various practical details of airplanes. The mechanical engineering department offers several courses in the study of motors and airplane design, and the department of mathematics and mechanics presents a course in aerodynamics. This is but the beginning of what some day should be, and most likely will be, a separate aviation department of the college.

With the establishment of an air station of the Naval Reserve here in Minneapolis by July 1 almost certain, a stimulation of aviation interest at the university is expected, which will hasten the development of a more comprehensive course in aeronautics. By working arm in arm, the university and the Naval Reserve will be able to give the students the advantage of both the theoretical and practical work in aviation. The Naval Reserve will be able to present the practical side while the university presents the theoretical. The establishment of an air station close to the university that will work in cooperation with the university, is an advantage of inestimable value.

General Goethals, an Engineer

THE knell has been struck for one of the greatest of modern engineers, Major General George W. Goethals. As builder of the Panama Canal, Major General Goethals surmounted difficulties that are now unrevealed to us as we view the finished product. Mountains had to be cut through; swamps had to be cleared of all malarial and yellow fever bearing mosquitoes; lakes had to be formed by dams that would withstand the terrific beatings of water brought down from the hills by the spring torrents.

All these under his direction were accomplished. Men before him had failed. He did not. He is a great example of the engineer who goes into a virgin country to surmount the hidden obstacles placed in his path by nature.

Now Major General George W. Goethals rests in the cemetery at West Point. People pass his grave, and they visualize a narrow ribbon of water crossing a continent. That is his monument—a great engineering feat.

Our Purpose

BACK in 1920 a group of students of the technical colleges felt that the technical colleges provided a proper field for a student magazine of a technical nature. The TECHNO-LOG was established, and it was found to fill a long felt want. It served to bind together the students of the technical colleges. Technical subjects were reviewed for the students in a readable, popular style. The magazine provided training for students interested in writing and editorial work. It gave students an opportunity to see what the students in the other engineering courses were doing. It brought to alumni of the institution, who are scattered all over the earth, a magazine that would tell them the doings of the old campus, and keep them in touch with the growth of the college.

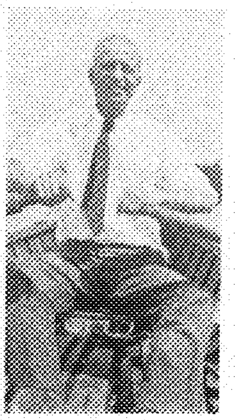
Needless to say, this is what the TECHNO-LOG strives to do today as it had ever since the begining of publication. It is as a college publication serving a need of the college, and useful as a means of communication and information for engineers, that the TECHNO-LOG has a claim upon the loyalty and support of Minnesota Engineers. As has once before been stated in the TECHNO-LOG, we are not trying to compete with the ENGINEERING NEWS RECORD. That field of the strictly technical publication is covered very well by the national magazines. In our field, we believe that articles of general interest as well as those strictly technical should be presented to our readers. The magazine is published for the readers, and what the readers would wish to see in the publication is what we wish to publish.

An expression of opinion on this from the students, alumni and faculty would prove most valuable to the editors. Letters pertaining to this or any subject are invited, and the magazine bespeaks the heartiest of cooperation of its readers in this. It is through the opinion of the readers that the TECHNO-LOG can become the mouth-piece of the technical colleges.

THE spring air is filled with whisperings of political campaigns. We engineers feel proud of our intense political rivalry because it indicates enthusiastic interest in the premier events of our campus life. St. Patrick and the Chairman of Engineer's Day should be elected with due consideration, for upon them falls the burden of making the day a success.

Faculty Sketches

HARLOW C. RICHARDSON



DEEP in the heart of every man there is a burning desire to travel among distant lands—to climb high mountains and sail the seas. Not very many of us find it possible to humor this longing, and it is not very often that we find anyone who does, but just such a man is Mr. H. C. Richardson, head of the English department in the Engineering College.

Harlow C. Richardson is a native of our neighboring state of Iowa. He was born in Cedar Rapids, and he received his early education there in the public schools. He graduated from Cornell in 1908 and began his teaching career in the Washington High School of his home town. Mr. Richardson came to the University of Minnesota in 1921 and ever since then he has been striving to improve the English of engineers.

Mr. Richardson's greatest hobby is traveling, and as soon as the school term is over each spring we find him setting out in search of new scenes. As a member of the Canadian Alpine Club he spent many summer vacations in the mountains of the West and of Canada. Two years ago Europe claimed him, and he spent that summer visiting the British Isles, Belgium and Holland. He terminated that trip with a week's stay in Paris. Evidently Paris has some attraction for Mr. Richardson for this last year he returned to Europe to really do Paris. This trip found him touring Normandy, Brittany and the Chateau country. The old Roman section of southern France was particularly interesting. Then on to the Gard River and the Riviera. He touched Italy, and traveled by auto from Nice through the Alps to Granolhe and on to Switzerland. One of the outstanding features of this trip was his visit to the opening day session of the League of Nations.

He visited Germany down the Rhine to the old University of Heidelberg with its historic dueling rooms and comic verses written on the walls of the jail rooms . . . then on to Cologne, to Holland, Belgium and back to France. We wonder where the next vacation will find him.

Mr. Richardson is a member of the Minneapolis Athletic Club, the Campus Club, and the Society for the Promotion of Engineering Education. He did post graduate work in English at the University of Chicago.

Last year with J. Raleigh Nelson of the University of Michigan, he made a study of the English courses being taught in the engineering colleges throughout the country. The results of this study were presented at the annual meeting of the S.P.E.E. last summer in Portland, Maine.

Herewith are published three of the better themes written by students taking engineering English during the fall quarter. These have been selected by the editors of the MINNESOTA TECHNO-LOG *from a group of themes compiled by the faculty of the English department, those with an engineering aspect being given preference. It is hoped that this page will bring between the English department and the* MINNESOTA-TECHNO-LOG *a closer cooperation—something that will grow in years to come. All students who are interested in writing are invited to come to the office of the* TECHNO-LOG, *room 37 of the Electrical building.*

During the spring quarter the best themes of the winter quarter will be published in a similar manner.

Three Themes

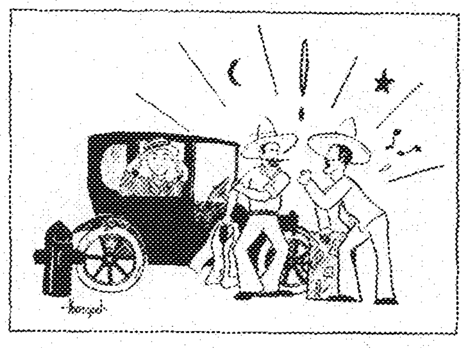
Highway Courtesy

By EDWARD H. FINCH, '30

IT all started when I stepped off the train at the little Cuban town of Guantanamo and gave my bag to one of the wildly gesticulating taxi drivers gathered on the platform. I attempted to follow the one that had it through the swirling crowd and general confusion that always announces the arrival of a train in this little town, but soon lost him. Then I made the mistake that almost proved fatal, to someone. I sauntered over to the line of taxis and, picking the least decrepit of the lot, I opened the door and got in, trusting to my driver's ability to find my bag.

For the next five minutes I witnessed an argument that would make the Dempsey-Tunney fight seem pale by comparison. The custodian of my bag mysteriously reappeared and seemed to take it as a direct affront upon himself that the driver of my cab had foully stolen my patronage from him. Not to be outdone, my driver stood up in his seat and let loose a stream of Spanish that sounded like the popping of firecrackers. Then the battle was on, each of them waxing more eloquent as it progressed until I was watching in fascinated horror, expecting to see no less than a knife fight or a dual murder. Other "chauffeurs" joined in the verbal struggle and even the drivers of some ancient, horse-drawn vehicles, known here once as "sea-going hacks" drove up and added to the din and confusion. I was completely forgotten; the fact that I was there and might have been in a hurry mattered not at all, so when I finally gathered enough to learn that my first driver's cab was only a few feet away, I got out and entered the other cab. Evidently this simple solution had not occurred to them, because the argument immediately stopped, and I was driven away amid looks of astonishment from the crowd. I had not been in the island long, and I was more convinced than ever that all Latin-American people are crazy.

That night, after learning that the power dam I was to work on was fourteen or fifteen miles away, I found my driver of the afternoon and engaged him for the trip. There are no roads in this country, and to get anywhere in a car, one must cut over fields and rocks, and unbridged rivers without much regard for bumps and jars. It took us two hours to cover the first eleven miles and we did well at that. Finally we approached a low-lying sector where it had rained hard the day before and, after a succession of dizzy skids and plunges we came to a stop, hub-deep in black, gumbo mud. All of our efforts to move our steaming vehicle proved futile and I was about ready to give up and begin walking to the dam when I heard the roar of a tortured motor in the distance and observed



"—let loose a stream of Spanish that sounded like the popping of firecrackers."

two dancing lights approaching us from the direction we were heading for before we were interrupted. Soon another car drove up and the driver dismounted, and came over to see what our trouble was. It proved to be none other than the other combatant from that afternoon's fray.

I expected to see the battle start afresh and speculated on its dire possibilities out here in the middle of night with only me as a witness. To my surprise, this fellow gave us everything possible in the way of assistance and, when we found that the car was stuck so badly that our combined efforts could not dislodge it, he walked over a mile to a farmer friend of his and borrowed a yoke of the oxen, that are used in place of horses in this country, and pulled us out. That was not all, he offered to wait while my driver took me to my destination and returned, in the event that he should get into trouble again.

The rest of my journey was on more passable ground and I had a chance to think things over and revise my opinion of these people. It was significant that the fellow had refused to accept any money whatsoever for his services, and Cuba is a country where many of our merchants of Hebrew extraction could take lessons in close bargaining and love of money.

I was also moved to wonder if our grandparents were as observant of some of the rules of highway courtesy as these people, back in the days when they were using oxen to plow their fields, and our roads had not yet been lifted from the mud. If they were, our present standard of civilization, supposedly higher than theirs, seems to have fallen slightly in this particular.

Steel Mill

By CLIFFORD ANDERSON, '30

THE ship's crew was gathered aft, as usual, on the starboard side of the vessel as the straining tugs, with a great puffing and showering of sparks, towed the loaded freighter upstream to its berth at the steel mill dock. The men leaned lazily against the after cabin and made uncomplimentary remarks about the various objects along the river banks.

As dusk came on, the flare of the steel mill furnaces, reflected against the sky, projected the many stacks and chimneys of the "plant" into sharp silhouettes. There were row after row of huge corrugated iron sheds topped by slender smokestacks and numerous blast furnaces surrounded by superstructures that looked like thin black lace against the flaming sky. From the coke "works" a billowing cloud of white smoke arose, followed by a sheet of flame that leaped sky-high and then subsided.

Then the boat docked amid a great clacking of deck engines and a hubbub of stentorian voices yelling commands. From our position aboard the ship we could see nothing but the ore-stained river below us and a high river bank towering to a level with the mastheads.

Soon the sailors began to go ashore. Ascending a precipitous stairway, they

(Continued on page 160)

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

A.S.M.E. Establishes Employment Bureau

Sinnott, Student Chairman, Outlines Organization Purposes

REALIZING that one of the greatest problems facing the young engineering graduate of today is the lack of suitable employment, the student chapter of the American Society of Mechanical Engineers has organized the first engineering student employment bureau at the University of Minnesota.

Enlarging on an idea used at Purdue University, this bureau's purpose is three fold: first, to give the prospective graduate complete information of those concerns that take Minnesota men each year; second, to endeavor to bring other firms to the engineering campus, and third, to lay a foundation for an all-Engineering employment bureau whose scope will be more comprehensive and complete.

Irvine Sinnott, as chairman of the bureau, is being assisted by the entire senior mechanical engineering class who have corresponded with different firms throughout the country.

That the entire mechanical department is back of this project is indicated by the intense interest Professor Du Priest, head of the department, has shown in cooperating with the bureau. An interview room is being arranged where representatives of various firms can see and talk with the seniors.

In outlining an all-college employment bureau Irvine Sinnott states, "First there would have to be a personality department to assist the students in improving their character and personality. Second, there would have to be some arrangement made to have a vocational guidance head to study and analyze the occupational fitness of the students and to assist them in finding their best field of endeavor. Third, there would have to be the placement bureau that would find proper employment for the graduates. Fourth, the bureau would see that the graduate after he has left school and found his job is kept in satisfactory positions and that he does satisfactory work. Fifth, a record of all the engineering students that would show their progress through the school, and their activities would also have to be kept."

Kodak Company Interviews Chemists

ON Jan. 24th Mr. Corey of the Eastman Kodak company visited the School of Chemistry and interviewed a number of men as prospective chemists for that company. Minnesota graduates have been highly recommended to him by other companies who employ university men.

Naval Reserve to Establish Minneapolis Air Station

ESTABLISHMENT of an air station here in Minneapolis for the Naval Reserve Aviation Unit, with which a number of Minnesota engineers are connected, is an assured fact, according to information given out by Ensign Earle D. McKay, commanding officer of the Minneapolis unit of Naval Aviators. Following the inspection of facilities in Minneapolis by Rear Admiral Ziegemeier on January 31, assurance was given that a station would be operating by July 1.

Negotiations for this field have been going on for a long time. Both the cities of Minneapolis and St. Paul have made offers to the Naval Reserve for the establishment of the station. However, due to the court action now going on concerning the Wold-Chamberlain field, action has been held up.

The flying field will be equipped with several advanced training planes, and some for preliminary training. Although flying will be conducted in connection with the student aviation courses now taught to students of the university, students will not receive preliminary training at the Minneapolis field, according to present reports. They will be sent to Great Lakes, Ill., for preliminary training. The Minneapolis air station will be used to maintain the flying efficiency of the officers of the Minneapolis Naval Reserve Aviation unit.

New $9,000 Testing Machine Added to Highway Department

THE Minnesota State Highway Department has ordered a new universal testing machine to be built by the Tinius-Olsen Company at a cost of $9,000. It will require four months for completion and will be ready for installation in the experimental engineering building about the first of May.

It will be necessary to construct a concrete foundation extending from the basement to the first floor to insure a rigid support for its total weight of 23,000 pounds. An allowance will be made for the future addition of wing supports which are used in testing beams and model trusses. The capacity of the machine is 400,000 pounds or twice that of the largest universal in use by the experimental department at the present time. It will stand eighteen feet above floor level and can accommodate specimens twelve feet in height. Steel and concrete specimens may be tested in compression or tension.

According to Mr. Bachelder of the Highway Department, the initial cost will be charged to the state highway fund and the university will provide for the cost of installation and maintenance. The machine will be used in conjunction by the State Highway Department and the students in the College of Engineering.

Large Crowd Attends Lecture on Valence

"VALENCE" was the subject of the lecture given by Professor W. A. Noyes at the one hundred and forty-fourth meeting of the Minnesota section of the American Chemical Society held in the auditorium of the School of Chemistry on January 26.

Immediately after the dinner-meeting of the section, the lecture was given before the largest crowd ever attending a meeting of the section. Speech amplifiers installed in the Chemistry auditorium for the occasion made the lecture distinctly audible in all parts of the room.

Dr. Noyes outlined the history of the growth of valence and electronic theories during the last two centuries. He spoke of Farady, who was the first to establish the conception of "atoms of electricity," as the greatest physicist of the nineteenth century. Dr. Noyes' idea of positive and negative ions developed from an embarrassing lecture experiment on Chlorine that failed to work.

"Early ideas may be imperfect but still contain a germ of truth which persists" said Dr. Noyes, and it was only due to the foresight of men who dared to publish startling new theories that science has progressed.

Professor Noyes, recently retired director of the Chemcal Laboratory of the University of Illinois, was formerly an instructor in Chemistry at Minnesota.

Physics Department Moves from Old to New

ON Dec. 22, 1927, the old physics building began to shed its array of batteries, meters, scales, and other equipment that went to make up a complete physics department. The apparatus was being moved to the new physics building located directly south of the administration building.

When it came time to move, the entire departmental staff put their shoulders to the wheel so that everything would be in operating condition for the winter quarter.

Large trays which could be wheeled and the university trucks served as conveying purposes. While carpenters dismantled cases and frames men loaded them on trucks with other things. On reaching the new building, another crew unloaded and the carpenters would rebuild the equipment in respective new places. Everything was scheduled to be torn down and set up at a certain date, otherwise the work would not have neared completion when the winter quarter began. The entire moving took less than two and a half weeks. The largest job yet to be done is the setting up of the D. C. battery supply and the switching systems.

Many Engineers on Varsity Teams

By Harold R. Shannon, M '29
Junior Class Athletic Manager

ENGINEERS now control the majority of stock in the Minnesota basketball market, and threaten to monopolize the entire business with Messrs. John Stark, E '29; Glenn Williams, E '29; and Fred Hovde, Ch '29, occupying forward, center, and guard in the company. Two other young men, namely, Ray Nelson and George Langenberg, show promise of brilliant careers. Already they have shown ability which would do credit to their more experienced partners and with a bit more polish and experience to give them confidence they bid fair to step into their present superior's shoes.

Johnny Stark, Minnesota's renowned forward, may lack something in physical size, but he confirms the idea of the "Giants of the North" on his opponents. His dynamic energy and exceptional ability have made him one of the most feared players in the conference.

Glenn Williams' folks used to be afraid their little son never would grow up and take his place in the world when they fed him the traditional Massachusetts diet of beans and codfish, so they packed up and brought Glenn to Minnesota. At that time Glenn was afflicted with infantile paralysis, and it was thought that he would never walk. Look at him now. Tall, rangy—between him and the Johnson Brothers the necks on this campus are getting pretty stiff. We feel sorry for the other conference teams when Glenn really grows up.

An unassuming blonde, Fred Hovde, believes in the old adage "All things come to him who waits," and he forcefully proves this on the basketball floor. Witness his remarkable ability in wrestling a basketball from an opponent.

Ray Nelson and George Langenberg are two upstanding men on the basketball squad. Both of these men are valuable this year as reserves and will be more valuable in the coming season when they become varsity caliber.

Then the hockey team. We present for your inspection the stalwart custodian of the goal, Carl Wilken, Ch. '30. Very few times has the puck ever passed him to be picked out of the net as a point for the opposition. To relieve him there is another engineer, Lloyd Russ, E '29. This man has done some notable stopping for Minnesota's "B" team. On the offense of the varsity the engineers are represented by Mally Gustafson, E '28, as dangerous a wing as Minnesota has. "Big Boy" Peterson is a defense man of the first class who likes to kid the opposition into an advantageous position, and then take the puck off their hands.

On the list of spares there appear the names of "Ranny" Fenton, Lloyd Westin, and "Eddie" Rundell. These are the three musketeers of the "B" hockey team, one of Coach Iverson's innovations at Minnesota. It has been claimed that there is so little difference between the varsity and this "B" team that "Ivy" often has doubts about which one to start.

(Next month the Techno-Log *will give a review of the engineers taking part in wrestling and swimming.)*

Stuart Shepley Is New Athletic Manager of Engineering College

STUART H. SHEPLEY, C '29, has been appointed athletic manager for 1927-1928 with Charles Hendrickson, E '29, as his assistant. Harold Shannon, M '29, Alden Stafford, C'30, and Howard Kroll, '31, being respectively junior, sophomore and freshman class managers. The new system this year allows each class manager to appoint a man from each college in his class to handle the duties. Professor Zelner and athletic manager Shepley believe this method will accomplish more with less work and time than previous methods did.

Engineers' Intramural Basketball and Boxing Tournaments Start

"SAY, we're so good the varsity won't play us," Fats Norley was overheard to state when questioned as to the ability of his Junior M. E. basketball team.

"Huh!" both Swede Anderson and John Perotti snorted at the same time. "If you think you're good you should see our teams."

Perotti and Anderson are living up to their boast. Perotti's General Engineering team walloped the Sophomore Chemists 44-7 while Andy's gang were taking the measure of the Freshman No. 1 15-11, in a hard fought contest.

In division II of the basketball tournament the Junior M. E. team defeated the Junior E. E. team 16-9 while the Sophomore M. E. had to be satisfied with a forfeit victory over the Freshman team No. 2. This forfeit is the first one in two years of engineering basketball competition.

All told, ten teams have entered the intramural basketball tournament. There will be two divisions of play. The two winners in each division will meet each other in the playoff to determine which team shall represent the engineering colleges in the all-U playoff. The winners will receive a silver medal for each man from the intramural department.

Boxing is also having its fling. Frank Freeman, middleweight, and "Chink" Shannon, featherweight, will both try for all-U honors.

Around the World With Our Alumni

Chemicals

'20—Claude P. Moe is occupied in a chemical engineering capacity by the Cowles Detergent company of New York City. Address him at 7411 Fourth Avenue, Brooklyn, New York.

'21—Clarence Ruchhoft can be reached at 6843 Dorchester Avenue, Chicago, Illinois. He is at present employed as a chemical engineer by the sanitary district of Chicago.

'24—Leonard Hartkemeier has relinquished his position with the engineering division of the Northern Pacific Railroad and is now an instructor in chemical engineering at the University of Colorado at Boulder, Colorado.

'25—Charles L. Johnson, who received his master's degree in chemical engineering in 1927, has recently obtained a position with the Roessler Haslacher Chemical company of Perth Amboy, New Jersey. Johnson was until a short time ago connected with the National Lead Battery company of Kansas City, Missouri.

'26—Parmalee Haugsrud's present address is 1025 South Lake Street, Los Angeles, California. He is working in an engineering capacity for the Los Angeles Gas and Electric company.

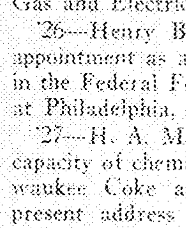
'26—Henry Bercovitz has obtained an appointment as a junior chemical engineer in the Federal Food and Drug Laboratory at Philadelphia, Pennsylvania.

'27—H. A. Moffat is now acting in the capacity of chemical engineer for the Milwaukee Coke and Gas company. His present address is 714 Marshall Street, Milwaukee, Wisconsin.

Civils

'05—O. B. Nelson recently left the employ of the C. L. Pillsbury company of Minneapolis to take a position with the Walter F. Schulz company, construction engineers of Memphis, Tennessee. He is now engaged in working on river terminals and transportation problems.

'20—A. C. Larson has left the employ of Morell and Nichols, landscape architects of Minneapolis, and is now with the Metropolitan Planning Commission on study and design of sewage disposal plants for the Twin Cities.



'24—Archie P. McCrady has applied for admission to the Bar in the District of Columbia. Archie has for some time been interested in the practice of the patent law. In 1924 Archie was an awe inspiring St. Patrick, and also filled the position of associate editor on the TECHNO-LOG staff. He is also a first lieutenant in the Coast Artillery Reserve.

'24—Martin E. Nelson, who was formerly located at Big Creek, California, where he was working as a concrete inspector, is now attending the Technological Institute of Stockholm, Sweden, as a fellow of the Scandinavian-American Foundation. He is studying electric power plant construction, water power development and water turbines.

"There are several other Minnesota students here," he writes. "One, my room-mate, is fellow of the Foundation who is studying plant nutrition at an experimental station here. Another fellow is at the Forestry school working on plant diseases, while still another is studying literature at the University of Upsala.—This country is very interesting, but I will be mighty glad to see the 'Father of Waters' once again."

'26—Ray Hohnson is doing engineering work for the Cook County Highway department of Illinois. He is at present located in Chicago.

'27—Kenneth M. Clark is now employed by the Pennsylvania Railroad, with offices in Chicago, Illinois. He is in charge of all assessments against the road for paving, water lines and sewer systems put in by Chicago and surrounding towns. He says that he likes his work although it requires no engineering knowledge.

Electricals

'23—George J. Schottler has recently resigned from the Washington office of the patent section of the General Motors corporation and is now with a firm of patent attorneys in New York City. Address him in care of Emery, Booth, Janney, and Varney, 149 Broadway, New York City.

'25—Carl Ellis is a student engineer with the General Electric company at Fort Wayne, Indiana. He says: "Nothing new, but still going strong."

'26—R. A. Beveridge is a fractional horsepower motor specialist, or as he says, a "motor peddler." He is with the General Electric company at Fort Wayne, Indiana.

'26—Alvin K. Mann, who has been employed by the General Electric company as a student engineer since July, 1926, has accepted a position with the Central Hudson Gas and Electric company at Poughkeepsie, New York. Mann's home is in Anoka, Minnesota.

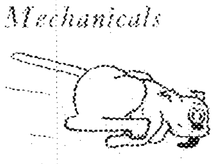
'26—George R. Deinema is now with the Northern States Power company at Chippewa Falls, Wisconsin. He writes, "I am doing switchboard work on the new hydro-electric plant which is being built at Chippewa Falls. This is a plant of six wheels, each generating 4 000 horse power." He can be reached at the Anderl Hotel in Chippewa Falls.

'26—Maurice W. Hart transferred from the Cutler-Hammer students' training course at Milwaukee to the sales engineering department of the Cutler-Hammer Manufacturing company at 323 Michigan, Chicago. His address is 2324 Lincoln Park, W. Chicago.

'26—Victor Etem was married on December 31st to Ethel E. Wahlberg of Minneapolis. He is now in business for himself in Kansas City.

'27—Joseph H. Wald and Henry A. Anderson, E '27, are taking the student's training course of the Ingersoll-Rand company, making the rounds of the different plants. At present they are in Phillipsburg, New Jersey. Wald's address is 349 Prospect, and Anderson's 353 Prospect, Phillipsburg, N. J.

Mechanicals



'02—William L. Bean is now mechanical manager for the New York, New Haven, and Hudson Railroad. He was formerly assistant mechanical manager for the same railroad. He is in charge of design and maintenance of rolling stock.

'07—Oliver H. Stephenson has recently severed his connection with the Washburn Crosby company, where he has been in an engineering capacity for several years.

'08—G. T. Peterson is contemplating a change of position. He is at present supervisor of apprentices for the Duluth and Iron Range Railroad with offices at Two Harbors, Minnesota.

Hermann C. R. Piper visited the mechanical engineering department recently. He is engaged in real estate and industrial development in Stillwater, Minnesota.

'23—H. O. Halden is now a sales engineer for the Fuel Economy Engineering company of St. Paul. He expects to move from Minneapolis to Kansas City territory soon.

'27—Roy C. Irons is with the Shaffer Oil and Refining company of Chicago in the capacity of lubrication engineer. His address is 300 West Adams Street, Chicago, Illinois.

'27—John W. Hall started work about the first of January in the development branch of the Western Electric company at its Hawthorne station at Chicago, Illinois.

Miners

'25—Bernard J. Larpenteur, who has been working at the Mines Experiment Station since graduation as technical assistant, has resigned to take a position with the Dorr company, of New York. He was recently married to Edith Fairbanks of Minneapolis.

'25—Edward H. Hennen, who is employed by the Ingersoll, Rand company in its New York offices, spent some time visiting his parents in St. Paul.

'27—Marshall Coolidge has accepted a position with the Allis-Chalmers company of Wisconsin. He was on the campus a short time ago.

Lignite Fuels of North Dakota

(Continued from page 145)

fire that the bituminous coals possess. As the moisture and gases are expelled, therefore, slacking occurs in the fire, and fine unburned material that may go through the grates is produced.

"Nevertheless, lignite can be successfully used as a fuel if certain precautions are taken in its storing and burning. To prevent the rapid drying out it should not be stored in open sheds where there is a free circulation. Nor should it be stored in the open, particularly during the summer months, where it is exposed to the drying action of the sun and wind. Any method of storage, however, that slows up the drying process is satisfactory. Such methods include storage in tight bins in cellars, in covered pits and in tight sheds. If such sheds are of wood they should be lined on the inside with corrugated iron."

Along the same lines, the late Dean E. J. Babcock wrote, "When people become accustomed to the use of lignite, they find it can be burned with good success in the ordinary cooking stove or range, in the various types of heating stoves, and in hot water and steam heating plants.

"It is very seldom necessary to make changes in stoves or heating plants, although some are naturally better adapted to burning lignites than others. Generally speaking best results can be obtained in stoves or furnaces having fairly large grate area and a little reserve capacity. It will be necessary to fire either heating plants or stoves more frequently than with anthracite, soft coal, or coke, because the fuel value of the lignite in its natural condition is somewhat less than the same weight of standard anthracite or eastern bituminous coal.

"With good judgment and a little experience lignite can be utilized far more successfully and economically than most people realize. . . . There are many reasons why the people of North Dakota and adjoining regions should quite generally use lignite. This can be done successfully and usually with a marked saving to the consumer."

Possibilities in Use of Lignite

There are a large number of possible uses of lignite and the future will undoubtedly see these possibilities converted into realities. Some of these that look exceedingly fruitful at the present time are:

(1) Production of carbonized lignite briquettes.
(2) Conversion of the lignite into electricity at the mine.
(3) Use of powdered lignite in larger heating and power plants.
(4) Production of wood stains by the extraction of materials from weathered lignite.

The fundamental principles for the production and briquetting of carbonized lignite have already been worked out at the School of Mines, University of North Dakota, under the direction of the late Dean Babcock. Several thousand tons of lignite were treated in the experimental plant, used for this purpose, which converted this fuel into exceedingly high grade briquettes. According to Dean Babcock, these briquettes were thoroughly tested and used in all kinds of stoves and furnaces, and proved entirely satisfactory.

E. J. Babcock and W. W. Odell give the following summary of their work on the production and briquetting of carbonized lignite.

"A careful consideration of the methods of lignite carbonization and briquetting and resulting products will show that raw lignite can be converted into a very satisfactory fuel of comparatively high value, admirably suited to domestic and other uses, and acceptable to the average consumer; this has been thoroughly demonstrated by extensive trial uses and tests.

"Among the many advantages to be secured by the briquetting of carbonized lignite are a large gain in heating value, prevention of the slacking characteristics of raw lignite, the ability to withstand storage with but small loss, uniformity of size, convenience for use, ease of burning and relative freedom from loss due to unburned carbon in the ash.

"The briquettes can be used to advantage in various types of stoves and furnaces and be kept under control during a long burning period.

"The briquettes burn to an ash practically free from unconsumed fuel whereas anthracite, for example, usually leaves much unburned fuel in more or less imperfectly consumed pieces and in clinkers.

"Well made briquettes with a flour and pitch binder will hold their shape and do not distintegrate in the fire as they become heated to a high temperature. The success achieved so far in the production of water gas in the central states from bituminous coal leads to the belief that properly made briquettes of the required size will make a satisfactory generator fuel."

The conversion of lignite into electricity and its subsequent transmission at high voltage is being given serious consideration, at the present time, because this development will mean much to the northwest and North Dakota in particular. Dr. Gauger says, "The trend throughout the world today is towards substitution of electric power for steam, and there seems to be no doubt but that development will take place along these lines in North Dakota and the future will see the establishment of large power plants at locations suitably provided with lignite and water."

The possibilities of using lignite in the pulverized form has always been in mind with those who have come in contact with this fuel. According to the experiments of G. B. Wharen, lignite when dried to a 10 to 12 per cent moisture content and pulverized to approximately 40 per cent through a 200 mesh screen is an ideal fuel for burning in suspension.

Within the last few years there has been started a new industry in the state of North Dakota. This industry is the manufacture of colored wood stains by the extraction of water soluble materials from weathered lignite. The finished product is known to the market by the name "Dakalite". According to Professor L. P. Dove, assistant state geologist, who discovered this material, Dakalite is a water soluble, brown coloring matter or dye stuff that is extracted from slacked or weathered lignite. It is now being produced commercially in North Dakota and is widely used as wood stains and bases for stains. It is a very effective coloring material for cellulose in any form. Through continued research work with this material many more uses for it will undoubtedly be found.

Conclusion

There are still many problems to be worked out in connection with the efficient utilization of lignite. Its use as a fuel for domestic and industrial purposes has already been proven. It remains for the people of the northwest to become acquainted with this material.

The future will, no doubt, see increased activity in the line of briquetting of carbonized lignite. There are many reasons why carbonized lignite briquettes should become a widely used fuel in this territory.

At present 85 per cent of the lignite consumed in this state is for domestic use. Because of the concentrated heat value which reduces difficulties in storage and the cost of handling, carbonized lignite briquettes will find a much larger market in the future, especially for domestic purposes.

Modern methods of mining, which are materially decreasing the cost of production, will be a large factor in increasing

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Television

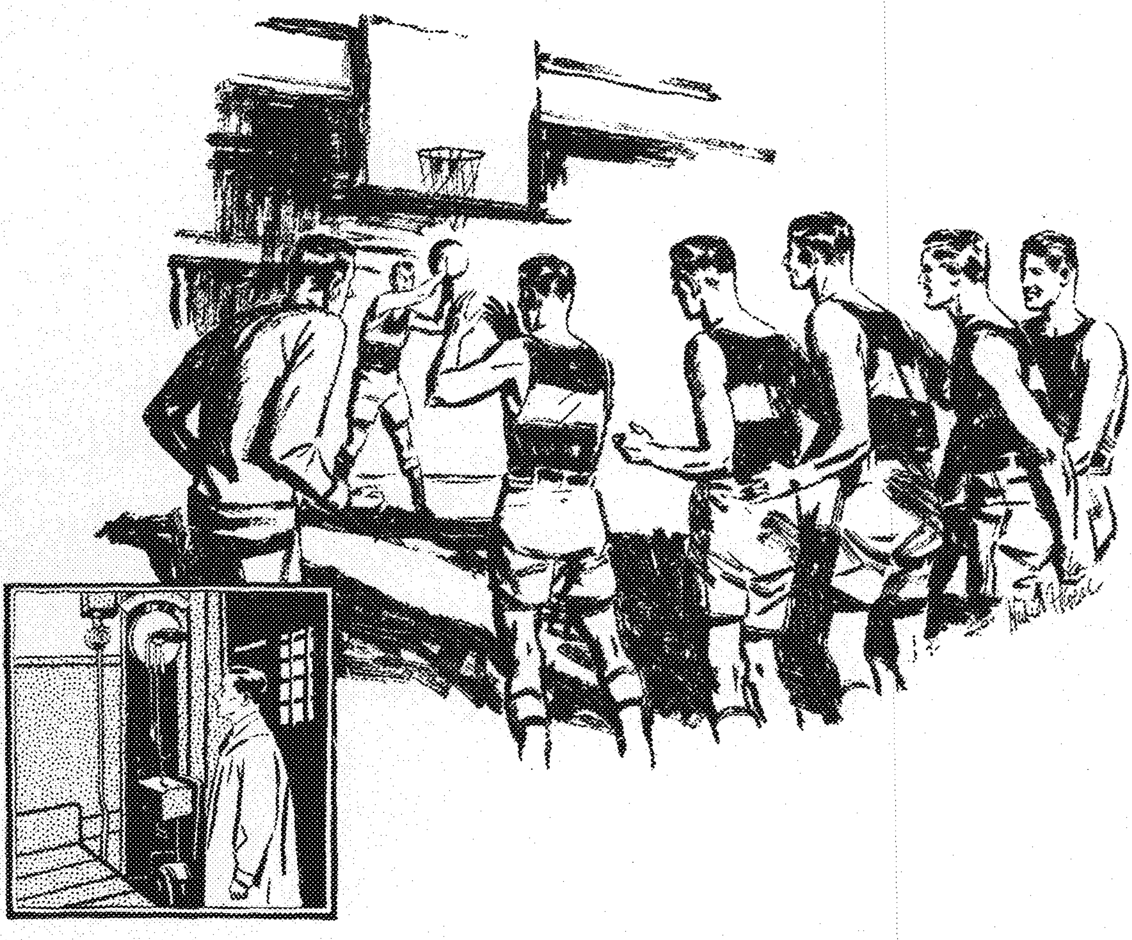
(Continued from page 142)

other and the 240 pole motors can then be used to hold the close synchronism that is required. In the final arrangement, the speed of the discs was made 17.7 revolutions per second instead of 16 as suggested above, giving 17.7 pictures per second. The frequency of the 240 pole motor would then be 2,125 cycles per second and this frequency could be transmitted over a separate line from that used for the television currents. The 17.7 cycle current for the low frequency motor was undesirable for transmission over telephone cables, and this problem was solved by allowing the 17.7 cycle current to modulate a higher carrier frequency and be satisfactorily transmitted. The carrier could then be demodulated at the receiving end and the 17.7 cycles used for synchronizing the two pole motors. The maximum phase displacement allowed in the positions of the two scanning discs was only 4⅓ minutes of arc.

As seen in Fig. 5, there is a hand wheel on the frame connected to the motor assembly by a worm gear. The purpose of this adjustment is to enable the operator at the receiving end to vary the motor position so as to frame the picture properly. This is similar to the arrangement on a moving picture projector for framing the picture on the screen.

The above method of receiving the picture is useful where only one person is interested in seeing the view at the transmitting end, or when two persons communicating wish to see each other. Sometimes it is necessary that a large audience be able to see the picture, as, for example, when a public speech is being transmitted. As the voice can be amplified through the loud speaker, it should be possible to place the moving picture on a large screen. To accomplish this, it was necessary to provide a special type of neon tube. The one arranged for this purpose was constructed of glass tubing zigzagged back and forth fifty times to represent each of the lines across the picture corresponding to each hole in the scanning disc. The glass used was a continuous tube filled with rarified neon glass at the right pressure. An electrode was run through the tube in a spiral throughout its length. On the back of each horizontal portion of the tube were cemented 50 pieces of tin or silver foil to form the 50 consecutive electrodes for the movement of one hole on the scanning disc across the frame. There were then 50 x 50 or 2,500 electrodes in all, each representing a spot on the transmitted picture. Each of these electrodes was connected to a segment on a dis-

(Continued on page 162)



Mr. K. J. de Juhasz, Inventor of Indicator

(Continued from page 139)

their own. Outside of taking attendance three times a day, the British interfered but little with the camp prisoners. No atrocities were committed, and the people were not tortured. Camp bands were established, and Mr. de Juhasz played in these. He also taught mathematics and engineering, and entered into the various camp sports.

Mr. de Juhasz is an ardent admirer of Jack London, and is a great follower of outdoor life. He says, "I owe much to Jack London for his great books; during the trying times of the camp life when many people were breaking down mentally, his books with their gripping stories took my mind off of the conditions, and perhaps saved me from the fate of so many." Mr. de Juhasz translated "White Fang" into Hungarian.

It was during his stay in the camps that he learned to speak English, although he had taken a course in English in college. He has a working knowledge of five languages.

"At one of these camps a group of technically inclined men formed a club, and we tried to invent things. Conditions were very hard for study, but I placed down in notes several ideas, and roughly designed the indicator. This was the only one that I developed," said Mr. de Juhasz.

He was transported home in 1919 following the end of the war, and he was immediately appointed Assistant Professor of Heat Engines at Budapest Technical College. Budapest is a city of about 1,000,000 inhabitants, and the college has about 2,500 students. Here he developed his invention, while teaching for the equivalent of $4.00 per month. By working at every bit of possible outside work he managed to raise this to about $8.00 per month. While engaged in this work, a few months after his return communism broke out, and extreme hardship prevailed for two years accompanied by famine and death.

"We owe much to America," he said. "Had it not been for the money and kindness they showed, many Hungarian children now living would long ago have been dead. Although America was one of our enemies, we are their friends now."

Design of the high speed indicator continued and in 1921 he had the first indicator constructed. His invention was such a success that the Hungarian So-

ciety of Engineers and Architects awarded him a gold medal for his brilliant work. The following year he took the invention to Germany where he showed it to a manufacturing firm. They agreed to make it.

That the instrument is of practical value has been proved in Europe where there are several of them installed in the leading automotive factories. In Italy a test was made on a Fiat racing "8-in-line" engine that registered 6,000 R. P. M. This test was entirely satisfactory and showed that the indicator could be used on higher speed without any trouble. This indicator is not something that will make the old style indicator obsolete, but is built to be used in communication with them. Mr. de Juhasz has set up an indicator in the Experimental building, and he is still conducting experiments.

He came to Minnesota three weeks after the quarter began, coming direct from Hungary through connections with the Institute of International Education located in New York City. It was on October 17 that he landed. Without stopping he boarded a train for Chicago, and from there came to Minneapolis. He took no time to see any of the sights in either city. On October 19 he arrived at Minnesota and without preparation and a knowledge of customs of the United States, he taught class the first day of his arrival. His papers and articles have appeared in newspapers and magazines in Italy, France, Germany, Hungary, England and the United States.

He likes the conditions here and he says, "Everyone has been very kind to me, and the students are very jolly and merry. You ask me the difference between here and Hungary; there is not much difference. Engineering students here as well as over there study harder than do students in other colleges. Over there the students have to work harder; they cannot be so merry. Conditions are not good. You have more equipment and laboratories than we have, and I think they are very helpful. In Hungary we have more theoretical work. Students work their way through school too, as they do here, but it is much harder to do over there. They don't get as much money for work. We have a Techno-Log too, but not so big, or so often. Only those who have gone to high school can go to the universities. After graduation the diploma is considered as a most valuable document. I have several copies of mine, and the original is kept in a safe place. If a man loses his diploma there, he is bad off. A man must show his employers his diploma."

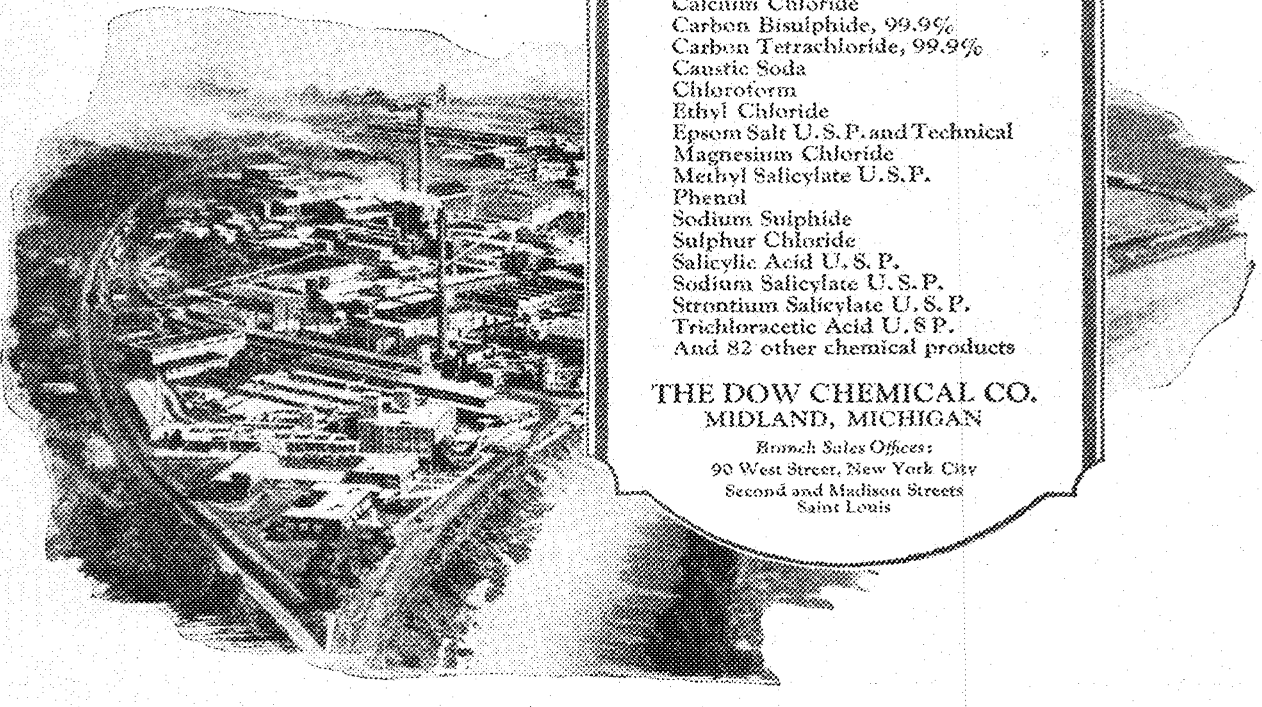
Lignite Fuels of North Dakota

(Continued from page 152)

its market range. Favorable freight rates will also contribute greatly to this end.

An abundant supply of lignite produced at a reasonable cost will be the chief factor in developing industry in the northwest. There is a saying, "Where there is fuel, there is industry." North Dakota is, indeed, fortunate in having as its chief mineral resource fuel which is essential to the economic development of this territory.

In conclusion, I wish to express my deep gratitude to Dr. A. W. Gauger, Director of the School of Mines, University of North Dakota, for his kind help in obtaining many of the pictures and much of the material used, and to Mr. R. L. Sutherland, Fellow on Lignite Research at the School of Mines, University of North Dakota, for his kind help in gathering material for my use, for his many suggestions, and for his aid in correcting this paper.



Three Themes

(Continued from page 148)

found themselves near a mountainous mass of ore and limestone which had been recently discharged from the boats. Two other men and I left the main party and rounding the huge pile of ore we found ourselves in the midst of the mill structures. A "hot metal" train passed by with a clatter, jolting the ladles filled with molten metal for the open hearth furnaces. The train left a characteristic steel mill odor of coal gas, burning sulphur and cooling slag in its wake. A little distance away we noticed a huge crane drawing a white hot block of metal from a "soaking pit."

"Let's look this over," said one of my companions. "Sure thing," replied the other and we entered one of the monstrous corrugated iron sheds. We saw the billet deposited on a scale, weighed and then lowered to the rolling machine. A grimy individual who wore colored glasses to protect his eyes from the glare, grasped a long lever and turned the billet on its side. A rumbling commenced as the billet was rolled back underneath the rollers into a snakelike slab of red metal. This rolling process took so little time that the billet merely changed from a glowing white to a cherry red color. Sparks flew about and steam arose where a jet of cold water struck the main rollers. The man with the glasses manipulated the levers several times until the slab had reached the required size, then going to a second set of levers he sliced the slab, as easily as one would slice a loaf of bread, into a number of pieces of convenient size. When the crane had carried these away, the rolling went on as before.

We, forgetting our other plans, stayed a long while gazing in silent wonder. Then growing weary of the heat and noise we turned away toward the plant entrance. The men were changing shifts and a heterogeneous mob, all carrying large tin dinner pails, met us at the "gate." There were young men and old men, from every nation on the earth going to some task in this vast melting pot of men and metal.

"The Flood Crest Passes"

By Clinton W. Janes, '31

MIDNIGHT on a Mississippi levee, and the minds of men black as the sodden, slimy night, with the blackness of despair. For weeks and weeks Nature had gathered her vast and far-flung forces for this stupendous effort in which the hand of Nature conspired against the hand of man. The waters that tonight threatened man's handiwork had come from thirty states, had been rolling relentlessly on their way for days, weeks, and even months.

Throughout the nation people were waiting for news of the outcome of this *great fight*; telegraph operators sat tensely at their keys; newspaper editors held space open in the morning editions for the news; broadcast stations stood by ready to relay the news on to the radio audience. The Red Cross was prepared for an emergency; the militia awaited the call; railroads were ready to aid in an exodus to higher ground, should evacuation become necessary. The crest of the flood was due at three o'clock. Death's zero hour. For sixty days the river gauge had risen steadily.

Then volunteers were called for, and a superstructure of sandbags was hastily constructed. Work progressed unceasingly, for as soon as a man became exhausted another was sent up on the levee to take his place. Yet the river rose, as though Nature, tired of being so long in bondage, had at last decided to show her real strength. Then, when a brief respite seemed to be in view, a new menace arose to baffle the fatigued men. Out of the North came a bitter wind, which lashed the murky waters to a fury, and congealed the muddy garments of the weary workers. A cry arose for "More sacks." "More sacks," "More

sacks, for God's sake!" and the men who not long before had been relieved that they might gain a much needed rest, were roused from the sleep of exhaustion to help combat this new disaster. While some filled sacks, others thrust the bags of mud and sand and clay into the breaches which momentarily appeared. So passed another dismal hour.

Came two o'clock, and through the efforts of some unsung hero or heroine, coffee miraculously appeared among the workers to cheer them on to greater efforts. A short lull, then suddenly and without warning all the Furies of the North seemed to gather their forces to bring the inky waters whirling down upon the levee. The tearing North wind ripped and drove the Father of Waters into a cataclysmic terror. There was water in the air, water everywhere, even the clay levee under foot seemed to crumble and turn to fluid as one walked on it.

But as the river rose to new and unequalled heights, the efforts of men rose to equal and surpass the efforts of Nature. Three o'clock came; the crest of the flood passed; the levee held. Man had conquered. Beaten, the Furies withdrew their forces, perhaps to reappear again in the dim and distant future, when the hand of Nature would again be raised against the hand of man.

What I Would Do

(Continued from page 138)

directing, coaching, financing, advertising, and novel art work.

I have mentioned only a few of the extra curricula. Every student will not find that his interests lie in the lines I have mentioned, and it's just as well that he doesn't. Each organization must have its leaders, its interested workers, and every one offers at least one of the advantages I have pointed out in those mentioned. Participation in practically any of the organizations on the technical campus will help one to realize our third aim; that is, "To get the other fellow to do things either with us or for us."

If one should follow the above program, I fully believe that he would have a real engineering education. There would be a sound ground work of engineering theory which he himself had laid under the direction of professors who stimulated him, persuaded him, and made an appealing adventure of his work. He would have a knowledge of the basic facts and principles underlying the subjects kindred to his own line. And last, though not least, he would have associated and worked with others in campus activities until he knew how to play ball with the rest of the team.

Television

(Continued from page 154)

tributor containing 2,500 segments. An arm with a brush was driven at synchronous speed by the motor arrangement described above. The back of this grid, the motors and distributor are shown in Fig. 6.

The invention of television cannot be attributed to any one man for it was brought about by the cooperative effort of probably 150 men, each of whom contributed his share in a particular phase of the whole problem. It is interesting to note in this connection that several former Minnesota men had a hand in making television a success. Mr. R. C. Mathes, EE '13, was in charge of the group responsible for transmission and order wires. This included construction and testing of phase measuring apparatus, operation of order wires, and equalizer studies. In this group was also Mr. D. K. Gannett, EE '17, who has been active in telephotography for a number of years. Mr. E. C. Manderfeld, B. S. '22, EE '24, was associated with the group responsible for synchronization of the perforated discs. Dr. O. J. Zobel who calculated the equalizing networks for the telephone lines, was an instructor in Physics at Minnesota for several years.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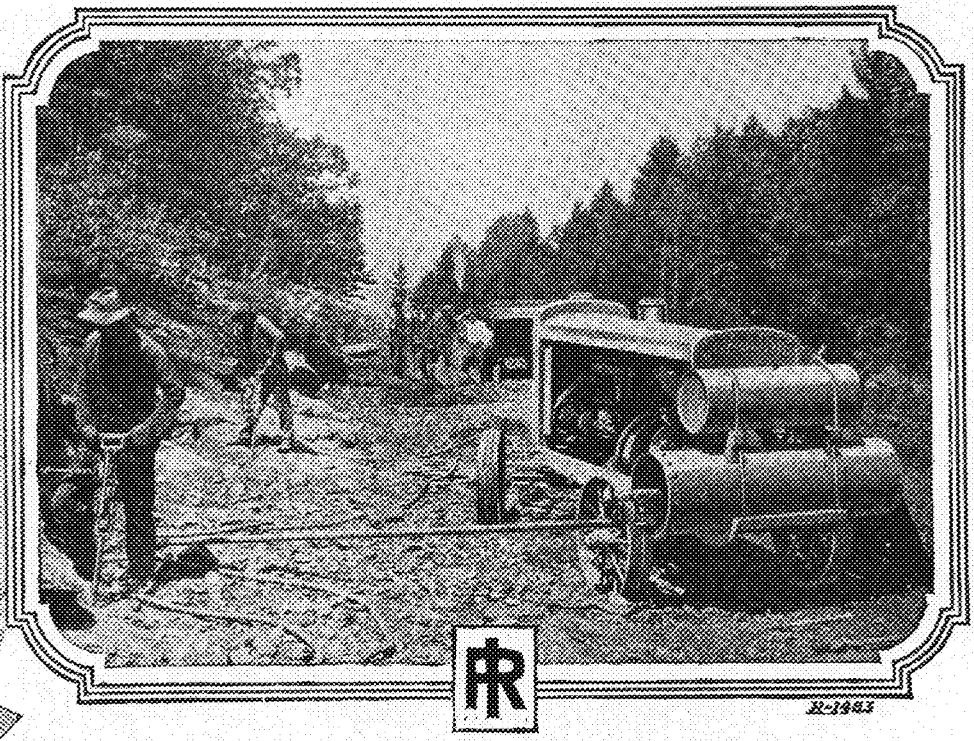
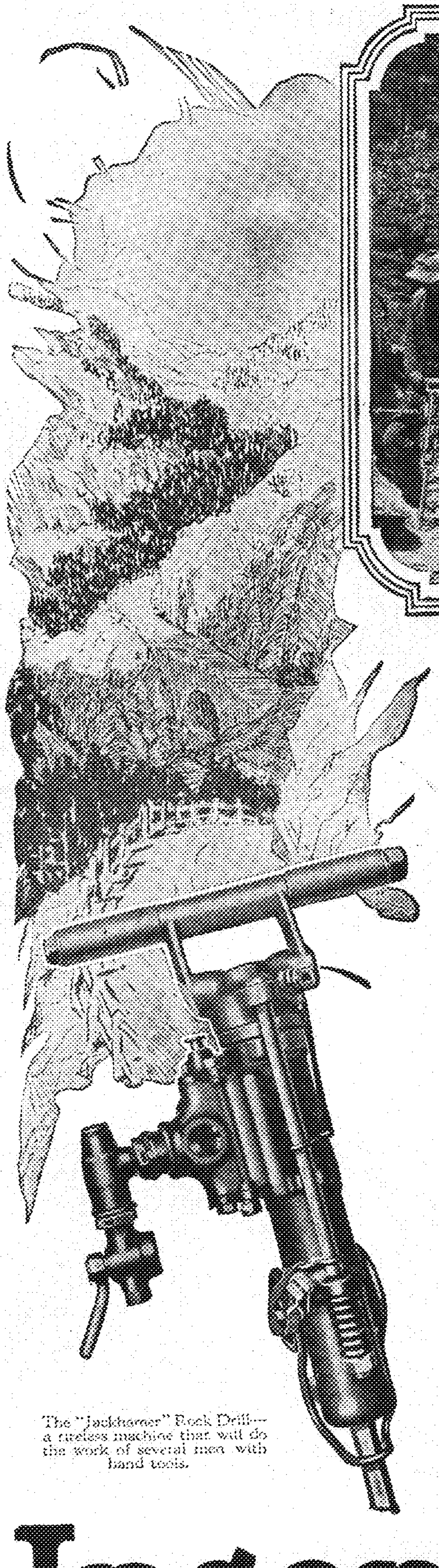


Ingersoll-Rand Portable Compressor and Air Drills on a road-building job.



The "Jackhamer" Rock Drill—a tireless machine that will do the work of several men with hand tools.

Air on Wheels

Modern engineering projects require equipment that can be moved about quickly, regardless of mountains, rivers, or other natural obstacles. Particularly is this true of our modern highway systems, for the road-building problem is a vital one in every section of the country.

To meet the increasing demand for better highways, the contractor is literally "taking his air with him"—equipping himself with portable air compressor plants that will operate his drills and other road-building tools. Good roads, judged by present standards, are rarely built in any other way.

I-R Portable Compressors and "Jackhamer" Rock Drills have supplanted the crude, laborious hand methods of a decade ago. Not only in out-of-the-way places, but in cities and factories as well, these sturdy little air plants are speeding operations and cutting overhead in almost every line of work.

Ingersoll-Rand Portables are furnished in six different sizes, each being available on several different types of mountings.

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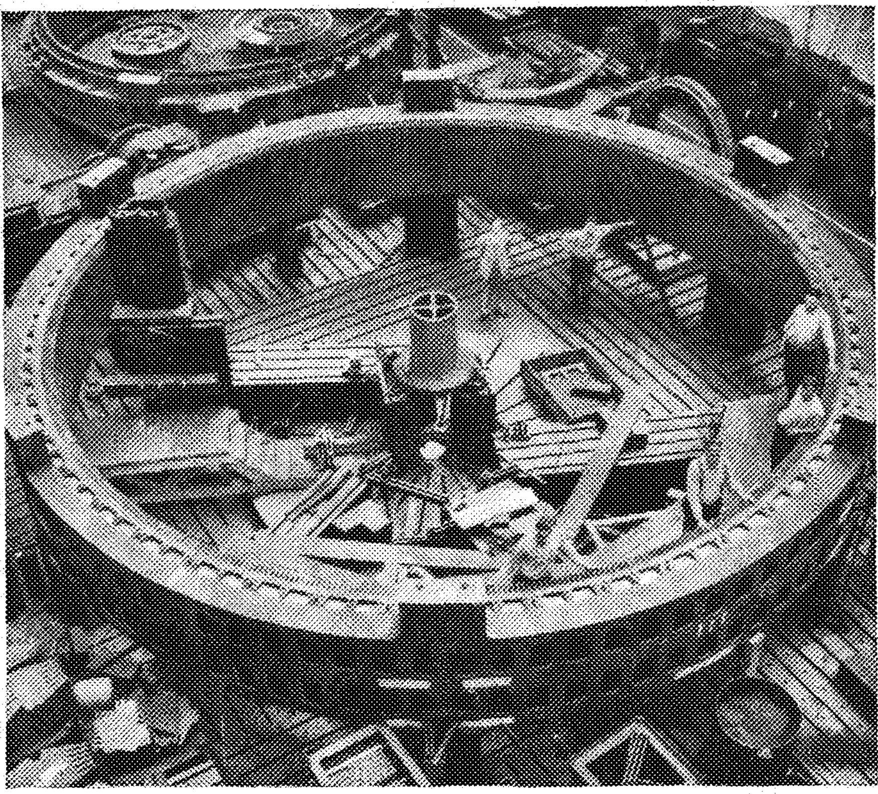


The picture above shows workmen assembling one of the huge Conowingo stators in the Westinghouse Works at East Pittsburgh. The men in the picture will give an idea of the tremendous size of these generators.

RENÉ BAUDRY
Drafting Engineer
École Nationale d'Arts et Métiers d'Aix-en-Provence '19

J. H. ASHBAUGH
Design Engineer
Bliss '18

S. B. GRISCOM
Transmission Engineer
Cornell '22

R. C. BERGVALL
Central Station Engineer
U. of Michigan '23

YOUNGER COLLEGE MEN ON RECENT WESTINGHOUSE JOBS

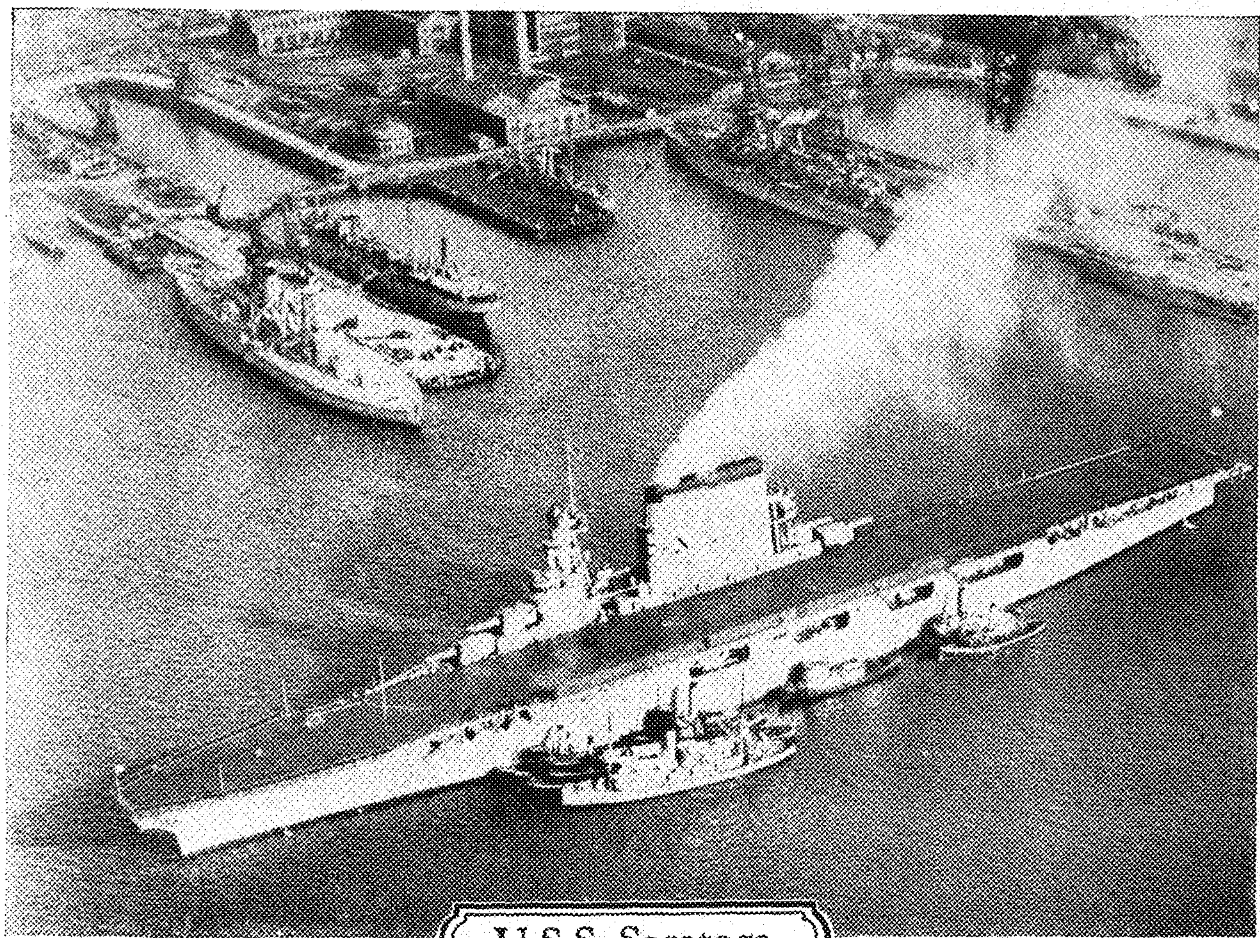
Conowingo

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

AT Conowingo, not far from where the Susquehanna River flows into Chesapeake Bay, the Philadelphia Electric Company is erecting a huge dam and power house. This hydro-electric development, one of the largest in the world, has an initial capacity of 281,000 kv-a. in seven units and an ultimate capacity of 440,000 kv-a. The generators, due to their very low operating speed of 81.8 r.p.m., are much larger physically than anything yet built, each machine being approximately 37 feet in diameter and weighing over one million pounds.

Only an organization of the size and resources of Westinghouse can undertake the building of such a large machine. Westinghouse offers great attractions to young men of enterprise and genius because it daily provides facilities and opportunities which smaller companies cannot offer.

Westinghouse



U.S.S. Saratoga

A Marvel of National Defense

From this 2½-acre deck, Uncle Sam's battle planes can now leap into action—sure of a landing place on their return, though a thousand miles from shore.

This marvel of national defense was accomplished—and duplicated—when the airplane carrier, U.S.S. Saratoga, and her sister ship, U.S.S. Lexington, were completely electrified.

In each, four General Electric turbine-generators deliver, combined, 180,000 horsepower to the propellers—enough to drive the ship at 33 knots (39 miles an hour)—enough to furnish light and power for a city of half a million people.

The design and construction of the electric equipment for the U. S. S. Saratoga and the U.S.S. Lexington, to which college-trained men contributed in great measure, exemplify the part General Electric plays in promoting the welfare of the nation.

6-24DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The MINNESOTA TECHNO-LOG

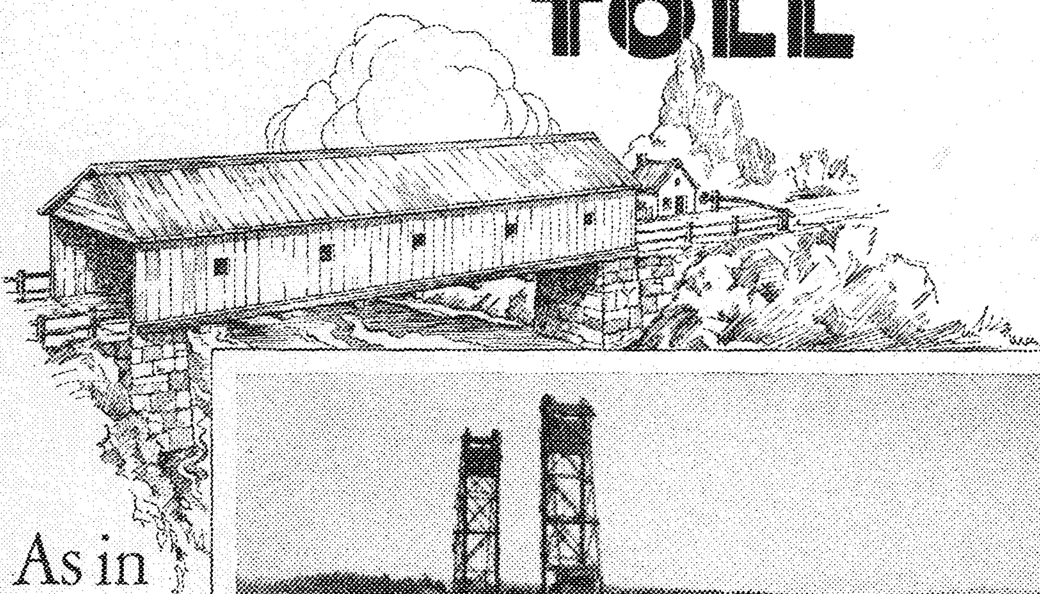
MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

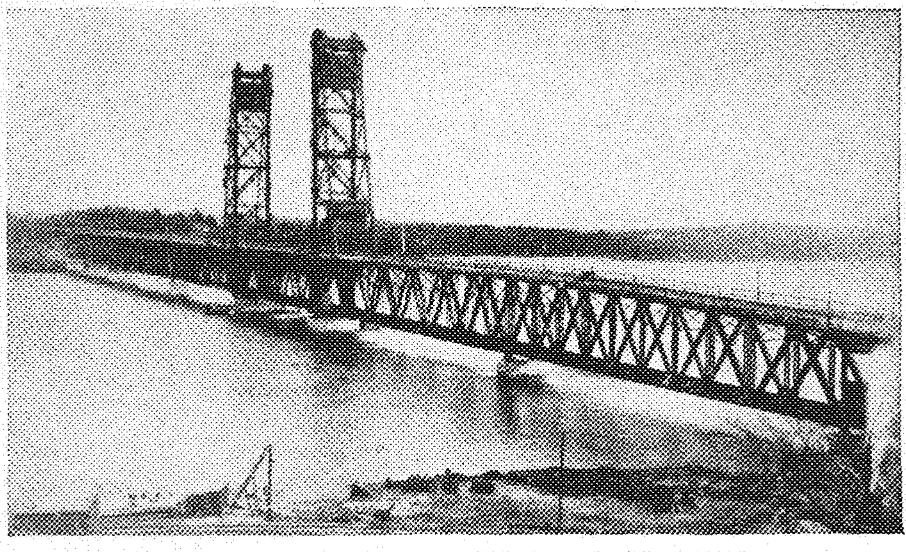
MEMBER • ENGINEERING • COLLEGE • MAGAZINES • ASSOCIATED

Electricals Test Mercury Arc

Volume VIII MARCH 1928 *Number 6*

TOLL





HIGHWAY AND RAILROAD BRIDGE AT BATH, MAINE
PIERS AND APPROACHES CONSTRUCTED BY THE FOUNDATION COMPANY

As in Years Gone By

THE toll bridge of early days bears but little resemblance to the one built today, but the reasons for its existence remain the same. A stream must be crossed by the public, and the passing public pays for the convenience provided by the bridge, either in taxes or tolls.

Toll was taken in the past as it is at present to pay not only for the upkeep of the bridge, but to repay to the owners the funds expended in its construction—whether the owners be private or public.

Modern highway traffic is rapid and seeks to travel in a direct line, requiring new roads and bridges. Present custom in many cases finds private toll bridges, with possible future reversion to the public, a solution of the problem.

The Foundation Company in the construction of some of these bridges, or the piers that support them, is in this way serving the public.

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BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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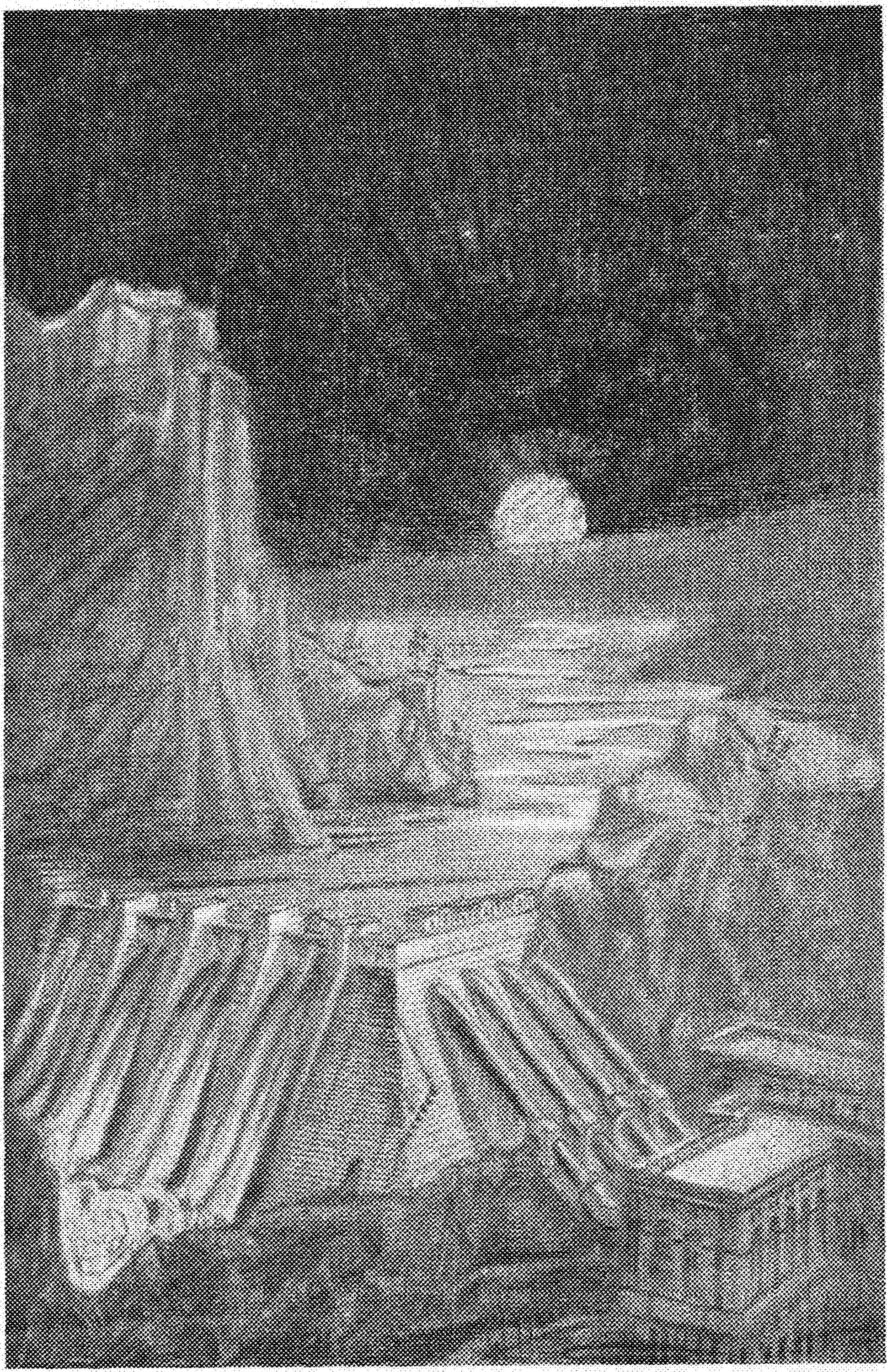


Foaming waters rushing through mighty dams generate the power that moves the world

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII — MARCH 1928 — Number 6

Engineering Overseas

Norway has huge water power development; engineers show initiative

By Francis C. Shenehon, C '95, CE '00

Consulting Engineer, Minneapolis

FRANCIS C. SHENEHON

Mr. Shenehon in addition to being a graduate of the University of Minnesota in the civil engineering class of 1895 was also Dean of the College of Engineering at the University of Minnesota during the years of 1909 to 1917. He has taken an active interest in the St. Lawrence to the sea waterway project, which he has advocated. At present he is a consulting engineer in Minneapolis. During the past year he took an extended trip through the European countries and investigated engineering developments over there. Throughout his travels, particularly in the Scandinavian countries, Mr. Shenehon has come across many things of general engineering interest, which we feel most fortunate to be able to present to our readers. Next month we will publish an article on water power development and general engineering features of Sweden.

PERHAPS American engineers have a comfortable consciousness of initiative and accomplishments so brilliant, that Europe, with its long traditions, appears in the deep shadows of the technical picture. It is a wholesome thing to penetrate these shadows and to find out that overseas initiative still exists and that accomplishments are substantial and satisfactory. My American view is chastened and less aggressive for my four months spent in examining the water powers of Norway, Sweden, Germany, Austria and Switzerland; in studying dykes and flood control in Holland; and in investigating sewage disposal in Germany.

As a prelude to my technical discussions it may be well to state that we drove from Minneapolis to New Haven, that we stored our car there and went to Montreal by train and sailed on the cabin class Cunard steamer "Alaunia" the last of July, 1927. And we steamed down the magnificent navigable avenue of the St. Lawrence River to the blue Atlantic. And on the blue Atlantic we passed close to some gleaming icebergs and secured some motion pictures of them.

This leads to the motion picture element in my examinations. A motion picture camera costs $150; 100-foot films cost in the United States $6 and in Europe a little over $7, including all development costs; and customs duties amounted to $30 on my 1,500 feet of films. My total film investment to preserve the graphic record of my visits to overseas engineering works, was less than $130. The value of the films is, of course, many times the cost. The motion picture has two values; first, it keeps vivid in the mind the things seen; and second, it helps in technical talks before students or engineers.

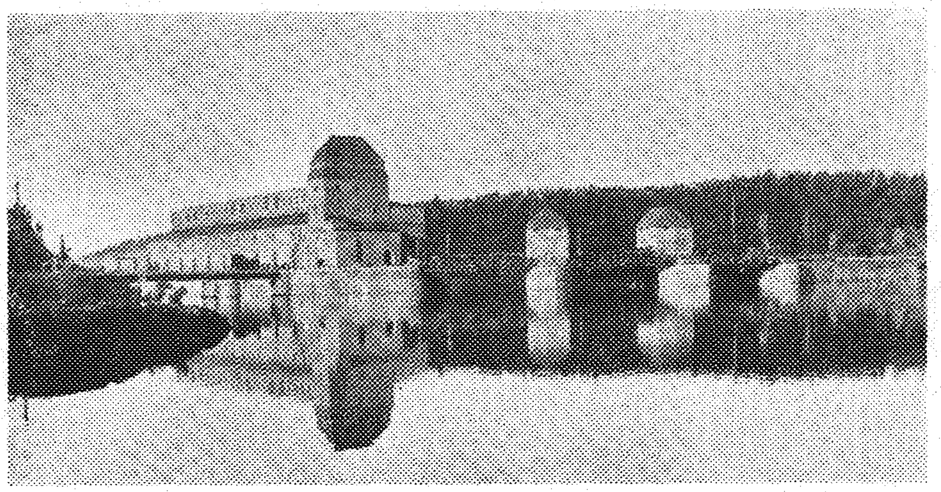
The ocean voyage, the landing in London and discovering Picadilly and Leicester Square; the northward trip towards Newcastle in the nice, diminutive English trains—with stopovers at Cambridge, Ely, Peterborough, Lincoln, York and Durham; and the trip across the North Sea from Newcastle to Bergen, Norway, are approaches to the old world of technical things. And this applies also to a visit to the Hardanger Fiord and the all-day trip in on observation car on the Scenic Railway from Bergen over the mountains—with glaciers at the crest—to Christiania—now called Oslo.

Norway is distinctly a Northland. The cities of Bergen and Oslo are as far towards the north pole as Petrograd; and Minneapolis is a thousand miles—and the tip of the Alaska Peninsula 400 miles—nearer the equator than these Norwegian cities. The university town of Trondhjem is nearly as far north as Iceland. The port of Narvik, where the iron ore from the Swedish mines is shipped, is in the land of the midnight sun, 125 miles north of the Arctic Circle.

But the north branch of the warm Gulf Stream flows upward along the coast, and tempers the intensity of the cold; and at the same time yields moisture. And the humid air blowing inland carries abundant rainfall to vitalize the lakes and streams and to perpetuate water power. It is a good thing that mountains receive the most intense precipitation, because the higher up the water begins its return journey to the sea, the greater the potential water power. The Kjolen Mountains running north mark the boundary line between Norway and Sweden. In this range isolated peaks reach well above 6,000 feet. In mid-Norway peaks reach above the 8,000-foot contour.

A SECOND characteristic of Norway, bearing on water power utilization, is the penetration of the sea, reaching into the very heart of the land in narrow,

* Dean of the College of Engineering, University of Minnesota, 1909-1917.



ABOVE THE DAM AT THE SOLBERGFOSS PLANT

FIGURE 3: This plant, occupying a deep rock gorge, is owned by the city of Oslo and the Norwegian state. It is on the lower part of the Glommen river, which is the largest river of Norway.

deep channels with canon-like mountain walls, called fiords. These fiords bring tail water closer to head water, and at the same time give fairly deep-draft navigation to the power house and sheltered harbors at the factories. The Sogne Fiord reaches inland nearly a hundred miles. Of course these fiords are ice-bound some months each year.

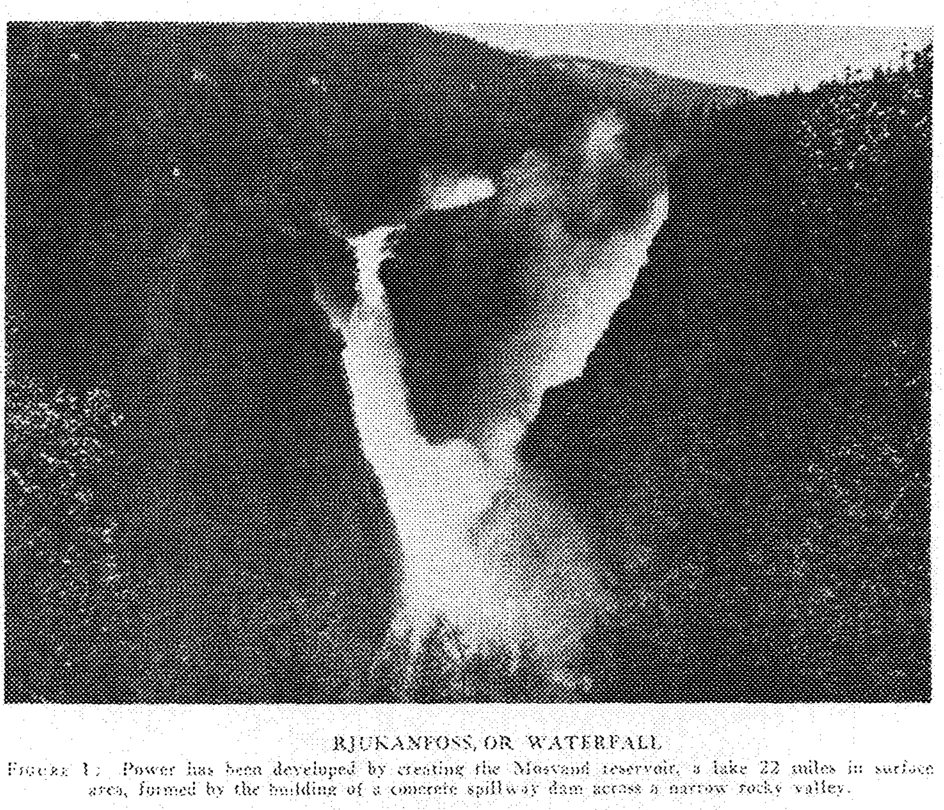
It must be kept in mind that Norway is not very big—less than half again as large in area as Minnesota; that the population is not great—not much exceeding that of Minnesota; that the area of the lakes and streams—5,000 square miles—is greater than the area of farm lands; that forests cover 27,000 square miles—over 21 per cent; and that three-quarters of the area is unproductive except as it may form the catchment basin for water power. But the developed water power—at present nearly 2,000,000 horsepower—is greater per capita than in any other country in the world. Canada has about 0.55, and Norway 0.72 horsepower per capita; while Switzerland, which we think of as a water power nation, has but 0.46 horsepower per unit of population and the United States only 0.10.

THE highest usefulness of electric energy is achieved when it enters into the intimate life of the people. This means lighting, cooking, heating and small power uses in homes, schools and hospitals; also in lighting the town streets and pumping the water supply. Next in usefulness comes lighting and small power uses in shops, offices and factories and the movement of street cars and railroad trains. These are the things supplied by our Public Utilities. Energy uses which are important, but rank lower in the scale of human needs, are those which move the machines in factories. The lowest grade of all, is the energy consumed in the grinding of wood pulp and in electric furnaces for metallurgical and chemical purposes—the smelting of aluminum, the making of carbide, carborundum, ferro-alloys and fertilizers. The volume of electric energy needed for electro-chemical uses is vast compared to the vital, delicate needs of community life. It takes 320,000 horsepower for the great Rjukan fertilizer plant of the Norsk Hydro Electric company; while one-quarter that amount will serve adequately the intimate needs of the 260,000 people of the city of Oslo.

Norway, since the population is small, must use much of its water power for manufacturing purposes. And where the power is easy of development and therefore cheap, it will be used for the things in which the power cost of the finished product is a large percentage of the sale price. Obviously, in a land of forests the grinding of pulp and the making of paper are important. Greenland, not far away, has cryolite mines, so we find aluminum one of the products of the west coast high-head fiord plants. Other products of this fiord power group are carbide, ferro-silicon and zinc. The city of Bergen has its light, power and heat uses from this group. The undeveloped power of Norway is estimated to be many times the developed power. Suggestions of transmission of energy to Central Europe have been made, but Berlin is 500 miles away with a salt-water gap in the Skaggerack.

IT will be illuminating as illustrating two types of Norwegian developments to describe the great Rjukan plant and the Solbergfoss development of the city of Oslo. These two plants represent: in the former high-head with relatively small volume of water, cheap development cost and electro-chemical uses; and in the latter low-head with large volume of flow, and high development costs with community uses.

From the point of view of travel in beautiful country, through river valleys to mountain lakes away from tourist lanes, following the trail of water power proved delightful. From Oslo the trip to Rjukan is roundabout by rail westerly through interesting country and historic towns to Tinnoset at the foot of Lake Tinn. This lake is deep-set in tragic hills. It is 624 feet above the sea; 20 miles long; and forms a reservoir for important water powers down the Tinns river as it flows towards the sea. The steamboat trip was memorable. From

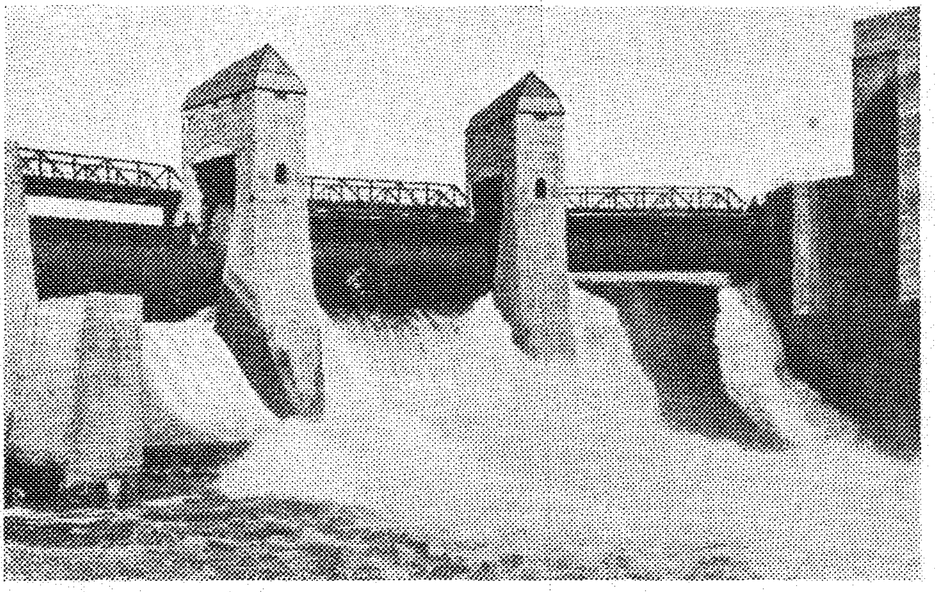


RJUKANFOSS, OR WATERFALL

FIGURE 1: Power has been developed by creating the Mosvand reservoir, a lake 22 miles in surface area, formed by the building of a concrete spillway dam across a narrow rocky valley.

the highlands innumerable gleaming cascades plunged toward the lake demonstrating the water wealth of the region. It was mid-August and the air was crisp, the sky blue and the sunshine warm. From near the head of the fiord-like lake it was a short rail trip up a valley to the factory town of Saaheim on the River Maane.

Here products are derived from atmospheric nitrogen; nitric acid, nitrate of soda, but chiefly nitrate of lime to be used as a fertilizer. These are shipped by rail and rail-ferry to a sea port 87 miles to the southward to be transported to the nations of the world.



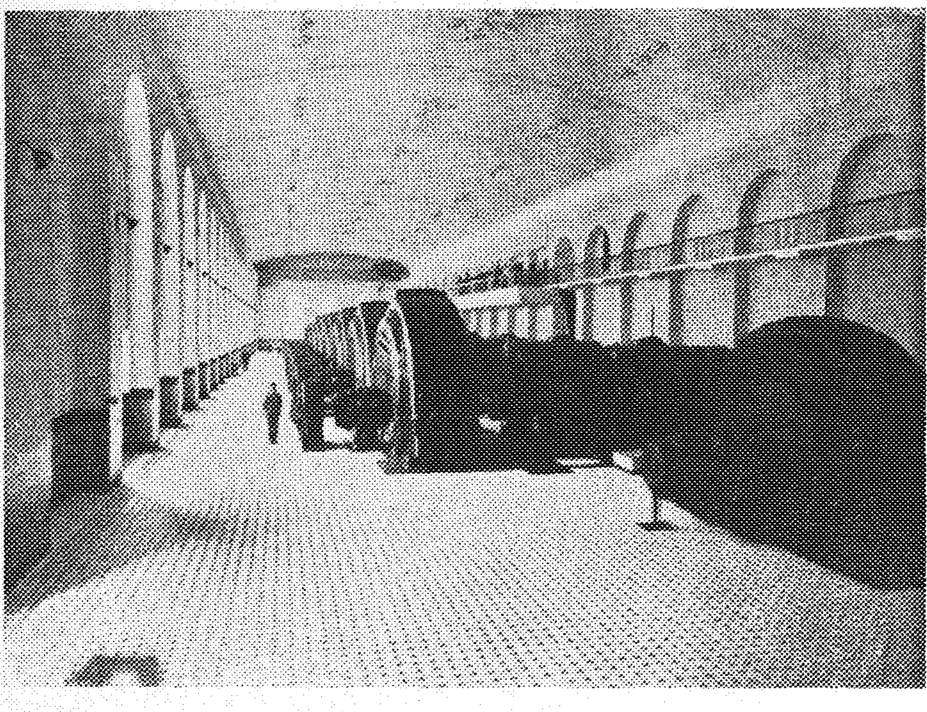
SPILLWAY WITH ROLLER GATES

Figure 4: These gates, 65 feet long and about 30 feet in diameter, are electrically operated and one is electrically heated. They represent excellent modern European initiative and practice.

A WATER power development involves three elements: first, a reservoir on the high-level end to store water in times of plentiful supply so that water use may be uniform throughout the year; second, conduits to lead the stored water from the reservoir to the penstocks where the water descends to the wheels; and third, the power house, where the wheels actuate the generators and create electric energy.

Ample storage is peculiarly needed in the Norwegian mountains, because there is little run-off from the watershed in mid-winter and the precipitation is snow. The Mosvand reservoir of the Rjukan development is a lake 22 miles in surface area, created by the building of a concrete spillway dam across a narrow rocky valley. This reservoir when full is nearly 3,000 feet above the sea. As the impounded water is used, the level drops about 50 feet. The water capacity is 30,000 million cubic feet. On this reservoir the ice forms to a depth of nearly five feet. In the watershed tributary to Mosvand the annual precipitation is normally about 59 inches—more than twice that of Minnesota. And the natural outflow varies from 14,000 cubic second feet in flood time to 440 cubic feet in April while the winter embargo still lasts. The normal flow is 1,700 cubic feet and the wheel installations require about 2,000 feet. See Figure 1.

From the reservoir the water passes in egg-shaped unlined tunnels carved out of the solid granite of the mountain. The area is over 400 square feet, with tunnel-full velocities of about five feet per second. The tunnel lengths aggregate about 10 miles. From the terminal gate house of the upper level main tunnel, the water descends in steel penstocks to power house No. 1; and from the wheels of this power house it passes into the lower level tunnel leading to No. 2 at Saaheim—then into the Maane river and to Lake Sinn. The undeveloped fall from the last plant to the lake is about 300 feet. See Figure 2.



INTERIOR OF SAAHEIM POWER STATION

Figure 2: The water for this typical Norwegian power station passes through another power station situated higher on the mountain, before it is utilized in this plant.

The total fall between the reservoir normal and the lake is over 2,300 feet—with a normal power use of 1,700 cubic feet per second. The utilized head in the two big stations is for No. 1, 970 feet; and for No. 2, 850 feet. Each power house is equipped with 10 wheels rated at 15,000 horsepower each. Originally these were Pelton wheels. Recently a single experimental Francis turbine has been installed in power house No. 1 under a head of 970 feet. This represents American practice. The energy developed exceeds 300,000 horsepower.

THE Rjukan development is an example of low unit cost power. It was largely built before the war. My information is that it did not cost more than $25 per horsepower; and that power may be sold for $5 a horsepower year. Post-war costs for additional power will doubtless be twice these figures. The city of Oslo pays $54,000 a year for the right to draw on Rjukan energy to the extent of 20,000 kilowatts in case of need. This is standby service and has been invoked only twice in six years. The region about Rjukan is rich in undeveloped power; and the same water that vitalizes the plants already sketched—and additional water tributary to Lake Sinn, serve for low-head plants following down the out-

(Continued on page 184)

Aluminum—A Growing Industry

Aircraft parts, typewriter frames, railway cars, radio towers, and paint colorings are a few of the things made with this metal

By CYRIL S. TAYLOR, C '13
Physical Chemist, Research Bureau, Aluminum Company of America.

THE aluminum industry is still a young man's industry. Barely 40 years have passed since Charles M. Hall, a youth of 23, just out of Oberlin College discovered the present electrolytic process of producing aluminum. In Europe Paul Heroult, another young man just the age of Hall, almost simultaneously made the same discovery. In fact it is only about 100 years since Oersted, the Danish physicist and chemist, first isolated aluminum. It is a "young" metal as compared with iron, copper, tin and lead, but it is rapidly growing up, and many young men are finding an absorbing career in being identified with this growing industry.

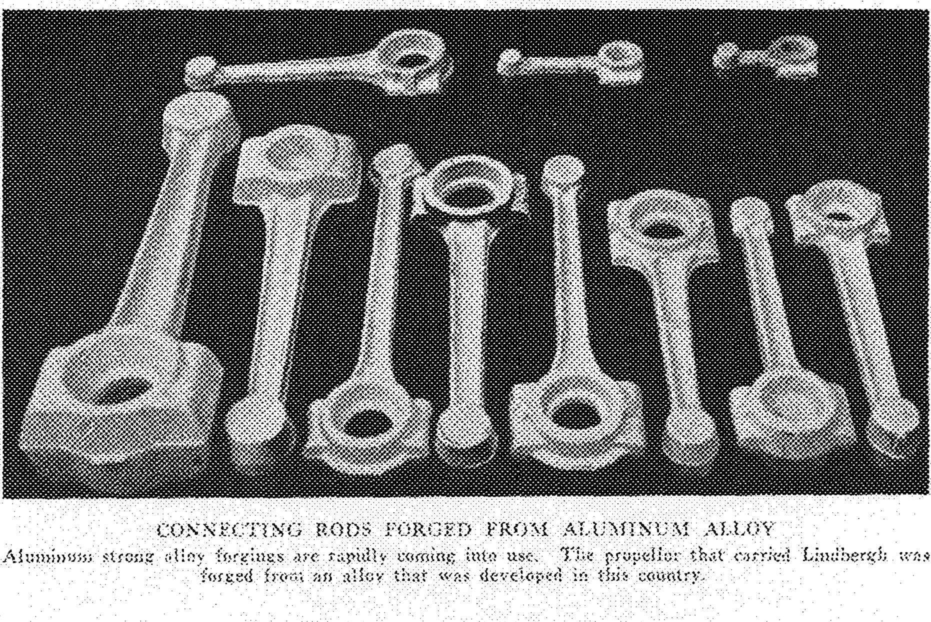
In the modern plant aluminum is still manufactured by the Hall process. Direct current is passed through a molten bath of cryolite in which alumina (Al_2O_3) is dissolved. The current is introduced into the molten electrolyte, which is contained in a large carbon lined steel tank, by means of carbon anodes which extend part way into the fused mass and which are suspended by copper rods from bus bars over the cells. An engineer upon seeing an aluminum cell for the first time remarked that it would make a good bath tub for an elephant. The current passes from the carbon anodes through the electrolyte and to the carbon lining which serves as the cathode. The metallic aluminum is deposited on the carbon lining in a molten condition and collects in a layer on the bottom of the carbon lined tank. This molten metal is tapped out at regular intervals. From time to time more alumina is dissolved in the electrolyte to replace that which has been reduced to the metal by electrolysis.

The procedure sounds very simple, but the successful operation of an aluminum "pot-room" to produce commercial aluminum involves many factors. Very elaborate technical control must be maintained throughout the entire plant. Good metal requires pure raw products, as almost any impurity which is added to an aluminum cell appears in the metal. The secret of producing pure aluminum is to use only pure raw materials. Bauxite, the mineral source of alumina, cannot be added directly to the cell, but must first be purified. This is so carefully done that the aluminum oxide which is finally added to the cell is almost 100 per cent pure. As the electrolysis proceeds oxygen is given off at the anode and attacks the carbon electrode. Theoretically about two-thirds of a pound of carbon should be consumed per pound of metal produced, but in practice the consumption is higher, and the traditional plant figure is one pound of carbon for one pound of aluminum. The power requirements of an aluminum plant are enormous. Published figures show that it requires about 12 kilowatt hours to produce one pound of aluminum.

A recent achievement has been the commercial production of very pure aluminum by a novel process, known as the Hoopes electrolytic refining process. While it is very difficult to produce by the Hall process aluminum having a purity as high as 99.7 per cent, the Hoopes process has made available for the first time since the inception of the industry, aluminum having a purity as high as 99.98 per cent. This material differs materially in its properties from aluminum of substantially lower purity. It is characterized by exceptional ductility and softness, and is markedly more resistant to the ordinary types of corrosion. This metal is proving to be very valuable for many special purposes.

Although the aluminum industry is a relatively new one, the amount of metal produced from year to year has been increasing rapidly. In recent years the tonnage of aluminum produced has exceeded that of tin, and at the present time aluminum stands fourth in rank among the non-ferrous metals, being preceded by copper, lead and zinc. It is estimated that the world production of aluminum in the year 1926 was approximately 213,500 metric tons of which the United States produced 91,000 tons and Canada 18,000. New plants or additions to plants for the production of aluminum are being built in Scotland, Norway, France, Spain and Italy. On the North American continent a large plant is being built at Arvida which is on the Saguenay river in the Province of Quebec, Canada. It will have available when entirely completed, nearly one million horsepower.

THE consumption of aluminum may increase by serving new purposes or it may replace some other material which has heretofore been used. One of the outstanding characteristics of aluminum is its lightness or low density. It shows remarkable resistance to atmospheric corrosion. Aluminum is an excellent conductor of heat and electricity. One very useful fact in connection with aluminum is that its compounds are colorless and are not harmful to the human organism. Thus aluminum utensils and apparatus are especially suitable for the preparation and packing of foods and beverages. In this connection it may be interesting to note that aluminum cans are being tried out in Germany for canning fruit. Aluminum equipment is being used more and more in the preparation of products which are graded on the basis of color, such as paper, rubber, rayon, petroleum products, dyes, alcohol, etc. Another important fact is that



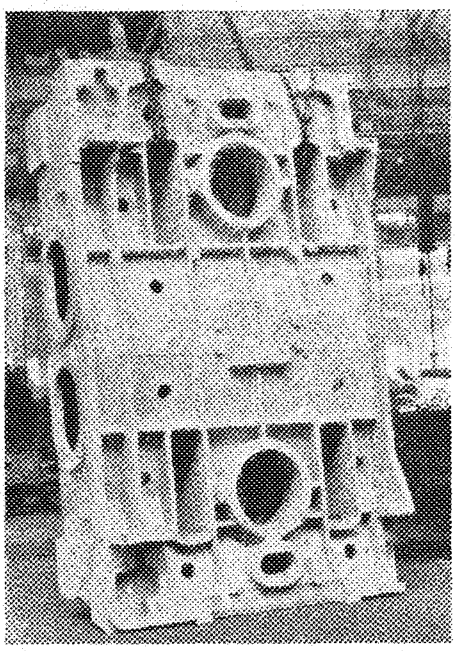
CONNECTING RODS FORGED FROM ALUMINUM ALLOY
Aluminum strong alloy forgings are rapidly coming into use. The propeller that carried Lindbergh was forged from an alloy that was developed in this country.

by adding small amounts of alloying materials to pure aluminum, various useful alloys are obtained. One group of alloys is amenable to heat treatment and while retaining the lightness of aluminum, has tensile properties comparable with those of mild steel. With such valuable characteristics, aluminum has been able to rapidly forge ahead and take an important position among the non-ferrous metals.

Aluminum is easily fabricated and commercially pure aluminum as well as certain of the alloys can be made into many forms such as sheet, plate, foil, bar, rod, wire, seamless tubing and pipe, rolled and extruded moldings and shapes, rivets, stampings, etc. A large amount of aluminum sheet is drawn, stamped and spun into aluminum cooking utensils. Aluminum can be welded with the oxy-hydrogen flame, and many forms of special apparatus for the chemical and food industries are made up by shaping sheet, plate or tubing into the desired form and assembling the combination by welding and riveting. Aluminum seamless tubing among other uses is extensively employed as electrical conduit. Aluminum foil is largely used in wrapping candies and confections, gums, tobacco and cigars, and for the construction of electrical condensers. Recently a metal trade journal stated that since the advent of aluminum foil, tin foil had entirely disappeared from the continental market.

A FAIRLY recent development in the aluminum industry has been the invention of the "strong aluminum" alloys. Some of these alloys, although they have the strength of mild steel, are only about one-third as heavy as steel. They have been produced in the form of sheets, forgings, structural shapes, stampings, bar, rod and tubing, as well as castings. This material is especially useful where the combination of lightness and high strength is essential. Aluminum alloy wheels are being used on buses in England, and aluminum alloy rear axle housings are getting to be standard on British motor cars. Aluminum strong alloy forgings are rapidly coming into use. Some examples are automobile connecting rods, aircraft propellers, airplane engine crank cases, etc. The propeller that carried the intrepid Lindbergh across the Atlantic and from one end of the country to the other was forged from a strong aluminum alloy developed in this country. In the United States strong alloy forgings are being used for locomotive connecting rods and other reciprocating parts. It is expected that forgings will be used more and more for reciprocating parts.

Aluminum castings are, practically without exception, aluminum alloy castings; the alloying elements are added to improve the mechanical properties and the casting characteristics of the metal. There are three general types of casting processes in commercial use at the present time: sand casting, permanent and semi-permanent mold casting and die casting. In sand casting the metal is poured into a mold formed from molding sand. In permanent mold casting the metal is poured into an iron mold. In the permanent mold method the cores are also of iron while in the semi-permanent method the cores are made of sand. In die-casting the metal is forced into a steel mold under high pressure. Each of these processes has a certain definite field of application. When only a limited number of castings are desired or the castings are large the sand casting process is employed. Metal molds allow closer tolerances and produce better surfaces. The die-casting process is especially suited for castings having thin sections, and castings requiring great precision such as fire alarm boxes, carbureters, meter cases, typewriter frames, small automobile fixtures, vacuum sweeper fittings, washing machine fittings, etc. The permanent mold process is used extensively in the manufacture of pistons for automobiles.



DIESEL ENGINE BASE

This is the largest complicated cored casting ever poured in aluminum alloy.

One of the common sand casting alloys contains about eight per cent copper. Alloys with 5 to 12 per cent silicon are a fairly recent development but are finding wide use in the casting industry. The sand casting process is used in the manufacture of automobile crank cases, oil pans, motor housings, vacuum sweeper parts, washing machine parts, etc. Aluminum alloy castings are in extensive use in places where a minimum of weight is essential, such as in motors and aircraft, automobiles, buses, small boats, etc. So far as known the largest complicated cored casting which has ever been poured in the light alloys was a Diesel engine base weighing 3,800 pounds made in the United States for installation on a yacht.

THE use of aluminum has grown very rapidly in the last few years, especially in the transportation industry—railway, street car and bus. One railroad alone has over 200 suburban-type cars in operation in which aluminum was used to a great extent in fittings and body construction. It has been estimated that approximately a $26,000 annual saving in electrical energy alone would be realized in operating these 200 lighter weight cars. There is also an estimated addition saving of $19,000 per year in lessened depreciation of road-bed and track. The greater cost of aluminum over steel is in a considerable measure offset by the decrease in the cost of the motors or regular locomotives required for a given size of train. One of the largest railroads in the country has some passenger coaches in operation in which practically no metal except aluminum was used above the sill frame work. A street car in which aluminum and aluminum alloy were extensively used, was tested during 1926 by the Cleveland street railway system in cooperation with the Brill company. The finished car weighed approximately 30,000 pounds in contrast with the usual 43,000 pounds and the power consumption is about 78 per cent of that usual for steel cars. The car has been operated for over 30,000 miles on a busy line in Cleveland.

The automobile offers a large field for the use of aluminum. In this respect Europe is far ahead of America. It has been estimated that if American automobile manufacturers used as much aluminum per car as European manufacturers do, the automobile industry alone would consume more than the present world's production of aluminum. However, there is a gradual increase in the use of aluminum in American automobiles. Crank cases, pistons, connecting rods, fittings and in some cases bodies are being made of aluminum. The use of aluminum pistons is rapidly increasing. It is claimed that the advantage of aluminum for pistons lies not only in its lightness but also in its greater heat conductivity. This permits higher compression ratios and increased power.

Aluminum as a light metal should be and is preeminent in the aircraft construction field. Almost the entire machine can be made of this metal. Certain European countries are abandoning

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"Kichimookoman"

Surveying in the wilds of Northern Canada

By LOUIS H. POWELL, '24

Mr. Powell, who is now a graduate student in the department of geology, walked over 500 miles through northern Europe in 1924. Returning to America he became a newspaper reporter in Philadelphia. Last summer he was assistant geologist on one of the far North reconnaissance parties of the Canadian Geological survey.

FREIGHTING IN NORTHERN CANADA

Island Lake Indian starting a three-quarter mile portage over muskeg and granite ridge carrying two trunks and a hundred pound sack of flour. All supplies which reach Island Lake must be carried over 34 portages in this manner. Indian freighters literally kill themselves carrying loads of 400 pounds over portages which make them gasp for breath and sometimes spit blood.

AFTER three rollicking years as a reporter it was almost fitting that my first real engineering experience should come as a "Bawl and Compass" surveyor in the wilds of Northern Canada. If it were possible to write a burlesque of all of the methods of traversing taught beginning surveying classes, the skit would probably include many of the methods employed in reconnaissance work on the Canadian Geological survey.

Given this problem: a 100 yard portage matted with deadfalls and brush and averaging some hundred odd mosquitoes per cubic foot, a staff compass, and a halfbreed rodman, what is the most efficient method of extending a traverse across the portage?

The answer of the geologist is: set up the compass on one end of the portage and send the rodman to the other. Have him shout as loud as possible. Take a bearing on the sound of his voice. For accuracy set up on the other end of the portage after pacing across and repeat the procedure. You are then a "Bawl and Compass" surveyor. And the method is accurate—if the traverse is to be plotted at the scale of four miles to the inch.

Hundreds of miles through the Devil's jackstraws, a ragged mantle of burned timber covering bare bleached granite like a tattered mantle, the seven members of our party had pushed into the "hinterland" which lies North and East of Lake Winnipeg toward Hudson Bay. Our task was to explore Island Lake, a fantastic labyrinth of over 3,400 islands and to extend a traverse beyond into the unknown.

On the latter task we followed an Indian map sketched by Jonah Harper, a full blooded Cree, on 11 sheets of scratch paper. He complained when he was through that we had not supplied him with sufficient paper to make a finished map. He sketched about 75 miles of tortuous canoe route from memory. The map ran in a straight line across the sheets. He was overjoyed when he found he was to receive a slab and a half of fat salt pork for his week's labor.

The instruments I used on our rapid survey were a Rochon micrometer and a staff compass. The micrometer is a telescope in which a calcite prism has been inserted. Thus the image is split and you see everything in duplicate. A target is carried ahead in the rod canoe. It has two bull's eyes spaced exactly six feet apart. When you look through the micrometer you see four bull's-eyes. You then slide the calcite prism along the tube until the two middle images are superimposed. There is a scale on the side of the tube to indicate the position of the calcite prism. Each position of the prism corresponds to a certain distance between the instrument and the target. The distance is determined from a curve which is plotted for the particular micrometer.

THE Rochon micrometer is a British marine surveying instrument which has been adapted for rapid reconnaissance surveys by the Canadian Geological survey. It has a range from about a hundred feet to 4,000 feet and an accuracy well within the limits of the type of surveying. With an ordinary staff compass a set-up can be made in almost any location and the reading is only a matter of a few minutes. The instruments are light enough so that difficult landings from a canoe can readily be made.

The halfbreed rodman took keen delight in giving me stations which were submerged so that I had to stand in the cold water and in forcing me to set up on cliffs which were so precipitous that I had to sit or kneel on the rock to prevent falling into the lake. In making our way up some of the shallow meandering streams all of the stations were on the muskeg banks to avoid clearing the bushes. Any change in my position would throw the compass to a rakish angle. I backsighted on peeled pickets to eliminate some error.

Often the going was so bad that we took to the bush. There a 200 foot piece of side line from a fish net knotted in fifty foot lengths served as a chain. The head rodman would traverse ahead sighting on some tree and a man standing in the middle of the chain would see that it was straight. I acted as rear rodman and took compass bearings along the cord. We usually travelled at a dog trot through the bush.

The reason for the makeshift methods of surveying was the speed required. We ran about 60 miles of unchecked line from a known location and established a bench mark at the end of our line. It will be picked up some other summer from the North. We made sketch maps of three small unknown lakes by tieing back and forth across them, and ran a shoreline traverse around a lake 35 miles long which had never before been charted. All of our traverses will be checked against airplane maps and will be plotted at a scale of four miles to the inch.

ISLAND Lake has been on the maps of Canada for over 50 years. In 1870 a boat log survey was run by canoe around the shore of the lake. The difficulties reported by that first pioneer were sufficient to force the abandonment of plans for the exploration of the labyrinth of islands on three different occasions. In 1925 R. C. MacDonald of the Canadian Geological survey ran a control survey around the lake establishing bench marks. Even that experienced control line surveyor missed the actual shore of the lake more than once and ran a traverse along a chain of islands. His traverse was used to reduce an airplane map of the lake to scale. With that airplane map we had no difficulty in navigating across the lake in any direction.

The Hudson's Bay company has long had a post at Island Lake. The catch of furs in the district amounts to around 50,000 dollars annually. For years the God's Lake Indians from the North sweated beneath pitch soaked shirts as they bodily lifted the enormous 30 foot open York boats over portage after portage down the Island Lake river. They dragged those crafts, resembling the Viking skiffs, fully loaded over one three mile swamp leading out of God's Lake into the Island Lake river. It was the hardships of that route which are believed to have been directly responsible for the practical extinction of the God's Lake Indians, famous at the time as the best packers in the North.

We had to pack all of our supplies over 34 portages before we reached Island Lake. Two of those portages were each over a mile and a half in length and wound over high granite ridges and through muskeg. We portaged our canoes and packs through the muskegs on a path lined with small poles. A misplaced foot meant a plunge into the bog to the knee or waist. Often we had to step along gingerly trusting that the poles would be where we placed our feet, as they were completely buried in the slime. Those two long portages were flanked by two three-quarter mile portages which were swampy throughout almost their entire length. The portages were reached by about 25 miles of narrow, shallow, meandering stream where a canoe can scarcely turn. During shallow water one wades and drags the canoe behind in that stream.

THE Indians call that combination the Ponask or "turning spit." The only allusion can be to the way one is tortured in traversing those portages on a

FATHER JOSEPH DUBEAU
Pioneer Roman Catholic missionary in Northern Canada. He directs the work at the St. Theressa mission at Island Lake. He is standing at the shore of the mission clearing.

hot day. The tump line draws your head down so that you gasp for breath. Your neck aches with the unaccustomed load. You gasp for breath, stumble, sweat, curse mosquitoes and black flies, and at the resting points sink back exhausted and let your pack roll to the ground. Indians who are not accustomed to that route often turn back there leaving their loads of freight in a cache for hardier packers to carry.

THE Island Lake Indians freight over the route all summer and carry enormous loads. On one three-quarter mile portage which was poorly cut out and had deadfalls to climb over and muskeg to wade, I saw an Indian carry four 50 pound boxes of sugar and two 100 pound sacks of flour. His knees could hardly hold him. Although that man was probably showing off his strength in the presence of white men, the Indians are expected to pack 200 pounds regularly. The clumsiest load I saw an Indian carry was a large steamer trunk surmounted by a 100 pound sack of flour and that in turn topped by a smaller trunk as a head load. Another Indian packed in an organ for a mission at Island Lake.

Starting a two-day traverse one morning I was hailed in Cree by a one-eyed Indian standing on shore. I swung in but as he continued to talk Cree I paddled on. An hour later I was overtaken by the same Indian. His little son was rowing the canoe as is customary in Northern Canada and the father loomed large in the stern steering with a paddle.

He gravely shook hands with the "Kichimookoman" (literally "man with a long knife," but the ancient title used by the Cree to describe an American). Then he reached into his shirt and pulled out a piece of iron stained quartz.

"Not much good," I commented.

"Namaskootch" the Cree word for wonderful was what he thought I said. He beamed delight and immediately produced several more samples. At last he carefully undid a small bit of rag in the ends of which he had knotted several small pyrite crystals. They were of course worthless. He talked in Cree and I replied in English. Neither understood. After he had sketched a portion of the lake in my notebook to locate his finds I thanked him, shook hands, waved, and at last he left.

To all those who venture into the North the mosquitoes and black flies are a constant and very genuine source of torture. Our first day at Norway House, the Hudson's Bay post at the North end of Lake Winnipeg, we met some grizzled old prospectors who had their grubstake and were going into the bush for the summer. The conversation ran from one subject to another but always swung back to mosquitoes. One man remarked that on the Yukon the "flies" were so thick that if one thrust his hand outside the tent and drew it in quickly you could see the hole which was left.

Another recalled a famous naturalist's criterion for the density of mosquitoes in any particular place. He is said to have "clocked" the number of mosquitoes which lit on his left hand in 10 seconds. A Hudson's Bay factor had listened to the conversation for some time. At last he drawled "Well, sir, if the mosquitoes at Oxford House in July were to get any thicker they'd have to be smaller mosquitoes."

A godsend to the traveller is a supply of the kind of fly spray used by grocers for killing flies. If it is sprayed in the tent at night it immediately kills all of the mosquitoes and insures at least comfort at night.

There are even curfew laws among the Indians. The chief of the Island Lake Indians had ruled that all of the squaws must leave the dances at dusk. At one dance which I witnessed the men bodily threw three women out the door at sundown when they persisted in staying. The dance went on with even more gusto than before. A portable organ and a violin supplied the music for the square dances. They were "called" in a good Scotch brogue by an Indian who did not understand English, but who had memorized the words. Moccasined feet tapped softly on the plank floor of a candle lit log hut. Small boys watched intently from the low doorway or jigged in the corners.

The Indians take their religion seriously. Every night on the road they hold prayer meeting. It is stirring to hear their musical voices in familiar songs like the doxology which have been translated into Cree.

I attended a morning service in a log house at Island Lake. An impression of dirt, squalor, and a strong odor of fish met me as I entered the doorway and was precipitated into a riot of colored shawls, head coverings, and skirts. About thirty squaws were sitting on the floor and in the intervening depressions were babies, squawling children, young Tom Sawyers and be-ribboned and braided girls. A second glance showed a dozen men on benches in one corner.

A MOMENT'S time disclosed the tawdriness of the colors and the true squalor of the scene. One head cloth had a vivid picture of a bucking horse and a title, "The Round Up." They were such things as one finds at concession stands at a county fair. Long skirts of bright yellow, red, and sedate blue were worn below loose, baggy, dirty bodices grimed by tiny pawing hands.

The songs in Cree were accompanied by the wife of the missionary on a portable organ which wheezed as she pumped the pedals and flatted and "missed fire" badly. The sermon was interpreted a sentence at a time by Jim McIvor, one of our halfbreed guides.

THE start of the sermon was evidently the signal for feeding time. The children began to cry lustily, and those not laced tightly on boards tugged at their mothers' dresses. Promptly a third of the women in the room began to nurse their papooses. One husky boy was a repeater. He cried so lustily after his mother had nursed him that she handed him to a nearby woman who followed suit.

"Stand Up, Stand Up for Jesus," by the wild choir ended the service. No one moved for about five minutes. At last one woman arose and dragged three unwilling youths to shake hands with the missionary. They were Peter, Thomas, and Zacharias. Truly frightened they pushed pudgy hands over the table which served as a pulpit. Other squaws followed and babies were once more tied to their boards with buckskin thongs and swung onto the backs of their mothers or sisters.

Practically all of the Indians at Island Lake have good Scotch names. It gives one a start at first to meet a big dusky skinned man named Angus McPherson. In the early days of the fur trading the traders used to give Scotch names to the Indians for convenience to replace their difficult Indian names. Most of the Hudson's Bay company men were Scotch.

The Icelandic fisherman who was hired as cook for our party turned out to be a first class mechanic. As a cook he was hopeless. He put cinnamon in the coffee to make it strong. He would not boil coffee, but boiled the tea instead. He even put mustard in the macaroni instead of cheese. We forgave him his cooking, however, when he spliced a broken timer spring on our outboard motor during a rainstorm. He used a piece of a copper pail for a splice, two spark plug tips for rivets, a file as a punch, a granite rock as a bench and a two-pound geology hammer to rivet with. He made a spring out of an elastic band which worked neatly and he saved us over a hundred miles of stiff paddling.

Even then we would have run short of rations if we had not chanced to kill our first moose. About three minutes after discovering that our two rifles had been accidentally left behind at the last portage, we saw a moose swimming toward an Island. "Mooso! mooso!" exclaimed one of the Indian guides. In a moment an Indian from my canoe transferred to a canoe carrying two other Indians and

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Professor Springer Improves Loudspeaker

Acting head of the electrical department says university of future will be changed by inventions of present

By WILLIAM C. HILL, C '30
Associate Editor of the Minnesota Techno-Log.

EVERYBODY in the electrical department of the Engineering College of the University of Minnesota sooner or later knows Professor Franklin W. Springer. A jovial man is Professor Springer, now acting head of the electrical department.

This is a story not about the man, but about one of his many hobbies.

Professor Springer has developed a loudspeaker mounting producing a true tone. If this is possible, just let us suppose that we let slip a few decades of years and take a peek at the future. Professor Springer's development has been commercialized, and put into general use.

It is the main lecture hall of a university in the year 2000. Fifty thousand students sit in a vast pit-like building and hold in their hands note books with electric styluses with which to write. There is a sudden whir as of a thousand humming birds. All chatter stops. A gong's deep, mellow tone breaks the silence. All pencils are held poised. A light flashes on the great silver screen before each gallery. Then a voice that seems to come from everywhere in this vast hall, announces, "This lecture is number six of a series of lectures on the 'Growth of Integral Calculus from the incomprehensible subject of 1928 to what it means today—the sum total knowledge of all matter.'" The pencils immediately start to write—not a sound is heard.

"The speaker this morning will be the mighty educator, Esiog G. Hopig, of Bradiocalopolis. Please pay attention to what he has to say as there will be an examination to be handed in next time. Remember that all examinations must be written in the presence of an upperclassman. If anyone knows the whereabouts of the occupyer of seat 5690—J, Section 8, Gallery G, please slip a note into the box at the end of the aisle. His tele-photograph has failed to appear for three consecutive lectures."

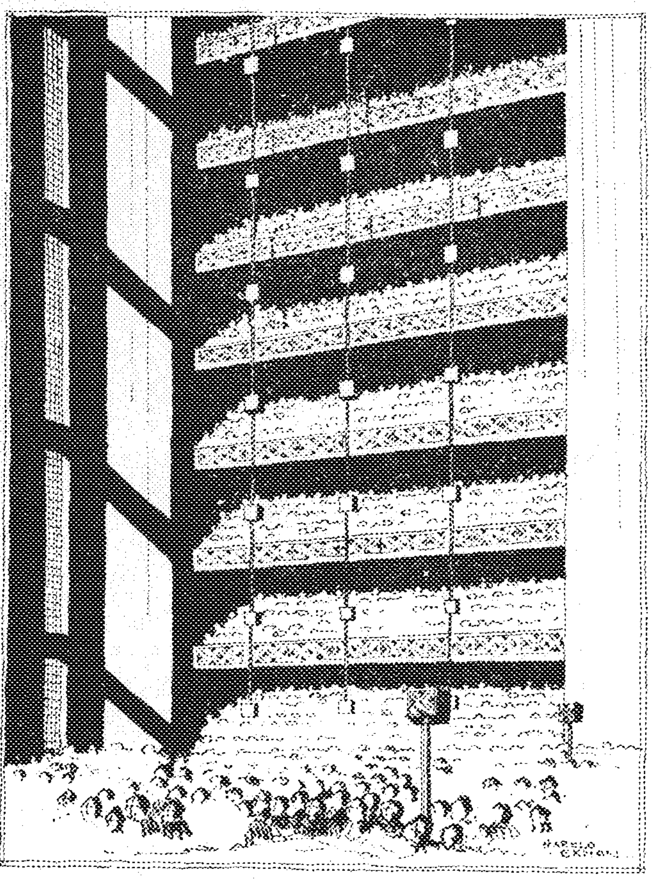
The vast hall is silent. Sunlight streams down through the tall narrow windows to cut swaths of gold across the spacious floor. The white, vertical walls rising from the floor seem to vanish in the immense height over head. Tier upon tier of galleries seething with students line the sides of this chamber, and the multicolored dress of more students cover the bottom of this pit.

The light of the screen flickers, and the form of a man can be plainly seen. He is pacing up and down a platform and seems very agitated.

The lecture begins, his voice filling the entire auditorium. There seems to be no particular place from which the voice comes, and there is no rasp. It seems as though the man must be in the room, and yet he is actually thousands of miles away in his own lecture hall.

Several black boxes suspended by cables are just above each section of seats in each gallery. The main floor has more of them on posts about ten feet above the floor and spaced evenly about. These black boxes bear no sign—there are no lights in them—they seem to be of no particular use. Of a varied size these boxes are covered on two sides with cloth, and by wood on the other four. The nearer to one of these boxes one gets the clearer and louder the voice becomes. This must be the source of the voice of the lecturer in that classroom. It is the loudspeaker.

Thus can one see a university class of the future. Enormous, no staff of lecturers, no attendants. Yet a class where the foremost knowledge of the world is daily brought to students by the most eminent authorities.



—it is the main classroom of Minnesota in the year 2000 . . . Fifty thousand students sit in a pit-like building; a telephoto lecturer appears on each gallery screen and lectures by loudspeaker!

JUST suppose that there had been a man of enough vision back in 1900 to publicly proclaim that all this was a positive possibility. Immediately there would have arose a pitying laugh, and the man would probably have been lodged in a padded cell.

Now all this is probable. It may happen in the near future—say fifty years. Professor Springer foresees immense lecture classes without a visible instructor, or monitor. There will be courses where only notes will be taken and a comprehensive examination given at the end of the course. This will need better loudspeakers than we have today, and a more perfected system of television, but it will come.

Already there have been conversations between New York and London. On February 16, 1928, a joint meeting of two electrical engineering societies, A. I. E. E. and I. E. E., in New York and London conducted a joint session wherein a motion offered by General Carty of the American Telephone and Telegraph company in New York was seconded by Sir Oliver Lodge in London and put to vote by President Page of the English Institute of Electrical Engineers. The vote was unanimous and heard by both audiences, each on its own side of the Atlantic Ocean.

"We all know," says Professor Springer, "that sound is much more perfect at its source than a few feet away. That has been frequently noticed when we have to move to the rear of the lecture or banquet hall and listen to the same speaker. In

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Beware of the Cadillac Chassis!

LAST week a student of the engineering college walked into the TECHNO-LOG office, and held up a hand. One finger was covered with many bandages, and it was set in splints.

"How did you get it?" we queried, and forthwith came a tale which is somewhat queer considering that this is an engineering institution, but nevertheless a tale that is highly revealing of the considerable embarrassment, not to say actual injury that has concurred upon several engineering students as a result of the Cadillac chassis in the corridor of the main engineering building.

The cut away chassis is fenced around with an iron railing, and a sign says, "Do not touch." But who could expect an engineer to obey such a ruling? It is inborn in an engineer to fondle, and try everything that is of a mechanical nature. So some students have tried to test the clearance of the pistons and the cylinder heads by placing their fingers in between, and then stepping on the starter. They discovered that there was but about an eighth of an inch clearance, and then upon making this discovery they adjourned their experiment to the health service.

Various students have bent far over the railing surrounding the model, only to place their pointing digits in the wrong place at the wrong time.

They have been catching their fingers in the most inconceivable parts of the motor, ripping off fingernails, breaking finger bones, and incurring much loss of blood, temper, etc. Four or five cases have been called to our attention, and we believe that some steps should be taken to prevent further catastrophes. It is the opinion of some that the chassis is not in the proper place anyhow. We have heard that some instructors while passing it daily, greet it with a disdainful look as if to scare it away.

However, it is a wonderful addition to the equipment of the engineering college, and every student learns much from looking it over. Yet, either some action should be taken to properly safeguard the students from injury, or the chassis should be moved to the experimental building, out of reach of the coeds and other non-engineering students who are wont to poke inquisitive fingers into dangerous parts of an unknown mechanism.

Or a sign could be placed above the chassis reading, "Poke fingers about chassis at your own risk."

"Just a Minute"

IT is twenty minutes after the hour. A bell in an adjacent corridor rings loudly indicating that the class hour is over. Students gather books in preparation for departure to distant parts of the campus, but the voice of the instructor continues, "Just a moment, please," he says, "until I finish this derivation." Or, "Wait for the assignment, please." Then in a hurried voice, amid a shuffling of books and of feet and impatient glances at watches on the part of the students, the instructor adds a few words of some or of no importance to his lecture.

This occurrence happens many times a day on the campus. Are these last few words important? No one knows, for the instructor is too hurried to do them justice, and the students, in their hurry to go to their next classes, give little heed. The students are late to their next classes, the information is lost because, having once given it the instructor will not repeat it at the next session, and five or six minutes of the time of a class of perhaps fifty students is lost. This element of time seems trivial upon first thought, but when one realizes that this is nothing short of inefficiency, the bane of all engineering work, it takes on the aspect of a "black eye" to the engineering college.

New Ideas for Engineer's Day

ELECTIONS for Engineer's Day are over; the political situation has quieted down, and the arrangements for the day proceeding. Engineer's Day is a memorable day in the Engineer's life, and it deserves the work and cooperation of the whole student body in the carrying out of plans.

In making this the best Engineer's Day since its establishment years ago, it is our opinion that something original should be involved in the plans. For the past two or three years, and perhaps further back than that, the programs of St. Patrick Day celebrations have all been more or less the same, but we do not believe they should continue to be so. Engineers are possessed of as much if not more imagination than the average student, and the Engineer's Day is an opportunity for them to express this to the whole student body. Engineer's Day is an advertisement for the Engineering College.

It remains for the leaders of the Day to outline plans that are original, things that are different and striking, yet plans that do not destroy any of the "ould time" traditions of the Day. We believe that the chairman of the Day, Louis Schaller, is well qualified for the task placed on his shoulders, and that Donald Riddell, a true son of the "ould sod," as St. Patrick will go far in making the program successful. We look forward to one of the most interesting, biggest and best Engineer's Days of all time.

Ford versus Daily

THE *Minnesota Daily* recently involved itself in an editorial concerning the braking system of the Ford car, to which B. J. Robertson of the mechanical engineering department made a reply stating that the Ford braking system was not all wrong as one would be led to suspect after reading what the *Daily* had to say on this problem of engineering which is subject to legislation in some states. He listed seven other cars which use braking systems similar to that used on the Ford, and concluded his reply by stating, "Evidently a number of automobile manufacturers do not agree with some of our legislators."

To which we wish to add that editorials on engineering subjects written up by academic students who have no knowledge of the engineering principles involved may make fine reading for those who do not know, but that they are pitifully weak in presenting the arguments to engineers who are acquainted with the principles involved.

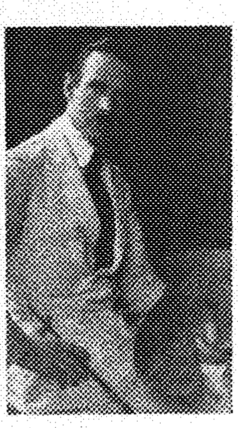
The problem of having people with non-technical training attempt to render decisions on problems of a technical nature is something that the engineering profession has to contend with all the time. It is peculiar how often people will disregard their lack of technical knowledge, and in order to save money, attempt some engineering problem without consulting an engineer thereby often bringing about disaster and loss of life much more expensive than the cost of engineering advice.

Brisbane's Engineering Editorials

HAVE you ever noticed how often those splendid editorials written by Arthur Brisbane, one of the most noted and forceful editorial writers of the day whose work appears every week in the *Sunday Tribune,* relate to engineering matters? He has dealt with the advance of inventions and their relation to engineering; with power and its usefulness to the people of the earth; with the tremendous buildings that now form part of our cities. His editorials and ideas are read by many people throughout the world, and they read them because he deals with matters that are close to their hearts, things that affect them as they are now.

To us this bears a significance. People now more than ever are tied up with the engineering profession. The engineer is being placed more before the public eye, and the prestige of the engineering profession is constantly increasing. It is the engineer who has provided so many of the modern luxuries and so plentifully blessed mankind. By his use of nature's forces; by his proper direction of forces that otherwise would be going to waste, the engineer has created power that now performs many duties otherwise done by human labor.

This is just the beginning—engineering is a growing profession, and we cannot see how anyone can say it is overcrowded. When it becomes a subject of editorial comment, it must be a live tonic.



Faculty Sketches

S. CHATWOOD BURTON

THE University of Minnesota is the treasure chest of men who are nationally known for having achieved mastery in their work. S. Chatwood Burton is a master among artists. He has achieved this position through the keen and earnest love for his work which is evidenced by the zeal with which he has enriched the world with many treasures of art.

As a young man, Prof. Burton first started teaching in a school which had been built and endowed by Queen Elizabeth at Chlitheroe, England. During the time he taught geometry, mathematics, and other subjects at this school, he pursued the study of art. While one of the professors was away from the art school one summer, Mr. Burton was given his position for the summer session. His work was so well performed that he was retained as an instructor after the return of the regular professor.

Shortly afterwards in competition with the best of five thousand art students, he won one of three scholarships offered. The scholarship entitled one to three years of study of art at any place. With such a royal prize, Mr. Burton went to France where he studied under the world famous Jean Paul Laurens at Paris; then to the Royal College of Arts in London where he was the pupil of Edward Lanteri, one of the foremost sculptors. The Royal College of Arts, being patronized by the Royalty, was the frequent host of famous men, statesmen, writers, artists. An hour spent with Sargent is one of the keenly treasured memories of Prof. Burton. After studying in London, Italy and Southern France were visited. During the time Prof. Burton had studied in Paris he had a studio with an American friend who invited him to visit him in America. This visit to America was made and shortly after his return to England he received an appointment at the University of Illinois at Urbana. After spending two years at Illinois, he was invited by Prof. F. M. Mann to come to the University of Minnesota.

After six years at Minnesota, Prof. Burton went to Europe and traveled through Spain and Northern Africa. As a result the world was enriched with more than three hundred drawings and etchings, a series of artistic works which have been exhibited throughout the United States and which have been highly praised. Many of Prof. Burton's etchings are permanent exhibitions in the great art galleries of this country.

Two years ago, with the first piece of sculpture undertaken for a period of twelve years, Prof. Burton won first prize at the Minneapolis Institute of Arts. Last summer a new field of art was opened in America when Minnesota's gifted artist traveled to New Mexico and made over fifty etchings of the Indians and of the cliff dwellings. This winter he enriched the University with a bust of Dr. Folwell.

The state is fortunate to have such a dominant factor in its art growth as Prof. Burton, a master of painting, sculpture, etching and drawing.

Foolish Specialization

"SPECIALIZATION while in school is FOOLISH," remarked one member of the faculty to us recently in a conversation, "it is very unlikely that a man specializing in a certain line of work will pursue that type of work following his graduation."

The faculty member continued by citing the case of a man who had taken up special work in some small part of engineering while he was a student at the university, and by special permission from the faculty dropped some of the otherwise required courses so that he might take this special type of work. Upon graduation, a splendid position in some other work presented itself to this man, and he accepted and never found use for the special studies he had made, although he did find that he had use for the courses which he had missed.

"This," concluded the faculty member, "was not the only case. There have been many, and many of these men have told me that they only wish they had taken their entire course as outlined. From this experience I recommend that every man take as general an engineering course within his own branch of the profession as is possible."

Seniors now realize this. Throughout their whole university life they no doubt have been thinking, "Shall I take up this type of work, or shall I study for this?" and seniors have tried to pick their courses on this basis.

This is an age of specialization, but it would be wise for the undergraduate to generalize. Four years is not enough in which to specialize; ask the seniors or alumni.

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

A. I. C. E. Chapter To Be Formed

Meeting of Chemical Engineering Students Conducted in Chemistry Auditorium on February 14th to Consider Organization of Student Branch at Minnesota.

DR. C. A. MANN, chief of the division of chemical engineering, spoke to the student body on the purposes of establishing a student section of the American Institute of Chemical Engineers here. He stated that Minnesota was selected by the American Institute of Chemical Engineers as one of the fourteen foremost universities of the country desirable for student chapters of the association.

The senior Institute is composed of about 350 of the country's foremost chemical engineers, and very high qualifications are necessary for admittance. Its object in establishing student chapters is to give the students the benefits of the association while they are still in school.

It aims to develop a professional spirit and interest in chemical engineering among the students. Since there is no orientation course for chemical engineers as there is for students in the Engineering college, the Association will do a great deal to fill that need. It will be a means for the students in all classes to become better acquainted, and will lessen the breach between freshmen and seniors in the college. It will also be a source of information through speeches given by prominent men who will be brought here by the section.

At the close of Dr. Mann's talk there was a large show of hands indicating the desire to establish a chapter. George Swenson, senior in the college, was elected temporary chairman, and the following were elected to represent their classes on the committee on Constitution and By-laws: graduate, K. Kobe; senior, R. Fawcett, and R. Gerlicher; junior, H. Rehfeld and W. McConnell; sophomore, C. MacMullen; freshman, J. Dickey. Dr. Montonna was elected Faculty advisor.

When the Constitution and By-laws are formulated, a petition for the student branch will be sent in to the Senior Organization.

Tech Commission Head Leaves School

Irvine G. Sinnott, senior mechanical and former president of the Technical Commission, will leave school at the end of the spring quarter to accept a position with the Pittsburgh Coal company as a combustion engineer at Pittsburgh. Only one quarter of school work separates Sinnott from a diploma.

His resignation as president of the Technical Commission has necessitated another election among the Commission for a new president. Carl Barthelemy was appointed to take Sinnott's place as a member, and Glendon Brown was elected to the position of president.

As temporary chairman of the A.I.C.E., George Swenson, chemist, has been made a member of the Technical Commission. Walter Hochthausen is filling the place on the commission that has been left vacant by Homer Tatham, who has left school.

> TRYOUTS
>
> *Students of the technical colleges who are interested in writing are urged to try out for the editorial staff of the* MINNESOTA TECHNO-LOG. *There are several positions open.*
>
> *Those interested are requested to come to office, Room 37 of the Electrical building. Positions on the business staff of the publication are also open.*

Experimental Lab Gets Airplane Motor

Representative parts of a Wright Whirlwind J-5 nine cylinder motor have just been received by the experimental engineering department and will be used for instruction in an aviation class by Professor Robertson. The engine is of the same type as that used by Colonel Lindbergh in his "Spirit of St. Louis."

$25 Prize Again Offered Imaginative Engineers

The C. Ralph Bennett prize of $25 for the best imaginative writing by a student in the College of Engineering will be again offered this spring.

Mr. C. Ralph Bennett, former instructor of English in the Engineering College, left this award when he went to teach English in the University of Cincinnati, Ohio. The length of the piece of writing is not specified. It may be prose, poetry, or a play, but it must be imaginative in theme and treatment.

Competition closes April 30 this year, the late date being set that better quality of writing may be turned in this year than was turned in last spring. All manuscripts must be in the office of the Dean by that date. Information as to form of manuscripts may be had at either the English department office or the office of the Dean.

Schaller, Riddell St. Pat Heads

Engineers Show Great Interest in Election of Chairman and St. Pat; Arrangements for Day Which is on May 4th, Proceed.

SHOWING an interest which has been unprecedented for a number of years junior and senior engineers at the St. Pat day elections held on March 1 chose Louis Schaller to act as Engineer's Day Chairman by an overwhelming majority, and elected Donald Riddell as St. Patrick in a more fevered and close race.

Schaller, a junior civil engineer, downed his only opponent, Glenn Williams, an electrical, by a vote of 119 to 47, while in a three cornered race featuring Pat Butler, chemist, Roger Amidon, civil, and Donald Riddell, electrical, Riddell won by garnering 80 votes to 57 for Amidon, and 32 for Butler. The last minute entrance of Amidon into the race for St. Patrick, splitting the votes expected by Butler, upset what was expected to be a tight race between Riddell and Butler.

Both Schaller and Riddell are well qualified for the work, Schaller having entered into many of the activities of the technical colleges. He is a member of Scabbard and Blade, Mortar and Ball, and is at present advertising manager for the Minnesota Techno-Log and president of the junior civil engineering class. Riddell, with plenty of Irish blood flowing through his veins, fulfills the primary requirement of St. Patrick. He has also been on the football team during the past two years, having made a letter both years.

Engineers' Day, which is scheduled for May 4, promises to be one of the best. Plans for the day are now going forward, and the committees will have two months in which to work up original and interesting features. Entire arrangements are in charge of Louis Schaller, who will appoint all committees and committee chairmen. Riddell as patron saint will choose the Queen of St. Patrick's Day, and will knight each senior on the campus knoll. Engineer's Day plans include open house in all departments of the engineering college, a parade, the knighting ceremonies, the green tea dansant, and the Engineer's Brawl.

New Device Tests Exhaust Gases

A unique device is being used in the experimental engineering laboratories for testing or determining the amount of unburned gases in the exhaust from gasoline engines. This instrument, which is called a carbon monoxide plus hydrogen indicator, is an electrical device consisting of a wheatstone bridge and galvanometer. The current is provided by means of a storage battery.

Two arms of the wheatstone bridge are located in ducts or passageways; air passing through one duct and the exhaust gases passing through the other. Any unburned hydrogen or carbon monoxide gases in the exhaust will be ignited in passing the heated wire in the duct. This action raises the temperature of one arm of the wheatstone bridge and unbalances the galvanometer which gives a deflection reading directly in terms of percentage of carbon monoxide and hydrogen in the exhaust gases.

Engineering Faculty Men on "U" Senate

Four men of the Engineering College faculty, Professors Holman, Bass, French and Zelner, have been placed on three Senate committees. On the Intercollegiate Athletic Committee Professor Zelner has a place. On the Committee on Student Publications Doctor Holman holds a position, while Professor Bass is on the Educational Committe. Professor French is on the Student's Work Committee.

Professor Zelner is placed at the head of two committees on intercollegiate athletics, the eligibility and field committees. In the report on the rotating schedule, the Minnesota delegate to the Committee of Sixty that met in Chicago, stated that Professor Zelner's rotating schedule was approved, but that action on it was postponed till 1931.

Bookstore Spends $500 for Steel Shelves

"Business has grown so rapidly in the last few years," declared Harold D. Smith, manager of the Engineers Bookstore, "that we must make efficient use of our limited floor space."

Therefore new shelving has been added; bulky, wooden shelving has been torn out and replaced with all-steel shelves that will stand up under any weight of engineering text books.

The improvements cost approximately $500, all being ordered by the Engineer's Bookstore Board of Governors at its last monthly meeting. This board is composed of faculty and student representatives from the technical colleges.

Prof. Springer Discusses Environment Control

Enlarging on the statements that "habit follows action," and "form follows function," and the converse to these statements "actions tends to follow habit" and "function tends to follow form." Professor Franklin W. Springer, acting head of the department of electrical engineering, in an article in the *Minnesota Alumni Weekly* goes on to explain that with these principles in mind anyone who can control his wants can succeed.

As continual action forms a habit so a habit constitutes a continual action. Also as the function or want is great a thing is made so as to satisfy that want. Conversely if the thing is formed to fulfill a want, there is a want to be fulfilled.

Now these wants, according to Professor Springer, are nothing more or less than the urges brought on by certain environmental conditions. If these conditions can be governed, or controlled so as to bring only the best wants to the person, that person will have only the best habits, and they will be formed for only the best functions of life. In other words he will be a success—he will be living life in the best possible way, doing capacity work in the best way.

Elsberg, C '09, Named Head of Federation

The Minnesota Federation of Architectural and Engineering Societies held its annual meeting February 17 and 18 at the Curtis Hotel, Minneapolis.

The convention was addressed by many prominent engineers from all parts of the country. Among them there were two Minnesota men, Prof. S. Chatwood Burton, Professor of Architecture, University of Minnesota and A. C. Godward, City Planning Engineer, Minneapolis.

Among the officers elected for the coming year at the business meeting are: president, N. W. Elsberg, C '09, and treasurer, Alvin S. Cutler, C '05.

Many Engineers Prominent on Varsity Baseball Track, Wrestling, Gym, Rifle, Swimming Teams

By Harold R. Shannon, M '29

Engineering and athletics seem to go hand in hand of late. Not content with monopolizing positions on the varsity basketball team engineers have decided to take over many places on the other teams as well.

Determined to get the jump on their competitors for positions on the baseball team the engineers turned out in full force at the first call for candidates. At present engineers reporting are: infielders, Winfred L. Hindermann, Frank C. Sweeney, Albert J. Wettels, Guy B. Arthur, Donald W. Kanne, Paul A. Sanders, Walter E. Carlson, Albert F. Bauer, Glenn Angell; outfielders, Leonard A. Kloski, Everett Bach, Walter Krueger; pitchers, Leonard Moore, George Langenberg, Charles Bingham and Addison M. Fisher also are out. "Johnny" Stark, the hard hitting shortstop, will not be able to report until the end of the present basketball season.

Track, too, claims the attention of the engineer. Bruce Strain and Gordon Bassett of the chemical school are two sophomores who show great promise of bringing further honor to Minnesota and the technical colleges.

We can't forget to mention our wrestlers as the two biggest men on the team are engineers. "Don" Kopplin brought further glory to the colleges when in a match with Illinois, conference champions, he was the only Minnesota man to win his match. He threw his opponent for a fall to climax a sterling bout. Louis Tiller, light heavyweight in size but heavyweight in ability, was forced to give his opponent a weight advantage of forty-three pounds. He put up an exceedingly good fight but the superior weight of his opponent finally asserted itself and he was forced to take the short end of a close time decision.

Kopplin has been doing good work of late. After losing a close match to Beers of Iowa he more than made up for it by winning the deciding points for Minnesota in the Wisconsin match when he gained a time advantage of over eight minutes on Heywood, their light-heavyweight. Clarence Neill handles the motherly job of listening to the woes of the matmen while bandaging their injuries. The position of wrestling manager is very ably handled by "Nuggetts" Neill.

At the present rate of progress the gym team will soon be composed entirely of technical students. Four of the squad of six are engineers, while one letterman of last year, John Wald, is at the moment ineligible. The tumbling engineers are: Harvey Dartt, Melvin Pass, William Reichow, and John Stewart.

On the team which is probably doing the most consistent work with the least recognition we have the "three musketeers", W. G. Lundquist, Wilbur Japs and Erwin Bingham, members of the varsity rifle squad. Any man gaining a place on the Minnesota rifle squad must be an expert, indeed, as Minnesota's marksmen are famous the country over.

Our famous swimming team has Donald Bayers and Clarence Waidelich upholding the high standard of engineering accomplishments. Both men recently did sterling work in the Central A. A. U. senior championships and open swimming meet held at the Minneapolis Athletic club competing against a field of stars including John Weissmuller of the I. A. C.

Intense rivalry and close competition marks the play in the inter-technical college basketball tournament, especially in Division 2 where at present three teams are tied for second place at the end of the regular schedule. In Division 1 the race narrows down to a fight for first and second places between the General Engineers and Anderson's Misfits. The Freshman No. 1 team gained third place over the Sophomore Chemists, who are just a step ahead of the Junior Civils. Although the schedules are as yet not finished, the Sophomore Civils have cinched first place in Division 2 with the Freshman No. 2, Sophomore M. E.'s, and the Junior M. E.'s, all grouped in second place. The Junior EE's are keeping themselves company in the cellar.

Around the World With Our Alumni

"Exposes" Mark Chicago Alumni Meeting

REMINISCENCES of the past and rumors of the future mingled Tuesday evening, January 24, as 50 engineers, chemists and miners—members of the Chicago Alumni Association met at dinner in the Central Y. M. C. A.

Following an informal introduction when each alumnus "exposed" life highlights of the person at his right, two former St. Pat's, Joseph Meagher, E '25, the patron saint of three years ago, and Raymond Kelley, knight-dubber and civil engineering graduate of 1926, gave short humorous addresses.

Barton Juell, C '26, newly elected secretary-treasurer of the association gave his monthly report, and distributed tickets for Minnesota basketball games. Mr. Juell succeeds Frank C. Appleman, E '24.

An interesting feature of the evening was several impromptu talks by the 1927 graduates present, who told their reasons for selecting Chicago as a location.

Chairmen for future monthly meetings were elected as follows: February, Baldwin Ellers, C '25; March, Maurice Hunt, E '26; April, Donald Mackay, E '26. New meeting places were discussed and a committee with Barton Juell as chairman will make an investigation.

Paul B. Nelson, E '26, former editor of THE MINNESOTA TECHNO-LOG, and author of "Broadcast," 1927 Arabs musical comedy, was the chairman.

Chemists

'25—Ernest E. Jewett, according to reports received at the School of Chemistry, has been appointed director of the research laboratory of the Proctor and Gamble company at Ivorydale, Ohio.

'26—August Willman visited the Technical campus and the School of Chemistry recently. Gus is an instructor of chemistry at the College of St. Scholastica at Duluth, Minnesota.

'26—Marvin Rogers was one of the recent visitors to the School of Chemistry. He is doing graduate work toward his Ph. D. degree and is assisting in the chemical engineering department of the University of Michigan.

Civils

'06—George I. Hayward has been appointed district engineer for the Northern Pacific Railroad at Seattle, Washington. He was previously located at Spokane with the same road.

'21—Burt C. Henry recently resigned his position with the Gauger, Korsmo Construction Company of Memphis, Tennessee. He has organized his own company and is now in the contracting business in Dallas, Texas.

'22—Ellsworth Johnson has been doing some extensive and intensive traveling of late. He says, "Having survived the hurricane in Florida, I went to New York, thence to South America, and back by way of Havana and New York.—In Chicago eight months and now on my way to Los Angeles via Seattle, Vancouver, and a boat trip down to California." Johnson's home is in Los Angeles, California.

'27—Lawrence Johnson, Tauno Pajari, and L. E. Briggs have accepted positions with the Northern Pacific Railroad. They are all located in the St. Paul office of the railroad.

'27—Frank R. Lundsten is a junior engineer with the U. S. Engineers at Milwaukee, 406 Federal Bldg., address, 180 Knapp.

'27—"Nick" Preus is now with the U. S. Engineers in Green Bay, Wisconsin, sounding the Fox River through the ice. Later he expects to be ordered up to Menominee, Michigan, to sound the channel and harbor. He says that though the weather is somewhat cold there is less discomfort in it than a cold bath in Lake Michigan water. He was back in the city and visited the campus.

"There are two things that a field geologist must know, probably above all others. The first is rock. Surely he must know his rocks. Second only to that, and probably as essential to his success is the subject of maps." So says Anton Gray, a former Minnesota student who is employed as a field geologist by the Selection Trust Ltd. in Northern Rhodesia. In a recent letter to Professor Zelner of the department of surveying he continues, "In the United States, where good topographical maps are the rule, one is apt to lose sight of the importance to the geologist of being able to make, as well as use and understand, an accurate map. Even in the United States it is sometimes necessary for the geologist to try and turn topographer. And in a place such as Rhodesia, and probably in most of the less well known parts of the world, it seems that the first part of any geological job is the making of a map. . . . At the present time we are prospecting a mineral concession of the British South Africa company, and in order to do the job thoroughly we are first making a geological map of the area.

"The area being covered is something over a thousand square miles, and when we started we had a fairly definite idea of the borders, a rough idea of the drainage, a few approximate elevations, and a limited time to make a reconnaissance of the area, physical and geological.

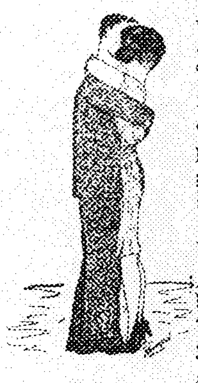
"We started out with compasses, measuring wheels, hand levels and plenty of paper, but soon discarded the wheels for pacing and what triangulating we could do, and the reconnaissance map is about finished. In pacing and compass traverses, run by two and sometimes three men, over ground by no means ideal for pacing, our largest error has been less than a half mile in thirty. Some of the men had never heard of pacing and looked on a compass as a sailor's toy.

". . . You can tell the boys that if they want to see the world via the geological route, they must learn to map. They will have to learn sometime, and Central Africa is a poor place to start to learn the fundamentals."

Electricals

'22—Martin F. Wichman, the first editor of the TECHNO-LOG, visited the technical campus and the TECHNO-LOG office recently. It was several years ago that Mr. Wichman and his assistants, working in a small, dark, room of the Architecture department, published the first issue of the MINNESOTA TECHNO-LOG, but his interest in it is still keen. He says: "At every visit to the TECHNO-LOG office I look at the first few issues of the TECHNO-LOG which I helped to make, to see the improvement made in succeeding issues and to note with a feeling of personal and parental pride the high standard of the magazine at this time." Mr. Wichman is division transmission engineer for the Northwestern Bell Telephone company. Mr. Wichman has been interviewing seniors in the department of electrical engineering in regard to appointments with the Bell System.

'23—Robert A. Hargreaves has accepted a position as assistant engineer with the Duluth, Messaba and Northern railroad with offices in Duluth. He was formerly employed by the General Electric company at Schenectady, New York.



'25—Karl Albrecht, we understand, took the dive into the sea of "Matrimony" sometime in December. Karl is employed as a junior patent examiner by the government patent office in Washington, D. C.

'25—Ernest G. Albrecht was married in January. Albrecht has been with the Tri-State Telephone company in St. Paul since his graduation in 1925.

'25—P. E. Richardson has recently been promoted from student engineer to commercial engineer. He is with the General Electric company with offices at 1635 Broadway, Fort Wayne, Indiana.

Mines

'05—Erich J. Schrader, consulting engineer of Reno, Nevada, recently explained to the mining students at the School of Mines and Metallurgy the details of making reports on mining properties.

'05—Harry T. Angst, who was formerly superintendent for the Marquette Ore company at Ironton, Minnesota, is at present conducting a jugging test for the M. A.


HERCULES POWDER CO.

Professor Springer Improves Loudspeaker

(Continued from page 177)

the back of the room we have lost some of the clearness that we enjoyed when in front. So why will not several speakers that send out perfect sound values be even better than a man lecturing in a huge room? You will even hear his breath."

TO clearly understand the true principle behind his development, Professor Springer shows us the difference between the tones of a Stradivarius and a $3 violin. The one having a true sounding board with its sound producing strings mounted securely upon it; the other having a loosely vibrating body with same strings mounted haphazardly upon it. The one giving an accurate tone value; the other emitting a rough uncertain tone unpleasant to the ears. In his speaker mounting Professor Springer has eliminated all vibration except that of the speaker element so that the speaker may deliver exactly what it receives without change. There are none of the coarse vibrations due to the loose construction of the $3 violin. There are only the positive true tones as in the Stradivarius with all other reflected values absorbed in the wall of the speaker, or sent around a long enough distance that they do not interfere.

The fundamental principle of the speaker is a short tone-tunnel, constructed of sound insulating material. This material, manufactured by the Union Fiber company of Winona, Minnesota, is known as "Fibrofelt" and is furnished by William L. Miller, E '07, manager of the company. In this sound tunnel is a power speaker operating a cone sound source mounted and stretched entirely across the tunnel to set the entire air column in motion. Both front and rear of the open tunnel are covered with a cloth screen, thus allowing the free vibration of the sound waves.

The tunnel mounted in a case abutting a hard, smooth surface has a sound deadening material mounted behind the tone-tunnel eliminating all reflected sound waves. If this is not done there would be interference of certain sounds and therefore a rough tone.

In all of this there is such a simplicity of work and principle that it is a wonder that it has not been done before. A tone-tunnel in which is mounted a power unit is the speaker. This tunnel is constructed of sound and mechanical vibration absorbing material, and is so mounted that the tunnel itself does not vibrate with the case of the speaker, but is supported by sound vibration deadening fiber.

The speaker is mounted in the tunnel and the tunnel bolted or glued together to give more rigidity. It is this use of the sound deadening Fibrofelt that gives the clear, undistorted tone values.

"Kichimookoman"

(Continued from page 176)

they started to paddle madly after the swimming animal. The motor was on my canoe and we ran around the island to head the moose off from land. We were in time and the Indians, overtaking the animal, fired several shotgun shells into the thick neck of an eight-year-old bull. It continued to swim rapidly. The Indians paddled alongside and the bowman caught the horns of the wounded animal and killed it with a hand axe. He then attached a rope to its horns and we towed it ashore. It is not unusual for Indians to kill young animals with a hand axe while they are swimming, and squaws have been known to drown a moose by throwing a tarpaulin over its head as it is swimming.

The three hundred mile trip down Lake Winnipeg on a freighting steamer took us five nights and four days. The trip was extended two days because the boat was tied up at a convenient point while the captain and first mate went duck hunting.

Engineering Overseas

(Continued from page 171)

let river to Notodden—where additional nitrogen fixation factories operate. These hydro-electric plants were visited.

THE Solbergfoss power plant, owned by the city of Oslo and the Norwegian state, is on the lower part of the Glommen river, which is the largest river in Norway. The total drainage area is 16,000 square miles. This plant lies easterly from Oslo and about 27 miles distant. The river flow is partially stabilized by passing through Lake Oieren with a normal surface elevation of 330 feet above sea level and an area of 35 square miles. The annual average flow of the Glommen river is about 21,000 cubic feet, with flood values of 116,000 cubic feet per second. The natural low water discharge in late winter is about 2,800 cubic feet per second. With the utilization of various head-water lakes as regulating storage reservoirs the low flow may be increased to over 10,000 cubic feet.

The power plant lies three miles down-stream from the outlet of Lake Oieren, and consists of a main dam, a spillway section, log chute and power house with forebay and tailbay. The structures occupy a deep rock gorge. See Figures 3 and 4. The spillway dam is of peculiar interest in its concentrated capacity and its roller gates. The three sections are each 65.6 feet in length with a normal depth of 29 feet over the crest and in extreme flood a depth of 46 feet. These sluices are controlled by roller gates electrically operated and one of the gates is electrically heated for winter operation. In extreme anticipated floods the volume of flow through each of these narrow sluices may be 47,000 cubic feet per second, which represents a fairly large flood on the Mississippi river at Minneapolis. These three great streams converge in a rock tail basin over 50 feet deep. Even with moderate spillway discharge the spectacle is imposing. See Figure 4. The roller gates, 65 feet long and about 30 feet in diameter, represent excellent modern European initiative and practise. The main dam flanking the spillway dam, is of concrete armored with granite masonry where ice thrust or ice adhesion indicate it. It is 174 feet long and 148 feet high at the deepest point. The power house is about 505 feet long, 105 feet wide and over 200 feet high—built of heavily reinforced concrete. The dam along the forebay is integral with the power house. The normal head on the turbines is 70 feet. In flood time the tail water rises to a greater extent than the head water and the head may be reduced to 52 feet. Eventually by the regulation of Lake Oieren the winter head—when stream flow is least—will be perhaps 77 feet.

The complete installation is for 13 vertical units—seven of which are now installed. The total installed capacity will be 150,000 horsepower. The turbines are Francis type—with a claimed efficiency of 93 per cent; the generators are umbrella type producing 10,500-volt, 3-phase, 50-cycle current. Modern concrete moulded scroll cases lead the water to the turbines. The draft tubes are steel lined. The current is stepped up to 65,000 volts for transmission to Oslo.

The Solbergfoss plant was built mostly in the years 1918 to 1924 inclusive at a time of high labor and equipment costs. The cost of all structures and appurtenant works, including the power house substructure for 13 units, the power house for 10 units and seven installed units, without interest during

construction, is stated to be $15,000,000. The ultimate total cost may be not far from $20,000,000, including all items, for perhaps 140,000 electrical horsepower, or $143 per electrical horsepower, which is not unreasonably high.

Another plant was visited, which will also serve the industries and people in the region of Oslo. This is at Nore on the Laagen river northwest of Oslo, where a 1,200-foot-head development is nearing completion. This plant will comprise four Pelton wheel units each of 36,000 horsepower capacity, with an anticipated over-all switchboard efficiency of 81 per cent. This represents modern big unit practise. The transmission line, 108 miles to Oslo, will carry 132,000 volt current. This plant is served by lake reservoirs aggregating 42 square miles in surface area. A second station will eventually be built using the same water further down-stream under a head of about 300 feet.

The abundant cheap water power of Norway leads to some uses of electric current not common in other countries less energy-rich. My room at a hotel in Kongsberg was heated with an electric stove. Electric cooking is an increasing practice. Extensive heating of dwellings in a climate as cold as Norway or Minnesota is not practicable even with cheap energy, aside from such regions as those about Rjukan. But a practise in the sale of current in Oslo does tend to the use of electricity to keep the chill off from the house in the off-peak hours after bed time. A householder may buy the use of a kilowatt of energy by the year—not by the kilowatt hour. In such a case if the current is not in use for light, cooking or water tank, it may be used in electric stoves, some times enclosed in the great tile stoves of historic times.

It would be ungracious to close this sketch without acknowledging the fine courtesy and helpfulness of the Norwegian engineers. They worked out my itinerary, arranged for automobiles, entertained me, provided technical guides and gave me much verbal and printed information. The Norwegians of Norway are as alert and as ingenious and courageous in design, as the Norwegians of Minnesota and Wisconsin. Norway is the Viking land of stalwart men, lithe women and rushing waters.

Aluminum—A Growing Industry

(Continued from page 173)

wood for aircraft and are turning to all metal planes. The crank case, cylinder block and pistons in the the motor are all constructed of aluminum. The aluminum propeller is rapidly becoming standard and wings, fuselage and coverings are chiefly aluminum.

Aluminum is a very good conductor of electricity. Weight for weight it has a conductivity over twice that of copper and volume for volume its conductivity is about 61 per cent that of copper. Aluminum cable for electrical power transmission has been in production for a number of years and consumes an increasingly large tonnage of metal. The cable as commonly made consists of aluminum wires stranded around a core of galvanized steel wire of high tensile strength and yield point. This cable is so satisfactory that one company alone has sold over 200,000 miles of such cable. With this type of cable longer spans can be made and fewer and lighter supporting towers are required.

MANY new uses for aluminum aer brought forward every year. In recent years aluminum bronze powder and aluminum paint have been introduced to the public and have proved their worth. Fine flakes of aluminum bronze powder stirred into the proper vehicle produce a paint which is unexcelled for many purposes. It forms an extremely waterproof coat on wood, and is especially

suitable for painting oil storage tanks as it cuts down evaporation losses by maintaining a more uniform tank temperature. Aluminum furniture is now being manufactured in the United States on a commercial scale. The metal can be finished to imitate the finest wood, and artistic, lightweight, and strong furniture is being produced. In the radio industry aluminum is used for many purposes, such as panels, shields, cabinets, condenser blades, and in the form of foil for fixed condensers. Loud speaker frame castings and diaphragms can likewise be made of aluminum. On account of the high price of tin, the aluminum collapsible tube is becoming more and more used for tooth pastes, shaving creams, and other products which are commonly packed in collapsible tubes. Some athletic and sporting equipment is now made of aluminum. Among the novel structural uses of aluminum are shingles, rails, rivets, spire roofing, church steeples and theatrical scenery construction. One of the most spectacular applications of aluminum was the construction in Germany of the tallest radio tower in the world.

Although aluminum alloys are much more resistant to corrosion than steel, their use in certain structural work has been limited in the past because they were not as corrosion resistant as seemed necessary. Paints of various kinds, varnishes, anodic oxide coatings and various other protective means have been employed to meet this difficulty, but not with entire success. In an effort to meet the requirements perfectly a new corrosion-resistant strong alloy product named "Alclad" has been developed by the Aluminum company of America. "Alclad" consists of a strong alloy core provided with a surface layer of pure aluminum; the exceptional corrosion-resistant properties of pure aluminum are thus combined with the alloy core of high strength. The surface layer is alloyed to the high strength material in such a manner that it forms a non-separable, integral permanent protection for the alloy. As the pure aluminum surface is apparently electro-negative to the alloy, "Alclad" is resistant to corrosion even on cut edges or on the surface where the coating may have been cut, scratched or otherwise damaged.

And what of the future of this growing industry? The supplies of lead, tin, zinc and other non-ferrous metals are limited and cannot last forever. Aluminum, on the other hand, is the most abundant element occurring in the earth's crust, and it is only awaiting the magic touch of science and electric power to make it available for the future needs of industry.

Industrial and Pharmaceutical Chemicals

DOW

It has always been our policy to manufacture Dow Industrial Chemicals to the highest standards of purity, uniformity and reliability. Unexcelled facilities for dependable service assure our customers of complete satisfaction.

Our research laboratories are in an excellent position to aid industry in confidential research work.

Users of chemicals are invited to discuss their chemical problems with us. Let us quote on your requirements.

A partial list of Dow Chemicals

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Ammonium Salicylate U. S. P.
Calcium Chloride
Carbon Bisulphide, 99.9%
Carbon Tetrachloride, 99.9%
Caustic Soda
Chloroform
Ethyl Chloride
Epsom Salt U.S.P. and Technical
Magnesium Chloride
Methyl Salicylate U.S.P.
Phenol
Sodium Sulphide
Sulphur Chloride
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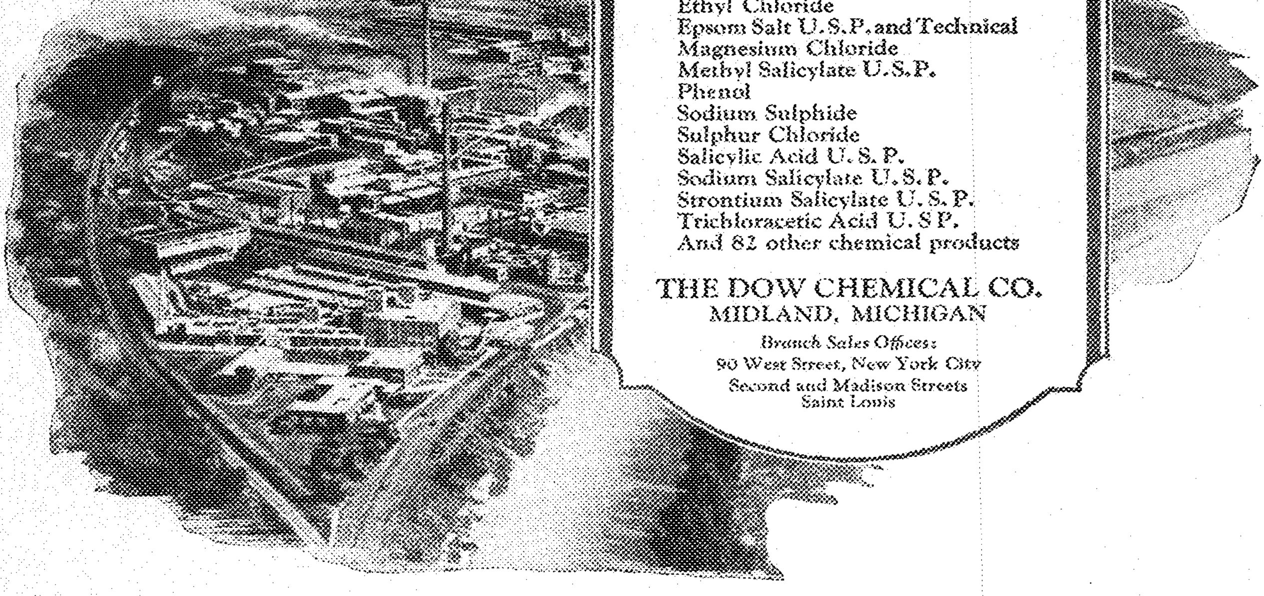
Second and Madison Streets
Saint Louis



Who will scout this industrial frontier?

WHETHER in the Bell Telephone Laboratories, in the Western Electric workshop, in the various operating companies or in the American Telephone and Telegraph Company, telephone executives are scouts on the frontier of new and better methods.

It is significant that your true telephone man, with the feel of the calling in his blood, never speaks of having "perfected the art of communication." And this in spite of the fact that America, in fifty years, has telephones everywhere and talks far beyond its borders.

Work in the Bell System demands the bold curiosity of pioneers and the infinite pains of pioneers who, like Columbus, Lincoln and Lindbergh, prepared "and when their chance came they were ready."

Scouting in research

Scouting ahead is accepted practice in the Bell Telephone System.

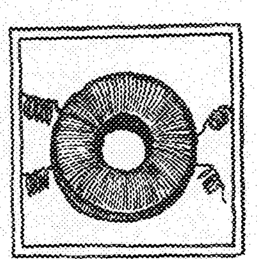
Research engineers are continually stepping over the borderline of new knowledge, seeking—and finding—the better way.

Scouting in management

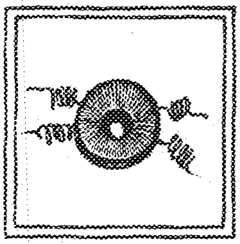
If an industry is to progress, the executives and supervisors have a special obligation to guide their organization on and up.

Telephony has advanced largely because of leadership.

Scouting in manufacturing at Western Electric



Compare this iron core loading coil with—

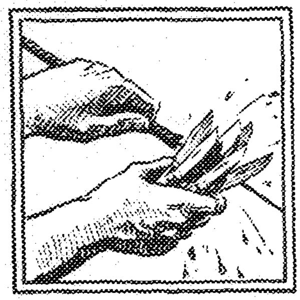


same efficiency core using permalloy—⅓ as large.

Western Electric is a place "where good enough isn't." "Good enough" suggests a self-complacency which the makers of Bell telephones do not feel . . . an important reason why improvement has steadily gone ahead.

As manufacturers for the Bell System this Company must continually develop better tools and better methods of production and must apply more and more exacting standards of test and inspection.

One measure of the success with which this is done is the fact that telephones are meeting an ever harder test from the public. People use telephones more, the number of calls per person rising from 34 in the year 1900 to 206 in 1927—or 505 per cent, while population increased 52 per cent, railroad passenger traffic 104 per cent, mail communications 292 per cent.



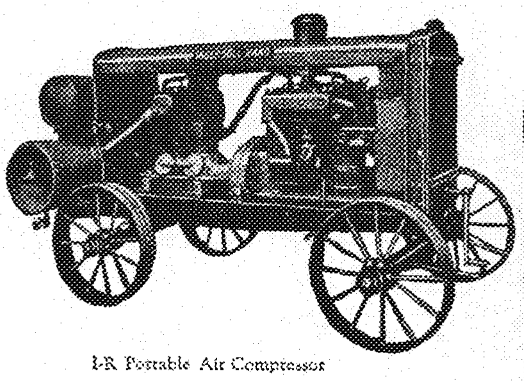
Now a machine, equal to 26 jack-knife-power, strips insulation from wire.

For the telephone workshop to measure up to the nation's requirements, both as to quality and quantity of output, necessitates pioneering into new ground of industrial efficiency.

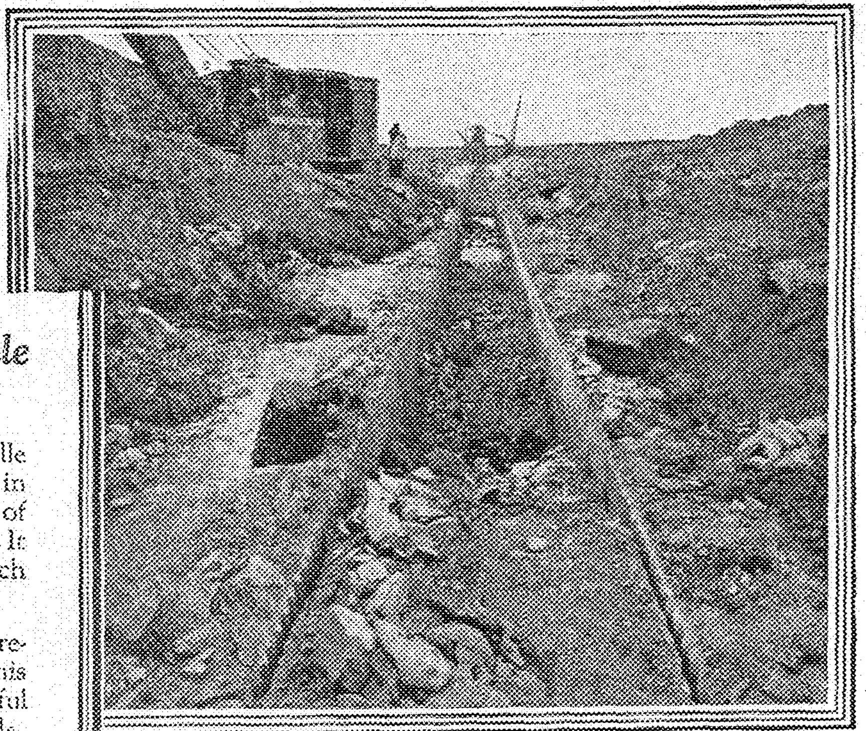
BELL SYSTEM

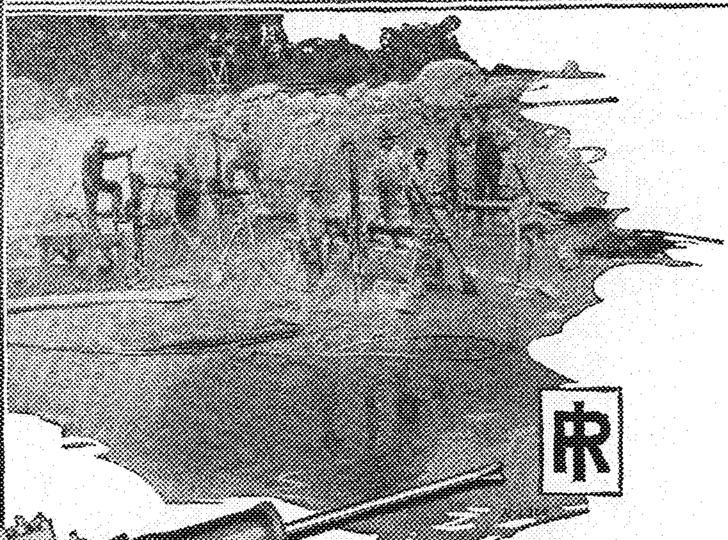
A nation-wide system of 18,500,000 inter-connecting telephones

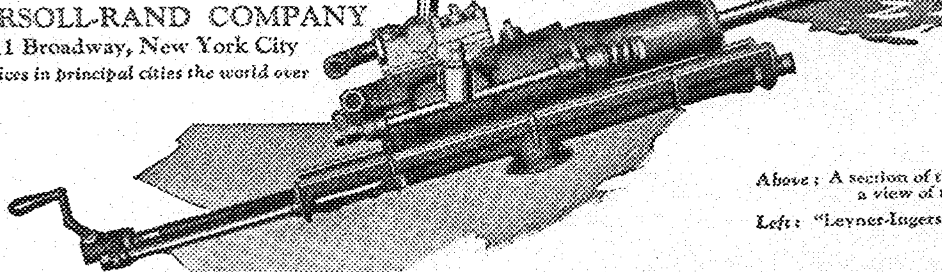
"OUR PIONEERING WORK HAS JUST BEGUN"



I-R Portable Air Compressor







Above: A section of the 9000-ft. keyway and a view of the drills at work.
Left: "Leyner-Ingersoll" X-72 Drifter Drill.

The Lund Press, Inc., Minneapolis

W. R. JACOBS,
Sales Assistant,
W. T. N. S., '22

L. E. LYNDE,
Headquarter Sales,
University of New Hampshire, '20

C. E. BASTON,
Equipment and Service Engineer,
Univ. of Cal., '21

F. E. MORGART,
Contract Administration,
W. T. N. S., '21

G. B. BALLARD,
Motor Design,
Queens, '24

R. C. JONES,
Control Designer,
Penn State, '23

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

The Great Northern Electrification

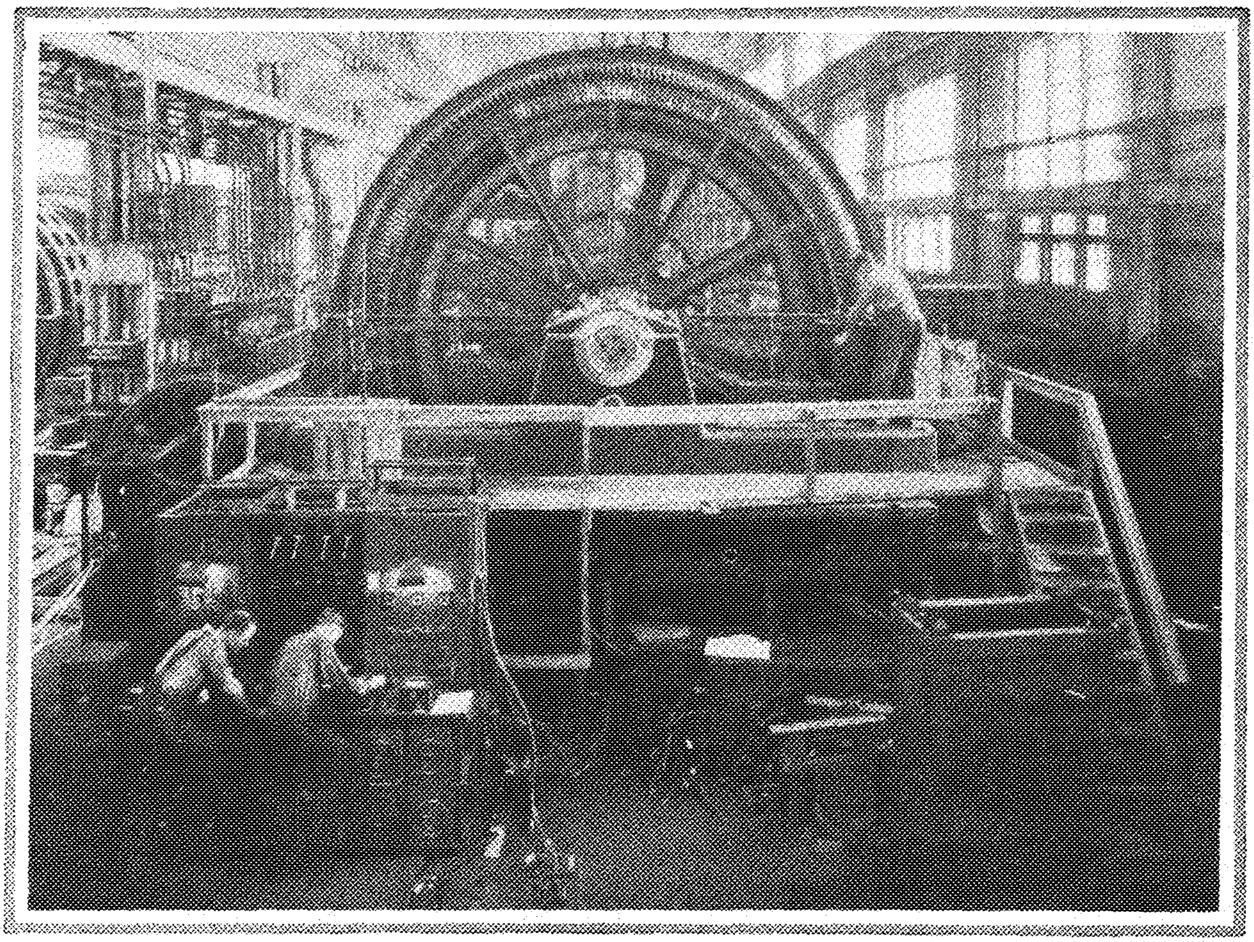
Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

SKYWARD from Skykomish climbs the Great Northern in Western Washington — up twenty miles of 2.2 per cent grade, around sharp 10-degree curves, scaling the Cascade Mountains, at an elevation of 3,000 feet. The new 7¾ mile electrified Cascade Tunnel, now building, will be the longest railroad tunnel in America. Besides shortening the present route 7½ miles, it will bring the maximum elevation below the level of excessive snowfall. Preliminary to its construction, and as an earlier step in the ultimate electrification of all trans-Cascade trackage, the section between Skykomish and the entrance to the present tunnel was electrified in 1925.

The big jobs go to big organizations. Westinghouse attracts young men of enterprise and genius because it daily provides facilities and opportunities which smaller companies can seldom offer.

A noteworthy feature of the Great Northern electrification is the use of motor-generator electric locomotives. These new-type locomotives draw high-voltage alternating-current power from the wire and convert it, on the locomotive, into low-voltage direct-current power for the driving motors. This system eliminates the need of substation power-converting equipment along the railroad right-of-way.

Westinghouse



Responsibility

A year ago, these young men were studying engineering in college class rooms. Here we see them putting a 5000-horsepower synchronous motor through its paces. As G-E Test Men, they have charge of this work; upon them rests a definite responsibility for determining whether this machine measures up to G-E standards of performance and will worthily represent General Electric in the service of the customer.

Opportunities such as these mean much to the industry as well as to the man, for the future leaders of the great electrical manufacturing and electric power companies must of necessity be those who have learned to assume responsibilities.

The General Electric monogram is the symbol of an organization whose engineers have met their responsibilities by establishing principles and developing apparatus which have made General Electric a leader in the great electrical industry.

95-530DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

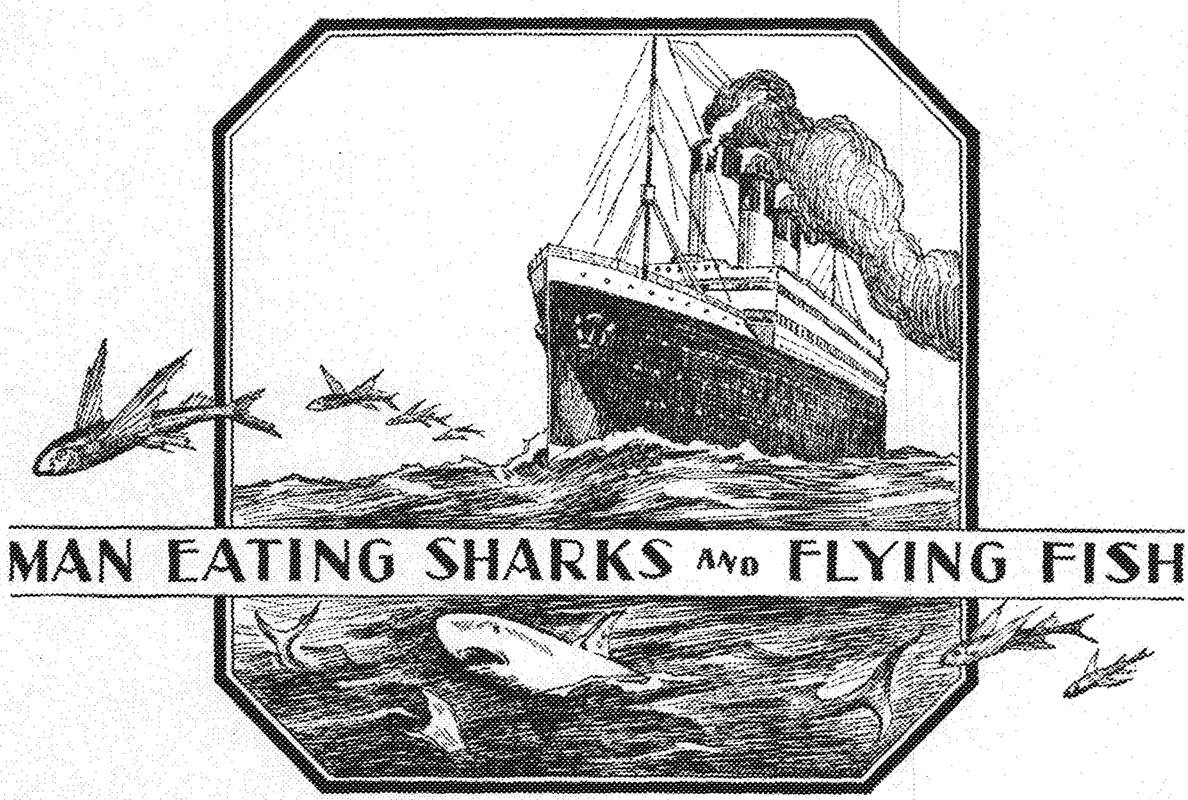
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Minnesota's Industrious Architects

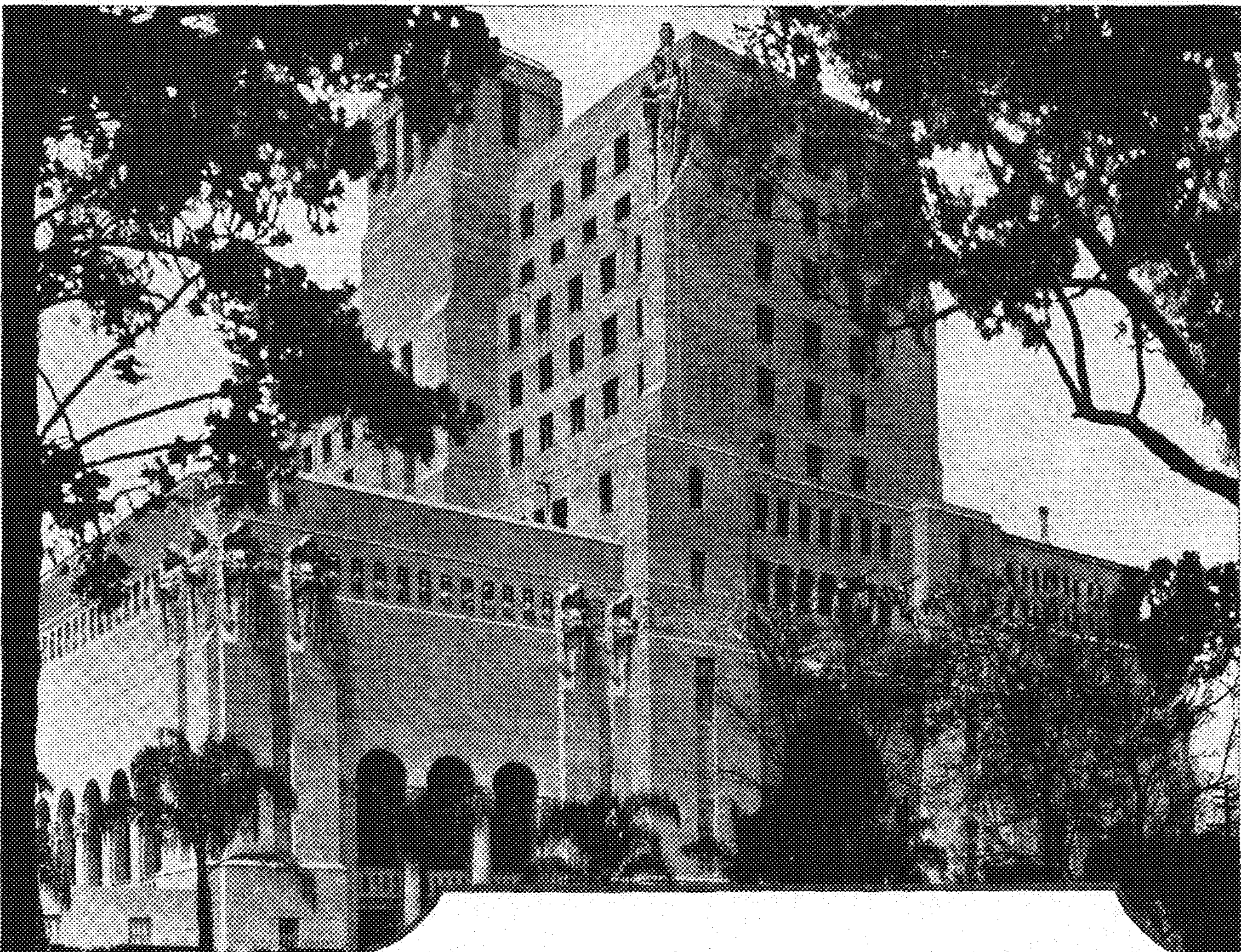
Volume VIII APRIL 1928 *Number 7*



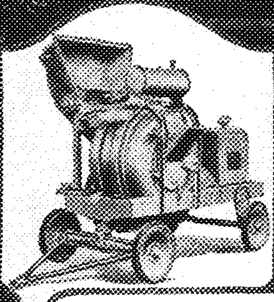
On your first trip abroad, you are doubtless prepared to see lots of interesting things—icebergs, perhaps—exclusive French restaurants serving corned beef and cabbage—cultured Englishmen who do not wear monocles, or say "Old Bean". Probably you would not even register surprise if you found high speed Otis elevators apparently as much at home on the Leviathan and other trans-atlantic liners, as in the finest buildings in all parts of the world.

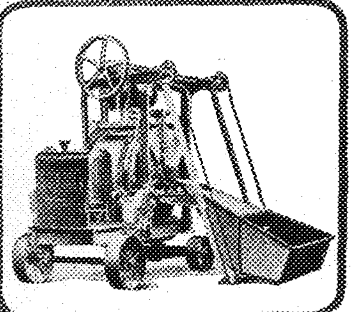
OTIS ELEVATOR COMPANY

Offices in All Principal Cities of the World



Re-mixed Concrete Endures





WHEN building for the future, an invaluable quality is sought—endurance. In endeavoring to capture it, every material is carefully selected to withstand the ravages of the elements and of time.

Just a glance at the new Elks Club building in Los Angeles, pictured above, gives evidence that the architect, engineer and contractor were striving for permanence as well as beauty. With these ideals the quality of the concrete did not escape their attention. Two Koehring mixers, a Heavy Duty 21-S Mixer and a Dandie 7-S Mixer, were used to mix the concrete for the foundation walls of this modern structure. Through the Koehring re-mixing action it was assured that every foot of concrete would be uniform and of dominant strength. Koehring re-mixed concrete endures.

The revised edition of "Concrete — Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, is now ready for distribution. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY
MILWAUKEE, WISCONSIN

Manufacturers of
Pavers, Mixers — Gasoline Shovels, Cranes and Draglines.

KOEHRING HEAVY DUTY

KOEHRING

THE UNIVERSITY OF MINNESOTA

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

Published monthly from October to June inclusive, by the Techno-Log Association, composed of the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines of the University of Minnesota.

VOLUME VIII — Minneapolis, Minn., April, 1928 — NUMBER 7

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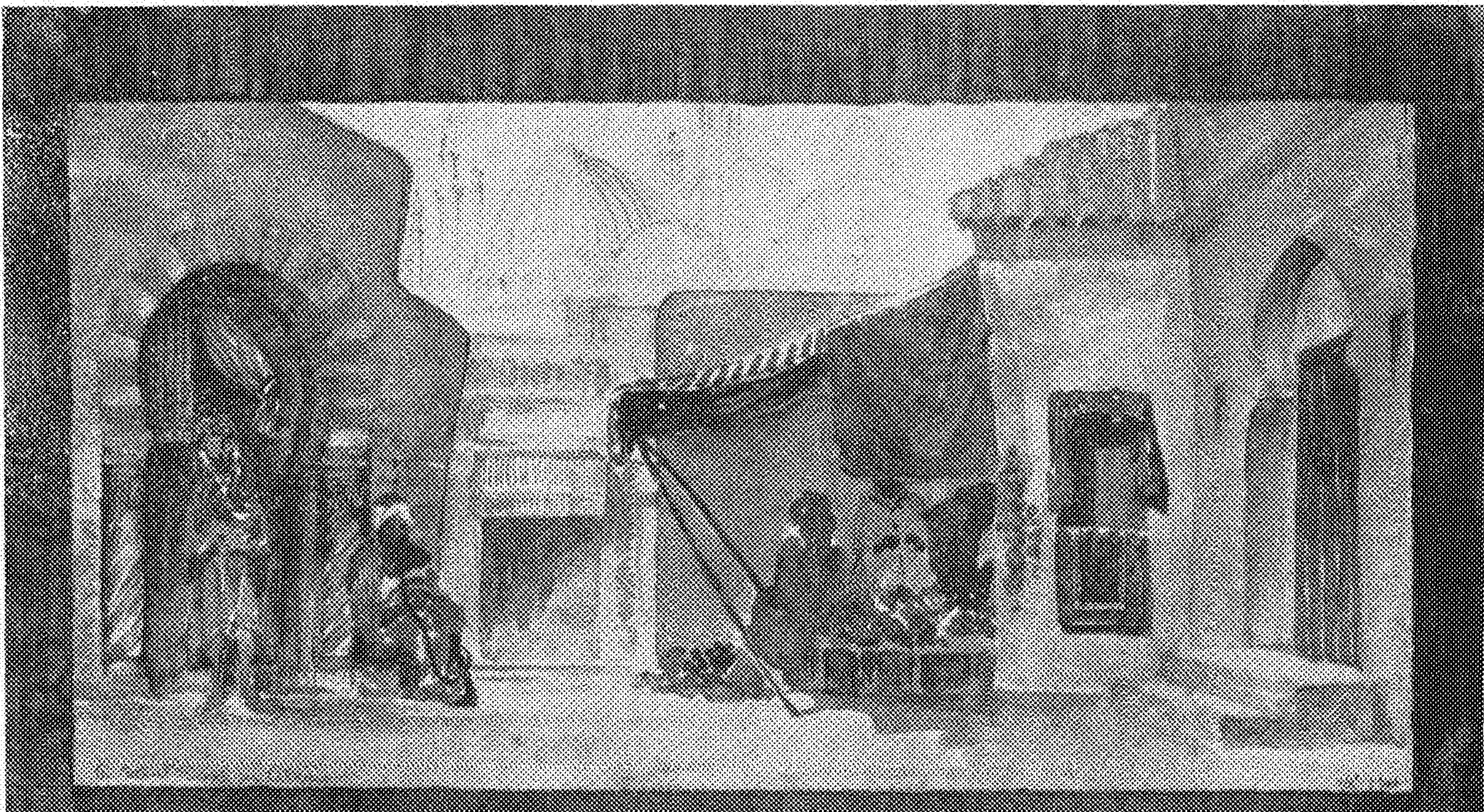


HIGH PRESSURE ··· ACT II ··· SCENE I ··· W.J. HUCHTHAUSEN

The MINNESOTA TECHNO-LOG
University of Minnesota
Volume VIII APRIL 1928 Number 7

Engineering Overseas

Sweden, a country of mountains, is utilizing every natural resource for power

By FRANCIS C. SHENEHON, C '95, CE '00
Consulting Engineer, Minneapolis


FRANCIS C. SHENEHON

This is the second article on water power development in the Scandinavian countries written for the TECHNO-LOG by Mr. Shenehon. A graduate from the University of Minnesota in the civil engineering class of 1895, he was also Dean of the College of Engineering of the University of Minnesota from 1909 to 1917. Interested in the St. Lawrence to the sea waterway project, Mr. Shenehon tells in this article how Swedish engineers have built a similar project in their own country. This is the last of a series of articles on interesting engineering features which he ran across in his European trip last year. We feel very fortunate that we have been able to present to our readers these two articles by Mr. Shenehon.

IT is a long day's journey in comfortable cars from Oslo in Norway to Stockholm, the beautiful capital of Sweden. And the journey is through a pleasant agricultural country, not unlike Minnesota.

It is well to accentuate one fact which is very vital in interpreting traveler's tales. This fact is that a fortnight's sojourn in a country prints on the mind, as sunlight prints on a film, certain impressions. These impressions depend on many elements; the weather, the facilities of travel, the hospitality of hotels and taverns and the cordiality of the chance people one meets. All these have to do with one's well-being. My pursuits on the trail of water power developments led me well north of the Arctic Circle in early September. The balmy days and the crisp nights were delicious and invigorating; railway trains passed from the zone of steam to the region of electrification. With my penetration into little towns or settlements, outside of urban influences, the cleanliness and comfort of the taverns and the excellence of the cooking still continued. The people, chance fellow travelers, speaking mostly, but not always, an incomprehensible alien tongue, and the men who superintended the various engineering enterprises, were invariably cordial and helpful. So, I think, with warm affection of this Northland.

Stockholm is a city about the size of Minneapolis, ancient in traditions and modern in efficiency. It has two of the tallest skyscrapers in Europe, which are symetrically located and have the aesthetic value of monuments. The town hall is one of the most beautiful things in modern architecture. The location of the city on a strait, where the sweet water of Lake Malar meets and blends with the salt water of the Baltic Sea, has an amazing appeal. And this meeting of the waters has inspired painters, sculptors and poets. The fresh water is a lithe maiden, the salt water a stalwart youth. The waterway, with the parliament building, the palace, the museum, the gallery of arts, parkways, and the town hall looking out upon it, is as vivid as the Grand Canal of Venice—and more efficient.

The art of efficient hotel keeping must interest engineers. In Switzerland—at Zurich—is a college for hotel keepers. This is sadly needed in Minnesota. The Grand Hotel at Stockholm is excellent and not expensive. However small the town in Sweden, you find in your hotel room a bed with a thick feather cover, immaculate linen sheets, a table beside the bed with a reading light, a flask of drinking water and two glasses, and at the dining table, deliciously cooked wholesome food.

The Swedish engineers at Stockholm worked out my itinerary for me, notified resident engineers or superintendents of my coming, who met me with automobiles and sometimes with interpreters. The cordiality was unvarying. My mission was to investigate water power, but as one of the most interesting developments is at Porjus in Lapland, near where the iron fields are, I was able to spend two days in the two great mines. As Stockholm is as far north as Alaska, and Porjus was 500 miles still further north with September at hand, it appeared imperative to strike north immediately and complete examinations in Lapland, working southward to visit other outstanding developments afterward.

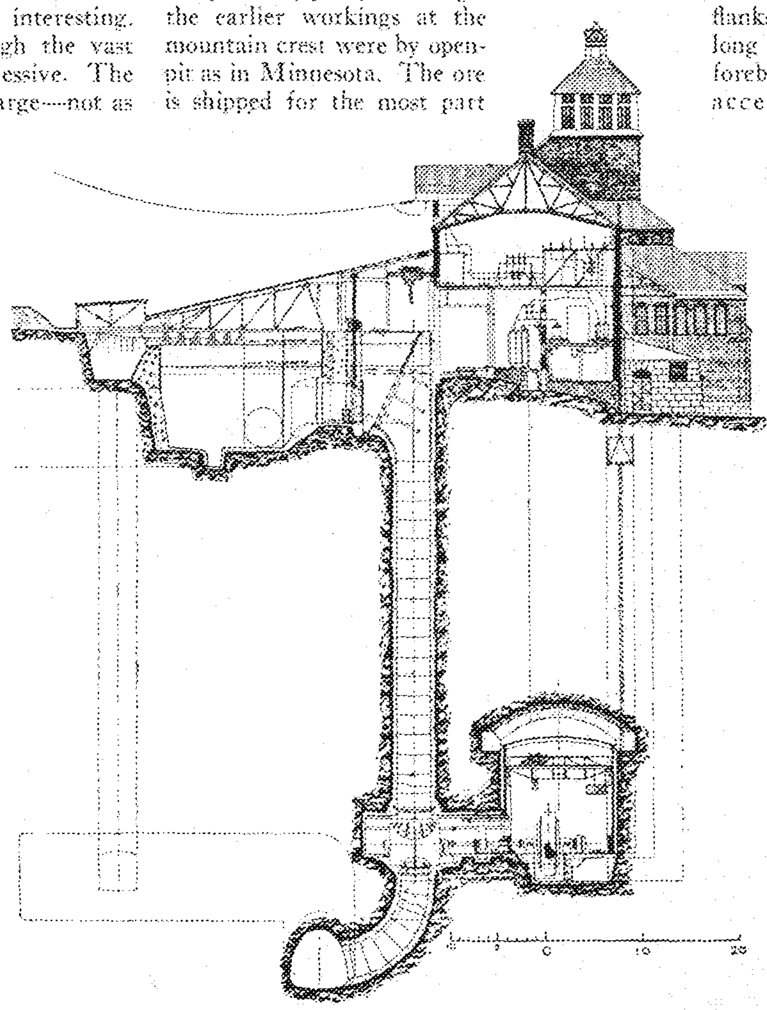
SWEDEN is a land of waters—of lakes and rivers—and along the western frontier is the range of mountains, whose western slopes are in Norway with streams flowing to the Atlantic and whose eastern slopes lead through Sweden to the Gulf of Bothnia. Much of the area of intense rainfall has elevations more than 1,600 feet above sea level. For water power the conditions are then: heavy rainfall, high levels, lakes for reservoirs and streams for flow to the sea—and a population of six million ingenious persons to develop and use the electric current created. The total potential water power is about 6,500,000 horsepower, of which about 1,500,000 is already developed. The potential power per capita is 1.08 h. p. and the developed power 0.25, which latter is 2½ times the per capita development in the United States.

THE rail trip from Stockholm to the iron town of Kiruna was interesting. In the region passed through the vast forest areas were most impressive. The Norway pine trees are not large—not as large as those of the Black Forest in Germany—but the forests appeared more like crops. The areas were devoid of undergrowth; the dead lower limbs had been cut off for fagots of fire wood; the forests were open so that vision penetrated a thousand feet into them; no evidence of forest fires was present. Our own tangled fire-swept forests are in singular contrast to these orderly, conserved timber resources.

The railway service was excellent, traveling second class. Trains were frequent and on time. The classification of passengers, first to fourth, was new to me. The fourth class rate is so low that the poor may travel, and the compartments were clean and not often overcrowded. Electrification is present in the north and is rapidly extending. All stations have excellent restaurants and many trains carry dining cars. First class travel and sleeping cars are less luxurious than our own home service.

The principal present electrified lines are from Stockholm, the capital, to Goteborg, the second largest city, a distance of 285 miles, the electric current being generated at the Lilla Edet water power plant on the Gote River; and the Lapland ore line, extending south-easterly from the mines at Kiruna to the shipping port of Lulea on the Gulf of Bothnia and north-westerly to the Norwegian shipping port of Narvik. The total electrified length is 296 miles, securing its electric current from the great Porjus water power on the Lule River.

The famous Swedish iron deposits at Kiruna and Gellivare, producing hemotite and magnetite richer in percentage of iron than our Minnesota mines, are in mountains with crests 1,500 feet above the level of the main railway. This means that gravitation helps the travel from ore bed to ore car. A main line tunnel with many branches penetrates under the upper ore body; and the mountain above is being honeycombed by chambers, with the ore dropped down through controlled chutes to the hopper cars. Electric current is utilized everywhere, in the railway, power shovels, air compressors, pumps and lights. Some of the earlier workings at the mountain crest were by open-pit as in Minnesota. The ore is shipped for the most part at the Norwegian port of Narvik and goes largely to Germany. The volume of ore is only about one-eighth of the tonnage taken from our Minnesota mines. At Kiruna, 1,600 miles nearer the aurora borealis than Minneapolis, hair and skirts are as short as at home, and Douglas Fairbanks, speaking Swedish, delights the people.



CROSS-SECTION OF THE POWER PLANT, PORJUS, LAPLAND
The most interesting feature of this plant is the underground turbine chamber, and the unlined tail tunnel hewn out of the native granite.

THE great water power development at Porjus is about 70 miles south of Kiruna and is on the Lule River at the foot of a long stretch of lakes, which have been regulated by the construction of dams and gates to serve as capacious reservoirs to insure continuous stream flow during the intense long winters. Porjus is further north than Iceland—but Iceland has warm ocean streams to temper its cold, while Porjus has not. In this region ice may form five feet thick and the snow lie six feet deep. But the Swedish engineers were not afraid of the winter or of ice thrust or troubles. They built a multiple arch dam, the most delicate of concrete hydraulic structures, as part of the works of reservoir storage regulation. At Porjus Falls they built an Ambursen type spillway dam with concrete-cored earth dam flanks—three-quarters of a mile long in all. This forms a deep forebay reservoir. It should be accentuated that the water approaches the penstocks through an intake tunnel from ice and snow-blanketed deep-water pools; that the water, despite low air temperature, is warm—perhaps, 37 degrees Fahrenheit; and this water, after passing the deep-set turbines, passes through a tail-race tunnel three-quarters of a mile long, to the river below the rapids, so that no ice troubles are present in this Arctic region. The head utilized here is 184 feet. The volume of regulated low flow will be 7,000 cubic feet per second, indicating a minimum output of 116,000 electrical horsepower. The present installation is of seven units, aggregating nearly 100,000 h. p. Three more units are under construction. All hydraulic and electrical equipment is built in Sweden. An outstanding feature of the Porjus development is that the turbine and generator room is carved out of solid granite, 160 feet below the ground surface and deep below the level of the river. No wheel house with walls, but just a rock cavern. And the tail race tunnel is of unlined granite, with a flow capacity—at 6½ feet per second—of 3,500 cubic feet per second. A second tail race tunnel will serve additional units. The units are on horizontal axes, which is not so good. The cost of the first six units—about 70,000 electrical horsepower—with riparian lands and reservoirs, was about $6,000,000, or $86 per electrical horse power. This is very cheap!

The reservoir cost was about $1,300,000, and this will serve the larger development now being installed and also other water power developments further

(Continued on page 218)

Motor Vehicle Lighting in Minnesota

University to have official equipment approval recommendations laboratory

By J. Robert Ginnaty, E '29

MOTOR vehicle traffic on our highways has attained such volume that its regulation has become one of the big national problems. Night conditions have been particularly bad and many accidents have resulted from both inadequate lighting and from glare.

Great difficulty is experienced by the motorist in going from one state to another on account of the multiplicity of regulations. This led to national action and it was to try to devise a traffic code that could be adopted by all the states and give a uniform traffic law that the Hoover conference was called. A code was produced by this conference, known as the Hoover Uniform Vehicle Code, and was approved in March, 1926.

Conditions in Minnesota are similar to those in the rest of the United States and a conference was called by Governor Christianson in December, 1926, to consider the Uniform Traffic Code and its passage as a law in the state of Minnesota. Committees were appointed to consider the various divisions of the Code. One of the sub-committees of the Equipment committee was on motor vehicle lighting. Professor Springer of the Department of Electrical Engineering, who had been doing some work on motor vehicle head lighting and had written articles for the Minnesota Federation of Engineering Societies, was called on to act as chairman of this subcommittee, composed of himself, J. A. Reynolds, M. R. Bass, and W. A. Thomas. Their report was presented to the governor's conference with those of the other committees.

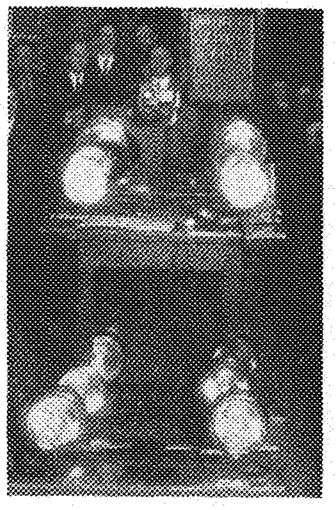
The Uniform Highway Traffic act was passed by the Legislature and became a law of the state in 1927. Among other things, the law laid upon the shoulders of the Commissioner of Highways the duty of enforcing the lighting provision of the act. An advisory committee to act in this task of building up a workable enforcement program was formed by Professor Springer at the request of the State Highway department. This committee is composed of Professor Springer, chairman, Judge Hall, J. M. Clancy, M. R. Bass, A. C. Godward, G. H. Herrold, J. F. Reynolds, W. F. Rosenwald, W. A. Thomas, G. A. Youngquist, and Professor Johnson of the Electrical Engineering department.

The Minnesota law does not require dimming lights, as safe driving requires light which will illuminate the road, but the law requires that the lamps be so adjusted that the main beam is directed downward, on the road, and not into the eyes of approaching drivers. Under the law no automobile head lamps, auxiliary driving lamps, spot lamps, signal lamps, or rear lamps may be sold in the state of Minnesota unless they are of a type approved by the Commissioner of Highways. It is intended that only such devices shall be approved that can give adequate lighting for their particular duty on the car on which they are placed and at the same time protect the drivers of other cars in all ways, particularly from the most prominent evil, that of glare.

That is, however, but one phase of the problem. The location of the lights and the direction of the light beam should be correct on every individual car used in the state, particularly the location of the headlamps. To reach this end, official automobile lamp adjusting stations are required, in numbers enough to be convenient to all of the automobile owners in the state. Then in each of these stations official automobile lamp adjusters, trained for this particular work, must be maintained to adjust the lamps properly and give a certificate of adjustment to the owner of each car tested.

Under the advice of the main committee and with the aid of the sub-committees, official adjusting stations are being established to meet the required conditions of the program. Under the direction of Mr. M. R. Bass of Dunwoody Institute, training schools have been set up for the proper training of the men who are to do the adjusting.

The Highway department requested the University of Minnesota to establish a motor vehicle light testing laboratory at the University to test and recommend approval of the various types of automobile lights. This request was placed before the board of Regents of the University and accepted. This laboratory is the official testing agency for the Highway department and is being built up and put into operation in the Electrical Engineering department of the University under the direction of Professor E. W. Johnson.



EQUIPMENT USED FOR INSTRUCTION
View of the equipment used by the head light adjusters' class. Note the official auto lamp adjusting station sign.

The work of the main committee is not yet over as a pamphlet for the education of the individual driver must soon be written in simple and clear language pointing out a few effective tests so that every driver will become an aid in the improvement of driving conditions in the State of Minnesota.

Three adjustment training centers have been established in the state by the state highway department. One is at the Dunwoody Institute, one at Virginia, and the other is at Duluth. In this manner has the driving safety of the Minnesota highways been increased. Fewer and fewer accidents, caused by blinding headlights, are reported each year.

The apparatus used in these testing stations is standard equipment. Standard lenses and lamps, which have been tested and certified by the University testing station, and the testing schools at Minneapolis, Virginia and Duluth are used in the different adjustment tests at the state stations. Each man as he completes the course of instruction in testing at the three schools is sent to one of the state stations and tests all lights brought to his attention as being dangerous to night driving.

These schools, besides sending our men to improve the safety of the night driver, have been a means of discovering many different characteristics of headlights.

The Human Eye

Narrow range of vision, and color distinction, wide spaced nerve endings causes many interesting phenomena

By Joseph Valasek
Associate Professor of Physics,
University of Minnesota

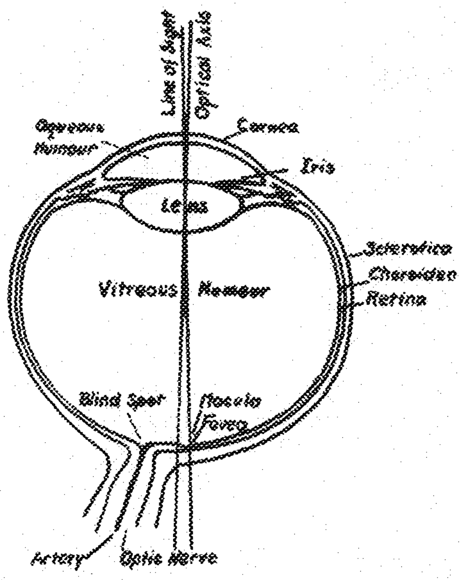
THE solution of many problems in applied optics and lighting requires a knowledge of the peculiarities of the eye and vision.

The structure of the human eye is indicated in Fig. 1. The outer skin, or sclerotica, contains a transparent portion, called the cornea, directly back of which is the iris diaphragm and the lens. Now, in general, whenever light passes through a surface which forms a boundary between two different media, the directions of the light rays are changed. Thus light rays from external objects strike the curved surfaces of the cornea and lens and are refracted to a focus, which, for clear vision, will be on the inner walls of the eye ball. The greatest part of the refraction occurs at the cornea; in fact, imperfections in focusing, such as astigmatism, are usually due to an imperfect corneal curvature. The function of the lens is to supplement the corneal refraction in such a way as to permit accommodation of the eye for objects at various distances. The necessary changes in focus are brought about by changes in the radius of curvature of the front surface of the lens. This is caused by the muscles which hold the lens in place and is more or less automatic.

The inner surface of the sclerotica is covered by a thin black layer called the choroidea. This is in turn covered by the sensitive retina. The retina consists of about forty million nerve endings which cause the transformation of the light energy into "nerve currents" which are transmitted to the brain by means of the optic nerve. The structure of the retina is indicated in Fig. 2, the light passage being downward. The two kinds of receptors are shown, these being called rods or cones in accordance with their appearance. Each cone has a separate nerve circuit to the brain, but there are several rods connected in parallel on each line. The circuits are partly broken at certain places by tree-like gaps, or synapses, through which the nerve impulse must pass. These impulses are probably electrical, although they do not travel as rapidly as one would expect on such a theory.

In one small region of the retina, called the macula, there are only cones, and these are packed very close together. An image focused on this part of the retina can be analyzed most minutely. When the eyes are turned to look at anything, the image is being projected on the macula. Thus the line of sight passes through the center of the macula, which is called the fovea. The line of sight makes a slight angle with the optic axis, i. e., a line through the centers of curvature of the refracting surfaces. When two points on any object subtend an angle of less than one minute of arc, they will be indistinguishable because their images on the retina will not be far enough apart to fall on two separate cones in the macula. The revelation of new, and often unsuspected, details in the structure of objects by optical instruments is due to their power to increase the angle between the cones of rays entering the eye from two adjacent points.

Regions of the retina farther from the fovea contain fewer and fewer cones until in the extreme peripheral region there are only rods. These are not only farther apart but also connected together



SCHEMATIC DRAWING OF THE EYE

Figure 1: Where the artery enters the eye is a blind spot.

in groups so that, while this part of the retina is sensitive to the detection of light, it is not efficient in resolving detail, as everyone knows. The function of the outer retina is, in fact, to make one aware of the presence of objects, while the macula is for their closer scrutiny. The same economy will be found to exist in the case of color perception to be discussed in the following.

There are no rods or cones at the point where the optic nerve enters the eye. Hence this spot is blind. This can be easily tested by placing two coins on a table about four inches apart and then focusing the image of the left coin on the fovea of the right eye. This is done by looking directly at the left coin with the right eye. If one is at the proper distance (about one foot) the image of the right coin will fall on the optic nerve and it will not be perceived. With a pencil, one can map out the form of the blind spot. A diseased retina may have other blind spots which can be located in a similar manner.

The stimulation of the light sensation is not proportional to the actual intensity of the light. For example, the illumination outdoors in full sunlight is 6,000 foot candles, while in a well-lighted room the illumination may be as low as 3 foot candles. To an observer, the artificial illumination does not appear to be such a very small fraction of that outdoors. This is, however, fully appreciated by anyone experienced in photography. The visual sensation of brightness is a wholly unreliable index of the actual intensity. This is due to the variation in sensitivity of the eye in response to general illumination. It is partly brought about by changes in the size of the iris, and partly by the secretion of pigment in the eye which migrates up around the rods and cones to shield them from excessive illumination.

THE change in the iris aperture takes place rather rapidly and is quite easily observed. The secretion of pigment is rather slow. One experiences this in the gradual adaptation of the eye to light. Thus on entering a darkened room (movie theater) there is, at first, too much pigment around the rods and cones, so that, although the iris opens wide, one still has difficulty in seeing. After a time the pigment recedes toward the choroidea and the eye becomes "dark adapted." The full effect requires about half an hour. After this time, the eye is fully a thousand times as sensitive as it was in full daylight. This partly makes up for the decrease in illumination. The presence of any unscreened bright lights would prevent this increase in sensitivity and must be guarded against in places such as motion picture theaters. A de-sensitizing action takes place when the illumination is increased, as when ones goes outdoors from a darkened room. The iris of the eye closes quickly as a temporary protection, but one feels discomfort until the proper amount of pigment has again covered the rods and cones. It is estimated that if the actual illumination changes in the

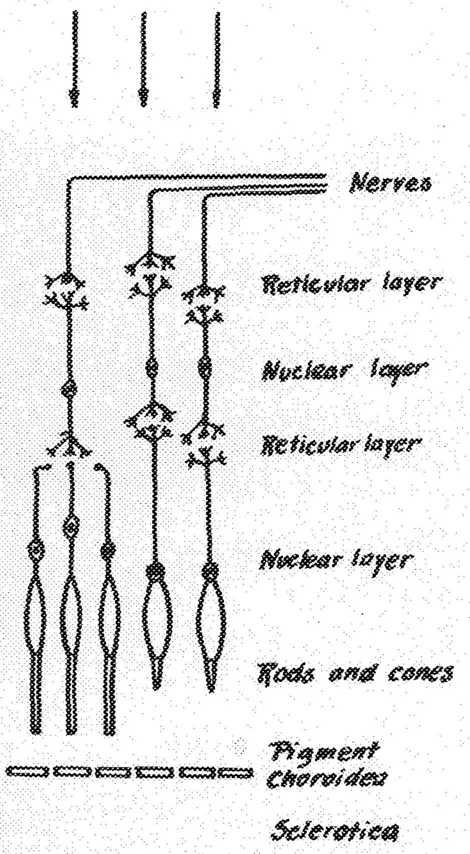


DIAGRAM OF SIGHT NERVES

Figure 2: When we examine objects closely, the cones carry the light sensations.

ration of 1 to 100,000, the visual intensity changes only in the ratio of one to 30.

The intensity of the light sensation also depends greatly on the wave length of the light. It is well known that the eye responds only to wave lengths between 0.000038 and 0.000076 centimeters. Moreover, in this range the response is not uniform, but varies in the manner indicated in Fig. 3. The ordinates give the light sensation per unit light energy. Two curves are shown. The curve *A* is for ordinary light intensities, while curve *B* is for a dark adapted eye. The maximum ordinates are arbitrarily set at unity. The shift in the curve due to darkness adaptation is called the Purkinje effect. It shows that the eye reacts much more strongly to blue than to red light when the illumination is very low.

UNDER ordinary conditions, a yellow-green light of wave length 0.000055 centimeters is the most effective in exciting the sensation of light. That is to say, it takes less radiant energy of this wave length to excite a given sensation of light intensity than if any other wave length were used. The exact relation is 0.0015 watts per lumen, and this is called the mechanical equivalent of light. Outside of the visible range of wave lengths the mechanical equivalent of light is infinite. No amount of energy will give one lumen of light.

The rather narrow range of wave lengths to which the eye reacts is responsible for the low efficiencies of the common sources of light. These usually radiate because some solid is heated to incandescence. All such sources radiate a wide range of wave lengths, many of which will not stimulate the sensation of light.

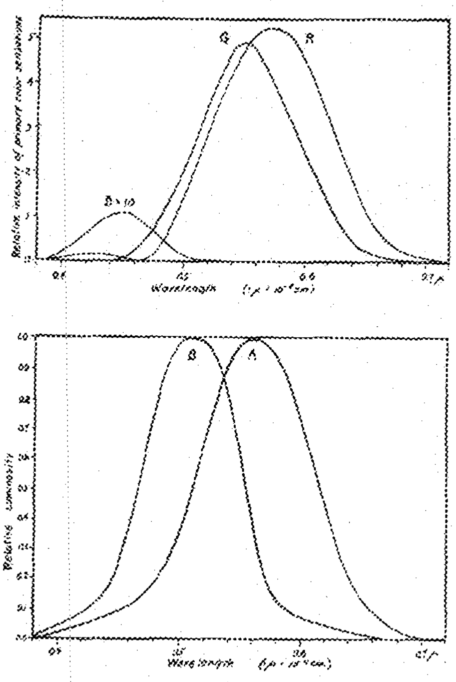
From Figures 3 and 4 it is evident that only a small fraction of the light energy can stimulate the retina. Moreover, the wave lengths near the limits of the range do so very inefficiently (see Fig. 3). Thus the ordinary sources are, at best, only 5 per cent efficient. Out of every dollar spent on electric lighting, about ninety-five cents is spent for radiations which do not stimulate the retina. Even slight improvements in the efficiencies of light sources such as have been made in the last ten years save enough in one year to pay for the operation of research laboratories like those at Nela Park for the entire ten years. The power still being wasted is tremendous.

A greater temperature would increase the efficiency, since the maximum of the radiation curve would shift to shorter wave lengths. However, the efficiency of a thermal radiator increases with temperature only up to 6000°C. which is the temperature of the sun. Beyond that, the maximum of the energy curve is in the ultra-violet and the luminous efficiency drops off again. The fact that the eye and the sun make the most efficient combination is no doubt a result of evolution. So far, temperatures higher than 3000°C. can only be maintained for a very short fraction of a second. They are obtained by exploding wires connected across a condenser of high capacity and charged to a high voltage.

Sensations of color play an important part in vision. The physical reality which corresponds to color is the intensity distribution in the visible spectrum. The eye, however, perceives intensity distributions imperfectly, and in a very qualitative manner. Thus for each color sensation there is an infinite number of distributions which the eye cannot distinguish. Physically, these colors may be easily analyzed by means of an instrument called the spectrophotometer. The eye is such a poor judge of spectral composition of light, that all color sensations can be stimulated by the combination of only three primary colors, viz., red, green, and violet.

Because the addition of three primary colors is sufficient to produce all colors, Young and Helmholtz proposed that the visual mechanism also combines three primary color sensations corresponding to red, green, and violet. Each colored light stimulates the three primary colors in certain proportions. Koenig found the relative stimulation of each primary sensation by the various wave lengths through a study of color mixture and color blindness. His results are illustrated in Fig. 4. The curves are so drawn that their sum gives the curve A in Fig. 3, which refers to the total light sensation.

IN some cases, one of the three color senses is lacking which results in a partial color blindness. Usually it is the red sensation, or the green, and very rarely, the violet. About 4 per cent of men and about one-fourth of 1 per cent of women are color blind. Usually this is not realized by those that are color blind. It requires some kind of a test, such as matching colored yarns, or projected patches of light, to show that an individual's color sense is defective. Some serious railway accidents resulted before it was found important to test the color senses of railway employees. Humorous situations also arise due to defective color vision. The famous English chemist Dalton could see no difference between the color of a laurel leaf and a stick of



CURVES SHOWING VISION RANGE

Figure 3, below: These two curves show the vision range of the eye in daylight and in the dark.

Figure 4, above: These curves indicate the eye stimulation to the primary colors.

red sealing wax. He is said to have appeared at a Quaker meeting with bright red stockings.

The type of color vision discussed above and illustrated by Koenig's curves

(Continued on page 224)

ENSIGN EARLE D. McKAY

The Navy Offers You Flight Training

Commanding Officer, Naval Reserve Air Squadron, Minneapolis, Outlines Course

By EARLE D. McKAY, C '15

HAVE you that very natural desire to fly? Most of you, of course, barring an early demise, will use the air as the common and accepted medium for transportation from one place to another. With the greater saving of time we increase proportionally that very human desire to go to places, do things and see people. In addition to stepping aboard a commercial plane and keeping an appointment in a distant city, most of you will own and operate a plane for pleasure purposes only. And this will be in the near future.

The advent of successful aviation, besides opening up new means of transportation, has placed a new weapon in the hands of war-going powers. To meet aggression in time of war we must have aviators trained in handling military aircraft. Since it is only too well known that a flier cannot be made in a day a nation is only secure which has a body of well-trained fliers subject to call. Many of the best fliers in the country today wear the uniform of the United States Navy—such as Commander Byrd and Al Williams—but in time of emergency there must be available a body of reserve pilots ready to take the air in the country's defense.

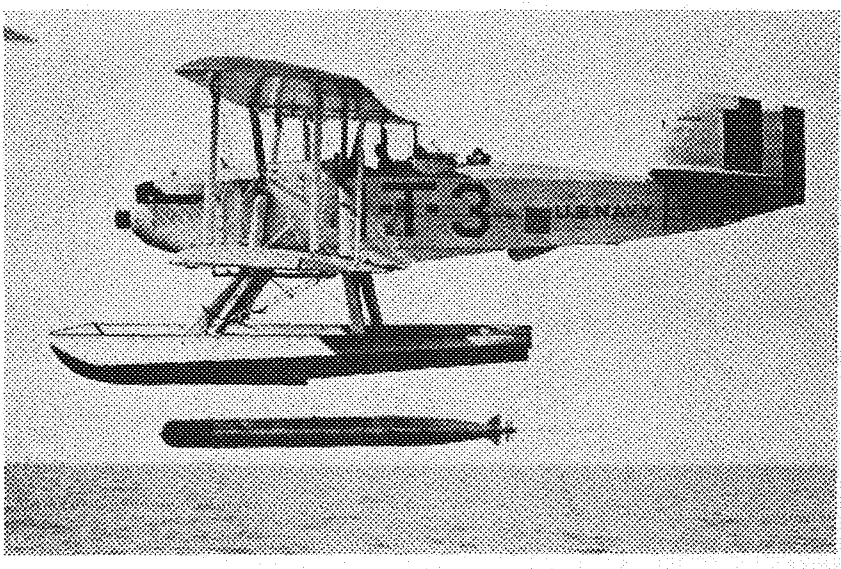
So much for background. What you want to know is "What does the Navy offer?" Briefly it is this—Assume that you are a student at the University, preferably a Junior for then you will have had some military training, one object of which is to teach discipline. Assume further that you are of officer caliber, in excellent health for the physical requirements are very stringent, and that you have a keen desire to fly.

There is a course offered in the Engineering college known as "Aviation" in which you may register at the beginning of your junior or senior years. From the members of this class are chosen those who are to receive flight training with the Navy. That you are chosen is our last assumption, which may be a large one for truly "many are called but few are chosen", so rigorous are the exactions of the Flight surgeon, the Crash board and the regulations for the government of the United States Navy. But you will be well repaid for your efforts, for at the conclusion of the school year you will be sent to Great Lakes (on Lake Michigan near Chicago) for preliminary training. Here you will live in student barracks, spending from two to five hours a day in the air. The balance of the time you spend on the beach or in the barracks learning to take radio code. The Government will provide transportation, food, shelter, clothing and the pay of your grade, which at this stage of the journey will be seaman, second class. Within the ten hours allowed for dual instruction you should solo and then the balance of your forty-five days at Great Lakes will be spent in piling up solo flying time in the N-Y's, U-O's and other training plane types.

At the end of forty-five days you will pack up your sea-bag, say good-bye to the Beach Gang and leave for Pensacola, Florida, to receive advanced training. Here they assume that you are a flyer having successfully passed the first initiatory and will accept you as a member of the air-fraternity. You will learn to fly everything from fast land pursuit ships to the large multi-motored flying boats. Your experience will be rounded out, between flights, by the atmosphere of a typical naval station. You will learn the procedure and customs of the Navy and the duties and responsibilities of a Naval officer. At the end of your tour you will go up for examination and then be sent home on leave.

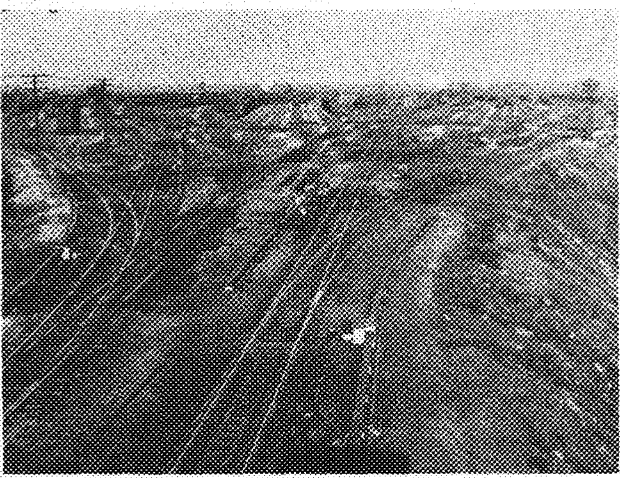
Here the ways part. Perhaps, if you have not already done so, you will want to finish school and get a job. Should you locate in the vicinity of Minneapolis you will be attached to the squadron which has just recently been assigned to that city and on Saturday afternoons or such time as you can (by now you will rate Ensign, U. S. Naval Reserve) you will present yourself at the squadron hangars, climb into a pursuit job and put in your required flying time. Perhaps the squadron will go en masse on a navigation hop or again engage in combat practice. You should like it. The Navy last year offered, and undoubtedly will in years to come, offer a one or

(Continued on page 222)

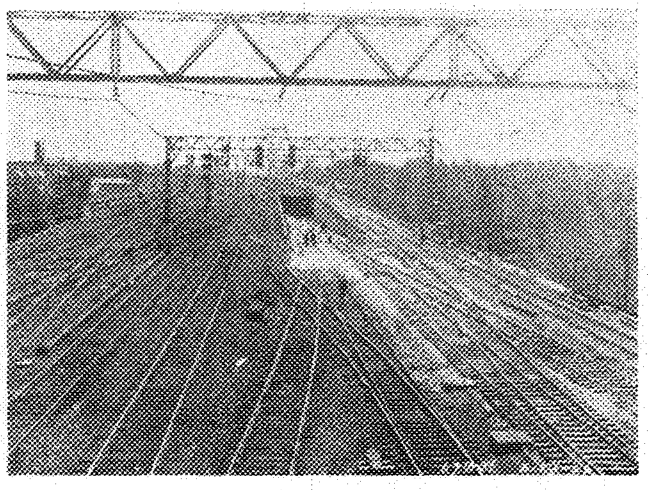


DROPPING A TORPEDO

An exceptional photograph of an S C type plane in action. The exhaust of the torpedo motor can be plainly seen.



MARKHAM FREIGHT CLASSIFICATION YARD
It is equipped with electrically operated car retarders, floodlight illumination and modern devices. Note retarders in foreground.



ELECTRIFICATION OF THE TERMINAL
Tracks of the Illinois Central looking south from 67th street, showing entrance to the duckunder tunnel for the south branch.

Illinois Central Electrifies Terminal

Railroad improvement program of $25,000,000 at Chicago includes construction of a large freight yard, shops, bridges, tunnels and subways

By ADOLPH A. SOMMERFELD, C '10

THE program for improvement of the Illinois Central terminal at Chicago is made up of a number of individual projects, any one of which by itself is a sizeable undertaking. Briefly, they include: elimination of all street, highway and railway grade crossings on the main line for the first thirty-eight miles south of the Chicago River; relocation of nearly all tracks on the terminal; construction of an immense freight classification yard; construction of extensive shop facilities; relocation and construction of freight and passenger car yards; construction of bridges, tunnels and subways; erection and reconstruction of suburban passenger stations; reconstruction of several miles of retaining walls; reconstruction of the signal and interlocking systems; erection of a monumental passenger terminal near the site of the present Central Station; complete replacement of suburban passenger train equipment, and electrification of suburban, freight and, under certain conditions, through passenger operation. A large part of this work, including most of the track work and the electrification of the South Side suburban service, already has been completed.

Wherever major engineering projects are under way the chances are that Minnesota will be represented among the holders of responsible positions in the work. The improvement and electrification by the Illinois Central System of its Chicago terminal—one of the outstanding railway construction undertakings of modern times—bears out this prideful assumption. Among the men charged with important duties in connection with this project is Assistant Engineer Adolph A. Sommerfeld, '10.

After graduation in civil engineering Mr. Sommerfeld spent five years as inspector and designer in the service of Toltz, King & Day, consulting engineers and architects, of St. Paul, Minn. He was then employed by the St. Paul Union Depot company as structural designer on the passenger terminal, being engaged in this work for approximately five years.

Mr. Sommerfeld entered the service of the Illinois Central System in May, 1922, as a designer in the Chicago Terminal Improvement department. Shortly afterward he was promoted to assistant engineer in the same department and assigned to the staff of the engineer of design, being in charge of the designing of improvements in connection with the work of the department. He lives at Homewood, Ill.

Some idea of the impressive scope of the program as a whole can be obtained from consideration of the following figures: the complete undertaking involves the movement of approximately 10,000,000 cubic yards of earth, the construction of sixty miles of new main track and 190 miles of side track, the electrification of 420 miles of track, the depression or elevation of eighty miles of track and the realignment of 120 miles of track. In the electrification of the suburban service it was necessary to erect more than 900 catenary structures and to string approximately 293 miles of transmission wires and 470 miles of messenger and contact wires.

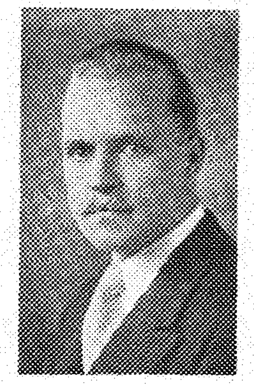
To replace the passenger train equipment used in suburban service under steam operation the railroad had built to its order 130 motor cars and 130 trailers, costing in the aggregate around $10,000,000 and providing seating capacity for nearly 22,000 patrons. These will soon be supplemented by twenty more cars of similar types, now being ordered. In addition to the two purchases of cars, the railroad spent about $4,000,000 for electrical work and about $9,500,000 for track re-arrangements, new track and station facilities and grade separations, making a total of almost $25,000,000 for improvements in connection with the electrification of the suburban service. An additional $20,000,000 has been spent in the rearrangement and improvement of facilities by reason of other phases of the terminal improvement program.

ONE notable feature of the construction work comprised in this improvement project is the fact that it has had to be carried on without interference with the normal operation of an extremely busy terminal. While the suburban electrification work was at its height approximately 600 trains a day were being operated over the terminal tracks, and in addition, around 125 switch engines were at work at various times of day.

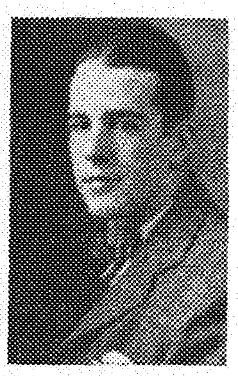
(Continued on page 224)

THE ARABS

SHELDON JOHNSON
Senior Electrical is Business Manager of the 1928 Arab Production



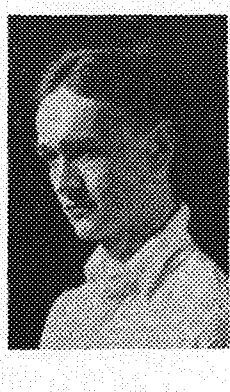
HAROLD EKMAN
A Senior in the College of Architecture is Production Manager for the Arabs' Play



CHARLES PETERSON
The Author of "High Pressure"

MARVIN FERGESTAD
Who Plays the Part of Zadhir, the Leading Lady

EUGENE WEBER
Jimmie, a University Student



GORDON BESTIC
Playing the Part of Bud, is a Companion of Jimmie on their canvass thru Arabia

"High Pressure" on the Desert Sands

The Arabs present for their sixth annual production a tale of two engineering students wandering through the mystic East selling patent medicine

THE glare of the burning sands of Egyptian desert penetrating the dense shadows cast by towering palms at noontide; the shifting colors of a radiant market place teeming with traders and slaves; the gaudy dress of the merchants and beggars; the dim interior of an oriental court of justice; the startling colorful drapes of the oriental harem—this plus a musical score, which, for pure beauty, surpasses any student production ever heard on the Minnesota campus is "High Pressure."

Presented in the Music auditorium of the University Friday evening, April 13, and Saturday matinee and evening, April 14, "High Pressure" is the sixth annual production of the Arabs, dramatic club of the College Engineering of the University of Minnesota.

Charles E. Peterson, senior architect, is the author of this year's production which deals with the trials of Bud and Jim, two engineering students selling patent medicines in the Sahara desert. Broke, the two are stranded on an oasis when Catulpa, a beautiful barmaid, comes to their rescue with the suggestion that the three journey to Algiers and set up a medicine show as the town is famed for its enthusiastic reception of entertainment.

The second act opens with the trio in Algiers, and here amidst the bustle of the market place Bud, Jim and Catulpa get into and out of trouble in many unique ways. With the exposition of how a desert sheik really loves, the play comes to a close at the end of the third act with Bud regaining the love of a co-ed who had turned him down because of the lowly standing of his fraternity.

Avner Rakov, composer of last year's music, has composed the entire musical score of "High Pressure." Melodies having the stirring rhythms of the East are the feature of this year's production. Songs like the "Love Song", sung by Sheik Ben Dorbraik, "Pink Ticket Blues," and "I Won't Say 'No'," are bound to keep the campus humming Arab melodies.

Settings under the direction of Rex Severson have been built by the engineering students during the spring vacation and the following busy school weeks. These settings, designed by Walter Huchthausen, have been treated with the usual imagination that is inherent in all Arab productions. The atmosphere of the Arabian desert has been caught in all of his scenes and the result is far above the Arab standard.

Carl Matthias Wise, instructor in the School of Architecture, and only charter member of the Arabs on the Minnesota campus, has directed the 1928 offering of the club. Dancing, one of the outstanding features of an Arab play, is directed by Miss Mercedes Nelson.

Arabs is a distinctive organization on the campus of the University of Minnesota. Founded in 1922 by a group of engineering students interested in dramatics, the Arabs has become the recognized male dramatic club of the all-University campus. Each spring the

(Continued on page 224)

PRODUCTION STAFF OF ARABS

Officers

Harold Ekman	*President*
Charles Peterson	*Vice-President*
George Burch	*Secretary*
Herbert Hathaway	*Treasurer*

Production Staff

Carl Matthias Wise	*Director*
Harold Ekman	*Production Manager*
Avner Rakov	*Musical Director*
Walter Huchthausen	*Scenic Designer*
Paul Dahl	*Properties*
Rex Severson	*Stage Manager*
Gordon Jones	*Personnel*
Karl Sommermeyer	*Asst. Personnel*
Thomas Finnell	*Singing*
Nathan Juran	*Costumes*
John Kriechbaum	*Lighting*

Dancing under the direction of Miss Mercedes Nelson.

Business Staff

Sheldon Johnson	*Business Manager*
Carl E. Swanson	*Business Associate*
Lawrence Johnson	*Business Associate*
Walfred Swanson	*Promotion Manager*
William C. Hill	*Publicity Director*
Albert E. Morse	*Publicity Assistant*
J. Robert Ginnaty	*Publicity Assistant*
Albert E. Morse	*Program*
Frederic Hakenjos	*Posters*
Realto Cherne	*Tickets*
Gordon Harris	*Radio Publicity*

THE CAST

Minnie Blomwitz	Thomas Finnell
Pete, her husband	Richard Robinson
Tourists from Kansas City	
Shiek Ben Dorbraik, dude wrangler	Erling Nelson
Al-Kuhl-ai-Iyke, old timer	Herbert Hathaway
Catulpa, ambitious barmaid	George Burch
Bud	Gordon Bestic
Jimmie	Eugene Weber
Students from the second largest state university	
Elboh Rhum	Donald Felthouse
Zadhir, coed from the same place	Marvin Fergestad
Jew. Algiers shopkeeper	Harold Shannon
Tough Cop	Donald Felthouse
Office Boy	Francis Gorman
Judge	Lawrence Hovik
Coal and Ash Man, Zadhir's father, a great commercial figure in northern Africa	Lawrence Hovik
Madame Pulon, French dressmaker	Francis Gorman
Reporter	Herbert Hathaway
2nd Reporter	Marshall Ervin
Photographer	Harold Shannon

Male Chorus

Karl Sommermeyer, Marvin Fergestad, Everet Ostlund, Richard Robinson, Clifford Mellin, Irving Grant, Fred Anway.

Female Chorus

Harry Hall, William Thompson, William Jennings, William B. Ervin, Marshall Ervin, Chester Nelson, Leslie Harlow, Francis Gorman, Leland Amundson, Wesley Gray, Harold Shannon.

Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

That Tragic Word Almost

STUDENTS often say that all they want out of a course is a passing grade. They say that they don't want to kill themselves studying. And so with this attitude in mind they go to class. These men seldom go very far.

It might be said that studies are the first obstacle in the race of life for a student. If the student fails to clear the hurdle he is out of the race. The way in which he clears it depends upon the amount of training that he goes through. If he trains haphazardly he takes a chance on getting a D or a flunk, while with a very little more effort expended he could be a brilliant student. If instead of spending 15 or 20 minutes a day in preparation for a class the man would devote another half hour to each study it would mean much higher grades, perhaps an A or a B. Many men will do just so much work, go just so far and no further. With the prize almost within reach they won't put forth that last little ounce of energy and effort to get it.

An Engineer's Duty

A MAMMOTH dam breaks and crumbles before the enormous force of spring freshets from the mountains. A wave of irresistable water sweeps through a prosperous valley and carries on its destructive crest the lives of the inhabitants. The headlines of the daily papers immediately scream of the stark tragedy of a faulty dam.

At once the cry is set up for an investigation, and the engineer in charge of construction is called upon to make his report. There is no escaping the responsibility. The engineer must shoulder the burden of the blame until he proves the dam strong, and shows why the fault occurred.

It is a good thing to bring before a student of the engineering colleges the idea that the engineer's responsibilities are not small. He takes over a piece of work with the understanding that he will carry through, and turn in a first class completion report. If there is a fault because he doesn't carry through, he is through as far as big work is concerned. There have been few engineers who have staged a comeback after having made a costly blunder. They seldom get the chance.

The graduating engineers at this time should keep all this in mind as they step from the protection of class room into their work where they are their own supporters.

A Babel of Reports

IN the engineering college, juniors, seniors and undergraduates all have to write reports and more reports. To the uninitiated an engineer's life seems to be just one report after the other and to the engineer who has courses in two or three different departments, as sometimes happens in the upper classes, life is just one report after another. No two departments want their reports written in just the same way and each report must correspond to the style that has been set up by that department else it is not considered for a passing grade at all.

Why can't all of the departments of a single college and the departments of the cooperating colleges get together and work out some form of a report that would be satisfactory to all of these departments and then set that form up as an example for the students to follow?

That Cadillac Chassis

THE tires still remain on the Cadillac chassis, standing in the front hall of the Main Engineering building.

It seems that some of our hoisting engineers have removed everything on the cut-open model that could be taken off without the aid of a hammer and chisel. It may be that they were taken to replace some wornout Ford part. It may also be that the engineering students needed these spare parts on their Cadillacs. No one knows, but it is known that if this attitude taken towards a gift to the College of Engineering be taken as the attitude of the students as a whole, the college will receive very few gifts.

It would be better that the chassis be placed in some less exposed position to preserve it from the souvenir gathering American student.

Plan Ahead

THE only way in which we can really get a clue as to what direction we should turn for permanent work is to make a careful self-analysis, not only when we graduate and look about for placement, but constantly, during the period of training in school, and during our temporary work in the summer vacations. It would be as foolish for a man to take the first position open when he gets out of school regardless of his suitability for that work, as it would be for a contractor to erect a building before knowing the use for which it was intended.

Many inventions have been placed on the market within the last ten or twenty years, and every indication points to the fact that in the future more and more conveniences will be made. Magazines are filled with articles on the engineering feats of the future. Huge skyscraper cities mount high up in the air; aircraft will fill the air; television will be as common as the present day telephone; electric power will be sent through air.

To the practical engineer of today this sounds fantastic, and very futuristic. He can't realize that such things will come, but very likely they will, just as modern inventions have come.

Tool Makers

IN the "Nation's Business" there appeared an article on the tool maker as a real power in the age of machines. Without the tool maker there would be no engines of such immense power as the steam engine and the combustion engine.

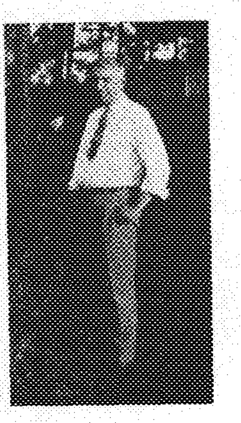
In 1775 Watt invented the steam engine. How many times had a steam engine been invented and failed? It is hard to say. Why was this invention a success at this time? Because of the tool maker.

Even today in our technical colleges throughout the country there are men of tool maker's minds. They are the men who are constantly seeking to improve what we now possess. They eternally ask "why" and "how". These men will some day give us an infinite range of utilities. We see our one time miracles becoming commonplace. The possibilities of the future are staggering to one who would but take the time to sit and think of the advancement through the past one hundred years all due to the sudden growth of the tool maker.

The improvements in the purely scientific fields have been due to the endeavors of these men who are pointing out, "Why cannot this step be eliminated or refined? The product is not yet perfect. Let us perfect it."

The field is still virgin. Why don't more take it up?

Faculty Sketches



ALVIN S. CUTLER

ALVIN S. CUTLER, professor of railway engineering, born at Pittsford, Michigan, in 1879, received his public school education at Hillsdale, Michigan. Later he attended Hillsdale College, pursuing the academic course.

In 1900 Mr. Cutler began his engineering career—a career that has led him into all phases of railway work—by directing bridge construction work in Iowa. In 1901, Mr. Cutler entered the University of Minnesota as a student. An interim of two years between his sophomore and junior work he spent as instrument man and draftsman for the Lake Shore Michigan Southern railroad, a part of the New York Central between Toledo and Chicago. During this time he was also engaged on a heavy grade revision project of the M. and St. L. between Minneapolis and Shakopee. After graduation, he worked in the office of the chief engineer of the Erie railroad in New York City.

About this time the railroad rate situation became a vital problem throughout the country and particularly so in Minnesota. So important did it become, in fact, that the Minnesota State Legislature authorized the State Railroad and Warehouse commission to make a valuation of all railroad property in the state. All railroads were requred to make a complete field and office survey, which was submitted to the commission for approval. The M. & St. L. placed Mr. Cutler in charge of a rate readjustment on these valuations.

In 1907, Mr. Cutler married Myrta R. Marshall of Pittsford, Michigan; and in the fall of the same year, began teaching railway engineering at Minnesota. He has held this position continuously since then, but has done a great deal of special work for the Grand Trunk, Great Northern, and Northern Pacific railroads. He was in charge of location on a line extension from Watertown, South Dakota, to the Missouri river. He directed soundings and borings for a bridge location across the Saginaw river as well as a survey for the freight terminal layout at Base City, Michigan, for the Grand Trunk railroad. In 1918, Mr. Cutler was placed in charge of cost valuation of the Great Northern for the federal government. In 1920, at the request of a citizens' committee of Minneapolis, Mr. Cutler made plans for the re-location of the yards and shops of the M. & St. L., now located in the Kenwood district. His plans called for their removal to the west side of Cedar lake in the vicinity of St. Louis Park. These are but a few of the projects, including location, line survey, cost valuation, grade changes, terminal layouts and office work which have made railway engineering so inspiring to Professor Cutler.

Mr. Cutler is a member of the American Society of Civil Engineers, the American Railway Engineering Association and The Minneapolis Engineers Club. He is a member of Tau Beta Pi, Sigma Xi and Theta Xi.

Appointed by Dean Leland to represent the engineering college as a faculty member of the Minnesota Techno-Log Board, he has taken an active interest in the Techno-Log and is one of our ardent supporters.

Scrambled Dramatics

OUT of the jumble of dramatic societies on the campus of University of Minnesota there arise but two organizations worth the name "organization." These are the University Workshop, an amalgation of several academic societies, and Arabs, a male dramatic club of the engineering college.

The poor drawing power of the academic clubs seems to have been the reason for the founding of the Workshop under the direction of Edward Staadt. There has never been the need of Arabs affiliating themselves with any other body for support. They have always been more than self supporting, filling their houses to capacity and realizing a substantial profit off of each year's production.

All this is but the lead to what we want to point out now. On the back page of the program of a recent production of the Workshop there appeared the statement that "the Workshop presents Arabs in 'High Pressure.'"

There is nothing farther from the truth than this misleading statement. Arabs have never intimated that they would to any degree affiliate with the Workshop, and it must be clearly understood by every student and alumnus of the engineering college that Arabs intend to continue an independent, self-supporting organization, staging their own shows, writing their own lyrics and music, designing their own settings, choosing their own leads.

Arabs have been self-supporting in the past. They will be so, with the engineering student body behind them, in the future.

Let's all loyally support Arabs in their productions this year and the following years.

Aeronautics at Minnesota

AN aeronautical course in the College of Engineering has been authorized by the Board of Regents of the University of Minnesota. This opens up a field of engineering little thought of until the world war showed the possibilities of the heavier than air craft as carriers.

Since the establishment of the Wold-Chamberlain field and the St. Paul municipal landing field, the Twin Cities have offered exceptional opportunities for the establishment of a practical course at the University of Minnesota.

School of Architecture Ranks High

Many students win honors in graduate work in eastern colleges; enrollment grows from 50 to 300

By Roy Thorshov, E '28

THE School of Architecture, one of the youngest of the departments in the College of Architecture and Engineering, was established in the autumn of 1913, completing its first year in June, 1914. Though this is the date of the founding of the department, architectural instruction had been offered at various times previous to this. In 1894 the first attempt to offer such instruction was made and Harry W. Jones, a Minneapolis architect, was the instructor. However, a lack of interest on the part of potential students did not warrant the continuance of the courses and they were discontinued.

The school of architecture as now established, is the work of Professor F. M. Mann. Professor Mann graduated from the University of Minnesota in the civil engineering class of 1893, and also held degrees in both the regular and graduate courses of architecture from the Massachusetts Institute of Technology. Previous to founding a school of architecture here, Professor Mann had organized a school of architecture at Washington University in St. Louis, Missouri.

The enrollment during the first year did not exceed 50 as compared with the 270 students at the present time. Courses for only the freshman and sophomore years were offered the first year. The year following junior class courses were added and during the next year senior class courses were added. Professors S. C. Burton, R. C. Jones, R. T. Jones, and J. Forsythe as members of that first faculty group with Professor Mann have founded a school that rapidly advanced to the forward rank of architectural schools of America. In 1918 Professor Leon Arnal, a brilliant graduate from the Beaux Arts School, was brought from Paris to Minnesota to take charge of the instruction in design. Professor Elmer Young is instructor in freehand drawing and water color in the department and has won frequent honors with exhibitions of his work.

With a faculty made up of such men, it is no wonder that Minnesota has already in the short time of fifteen years produced many honor students in architecture, men who have won high places in graduate work at eastern schools. To name but a few would include the names of George L. Dahl, Ralph Hammett, Jake Leibenberg, I. Woodnar Silverman, Olaf Fjelde, and Edward Holien. Both George Dahl and Ralph Hammett won scholarships at Harvard which entitled them to study in Europe. A few years ago an exhibition of drawings by Ralph Hammett was held in the architectural department. George Dahl has enriched the architectural library by a book of his called "Doorways of France," the result of his scholarship to Europe. Jake Leibenberg won the gold medal at Harvard University offered to the student attaining the highest scholarship in architecture. Edward Holien is now travelling in Europe, studying.

The average engineering student who has not been initiated into the secrets of the architectural drafting room wonders what it is all about, what we do with our time, and how we solve our problem. Each problem might be divided into three stages: the esquisse, the development, and the presentation. The first stage in which the esquisse, a sketch showing what solution is going to be followed, is drawn, covers a period of nine hours. At 1:30 in the afternoon the class is given a program of the problem to be studied with all its requirements, the scale at which it is to be drawn, and the date when it is due. That night at 10:30 the esquisse is due, showing the scheme of design which each one has adopted to develop. This esquisse is made without reference to any documents or sources of information. The stage of development begins by the criticism by the professor of the esquisse which we had prepared. Studies are then drawn, criticized, re-drawn, criticized again and again until the time is at hand for the presentation of our solution. The presentation represents the final stage of development and calls forth all the skill of the student in rendering and drawing.

A visit to the drafting room a few nights before a problem is due will make anyone understand why architectural students leave home, and interior decorators get gray hair. Everyone is working at top speed on his solution with time, nevertheless, to crack wise or sing some little ditty that will eventually be the hit of an Arab show. And if some interior decorator or architectress should be present, she is sure to be the victim of a bit of repartee. Yet, the interior decorators seem to thrive on such treatment.

The drafting room is not a place inhabited by the dead. Once in a while to make things interesting "sink parties" are given and some kind soul is initiated into the order of the bath. Such a ceremony is simple, requiring nothing more than a sink full of water and a candidate for initiation. The popularity of such initiations is so great that one architect has already requested two this year and has received both with great satisfaction to everyone.

Then the architects have their parties. During the fall quarter a freshman reception is held, which is attended by most of the seniors, juniors, sophomores, and some freshmen. The object is to get the students acquainted with each other and to make the freshman feel at home. During the winter quarter a smock party, called such because everyone wears a smock, is held in the senior drafting room. The upper portion of the walls is decorated with cartoons of students and faculty in characteristic poses and predicaments. And these decorations are quite permanent. After the party they remain as reminders of past good times and future better times. During the spring quarter a grand costume ball is held. This ball is modelled after the Beaux Arts' ball at Paris. Days are spent in preparation and the engineering auditorium is decorated to transport one far from reality into a land of dance, music and make-believe.

Besides being active among themselves, the architects have played an active part in dramatics and athletics in the Engineering College and on the campus as a whole. "The Blue God," "Riquiqui," "Mona Lizzie," besides this year's Arab production were written by architects, as was the music for these plays.

The contributions from the department to the varsity athletics of Minnesota have ranged from men of the caliber of "Black" Rasey, Homer Tatham and Lawrence "Duke" Johnson, to the many freshmen who win their numerals in the many Minnesota sports.

In the other activities of the college, such as the publishing of magazines and papers there have been Stanley Bull, business manager of the 1925-26 Techno-Log, Lawrence B. Anderson, art editor of the 1926-27 magazine, and Walter Huchthausen, present art editor of the magazine.

Such is the history of the department of architecture and such is the life of its students at work and at play.

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

Concrete Test Slab Finally Broken

Ten Feet Square by Four and Three Quarters Inches Thick, This Slab Has Been Measured for Stress and Shrinkage Effects of Time on Concrete.

AFTER 14 years of testing, a concrete slab ten feet square and 4¾ inches thick broke during the month of March under the pressure of 30,000 pounds. Originated for the purpose of studying time and shrinkage effects in concrete by Mr. F. R. McMillan, director of research for the Portland Cement Association, this project has continued from May 28, 1914, to the present.

The slab rested on two knife edges ten feet apart and was reinforced with ⅜ inch plain round bars 5½ inches on center longitudinally and 5/16 inch round bars, 12 inches on centers, at right angles and directly above them.

Readings totalling into the hundreds of thousands have been taken on this slab by members of the Civil Engineering department. It was only because of the need of space for the foundation of the new 400,000 pound testing machine that the slab was broken under the pressure of 30,000 pounds. These readings will be made into a bulletin to be published later by the department.

$10,000 Prize Offered for Essay on Traffic

Students and members of the faculty in all departments of University of Minnesota are eligible to compete in a $10,000 traffic contest being conducted by Nation's Traffic, the national publication devoted to street and highway traffic published in St. Louis. The contest is intended to induce new ideas on traffic control and regulation and to cut down the tremendous death toll taken in motor vehicle mishaps.

Fifteen cash awards will be made. First prize will be $2,500 and the second $1,500. The next three awards will be of $1,000 each, with the sixth prize $750 and the others ranging in amounts from $100 to $500.

The subjects to be written on are as follows: Text for uniform traffic ordinance, plan for regulating movement of traffic with signals and signs, plan for the solution of municipal parking problems, typical city plan to better traffic conditions, curriculum for adult education, plan for handling traffic violators, plan for regulation of pedestrians, curriculum for juvenile education, plan for reducing railroad crossing hazards, plan for traffic police organization, street lighting plan to aid traffic, plan for motor vehicle registration and identification, and plan for handling tourists.

The contest closes April 30 and the Committee of Awards will announce their findings in May. Information regarding the contest may be obtained by writing Nation's Traffic, Title Guaranty Bldg., St. Louis, Mo.

TECHNO-LOG BOARD ELECTIONS

FILING OF MANAGING EDITOR AND BUSINESS MANAGER APPLICATIONS

Announcement has been made by the Techno-Log Board, governing body of the Minnesota Techno-Log, that all men wishing to file for the position of Managing Editor or Business Manager of the Minnesota Techno-Log must have their application in the hands of George Ferguson, president of the Board, by 5:30 p. m. Monday, April 16. Applicants for the respective positions shall state plans, experience, activities and scholarship. Also they shall state their year in school and course. Any person in the technical colleges may file for either of these positions.

Election of new members of the Techno-Log Board for the coming year will take place at the regular all-university elections. Seven men are to be elected; one from the School of Architecture, the civil department, the electrical department, the mechanical department, the School of Chemistry, the School of Mines, and one at large from all the technical colleges.

Minnesota Chapter A. S. C. S. Elects

Dr. M. C. Sneed Made President, Dr. R. E. Kirk, Secretary, and Dr. R. E. Montona, Treasurer. Councilors are Dr. C. A. Mann, and Dr. R. A. Gortner.

THE Minnesota chapter of the American Chemical Society elected officers for the coming year at the last meeting. Dr. M. C. Sneed, chief of the inorganic department of the University of Minnesota, was elected president. Dr. F. C. Exner of Carleton College was elected vice president. The other officers are: Dr. R. E. Kirk, secretary, and Dr. R. E. Montona, treasurer, both from the University of Minnesota. Councilors for the coming year are Dr. C. A. Mann and Dr. R. A. Gortner, also both from Minnesota. Appointments to the Senate of Chemical Education are as follows: Industrial, Dr. Gray of the Pillsbury company; High Schools, Mr. Nordstrom of Crookston High School; University, Dr. R. E. Kirk of the University of Minnesota; and contributing editor to the Journal of Chemical Education, G. B. Heisig of the University of Minnesota.

Meterman Short Course Offered in Vacation

Spring vacation found the Electrical Engineering building utilized by the Minnesota short course for Electric Metermen. This course had for its purpose the presentation to users of electric meters of the latest, safest and most economic methods of installing and calibrating meter

(Continued on page 230)

Puzzling Black Box on Electrical Building Aerial Is Short Wave Tuner; Not a Bird House or Weight

ABOVE the roof of the Electrical building a box is fastened to a vertical radio antenna. A rod is fastened to this box, but it is the box that receives the most comment from passing students.

"Since when did the engineering college go in for bird husbandry?—"

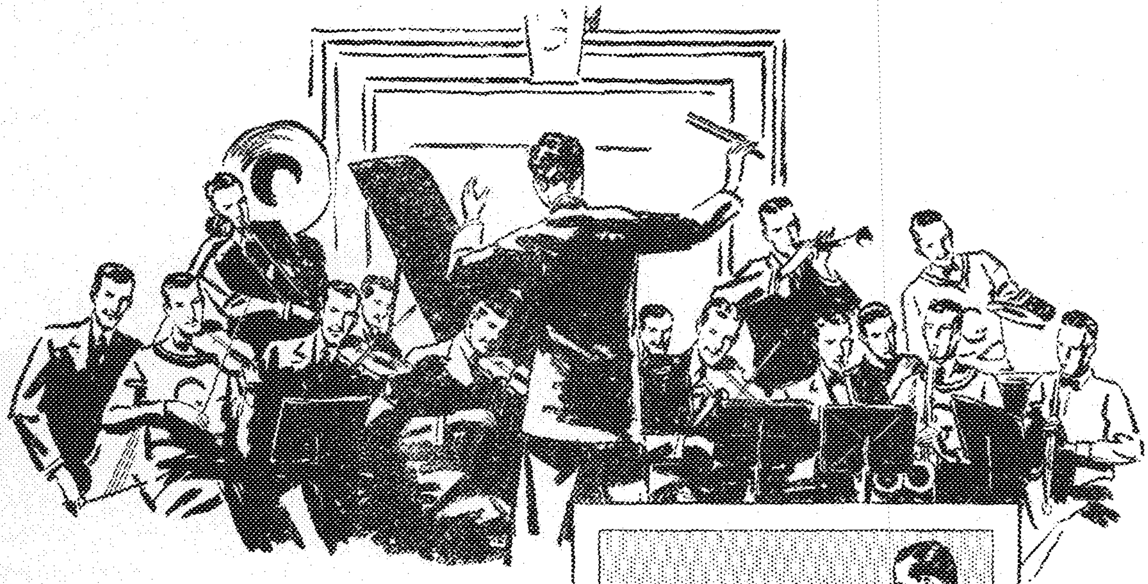
"That's a weight to keep the aerial tight in a strong wind."

These are but a few of the exclamations applied to this black box.

Back in the days when the short wave transmitting set was a novelty, the University of Minnesota was one of the earliest to install a transmitter. The first signals sent out were of poor quality, so a meter was placed in the antenna itself, in order to indicate the true current.

The meter was required to be waterproof, so it was placed in a box with an opening through which to read the dial. Reading this dial proved difficult as the meter hung twenty feet above the building, and the dial was all but invisible. A sextant overcame this difficulty, but a sextant, while very easy to use in the summer, was almost impossible to use in the best transmitting season, the winter.

Realizing this, during the first year readings were taken of the meter and the data was used to compute what capacity must be used in the antenna to give the required signals. Then the meter was taken down and a variable condenser fixed at the computed capacity was housed in the same box and put back.



Around the World With Our Alumni

Architects

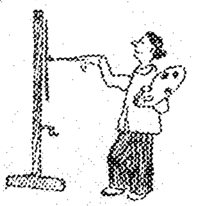
'23—Otto C. Person, former business manager of TECHNO-LOG, has been with the Schuett-Meier company of Minneapolis since his graduation, with the exception of six months that he spent on the city planning commission of Duluth. His work has been mainly in the design and detail of reinforced concrete buildings of all types.

'23—The address of Clarence H. Luedeman that was given in the January issue of the TECHNO-LOG, we learn, is incorrect. He is at present connected with the Comer Metal Lath Construction company. Address him at the office of the company in the Pioneer Trust building at Kansas City, Missouri.

'24—Mark L. Nelson is with Thomas Ellebre and Company, architects in St. Paul, as are also Clyde Lighter, '26, and William Edwards. Nelson was formerly working in Owatonna, Minnesota, and Lighter was with Colburn and Forsell of Minneapolis.

'26—Raymond (Black) Rasey has resigned from the Winston-Hill contracting company at Gasconade, Missouri, to take a position in the technical department of the Northwestern Fuel company of Minneapolis.

'26—R. K. Redin has relinquished his position of structural draftsman with the Schuett-Meier company of Minneapolis and is now with the state highway department.



'27—R. V. McCann has accepted a position with the O'Meara-Hills company and is now located in their architectural office in St. Louis, Missouri.

Chemists

'24—Albert Zima, who is chief chemist and metallurgist for the Western Crucible Steel Casting company of Minneapolis, returned to the campus on March 29 to read a paper on "The Steel Foundry" before the Minnesota section of the American Chemical Society. Mr. Zima entertained the members of the section in the afternoon with an inspection of the plant of the Western Crucible Steel Casting company.

'26—S. R. Olsen was awarded the degree of M. S. in biochemistry at the winter quarter commencement.

'26—Parmalee S. Haugsrud has returned from California and has entered the graduate school, where he is doing work toward his M. A. degree.

'26—John L. Tronson has taken a position as plant chemist with the Goodrich Rubber company at Akron, Ohio.

Civils

'02—Louis Yager, who is assistant chief engineer for the Northern Pacific railroad, was recently elected first vice president of the American Railway Engineering Association. Mr. Yager has been with the Northern Pacific since graduation from Minnesota, with the exception of time spent during the war as a member of the railway administration at Washington, D. C.

'05—Oliver Mattison, as president of the Minneapolis Bridge company, has been awarded the contract for the construction of a new concrete bridge across the Mississippi at Anoka by the Minnesota state highway department.

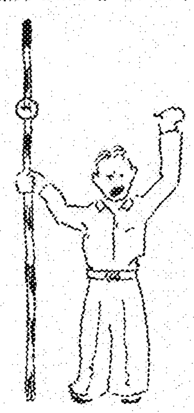
'09—Nels W. Elsberg, city engineer of Minneapolis, who has long been known as the city hall's most confirmed bachelor, was married recently to Rose Borthwick Johnson of Liverpool, England. Mr. and Mrs. Elsberg plan to make their home at the Leamington hotel in Minneapolis.

'13—Oscar Wangaard, who was formerly an architectural engineer for the Minneapolis school board, has accepted a position with the Schuett-Meier company at 913 Pioneer building, Minneapolis.

'19—John M. Hannah is now with Magney-Tusler and Company, architects, of Minneapolis.

'21—Carl S. Johnson has recently changed his address to 112 Groveland Avenue, Buffalo, N. Y. He is still with the Lackawanna Steel Construction Corporation of Buffalo.

'26—Edward F. Young is with the U. S. Engineer's office at Detroit, Michigan. That he is enjoying his work is evidenced by the following excerpt from recent letter: "The only trouble with the work here is that it is so pleasant that one hates to quit.—I have also discovered that to remain in government employ too long deadens one." "Ed" is bowling on the Minnesota team in the Intercollegiate Alumni Association league in company with "Ken" Swanson, Bus. '23, and Axel Malmstrom, E.E. '17, who is working for the Detroit Edison company at Detroit. "Sorry to say that we aren't even leading the second division but we do our 'darndest' and have a lot of fun out of it," says "Ed."



'26 — Truman P. Young has severed his connection with the Chesapeake and Ohio railroad, and has accepted a position with the Union Terminal company of Cincinnati, Ohio, as a structural designer.

'28 — George J. Schroepfer has an engineering position with the bridge department of the Minnesota state highway department.

'27—Clarence C. Lande, who is working for the Kimberly-Clark Paper company at Appleton, Wisconsin, furnishes some interesting information about an engineer's work in a paper mill in a recent letter to the TECHNO-LOG. Lande writes: "I am working in the development unit. Our work is to plan and design new methods or improve existing methods in the various steps in the manufacture of pulp and paper.—Each engineer or group of engineers work on a special problem until it is completed, so a fellow has a chance to use the 'ol bean' and work out some of his own ideas."

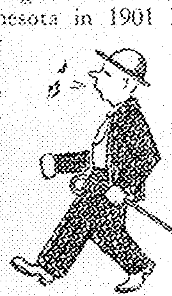
'28—Mons H. Benson has recently accepted an engineering position with the United States Army engineers. He is stationed at Grand Rapids, Michigan.

Electricals

'01—Charles E. Tullar has recently been made assistant manager of the General Electric company patent department. A recent letter from the General Electric company gives the following interesting resume of Mr. Tullar's engineering activities:

"Charles E. Tullar, who was recently made assistant manager of our patent department, knows engineering both from the theoretical and the practical standpoints. In addition to this, he has had a number of years of experience in government service in the patent field.

"Immediately after his graduation from the University of Minnesota in 1901 he worked as an operating engineer for the St. Louis Gas and Electric company. A year later he entered the employ of the Fairbanks - Morse company, where he remained until, at the end of the year, he rejoined the St. Louis organization as chief operator of one of its power stations. In November, 1904, he entered the service of the government as electrical engineer and draftsman in the supervising architect's office of the Treasury department. From July 1, 1905, when he entered the United States Patent Office as an examiner, he advanced through the various grades until, in October, 1917, he was appointed principal examiner in charge of one of the electrical divisions of the Patent Office. He joined our patent department in July, 1919, and in December, 1927, was made assistant manager."



At the present time Mr. Tullar's principal avocation is golf. There was a time when he was interested in skating, but on one occasion he went through the ice in the Tidal Basin at Washington—since then the fairway looks better to him than the straightaway.

'23—James P. Johnson is now division commercial engineer for the Nebraska district of the Northwestern Bell Telephone company. A recent issue of the *Northwestern Bell* published the following sketch of Mr. Johnson's activities since he has

(Continued on page 226)

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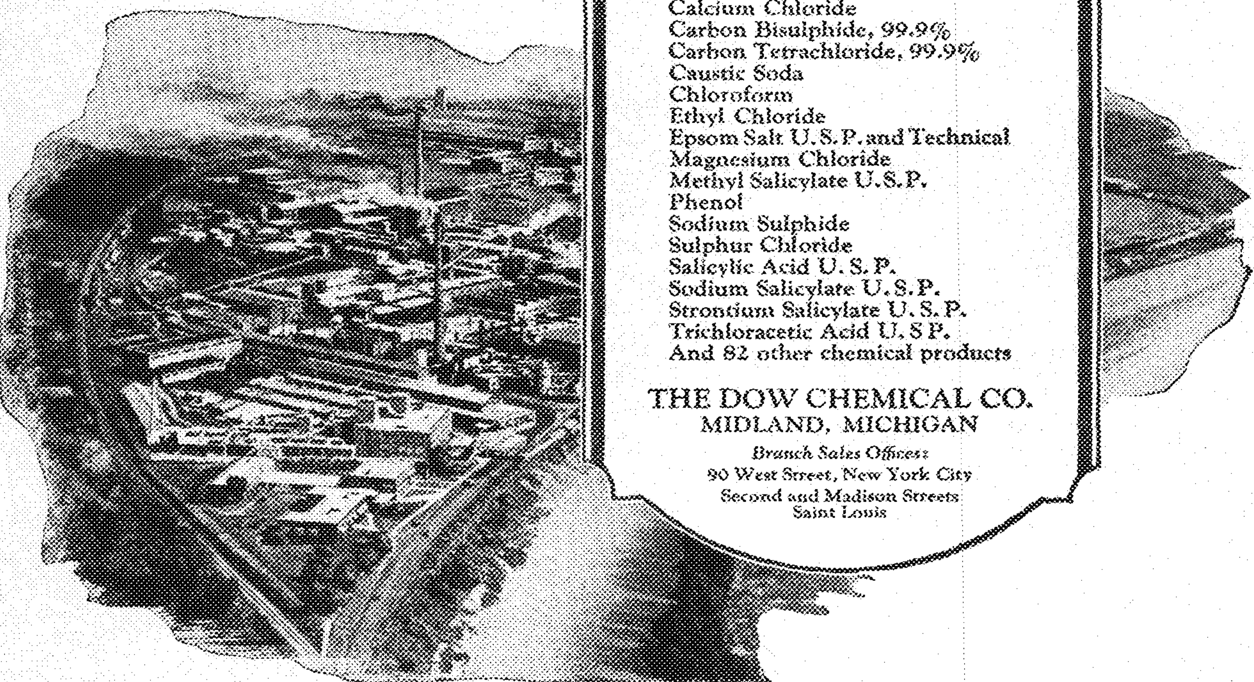

Engineering Overseas

(*Continued from page 202*)

down stream. Plans have been made for a 348-foot-head plant at Harsprengt; and three additional plants with 100-foot heads are below this. The Lule River will eventually produce 400,000 electrical horse power. The impression left by this great development in a region of reindeer, lichens, stunted trees, bowlders, ice, snow and midnight sun, is of the courage, initiative, resourcefulness and enterprise of the Swedish engineers.

The limits of this article shut out more than a mention of the power centers visited in my south-bound trip: Krengfors, Norrfors, Hammerforsen and Elvkarleby. Three of these are new or under construction and represent the most modern practice in dams, power houses and equipment.

In leaving Stockholm we proceeded by steamer in the inland waterway known as the Gota Canal, a three-day journey through beautiful lakes, island-crowded Baltic Sea channels, winding rivers, narrow canals through farm country with flights of vessel locks like stairs, two great lakes, and finally down the capacious Gota River, through modern ship-locks to the attractive city of Gotenborg. Water power investigations were arranged for Motala at the outlet of Lake Vettern and at two plants on the Gota River, at Trollhettan and Lilla Edet.

The power plant at Motala has the second largest Swedish lake, Vettern, as its storage reservoir, and the water discharges from the turbines under a 50-foot head, into a smaller pool, Lake Boren. Five units of 6,000 horsepower each comprise the equipment. One of these turbines is so designed that it may spin backwards, and serve as a turbine pump, while the generator, with current from other plants, serves as a motor. Water is then pumped through the penstock from the low-level Lake Boren for storage in Lake Vettern. The object of this reversal is to utilize the off-peak current in continuous-flow streams and store otherwise wasted electric energy in the form of hydraulic energy, for peak load use at Motala. Wasted energy is present in many water power developments during night hours and on holidays. The Motala plant is designed to operate only six hours a day. This is the hydraulic accumulator, which exists in a variety of forms in Germany, Austria and Switzerland.

The Gota is Sweden's most important river, draining 17,800 square miles; with Lake Venern, 2,150 square miles in area and 145 feet above sea level, as its storage reservoir to insure even flow. Only two lakes in Europe are larger than Venern. The natural low flow of the river is 10,600 cubic feet per second, the flood flow 30,700, and the mean flow 17,600. One of the great projects of Sweden is to place under regulation this great lake above the Gota River. Chief Engineer of Water Falls, Axel Ekwall, is vitally interested in the achievement of this great work. It is proposed to maintain during the season of navigation a level of 1.3 feet above the unregulated natural mean level in Lake Venern, storing the generous water supply of the rainy months of the year and drawing off the accumulated water savings in the cold winter months, when the flow of streams without ample reservoir capacity is meager. As all the water power and steam plants of central and southern Sweden are interconnected with a net of transmission lines, the increased electric energy in winter—when the demand is large for light and heat—will save the capital costs of steam plants and the consumption of coal. This budget system for the outflow of a large lake is in line with the Shenehon project for the regulated outflow of the Great Lakes, to

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make more valuable water power on the Niagara and St. Lawrence Rivers. Sweden's project is nearer realization, however, than our own. With regulated outflow in the Gota River, the installations of three plants—one new and two existing—will be 340,000 electrical horsepower, ice troubles will disappear and both navigation and power will be better. The winter power output without regulation may drop to 205,000 horsepower—showing a gain for regulation of 135,000 electrical horse power. A steam station to generate this energy in the United States would cost 13 million dollars. The cost of regulation aside from riparian damage will be less than a million dollars; and the cost of additional power equipment probably not over two million dollars.

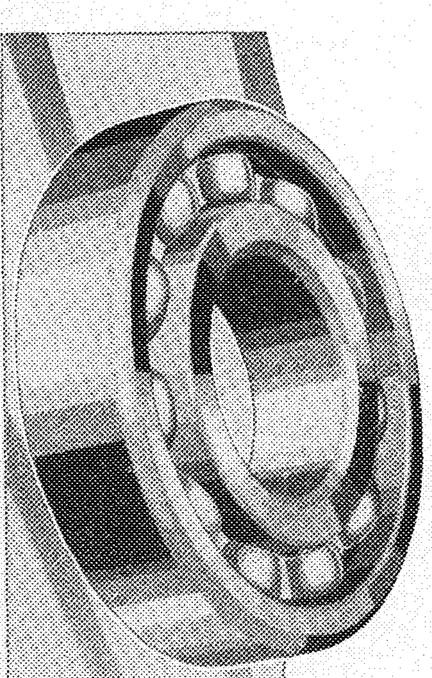
The Trollhettan power plant on the Gota River, 14 miles down from Lake Venern, and 45 miles from Goteborg at its mouth, is the most magnificent architecturally and scenically of the Swedish water powers. It belongs to the continuous-flow, large-volume with low head type of plant, located within easy transmission distance of the richest and most densely populated area of Sweden. It is subject to some ice troubles, which will largely disappear with avoidance of swift river flow by developing the 16-foot head power at Vargon, six miles above Trollhettan.

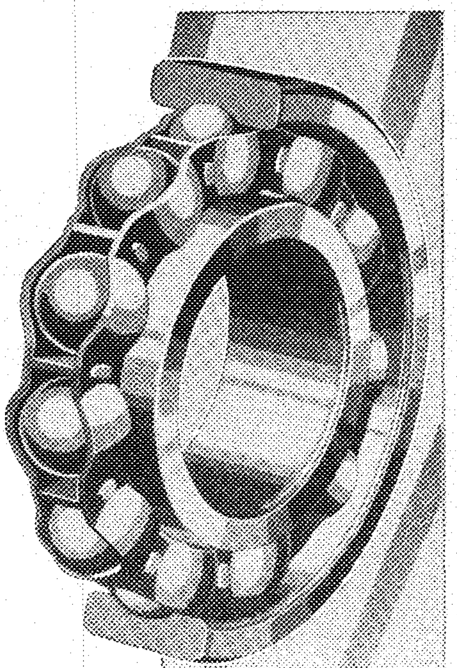
Passing the plant, in a flight of four modern, beautiful shiplocks, are vessels which ply the salt water seas and penetrate the major inland waterways such as the Rhine and enter English and French ports, carrying 2,400 tons each of lumber, wood pulp, iron, coal and fertilizers.

The Trollhettan power house is equipped with 13 generating sets of about 12,500 h. p. each, or speaking electrically, a total of 115,000 k. w. Eventually this will be increased to 200,000 k. w. Operating under a 105 head, this station's energy is used largely for public service.

Downstream 11 miles is the 23-foot head plant, Lilla Edet, with an eventual capacity of 35,000 k. w.; and 30 miles further down is the port of Goteborg, with the northern tip of Denmark visible twelve miles across the gleaming salt sea.

A versatile, virile, imaginative people are the Swedes, dwelling in an invigorating northland rich in traditions. It is a good thing to have a Swedish strain in one's blood for those dwelling in Minnesota. The breed which gave us Erickson, the engineer, is still producing engineers of outstanding capacity and courtesy.





The Navy Offers You Flight Training

(Continued from page 206)

three year cruise with the Fleet to such students as successfully pass their commission examinations and show aptitude for the Naval service. This means that you may be sent to the East coast where you will join the scouting fleet going south into the Carribean Sea for the winter and along the Atlantic seaboard —Hampton Roads and New York—for the summer, or you may be sent west to join the Battle Fleet at San Diego making the cruise to the Hawaiians for the winter war games. Perhaps you will be assigned to a destroyer, mayhap to a battleship or, best luck of all, to the newly commissioned air plane carrier "Saratoga". The cruise, whether for one year or for three years, will be instructive, interesting, highly educational, and broadening since few can afford travel at the age of life when it means the most to them; and fewer yet on the salary and allowances of an Ensign, U. S. Naval Reserve.

The year ended you will come back to your squadron and your life job, a better man, physically, mentally, and, yes, morally, for having had this varied and delightful career.

Engineering Sports

The curtain has finally dropped with a resounding thud on the winter sports activities of the athletically inclined engineers. But it needs must arise for a moment as we present our intramural basketball champions.

The Anderson Misfits after climaxing their sterling work by trimming the General Engineers 14-10 in the finals of the engineering playoff engaged the Royal Flush aggregation (champions of the independent league) in the all-U tournament and were defeated 13-10 only after a hard fought contest. These serious contenders led by Irving "Swede" Anderson were composed of Westby, Krema, Eck, Carlson, Lindberg and Halvorson.

The General Engineers have the honor of scoring the most points (44) in one game as well as the highest average per game (27) although the Misfits are right behind with (23). John Perotti, captain of the General Engineers collected 16 points for high individual game honors.

But we must give the honor of the highest individual scorer to a freshman, Donald "Pewee" O'Neil, who made 46 points for an average of 9.2 points a game. With a beef and milk diet and crowbar trundling this coming summer the Freshman No. 2 star should develop into a second Johnny Stark by next winter. Close behind him was Harold Shannon of the Jr. M. E. with 44 for an average of 8.8 points a game. The rest of the ten highest scorers who competed in two or more games, follow in the order named:

George Harpel, Sophomore Civils, 8.25; Westby, Anderson Misfits, 8.0; Roman Soufal, General Engineers, 6.5; Irving Anderson, Anderson Misfits, 6.5; John Perotti, General Engineers, 6.5; Arthur Lindberg, Anderson Misfits, 6.3; Frank Sweeney, General Engineers, 6.0; Kenneth Kingsley, Freshman No. 2, 4.8.

As one can see from the above, the General Engineers and the Misfits monopolized six of the ten places between themselves. They also seemed to have had quite a race among themselves with the Misfits just a step ahead.

In division II the Sophomore Civils with four won and none lost copped first honors quite easily. Second place was hotly disputed between the Freshman No. 2, the Sophomore M. E., and the Junior M. E. teams finally ended in a tie. In the playoff, the Freshman No. 2 team walloped the Sophomore M. E. team 20-5, and barely squeezed out a victory (19-17) over the Jr. M. E.'s to get the prized second place.

In the division play-offs the General Engineers entered the finals by trimming the Freshman No. 2 team 25-9 while the Sophomore Civils put up a stiff battle before bowing to the Misfits 23-17.

Illinois Central Electrifies Terminal

(Continued from page 207)

Despite this handicap, electrified suburban trains began operation seven months in advance of the date for which they were scheduled.

The first operation of electric trains in regular service took place on July 21, 1926—exactly seventy years from the day the first regular steam suburban service was operated. The suburban timetable now in effect calls for approximately 540 electric trains every weekday, an increase of approximately one-third over the number of trains operated in the same service under the last timetable for steam operation. The running time of suburban trains has been reduced an average of from 15 to 25 per cent as compared with the old steam schedules. The service is now being used by nearly 125,000 persons every weekday.

The freight classification yard included in the terminal improvement program is located about three miles south of the city limits of Chicago. The yard is three miles long, and more than 110 miles of track in it have already been placed in operation. The ultimate development of this yard calls for 175 miles of track, with a total capacity of 13,550 cars. The yard is of the modern "hump" type and is designed to receive and dispatch trains at either end. It is equipped with electrically operated car retarders, floodlight illumination and other modern devices. A large mechanical terminal consisting of several extensive shop buildings has been erected and is now in operation at the yard.

The Human Eye

(Continued from page 205)

holds only for the region of the retina in the neighborhood of the fovea, and for lights of ordinary intensity. In other words, it only refers to the cone vision. Around the central region of the retina is a zone of partial color blindness in the case of even normal eyes. In this zone, red and green cannot be distinguished from yellow, but yellow can be distinguished from blue. Furthermore, even in the case of normal eyes, the outer zone of the retina is entirely color blind. These zones can be mapped out by fixing the eye at a definite point and having someone bring in colored objects from the side, and noting when the colors can be distinguished without error. At very low intensities the entire retina is color blind. This occurs near the threshold of vision, and is associated with the Purkinje effect. Under these conditions one has only rod vision. It is well known that faint lights, e. g., stars, can be more readily detected by the non-foveal region of the retina where the rods are more numerous.

Thus, the various parts of the retina serve for different purposes. The outermost area has for its function only the indication of the presence of objects without revealing details of form and color. The intermediate region begins to indicate imperfectly the presence of color. But the central region with its closely-packed cones gives one the full appreciation of details of form and color, insofar as our eyes are capable of reacting to these things.

"High Pressure"

(Continued from page 209)

Arabs present a musical extravaganza having "takeoffs" on the various faculty members and university problems of the year. All this is treated imaginatively, and the result is often the most artistic presentation of the year. Successes as the "Caliph of Kolynos" in 1922, "The Blue God" in 1923, "Riquiqui" in 1924, "Mona Lizzie" in 1925, and "Broadcast" last spring, have presented to the campus the most musical and beautiful productions produced by students.

Around the World With Our Alumni

(Continued from page 216)

been with the company: "Mr. Johnson started as an outside man in the commercial department at Minneapolis in July, 1923, and four months later he was made a clerk in the division commercial office. In December, 1923, he became a division commercial accountant and in May of the following year, he took up new duties as assistant to the division commercial engineer at Minneapolis. In April, 1925, he was transferred to Omaha as assistant to the commercial survey engineer. From December of that year to the present time he has held the position of division commercial engineer for Nebraska.

'24—T. E. Lobeck was one of the recent visitors to the technical campus. Lobeck is in charge of the laboratory of the meter department of the Northern States Power company in Minneapolis.

'24—Fredrick R. Kappel recently has been promoted to foreign wire relations engineer for the Northwestern Bell Telephone company. He was formerly interference engineer. Mr. Kappel was married last June to Miss Ruth Ihm (Home Ec. '25).

'25—Winton Broun, we understand, is with the Union Public Service company of St. Paul.

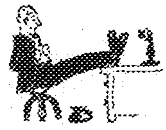
'25—Robertson B. Johnson is employed in the relay department of the Northern States Power company, where he is at present engaged in working on telephone carrier current problems. Johnson has been with the power company since his graduation in 1925.

'25—August L. Untinen is a transmission engineer for the Northwestern Bell Telephone company. To our question as to his marital state, we received emphatic information that he has not been married.

'27—Two days after he had received notice of his new position, Lloyd V. Berkner, Ensign in the Naval Reserve, chief operator of the university radio stations, and graduate student, traveled to Washington, D. C. There he is now working for the Department of Commerce, Bureau of Lighthouses and Docks. He is studying the problems of radio beacon installation, and will later direct the installation of these beacons on principal mail plane routes. In this service he will fly airplanes also, which he can do, having received a commission in the Naval Reserve Aviation division after completing flight training a year ago.

Mechanicals

'98—Roy V. Wright has been elected president of the United Engineering Society for the year 1928. Mr. Wright is the managing editor of the Railway Age, a publication of the Simmons-Boardman Publishing company.



'13—Floyd A. McCartney is putting his engineering training to good use in his capacity as branch manager of the Equitable Life Insurance Society of the United States. Mr. McCartney's home is at White Bear, Minnesota.

Mechanicals

'27—"Ed" Coates, who is enjoying life with the Army air corps at McCook Field, Dayton, Ohio, has recently changed his address to 200 Five Oaks Avenue, Dayton.

'27—Richard Trexler, who is employed at the Patent Office, says in a recent letter: "I am taking the four year law course at Georgetown university—working days and attending law school nights is not the most pleasant situation in the world. Patent work is fairly interesting and it offers a better future, speaking from a financial standpoint, than any branch of engineering with which I have come in contact."

Miners

'11—William F. Jahn, who is general superintendent of the Minas Pedrazzini gold and silver mining company of Arizpe, Sonora, Mexico, was a recent visitor at the School of Mines.

'17—William H. Elson was a recent visitor to the technical campus. Elson is the head of a firm of independent oil operators in Tulsa, Oklahoma.

'17—A. Irving Levorsen is reported to be one of the leading geologists in Tulsa, Oklahoma. He is working for the Philmack Oil company.

'18—Percy G. Cowin, who is a consulting mining engineer of Birmingham, Alabama, was one of the recent visitors at the School of Mines.

'18—Ralph L. Dowdell, who is assistant professor of metallography in the School of Mines and Metallurgy, with other metallurgists has recently had the results of research work on the endurance of rail steel published in pamphlet form by the Bureau of Standards.

'18—Guy E. Ingersoll is at present connected with the Southern Pacific Company with headquarters at San Francisco. He was formerly an engineer for the Hecla Mining company.

'20—John Edwin has recently given some very interesting addresses before the School of Mines society on his work in Dutch Guiana and Russia.

'23—Word has been received from George W. Hezzelwood in connection with his work in Mexico that in running an 8 x 8 drift he and his men beat all mining records. They drifted 1,001 feet during the last month of work. The length of the drift was 5,440 feet and he finished his contract twelve days ahead of time. This record that he made has brought to him many offers in Mexico of work of a similar character and at the present time he is considering a request to run a large water power tunnel in Massachusetts.

'23—Vern L. Kegler, superintendent of mines at the Ducktown Chemical and Iron company at Isabella, Tennessee, spent his Christmas holidays in Minneapolis. Before returning to his work in Tennessee he underwent a successful operation at Rochester, Minnesota.

26—Thomas F. Andrews, who is now manager of the Roan Antelope Mine, N'Dola, Northern Rhodesia, South Africa, was a recent visitor at the School of Mines and Metallurgy.

Meterman Short Course Offered in Vacation

(Continued from page 214)

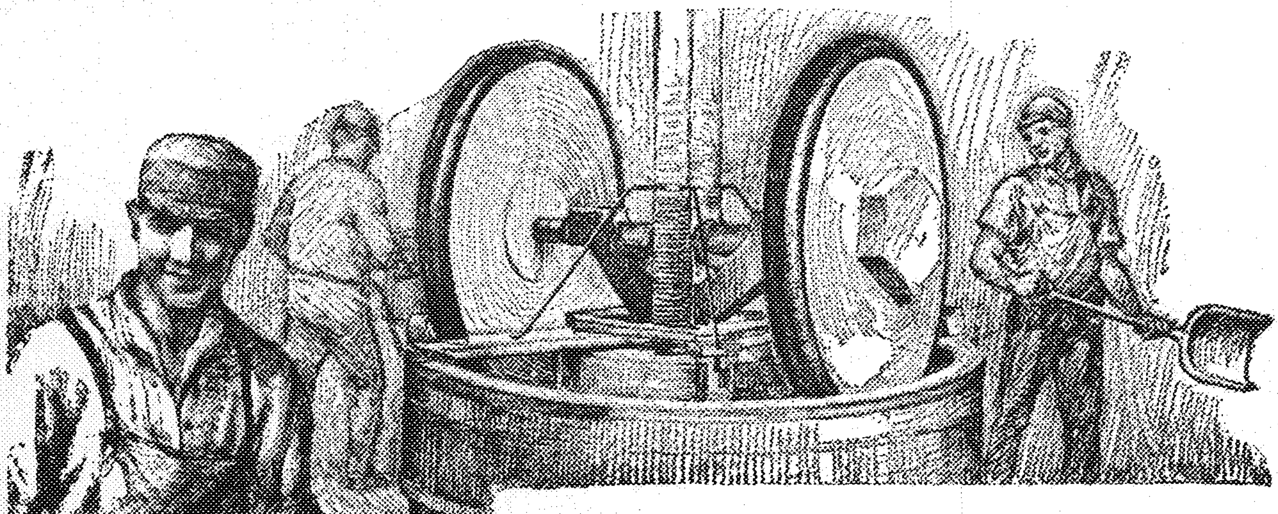
devices, test switches, meter test blocks, etc., and was the third session of this course held at the University.

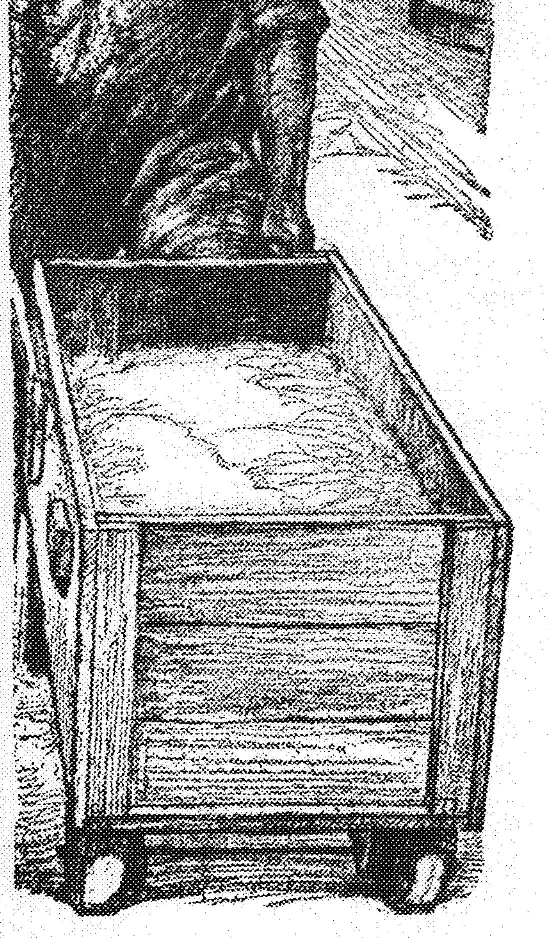
This short course for metermen is an intensive course on meter installations, testing and laboratory methods. Superior equipment such as that used by the largest public utility companies was used in the demonstration lectures and laboratory work. Instructions were given by members of the Electrical Engineering department and by practical engineers experienced in meter work.

The National Electric Light Association is sponsoring a series of these short courses which are being held at twenty-eight universities throughout the country. The general growth of light and power systems have introduced metering problems that need very careful consideration. The maintenance of meters at the high level of accuracy required necessitates a competent and thoroughly trained corps of metermen.

"Why," cried the instructor in that loved and highly esteemed subject, yclept mechanics, "did you flunk that last test so disgracefully?"

"Sir," replied the student in trembling tones, "I did it in a moment of inertia."
—*Drexerd.*





IN THE MIXING HOUSE

THE men in the dynamite mixing house work together with the smoothness of an eight-oared crew. Without hurry and yet without a wasted motion each does his appointed tasks with the precision and alertness of the trained powder worker.

These men must not only work smoothly, but they must think correctly. Nothing must go amiss without their instantly detecting and correcting it. They must know the weights and proportions of dope* and nitroglycerin used to produce the many different grades of dynamite mixed under the great mixer wheels, which are shod with rubber for safety. Any slip of theirs here will quickly be brought to light by the chemists' analysis.

It has taken years of patient work and careful experimenting to bring this seemingly simple mixing process to its present perfection. But no matter how perfectly the machine does its work it would be of little avail without the skill and practical knowledge of the mixing house crew.

To the men of the mixing house is due, in no small measure, the credit for the important work done by Hercules Dynamite as it fights on the side of man in his battle with nature—leveling mountains, altering the courses of rivers, changing the farmers' arid land into fruitful fields, in fact performing for man tremendous tasks which he could never accomplish unaided.

*"Dope"—the powder makers' term for an absorbent containing proper proportions of nitrate of soda, nitrate of ammonia, wood pulp, flour, starch, sulphur, chalk, and other ingredients and which by their own combustion furnish explosive energy.

HERCULES POWDER COMPANY
(INCORPORATED)
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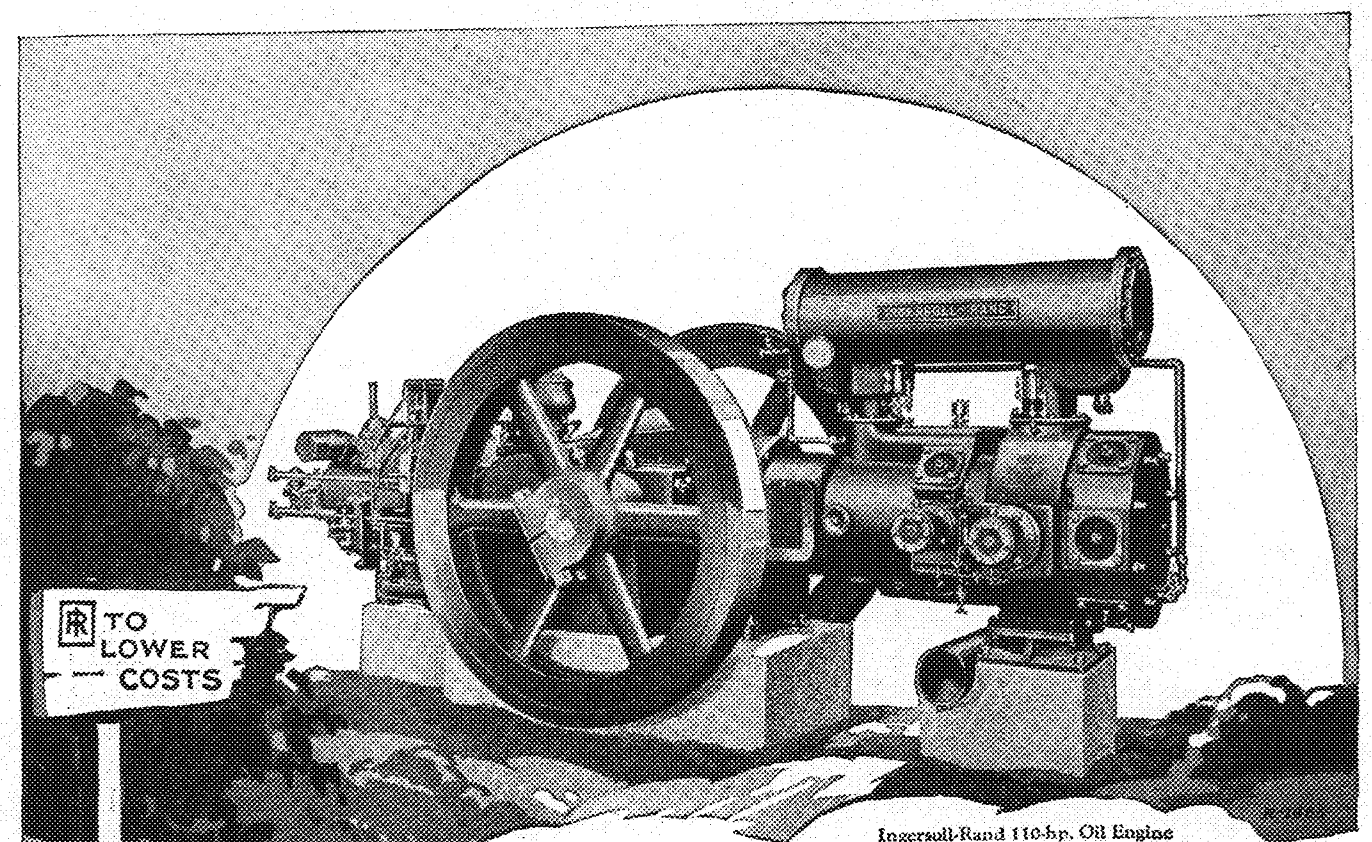

Ingersoll-Rand 110-hp. Oil Engine
Air Compressor.

Compressed Air at Low Cost

In these days of keen competition, low production costs are often the dividing line between profit and loss. Small wonder, then, that users of compressed air are turning to the oil-engine-driven compressor unit in their efforts to curtail expenses.

The oil engine air compressor shown above will operate at a fuel cost of 36 cents per hour. It will deliver 1,000 cu. ft. of free air, compressed to 100 lbs. discharge pressure, at a cost of 1.2 cents. Its full-load fuel consumption is only 6 gallons per hour. This represents a day-in, day-out economy that cannot be matched by any other form of prime mover.

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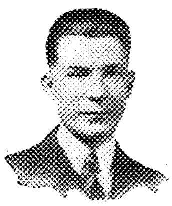
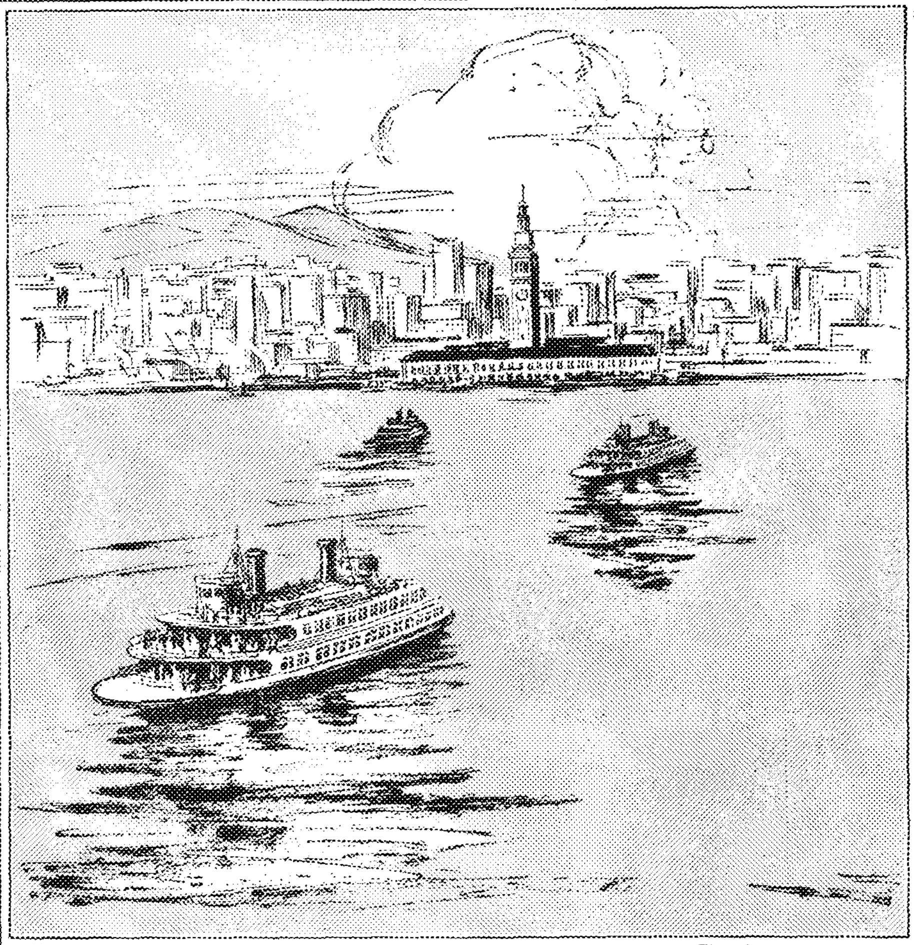
Ingersoll-Rand

C. T. PEARCE,
Design of Generators,
University of New Mexico, '23

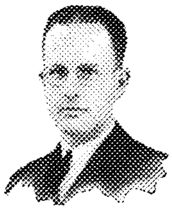


MERLE ROBISON,
Switchboard Engineer,
Carnegie Tech, '20

B. C. COLMAN,
Headquarters Sales,
Ohio State, '23



YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS



W. A. McGILL,
Traction Apparatus Sales,
Carnegie Tech, '22

L. C. FLETCHER,
Turbine Test,
Clemson, '17

W. R. OVERHOLT,
Contract Administration,
Ohio Northern, '08

The San Francisco Ferries

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

SAN FRANCISCO now has the finest ferry fleet in all the world. Recently there were added to it four Golden Gate Diesel-electric auto ferries; one Southern Pacific Diesel-electric auto ferry; one Northwestern Pacific Diesel-electric auto ferry; and the Key System's two electric-drive giants — the largest passenger ferries ever built. These modern steel boats — all Westinghouse-equipped — give to the Bay cities a ferry service unsurpassed for speed and safety, cleanliness and comfort.

The big jobs go to big organizations. Westinghouse attracts young men of enterprise and genius because it daily provides opportunities for pioneering and outstanding work which smaller companies can seldom offer.

The Key System ferries are each equipped with two 2,250-shp. Westinghouse main propulsion motors; one 1,900-kilowatt Westinghouse generator; and one 3,010-hp. Westinghouse-Parsons turbine. The Southern Pacific, Northwestern Pacific, and Golden Gate boats likewise have Westinghouse propelling motors and generators. Auxiliary units, such as motor-drive pumps and steering apparatus, are Westinghouse on all these ferries.

Westinghouse

SKILL

THE twist of the wrist, the "throw" of the arm, the shifting of the weight—these are among the many little points which make the skill that you admire in the javelin thrower as he hurls the shaft two hundred feet or more.

As on the track or the football field, in the gymnasium or on the water, so in industry progress is the result of fine improvements—a thousandth of an inch here—a minute variation in a curve there—slight changes foreseen by engineers and carried out by skilled workmen.

It is this attention to detail that is constantly improving General Electric apparatus and contributing to the electrical industry, which, though still young, is already a dominant force, increasing profit and promoting success in every walk of life.

Whether you find this monogram on an electric refrigerator for the home or on a 200,000-horsepower turbine-generator for a power station, you can be sure that it stands for skilled engineering and high manufacturing quality.

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The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

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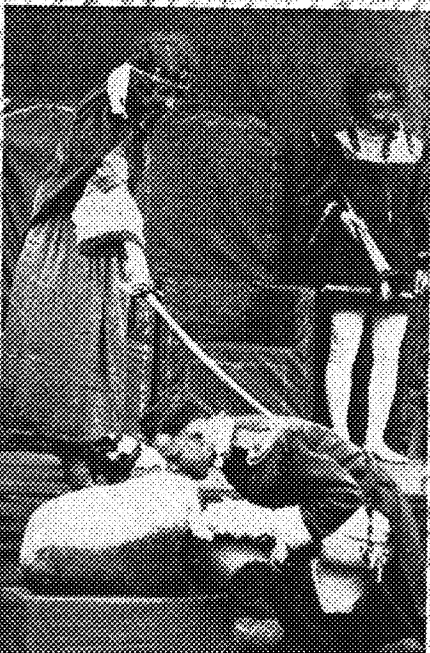
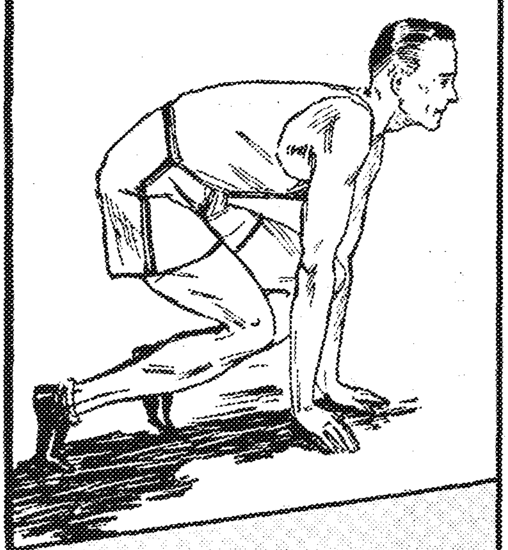


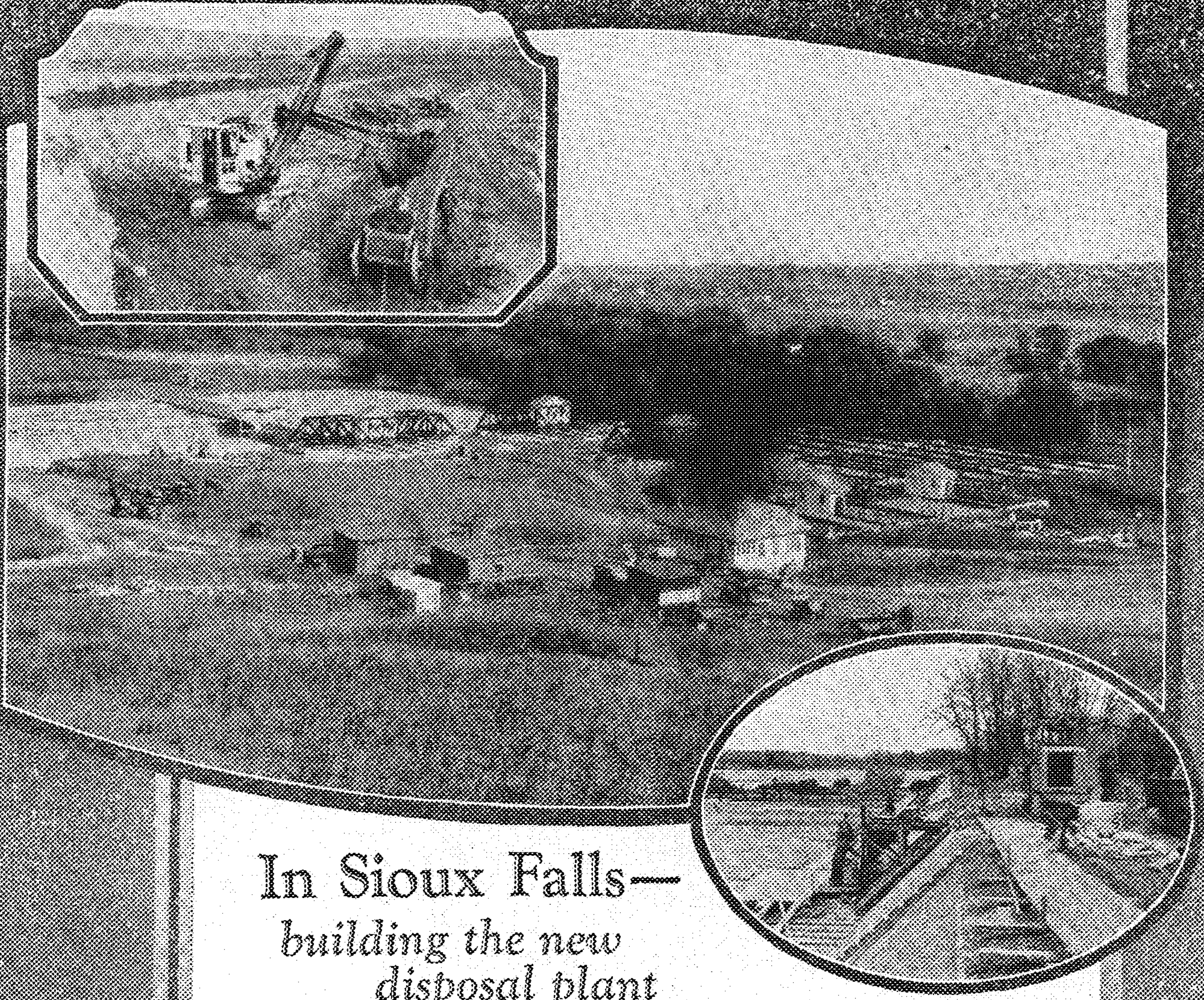
ST. PAT IS KNIGHTED.

Volume VIII MAY 1928 *Number 8*

Engineer's Day Number: - Memoirs of a Duogenarian - Engineer's Day

History of the Blarney Stone - Salvo! - Scientific Instruments





THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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VOLUME VIII — MINNEAPOLIS, MINN., MAY, 1928 — NUMBER 8

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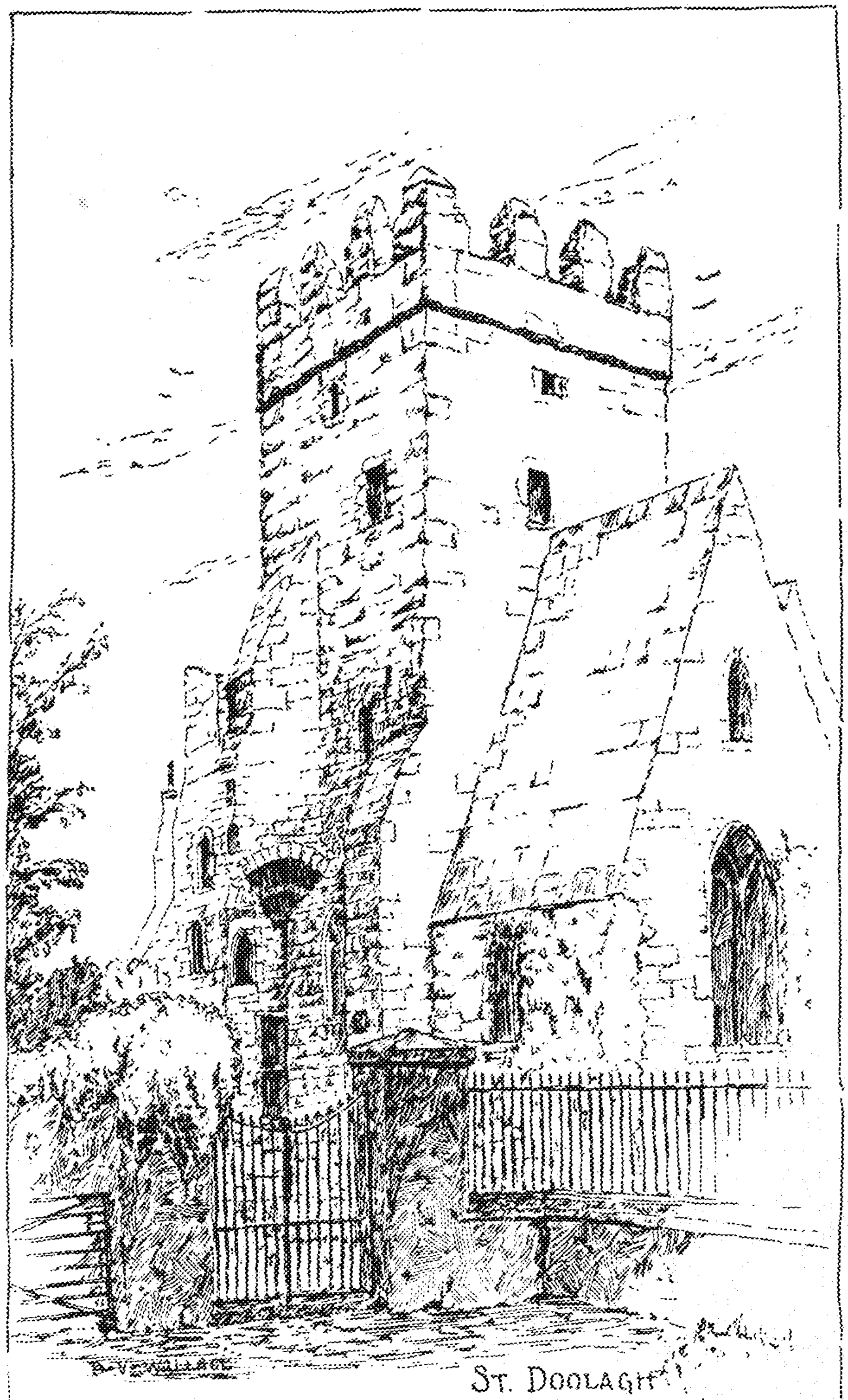
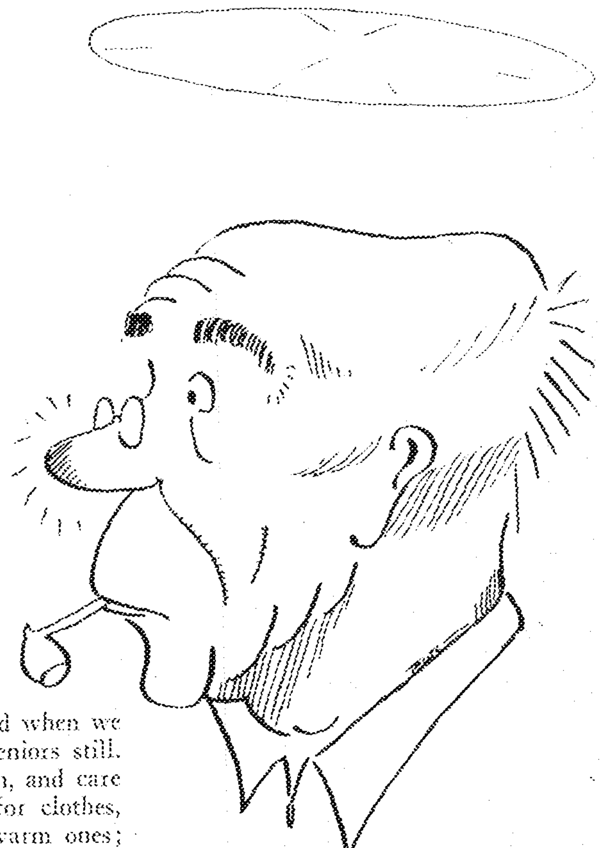


St. Doolagh's
Dublin County

The MINNESOTA TECHNO-LOG
University of Minnesota
Volume VIII MAY 1928 Number 8

Memoirs of a Duogenarian

An Interview with Glanville Smith, Prolific Alumnus Writer Who Recalls Engineer's Day Traditions of Four Years Back



¶ That noble Saint, our patron Patrick!

MINE, gentlemen, was the class of '24. I wonder, can you picture us? We wore baggy suits of a pale blue stuff with Norfolk jackets buttoning close under the chin. If our parents stared when we came home in these on holidays, thinking we had come in flannel pajamas, we knew we were perfectly in style. Our hats were gray, lofty, and domical with a hint of a dent from fore to aft; our shoes were orange, and we wore no garters.

Thus we graduated. And what we wore when we were Freshmen was no doubt still more in the spirit of a costume play, though all the recollection of it that I can conjure up in this bald old head of mine is, that our hats were squashed down on top, wrinkled and tortured on the edges, and breezily upturned in front. Ah yes! and when we were Freshmen we wore BVDS, but by the time we were Seniors these had been supplanted by underwear in two pieces, and our outer shirts were thrust off whenever feasible so that the world might know that we had made the change. When we were Freshmen we whistled *Hiawatha's Melody of Love* in unison at football games while the band played—it sounded very strange and sour, and the wintry drafts rising between our legs from through the old wooden grandstands of Northrop Field lifted the music wavily into the air; when we were Seniors we sang *It Aint Gonna Rain No More* with additional stanzas which, since they were unfit for publication, now exist only in the heads of such duogenarians as myself. When we were Freshmen we played Mah Jongh (at parties) and when we were Seniors we played—but I imagine what we played when we were Seniors is played by Seniors still.

But now I am an old man, and care not even the customary fig for clothes, so long as my slippers are warm ones; and as for whistling, I am guilty of that only when I have forgotten to insert my teeth. I have arrived at the reminiscent age.

(Matilda, bolster me up a little please, while I talk with the gentleman.)

When a man is in college he must do what he can. I remember that distinctly. I, for instance, began on a third floor window sill on a dark autumn night. I had been driven there by I know not what power, I think it was the will to do or die. But I had my instructions, which were as follows, to nail Homecoming bunting to a brick wall. The elaborate decorations designed for the Main Engineering Building having been denounced in harsh terms as impractical at six P. M., the committee in charge disbanded, leaving the bunting (already cut to suit the rejected scheme) in the hands of two simple Freshmen. I was one. Who, I wonder, was the other? I have forgotten, and am sorry for it, for I think of him with a warm emotion. And I am ashamed to be building my own monument in these words, which you take down in such enraptured shorthand, without mentioning his name.

But to continue: The north wind whistled about us in the gloom, the nails obstinately bent into U's, and the hammers in our purple fists were locked in a grip which only prolonged heating could thaw. And so the building was adorned for the great day, though the wind by morning had whipped some of the bunting to rags and twisted the remainder into skinny ropes. But the college honor was saved, after a fashion.

Hack, hack! the thought of how cold I was puts me in mind of my bronchitis.

WHEN Saint Pat's Day came my talents were employed in a new field. Tea was served on four floors of the building; the people pushed in for it by hundreds, and consequently there was much dishwashing, I should say cup washing, to be done. This secret part of the day's gaiety was conducted in a minute office on the third floor where scalding hot cups were flung out from vats to be dried in towels long since saturated to dripping. I meanwhile shinnied nimbly up and downstairs with trays full of these cups, clean or dirty, and the number of trips I made from top to bottom and *vice reversa* must have been consid-

"Tea was served on four floors of the building; the people pushed in for it by hundreds, and consequently there was much dishwashing, I should say cupwashing, to be done."

erable, since next day I awoke feeling not at all nimble, instead my joints had in them that protest against bending which they now feel when the wind is east by northeast and it's blowing up a rain.

But that same spring I was "given away." A supposedly true friend from my home town blabbed on me, revealing the fact that I had once had a story published in the high school paper. Thence forward these pleasant menial tasks were turned over to those whose gifts were mercifully unknown, while I was set to writing. Gentlemen, the Saint Pat's stories I wrote for the *Ski-U-Mah* and the TECHNO-LOG together with the skits for the Jubilee, the Jinx Ball, and the Gridiron Banquet, would; if put end to end———. But no, I must not go on in this personal vein. However, it is true, and my case illustrates it, that when one is in college he must do what he can. Perhaps you have observed yourselves, that he who can carry a tune, is made prima donna of the Arabs most prodigious show. Or if one has learnt in kindergarten the outlines of the pumpkin and the wigwam, now he is set to work making posters, and nonplussed to see them nailed up presently in conspicuous places.

But just because one cooks one need not stay in the kitchen forever. I not only saw some of my skits performed, and read (with irrepressible merriment) my own articles in the TECHNO-LOG but even saw some of the thing known as "college life," that is, tasted occasionally of some one else's cooking. Would you have me describe a Saint Pat's Day as it was in the old times?

It all rises before me very plainly.

The mercury is low. A raw wind sneaks in and out. Sleet falls at odd moments. There is a great clashing of unbuckled galoshes—buckles as the girls from the school of education troop over to see the parade.

CLOWNS come busting down the street on high wheelers, or six-pedal bikes. We laugh hollowly, anxious to be amused, then turn our attention to a Fordful of bums which comes zigzagging, hissing steam at its sprung seams, and flaking rust from its battered sides. But these early arrivals do not fool us. There is still a fifteen minute wait before the R.O.T.C. band marches into view, their music in the racks doubled up and glued page to page by the sleet that perversely chooses to fall. Behind the band comes that noble saint, our patron Patrick, his legs pushed very far asunder by the billiard table breadth of the white brewery horse on which he is mounted. Behind the saint come his knights, green capes tossed over their shoulders, green stovepipes on their heads, and clay pipes in their mouths. And behind them come a number of "serious" floats.

For instance, here comes a model of the stadium, a white marble vision elliptical in form quite unlike that red brick U our dollars built. And this next float is an enigma—it has a wireless aerial on it, and a horn. Can this be an example of the radio of which we hear so much? From it we hear so little. The operator has a distracted look, maybe the sleet has got into the works. The science really is in its infancy, you know; that is one of the phrases, "in its infancy." The other phrases are, "It seems simply uncanny that—," and "How wonderful it is that just sitting here at home we—"

Behind these "serious" floats come the "funny" ones—if you think it is funny to have raucous chemists drop stinkbombs at your feet. But we hold our noses, and survey with surprise the gigantic bottle of castor oil that comes reeling along. (Those were the days of Teapot Dome, you see, and this was labeled *The*

A Statement from the Appreciation Day Head

THE combining of the Engineers with the University Appreciation Day committee, is making possible one of the greatest festivals ever staged on the University of Minnesota campus.

At the outset, it was very evident that the ever responsive College of Engineering was essential to the complete success of University Appreciation Day, set for May 5th by the Governor. There appeared to be an unfortunate circumstance, that the traditional Engineers' Day program should come on May 4th. When the St. Patrick committee, headed by Louis M. Schaller, assisted by Leon Mears, agreed to join with the University Appreciation Day committee, it was a forward step for the mutual benefit of both groups.

The mammoth bonfire to be featured by the Engineers under the direction of John C. Newhouse, on Friday evening, will make a colorful opening for the St. Patrick Spring Homecoming, followed by the traditional "Engineer's Brawl" to be held at the Leamington Hotel.

Thousands of people will witness the colorful, mile-long parade to be staged Saturday morning, and will realize, as we have realized, the power and originality of the Engineers on the University Campus.

HAROLD E. STASSEN, Campus Chairman,
University Appreciation Day Committee.

As the Fordful of bums actually looked in the parade years ago.

Great Oil Scandal.) Next comes another dainty of the same kind, a manure spreader, from whose flying spikes emanate (so the placard says) Dean Leland's B. S. degrees. Two supposed engineers come next, they are unshaven, in fact not at all neat, their clothes have that bunkhouse air; they are rolling dice, and the dice are about the size of hatboxes. What? You say this is still a feature of the parade? No matter. Did you ever seen in it an Oriental houri drawn through the streets by Arabs in a papier-maché car, large areas of her thighs and stomach (I think it was) exposed to the elements, to tempt lustful males into the Armory to see more? Teddy Prichard offered himself up as a sacrifice of this kind, on the Arab's advertising program, Anno Domini, 1922.

MEANWHILE the Northern Pacific suspended traffic "at a great loss" (so says the *Daily*) on its tracks lying through the campus—tracks long since gone and forgotten—and on these is enacted the next scene of our drama, to-wit, a handcar race. The spectators on the banks strain their eyes and eat peanuts, and presently up puff our heroes! not especially fast it is true, but with a great display of shirt-tails that have pulled up from their wonted moorings. How willingly the contestants come to a halt just on the other side of the tape, and one of the gang on the losing car points an indignant finger at the track behind them, apprising the judges that of the two tracks *theirs* had distinctly the stiffer grade.

Afternoon finds faculty wives in rather odd hats pouring tea while hungry Academics tuck away cookies with green shamrocks iced on them, and stare at the architectural problems mounted in the hall. How impractical! they cry, all these city halls, natatoria, orphanages, civic centers, and railway stations! What good does a knowledge of such large scale works do a young architect when he has graduated? What he *needs* is to know how to design residences. I know the most attractive little bungalow out at White Bear—etc.

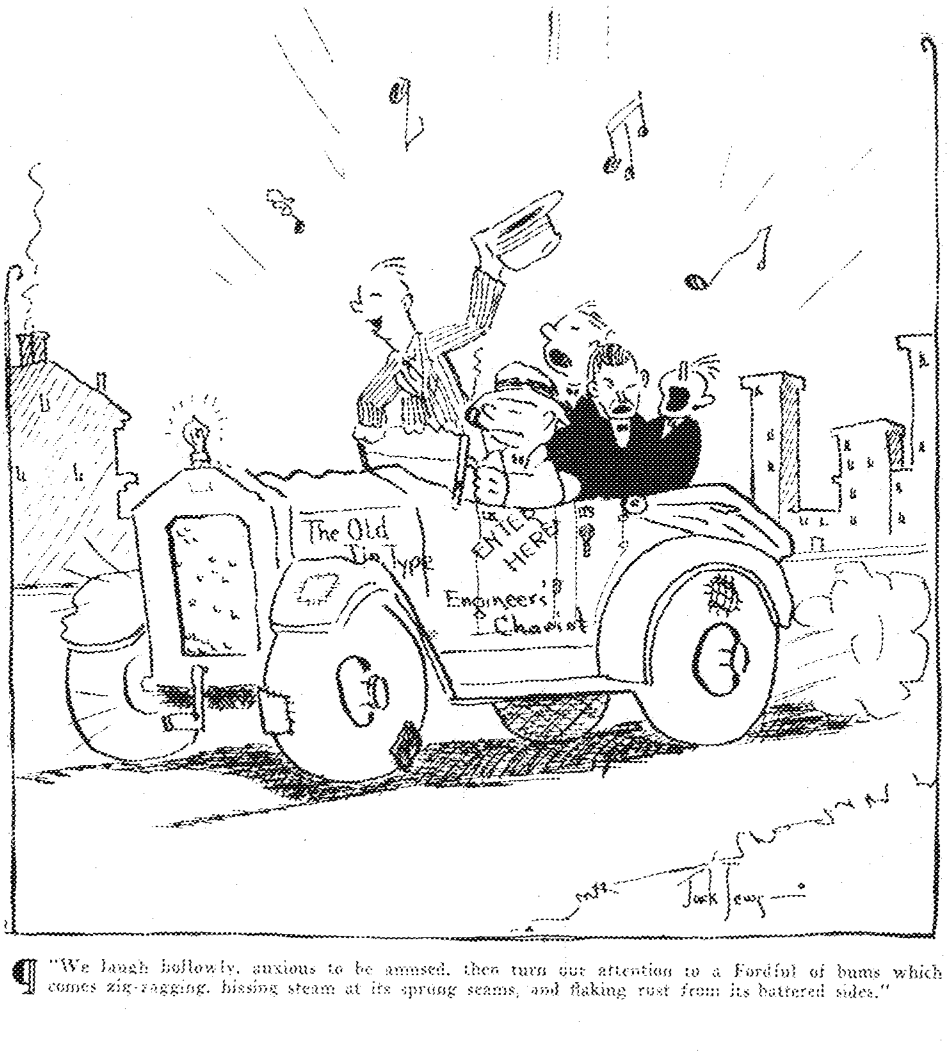
SAINT Pat, meanwhile, with a strange look to him as though he still felt the breadth of that brewery horse between his legs, stands by the Blarney stone in the Experimental building, among all the engines, dubbing his knights. And if you are a Freshman, you wonder timidly if all the blarney you have read about that stone in the *Daily* is true. Were the Miners ever so fierce? And did they really hold up Hennepin Avenue traffic while they dropped that innocent-looking rock down a manhole, laughing satanically the while? And did the Civils really "shoot" in pursuit?

As for the Ball, it is a great success, thanks largely to the ingenious Electricals, who have rigged up not only all sorts of "spots" and lanterns, but installed a radio loud-speaker. Imagine dancing to the radio? What an extraordinary thrill!

But you say that except in small particulars (such as queens) this is a description of Saint Pat's Day in the present epoch? Well 'tis a pity from your point of view that I have no stranger tales to tell; but when you look at it from *my* point of view you will agree with me in exclaiming, so much the better! Don't you suppose, gentlemen, that I should feel a pang and a tie broken, if I should hear that Saint Pat had been supplanted by a goddess? or that the Blarney Stone had been condemned as unsanitary, mopped off, and put among the geological specimens? What ties me to the present generation, the current Freshmen or Seniors, like these same quasi-ridiculous rites and doings?

But don't study to find an answer. There are other ties, but none so picturesque, and none so full of the flavor of youth.

And now good day, gentlemen, and please be so good as to remember me to my friends when you return. Matilda, show the gentlemen to the door, and bring me my gruel and prunes, please.

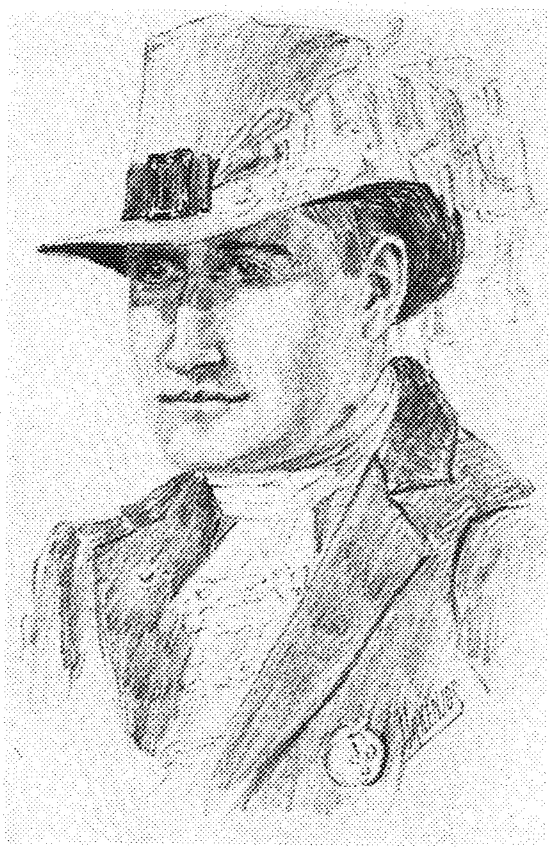


"We laugh hollowly, anxious to be amused, then turn our attention to a Fordful of bums which comes zig-zagging, hissing steam at its sprung seams, and flaking rust from its battered sides."

St. Patrick Tells How We Got the Blarney Stone

By

His Irish Majesty for 1928
Donald Riddell, E '28



DONALD RIDDELL, ST. PAT

TRADITION. Like old violins and rare liquors, tradition improves with age. The Foresters have their Paul Bunyan famed throughout the country for his achievements in the realm of logging. Their talisman is a certain log, guarded and revered because it is a tradition. The Engineers have their St. Pat and a graduating senior is elected each year to impersonate him. St. Pat was our first Engineer. The talisman of the Engineers is the Blarney Stone. Why St. Pat was the first engineer and why the talisman is the Blarney Stone is tradition. The story follows:

It appears that Pat had a job, a long time ago, opening and closing a certain gate. It was an old fashioned gate, one of those that did not have hinges but opened and closed by sliding back into the fence itself. Now Pat was a lazy cuss and he could not see any reason for opening the gate as wide for a pedestrian as for an ox team. That was the beginning of the law of the conservation of energy. So he determined just how far the gate would have to be opened to let a certain party, team, or group through. He then made some marks at regular intervals on two of the adjacent, sliding members of the fence and gate. This worked beautifully but in spite of his laziness, Pat also was rather observing and discovered that when the sliding members were in certain positions they completed a simple mathematical operation in both multiplication and division. This is the fundamental principle of the slide rule, the most valuable tool of the Engineer.

The slide rules of today are a vast improvement over Pat's crude affair and aside from solving the most involved problems in powers, roots, reciprocals, and trigonometric functions they will also translate French, Spanish, and German into English. Their curative effect on most diseases is stupendous and when taken in the prescribed quantities will cure anything from dandruff to ingrowing toe-nails.

That part of Ireland where Pat had lived so long ago happened to be the centers of all the fairy Clanns of Kilomasheague and it is even whispered that one of his aunts, the Thin Woman of Inis Magrath, was really an outcast of the clann of the Lepracauns of Gort Na Cloca Mora. This was by far the most powerful Clann at the time and their Queen lived under the roots of the Elm of Gadmot. The entrance being marked by their talisman which was a fragment of a giant batholith brought down by the glaciers from the Country of the Gods.

The Clann of Angus Og and his Firfs from the Slopes of Magh-Ilar was gaining strength every day and the Shee of the Lepracauns began to worry about the growing strength of the Og fearing that he would eventually usurp her predominance. So she contrived with Brigid Beg, one of the Firfs of Angus Og, who had been expelled for refusing to taste the porridge in the great Cauldron of Emania, to arrange to build her a castle in which she might reside in peace and security. So Brigid Beg assumed the earthly shape of a man and took unto himself the name of Carmac McCarthy and began construction on what was to become Blarney Castle. The material came from the Far Countries. The timbers were hewn in the Forest of Lebanon by Bove Derg, the fiery, whose Harper was the son of Tragan, and his music healed the sick and made the sad heart merry. The decorative trimmings were supplied by Mananaan Mac Lir and came from the Crystal Formations in the Caverns of the Jinn. The stone was cut by the Driads of Enochy Mac Elathan, the Dragda Mor, the Father of the Stars.

The castle grew in size and magnificence. The last stone laid was the talisman of the Lepracauns, the one that had marked, for untold ages, the entrance to the Shee's cave below the Elm of Gadmot. It was placed with honor and ceremony above the entrance to the castle. It could be seen day and night. It stood out in its splendor for we must remember that it came originally from the Country of the Gods.

The castle was named Blarney Castle in honor of the great, great uncle of the Shee. The uncle, Gadna Kan, had broken away from the tyrannical power of the ruler of the Shannons and had founded the Clann of the Lepracauns of Gort Na Cloca Mora. So the Stone above the entrance became known as the Blarney Stone and was famed for its powers to inspire its owners to everything that is fine and great.

THE term "blarney" that has come to us through the ages originated in conjunction with Blarney Castle. Carmac McCarthy had to spread the blarney on thick and heavy to keep the Lord Mayor from finding out the true facts of the case, that Blarney Castle was the home of the Lepracauns.

So for some time the castle withstood the attacks of Angus Og. Its walls were too thick and high.

Pat, being in the immediate vicinity of the castle, made the acquaintance of Carmac McCarthy and the latter rather liked him for his unassuming nature. From the lips of Carmac, Pat heard most of the fairy lore of Ireland.

But finally the old Shee lay dying and calling the Clann before her she told

(Continued on page 254)

Engineer's Day, May 4 and 5, 1928

Louis Schaller, *Chairman*

Donald Riddell, *St. Patrick*

Harriet Ellis, *Queen*

Committees in Charge

Louis Schaller, *Chairman* Glenn Williams, *Treasurer* Harold R. Shannon, *Secretary*

General Arrangements
Leon Mears
Albert Bauer
Jack Ginnaty
Curtiss Cederstrom
John Grant
Harold Rehfeld

Parade
Richard Rohn, *Chairman*
Douglas Schoemaker
John Newhouse
Marvin Kline
John Perotti
Robert Adams
Harold Fridlund
Paul A. Sanders

Brawl
Stuart Shepley, *Chairman*
Melvin Eck
Glynn Shifflett
Robert Orth
Ray Hardenbergh
Lawrence Otis

Program
Albert Morse, *Chairman*
John McCauley
Victor Zeuthen
Lloyd Kernkamp
Robert Friis
Merle Anderson

Open House
Carroll Elliott, *Chairman*
Gustafe Heinemann
William Moisesku
Winfred Hindermann
Theodore Jenson
Kenneth Melin
Leon Knempel

Knighting
Lawrence Johnson, *Chairman*
John Stark
Arthur Abrahamson
Paul Halseth
Robert Mueller
Marvin Fergestad
Donald Shilken

Button
Nordahl Rykken, *Chairman*
Donald Alderson
Leland Amundson
Carroll Clark
Thomas Finnell
John Millunchick
Donald Felthous
Wilbur Sperry

Publicity
Harold R. Shannon, *Chairman*
William Painter
Karl Eggen
Millard Garrison
Maynard Briggs
Carl Berzelius

Dansant
Fred Hovde, *Chairman*
James Hartigan
John McConnell
Lewis Rodert
Delbert Heath
John T. Bailey

Green Tea
Grace Jones, *Chairman*
Louise Zetterberg
Ruth Carter
Mary Smiley
Helen Fausey
Margaret Bradbury

Finance
Harold Lockhart, *Chairman*
Robert Lohn
Dean Taylor
Stanton Wallin
Gordon Reed
Donnell Meeks

Posters
Frederik Hakenjos, *Chairman*
Erling Nelson
Louis W. Santo
Stanley Marshall

Alumni
Lloyd Russ, *Chairman*
Earl Spokely
Charles Ten Brook
Chester Nelson
A. A. Anderson
Edward Kuefler

Decorations
Lawrence Hovik, *Chairman*
Dudley Bayliss
Lyle Nelson
George Burch
Fabian Redmond
Milton Melzian

Broadcasting
Gordon Harris, *Chairman*
George Weir
Theodore Goodner
William McIlvaine
Herbert Heidemann

Printing
Grant Waits, *Chairman*
Cyril Wall
Howard Draper
Paul Kingston
L. E. Anderson
Donald Dunshee

Record
Donald Bohrer, *Chairman*
Carl Eyberg
Claire Fox
William Cloupek
Remus Owens
Rialto Cherne

Bonfire
John C. Newhouse, *Chairman*
Donald Burris
Russell Pincoe
Ralph Sprungman
William Martenis
Wilbur Donaldson

Program of the Celebration

Friday, May 4—*(Afternoon and Evening)*

2:30—Green Tea is served at the Green Tea Dansant held in the electrical laboratory. Fair co-eds of the campus will be there!

8:00—Engineers get all het up for the big "Brawl" at the huge bonfire on the parade grounds.

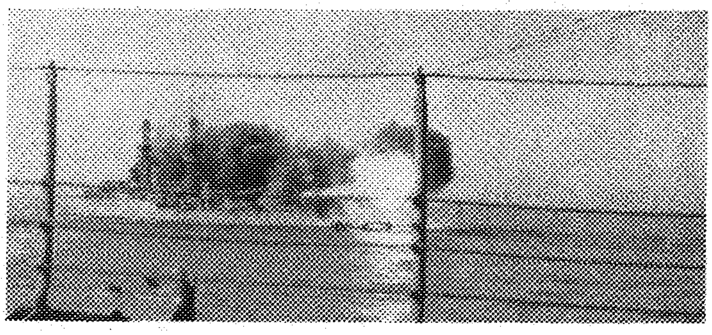
9:00—Engineers again turn thoughts to the shuffling of feet at the grand party of the year for the technical colleges, the Engineer's "Brawl." St. Pat and Queen lead the Grand March.

Saturday Morning, May 5

9:00-12:00—All of the laboratories, shops and every department conducts open house for the visitors and alumni. Souvenirs are given out!

11:00—Loyal sons of St. Pat parade before the populace of the Southeast district, displaying many floats depicting the engineer's view of most everything. Remember the Blarney Stone will be there!

12:30—Senior engineers are knighted on the campus knoll by none other than their royal St. Patrick. Announcement of members of Plum Bob is made.



U. S. S. NEW MEXICO FIRING A SALVO
Her main batteries let go in long range battle practice, shooting more than eight tons of projectile from her twelve 14-inch guns.

Salvo!

By CARL F. LUETHI, C '27

Ensign, U.S.N.R. and Managing Editor of the Minnesota Techno-Log 1926-27

EIGHT o'clock on a cool December day some 40 miles off the coast of southern California. A tolerant sea with long, gentle swells that reflected the early morning light in sparkling beams, seeming to foretell a perfect day. In the distance, a gray, gaunt vessel, whose sinister turrets and masts were outlined against the purple haze that was the Santa Catalina Islands.

Below docks, a group of young ensigns in the junior officers' mess of the U.S.S. Idaho, one of Uncle Sam's first line battleships. An eager crowd, some excited, some quiet, but all with an air of expectancy that betrayed an important event near at hand—an event climaxing weeks of drill and preparation on the part of officers and crew.

A perfect stage! And the play that was awaiting the final signal was the firing of the 5-inch and 14-inch batteries on the first practice of the gunnery year—short range battle practice, the test that decided whether or not the coveted E of excellency was to be painted on turret or gun base.

"Hey, Swede, give you ten to one your turret don't make an E."

"G'wan. What do you expect with all our pointers in sick bay?"

"Tommy, do you get much of a shock in the pits when firing?"

"Oh, don't ask him. He never fired before. He's as much of a boot as you are."

And at the sound of closing hatches, unrigging stanchions and lifelines, there was heard the famous last words, "Batten down all hatches."

Many of these men were graduates of the 1927 class at the Naval Academy, and this was their first firing of official short range battle practice. The day before had seen all guns boresighted, and check-off lists gone over in turrets and on the 5-inch batteries. The Idaho, in company with the New Mexico, which was towing the target, had gotten underway the night before in order to be on the range early in the morning. Now had come the zero hour when everyone was ready for the showdown and competition was keenest between the gun crews.

And on the sidelines taking it all in, a young Naval Reserve ensign, whose salt water career totaled less than three months, sat and wondered just what connection existed between all this and the four years of school he had just completed back at the University of Minnesota acquiring a degree in civil engineering.

The prolog to this scene began several years ago when the Navy Department decided to augment its auxiliary air forces by training and commissioning men in the Fleet Naval Reserve. Most of these men were recruited from the various universities and colleges throughout the country, and a goodly number of them in the last three years have come from Minnesota.

A DISTRICT reserve order was distributed last year and its contents began with the magic words, "In order to build up and increase the efficiency of Naval Reserve Aviation, the Bureau desires to send fifty Reserve Naval Aviators of the rank of ensign to the fleets for one year's training duty involving flying beginning July 1, 1927." This seemed to be the only spark necessary to fire the ambitions of many young fellows who had been thinking and dreaming of little else but aviation since their first delicious hours in the air. Those that decided that their civil affairs were not so essential that a year's delay would greatly harm them immediately sent in requests to the Bureau of Navigation. The result was that the fifty who first requested the duty were divided between the Scouting Fleet on the east coast and the Battle Fleet on the west coast, and are now in the midst of an experience the equal of which most of them had never dreamed before.

And thus begins my story.

Four of the fifty who could not resist the call of adventure journeyed from the University of Minnesota, and two of the four were from the College of Engineering. Douglas M. Cambell, C '27, joined the Aircraft Squadrons, Scouting Fleet, at Hampton Roads, Va.; while Richard Hanson, S.L.A., Douglas L. Mesker, Law School, and I were sent to the west coast.

Mesker and I made the trip a la American tourist, traveling in his Ford roadster by day and sleeping wherever evening found us at night. Passing over a wonderful trip in a brief manner, suffice it to say that after long hours of driving through the gumbo of South Dakota, the constant winds of Wyoming, the beautiful mountain passes of Utah, and the sweltering deserts of Nevada, we finally passed over the San Bernardino mountains into the beauties of southern California. Long avenues lined with stately palms and eucalyptus and bordered with acres of orange and lemon groves led us into Los Angeles, a few short hours from the end of our journey.

The Naval Air Station, San Diego, is located on North Island, but a few minutes across San Diego Bay from San Diego itself. The Navy owns the north portion of the island comprising 524 acres, while Rockwell Field, the U. S. Army aviation field, has the remaining 773 acres. The Naval Air Station is much the superior of the two in both equipment and general appearance. Numerous well-built hangars house the many aircraft on the station and the buildings containing shops, offices, and living quarters of officers and enlisted personnel are of the finest in the services. The grounds are well-kept with flowers and shrubbery surrounding the buildings, and altogether the station presented a very imposing spectacle to those of us who had never before been there.

THE first few days were spent getting squared away and comparing notes with other reserves, many of whom had received training together. The check-up disclosed that 27 reserve ensigns had been detailed to this coast and were divided among the Aircraft Squadrons as follows:

7 to VO-1B (Observation)
7 to VO-2B (Observation)
2 to VF-1B (Fighting)
2 to VF-6B (Fighting)

4 to VT-2B (Torpedo and Bombing)
5 to VJ-1B (Utility)

Our first thoughts, of course, were questioning ones concerning the duties which we would be given. As it turned out, the months of July and August comprised a concentration period of all Battle Fleet squadrons for the purpose of conducting tactical exercises and instruction involving all squadrons. We had arrived just at the beginning of this period, and were thus more or less "step-children" until we could become indoctrinated into our squadrons.

Observation Squadrons One and Two, and Fighting Squadron Two (to which no reserves were attached) are battleship squadrons, but during the concentration period the battleship divisions were engaged in summer maneuvers in the vicinity of Puget Sound, and these squadrons were operating on wheels here at the air station.

THE first thing on the program was naturally that of familiarizing the newcomers in the type of craft being used. One of the huge twin-pontoon SC planes in VT-2 was fitted up with dual controls and was used for instruction of the four in that squadron. The rest of the men in all squadrons were detailed to VJ-1 for a period of instruction in three UO-1 sea planes that were set aside for this purpose. These planes were the standard observation planes of the fleet at this time, and represented the highest peak of our ambitions in the old training days at Great Lakes when the only equipment at that station consisted of three N-9's, before new equipment had been obtained. At this time, however, most of the reserves had some UO work before coming on this duty and were fairly familiar with them.

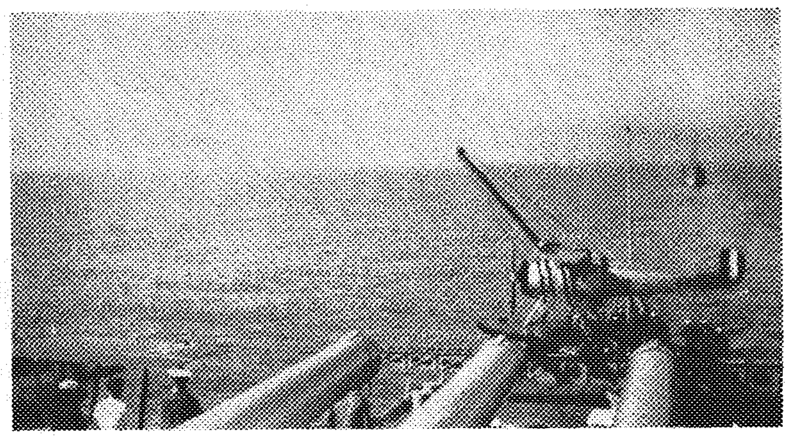
The course laid out for us at VJ-1 consisted of instruction as necessary followed by two hours rear seat solo. Then came a front seat (pilot's seat) check followed by two hours front seat flying. After that, there was instruction in formation flying with a three-plane formation and then two hours of familiarization flying in formation during which time each man alternated as number 1, 2 and 3 of the formation. This was all great sport, of course, and after the training VJ-1 turned us over to our respective squadrons, disclaiming all credit for the resulting product.

In the various squadrons, the reserves began to work into the duties that would be required of them. In VT-2 the men took part in formation work with the big torpedo planes, and made practice torpedo runs with the rest of the squadron.

Those in VJ-1, to which Hanson and Mesker were attached, were sent out on torpedo recovery flights with the destroyer divisions which operated from this base, and were also given instruction in flying big boats—F-5-L's and H-16's. When they qualified in these, they were put on the daily mail runs between San Diego and the fleet at San Pedro, and participated in various other duties in connection with the fleet.

In VF-1 and VF-6, the reserves were given a great many hours in UO landplanes before they were allowed to fly the Boeing single-place pursuit ships. The long wait was well worth while, however, when the day came that they were allowed to take off with one of those powerful planes, built for combat around one man and a couple of death-spitting machine guns.

The fourteen reserves in the observation wing were checked out in UO-1's equipped with wheels and given a number of hours as pilot in familiarization flights. They were also checked out in Loening amphibians, flown as seaplanes, for these planes were also standard observation planes and composed part of the flying equipment of the observation squadrons. In addition to this, they were all given instruction in the theory and operation of the air-propelled catapult, which starts a plane from rest and brings it up to flying speed in a short accelerated run. Two instruction shots were also given, one as passenger and one as pilot. Naturally, everyone was greatly absorbed in this novel method of taking off and this stage of instruction passed all too quickly.



CATAPULTING A SEAPLANE FROM THE SHIP
The camera has caught the plane at the center of the accelerated run. The boom for hoisting the plane on board is shown to the rear.

By the first week in September this period of the year's training came to an end for the observation squadrons. The fleet had returned to the base at San Pedro from the summer maneuvers in northern waters and it was time for the battleship squadrons to rejoin their ships. Consequently, the last few weeks at San Diego was a busy time for all concerned. Each battleship unit, comprising a senior aviator, several junior naval aviators including one or two reserve officers, and a quota of enlisted personnel, was organized and prepared to return to the fleet with all its equipment. All planes which had been used for the tactical exercises were turned in to the Naval Air Station for major overhaul, and newly overhauled sea planes, glistening in paint and varnish, were drawn to take their places. Spare parts, tools, gunnery and radio equipment, handling trucks, and all other miscellaneous gear that goes toward the operating of an aviation unit aboard a battleship was crated up or otherwise prepared for transport to San Pedro via a Navy tug detailed for that purpose.

On the day before that scheduled for rejoining the ship, all the bustle and activity of the last week or so came to a head. Equipment was loaded, and personnel embarked on the U.S.S. Aroostook, aircraft tender, which steamed away for the trip up to San Pedro, where the respective units unloaded the gear to their various ships and awaited the arrival of the planes. On the morning following the departure of the tenders, the observation wing accompanied by VF-2, with all cockpits filled and with suitcases lashed to the wings, took off and presently disappeared in the haze to the northward as they headed towards their huge, floating bases, the battleships which form the first line of defence of our land.

It so happened that the U.S.S. Idaho, to whose unit Ira Smalling and I were attached as members of VO-2B, was up at the Navy Yard at Bremerton, Wash., at this time undergoing her annual overhaul. Our unit remained at San Diego, therefore, until she returned to the fleet early in November. That gave us a period of two months during which the Idaho unit operated alone with the landplanes which had not yet been turned in. Most of this time was spent on gunnery practice with the fixed machine guns with which these planes were equipped. Smalling and I were given the task of flying the plane which towed the sleeve target and as a result were able to pile up many gratefully accepted hours of time.

Toward the end of October we turned these planes back to the air station and drew out three new seaplanes, resplendent in paint and varnish. They were two UO-1's and one FU-1, the latter

(Continued on page 254)

How We Get Our Scientific Apparatus

Designers turn inventors ideas into fool-proof, workable instruments, often coming into contact with bizarre results of "freak" inventors

By Paul E. Klopsteg, '11, '13, '16

Director in charge of Development and Manufacturing, Central Scientific Company, Chicago; formerly Instructor in Physics, University of Minnesota.

IN the development, design and manufacture of scientific apparatus there is nothing spectacular, nothing to "make" the newspaper headlines. The industry, measured in sales volume, is small, and it is highly specialized. Unlike the demand for chewing gum, cosmetics or other stenographic requisites, the demand for the products of the scientific apparatus manufacturer comes from a limited field. The average intelligence level of his employees, and consequently his average payroll level, are higher than in almost any other industry. In relation to sales, the cost of developing new apparatus and new methods is much higher than in any other business. The total number of items manufactured is exceedingly large. The quantity of a given item produced in a single lot is, on the other hand, very small. In terms of dollars and cents the average order is small, and their number is very great.

All the facts just mentioned mean high cost of product. They have conspired to make the names "apparatus manufacturer" and "highway robber" somewhere near synonymous in the mind of the professor who has the responsibility of purchasing apparatus. Yet the possibility of more than a nominal profit is precluded by keen competition in a small industry like the one under discussion. Apparatus prices are high compared with prices of articles sold by the "five-and-ten" and by hardware stores. In making such comparisons it must be remembered that because of the complications mentioned, and the expenses resulting from them, articles manufactured as scientific apparatus cost much more than vaguely similar articles sold by the hardware store. The household article is manufactured in enormously larger quantities than is the laboratory appliance. Without going into all the reasons for high cost of scientific apparatus, it may be remarked that if the development, design and production of scientific instruments were not largely the kind of work about which one can get genuinely enthusiastic, and which is never, not even for a moment, uninteresting, some of us in the business would probably be doing something much more simple, and taking life correspondingly easy.

During the past few years the scientific horizon of human knowledge has been immensely widened. In the United States especially, several agencies have been established for the dissemination of new scientific facts among laymen. Perhaps never before has the layman been so much interested in science as he is today. Undoubtedly he will soon recognize, as does the scientific worker, that the material welfare of humanity depends in a greater measure on scientific progress than on any other single factor. It need hardly be argued that the intellectual and spiritual interests of man bear an intimate relationship to his material welfare. We find it difficult to imagine life without electricity, gas, and means of rapid transportation and communication; without newspapers and magazines; without modern medicine and surgery; yet it has not been many years since these necessities of modern life were unknown. All of them are direct and indirect results of scientific research.

Granted that one of the noblest endeavors of man is to make the existence of mankind a happier one; that this endeavor will in time be accepted by the individual as his obligation towards his fellow man; that scientific investigation is one of the most powerful agencies in helping the individual to fulfill this obligation; the conclusion is then inevitable that scientific training will occupy an increasingly important position in the educational curriculum. Scientific apparatus, a most important factor in scientific education, will be demanded and used in increasing quantities. Obviously the designer and manufacturer of such apparatus has no small responsibility in keeping abreast of the demand both as to quantity and kind.

REGARDLESS of the purpose for which a scientific apparatus is to be used —whether it be intended for the educational or industrial laboratory, whether it is to be applied to inspection or control work in a manufacturing plant, whether the intended use is physical, chemical, biological or medical—the apparatus in question largely represents the practical application of physical principles. An illustration of this fact may be given by describing briefly the apparatus employed in connection with two very recent developments. The illustration will serve at the same time to show how the fundamental principle may be applied to widely different uses.

For several years studies have been carried on at the University of Chicago and in the Laboratory of the Chicago Department of Health to determine, if possible, whether a useful technique in diagnosis might be evolved from the fact that colloidal particles, suspended in water, migrate or travel when subjected to an electric field. Bacteria—one kind of colloidal particles—had been found to travel in an electric field towards the positive pole or anode. Such motion is called electrophoresis.

DR. FALK and his associates, who have been carrying on the studies, found parallel relations between the speeds with which different strains of pneumococci move in an electric field and the virulence of these strains. They are able to predict the outcome, in other words, to make a correct prognosis of pneumonia, with almost unerring accuracy, by measuring the electrophoretic velocity of the organism involved. Applying the same method to diphtheria bacilli they are able to distinguish clearly between the virulent and non-virulent strains within a few hours instead of having to wait several days for the result by the usual guinea pig method.

When a research of the type described has been carried to a certain point, particularly if the results of the research indicate that other laboratories might wish to carry on similar studies, the apparatus designer's function enters the picture. The scientist cannot be expected to design apparatus which will meet the requirements of being compact, as simple as possible, be economical to manufacture, and have the appearance which might be expected in apparatus supplied by a manufacturer. The designer studies the scientific requirements and on the basis of his experience and with his knowledge of manufacturing economies works out the design. As an example in a single unit he combines an assembly of electrical measuring instruments. Two simple keys are arranged for reversing the electrical potential to take the place of a reversing switch and a key. In addition, clearly marked binding posts are placed to enable the laboratory technician who knows nothing about the electrical principles involved, to make his connections without the possibility of error.

A laboratory device which depends to

a large extent on the same phenomenon of electrophoresis was designed to take the place of the water still for the purification of water. Instead of evaporating the water and leaving the impurities behind the new method removes the impurities and leaves pure water behind. The impurities which may consist of dissolved salts and colloidal particles are drawn by the electrodes from a compartment, the sides of which are made of a heavy cotton duck, with the positives and negative electrodes on opposite sides of this compartment. The colloidal impurities migrate in the same way as do the bacteria in the Falk Electrophoresis Apparatus; and the dissolved impurities pass out of the compartment and to the electrodes by electrolysis. The water being purified is passed through a series of such compartments, and after it leaves the last of this series its purity is as high as that of ordinary distilled water. The remarkable thing about this method of water purification is that the cost of the electric power is less than 1/100 of that required to operate an electrically heated still of the same capacity.

THE illustrations show the "before" and "after" of an optical instrument which was devised for measuring the gloss of paper, leather and lacquer finishes for automobiles and furniture. The original form consists of a wooden box having anything but instrument-like appearance. The new design not only looks like an instrument, but it possesses advantages over the original such as freedom from warping, and hence loss of accuracy, and the possibility of using it on the surface of a wall, or an automobile body, or on paper in the original sheet.

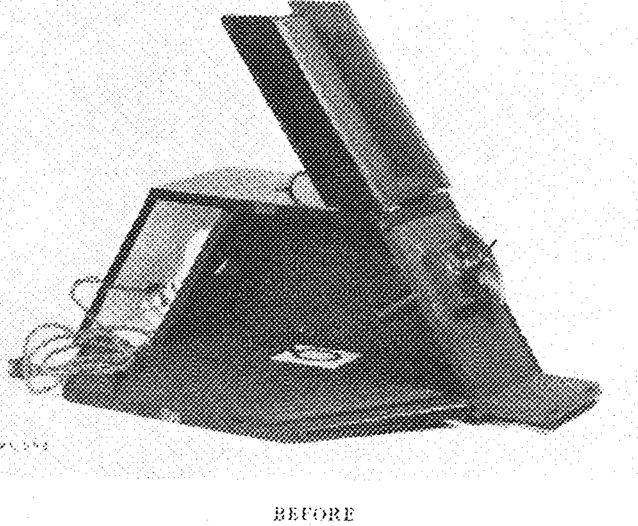
From the time an idea for a new piece of apparatus is conceived until the apparatus has been manufactured, inspected, and is ready to sell, every stage of its evolution is full of problems. The first step is usually a development job, which consists of studying all of the physics or chemistry or other science involved in the idea, with the obvious purpose of evolving an apparatus which is correct in principle and economical to manufacture. A typical development may, for example, consist first, of a thorough-going study of all available references to the subject, combined with research on its theoretical aspect. On the basis of this work an experimental design is evolved. A model is then built and thoroughly tested. Usually the tests at once reveal or suggest points which are capable of improvement. A study of the first model may and usually should result in simplification and improvement of design.

Often the scientific study involved in the development process makes necessary the design and construction of special apparatus. As an illustration of this point may be mentioned the very extensive problem of working out the correct design of such electrically heated and automatically controlled constant temperature devices as water baths, incubators, and drying ovens. In this study it is necessary to decide first what precision of temperature control at any given point in the bath or air chamber is required, and what uniformity of temperature throughout the bath or chamber is necessary. To determine whether in a given design the requirements are met both during short intervals and over very long periods of operation, two alternative methods are possible. The one is to have the experimenter make periodic observations at short intervals for hours or days at a time, using instruments for making the measurements which have the required degree of accuracy. This procedure is extremely time-consuming, and there is no question but that the observer's time could be spent to better advantage. The other procedure is to construct an automatic recording device, the sensitiveness of which can be adjusted to suit the requirements of the most precise control, as well as those less exacting in their demands for precision. In the course of one investigation, such a recorder was designed and built. Two simultaneous photographic records are obtainable by the deflection of sensitive galvanometers operated by thermoelements. A sensitiveness of .001°C for 0.2 inch on the record can be obtained. The photographic record automatically has one-minute intervals recorded on it, and it comes out of the recorder developed, fixed, washed and dried. The great saving of time and of nerve-exhausting work, and the fact that permanent records are secured by means of the device, are sufficient justification for the considerable expense involved in its design and construction.

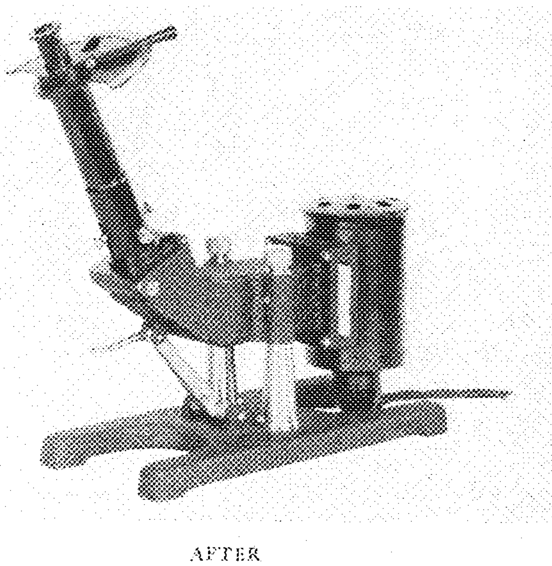
WHEN all the necessary tests on the model of a new apparatus have been completed the apparatus becomes the subject of study by the engineering department. The designer must be conversant with all manufacturing processes, with standard dimensions of materials that might be used, with foundry practice, with the relatively new processes of die casting and bakelite moulding, and with other details of manufacture which have a bearing on the production of the finished article. After the designer has completed the preliminary sketches the latter are checked by the chief engineer who studies them from the standpoint of manufacturing requirements and also from the standpoint of performance of the apparatus. The latter point is important because the finished product must duplicate the performance of the laboratory model.

After the engineering department has completed its work on a particular apparatus, a conference of the "design com-

(Continued on page 252)



BEFORE
An instrument for measuring gloss of surfaces such as paper and lacquers as it has been devised by the inventor.



AFTER
The same instrument after the instrument designer has made his study and contribution to its development.

The
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University of Minnesota

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Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

Engineer's Appreciation Day

IN combining with the Appreciation Day celebration the engineers have performed a great act of wisdom and betterment for the Appreciation Day and for Engineer's Day. By common cooperation both groups are the benefactors. Appreciation Day receives the backing of a traditional enterprise, something that has existed on the Minnesota campus for 19 years. Engineer's Day is made more impressive by the combination; the crowds on hand to witness the affair will no doubt be greater, and the Day is brought more before the public, and in a better light than ever before.

The ideals and purposes of Engineer's Day are made more outstanding. Perhaps no one has ever thought of Engineer's Day as an appreciation day—but is it not? We as engineers have always appreciated our college, and in an effort to display to the others in the University our appreciation of what the college has done for us, we have declared a holiday, and used Engineer's Day as a demonstration of our feeling for the college—we have advertised ourselves—we have shown a loyalty to the college not shown by students in other colleges on the campus. It might have been called an Appreciation Day, but it has not. However, this is Engineer's Appreciation Day 1928—we as engineers do appreciate our college—we will show it by doing all in our power to aid in the general appreciation day of the University.

Timing

WHEN a golfer swings on the ball he at times hits it and drives it two or three hundred yards, but if his timing is not correct, and he does not get his weight and swing exactly timed, the ball will not go far or fly true. A student studies—occasionally he studies whole heartedly—other times with only half a heart. The spring time is nice—the evenings are getting longer—soft breezes blow, and the urge to neglect lessons and go walking is great, so great that the mid-quarter grades have suffered. But now that spring is really here, and we are becoming inured to the idea of nice weather, we should be able to settle down and do some real work and raise the low grades that we received at mid-quarter.

One Issue More

THE end of the year draws near. There remains yet but one issue of the MINNESOTA TECHNO-LOG to be published by the present staff. It has been a most profitable year: the magazine has flourished, the number of subscriptions has increased; and we believe our readers have enjoyed the publication. We of the present staff have enjoyed our work in putting the magazine out, but our work is not yet finished. The biggest and largest issue of the year, the alumni directory number, is the last issue of the year, and its publishing involves work.

Perhaps you as a reader are interested in publishing work. If so, why not drop into the TECHNO-LOG office this spring and get started in the magazine work so that by next fall when school starts you will have an idea of what the work consists of? It is not too late to get started this year, and we in the office will be glad to have you help us out.

Hoover's "Fifteen Lost Years"

"THEY speak of his 'Fifteen lost years' between 1899 and 1914, in spite of the fact that during this period the whole engineering world knew all about him and his doings."

A writer was describing Hoover, and had hit upon a point. Strange that people should call Hoover's years of hard work in the engineering profession "fifteen lost years." Yet how natural that is. The average mind cannot understand how the engineering profession can help to develop a man's mind; it cannot see how engineering is a preparation for the duties of a leading man in the country's affairs. Even if the average mind could see how engineering could profit a man, it would be inclined to glibly say that the years spent in preparation for high duties were useless.

It seems that once a man becomes well known because of his great ability, people do not stop to consider that his ability has come as the result of training, study and work. Not every one can be a Lindbergh, and in one exploit command the attention of the world. It is usually a gradual process—the working out of natural ability. Yet even Lindbergh had to go through his years of preparation for which the average person is not wont to give consideration.

"Fifteen Lost Years"? Not at all—just fifteen years in building a foundation—fifteen years in which he was foremost among the engineers of the world.

Moustaches—Horsefeathers

THE present appearance of the masculine upper lips on the campus at large, and the engineering campus in particular, speaks eloquently for the fact that students, for all their claims of individuality, are largely governed by a "follow the crowd" spirit. Since certain members of the university band have taken up raising facial hirsute adornments as professional equipment for their forthcoming European tour, the male portion of the campus has seen fit to follow their lead with more or less success.

For engineers who heretofore have expressed abhorrence for anything of the effeminate in their personal make up, the appearance of tiny "misplaced eyebrows" poised coyly beneath their manly noses seems, to say the least, inconsistent with this former declaration. From the foregoing, it may be gathered that we are opposed to the "hair-raising" conduct of the engineers. This is not the case—it is merely the complete standardization of these moustaches that rouses our editorial ire. Engineers will be engineers and standardization is excellent in its place, but in the matter of moustaches—horrible! It is our opinion that the technical campus can be improved and beautified to a very great degree by proper variation in moustache raising. Imagine the restful effect on an instructor's nervous system—and the consequent improvement in grades of his classes—for him to be able to call on members of his classes by moustache or beard instead of memorizing long lists of names. For example: "Will the gentleman with the black Van Dyke please awaken the gentleman with the red Burnsides?" or "Will the man in the blond Mandarin work the problem?" would replace the present seventeen letter names beginning in F, X, and Q.

All together now, engineers, let's grow big ones, little ones, wide ones, black, brown, blond, or red ones, but let's have diversification.

Architecture Advances

ONE great outstanding change which has come about in American architecture is in the treatment of the skyscraper. Ever since the war most striking as a characteristic of modern architecture in this country has been the placing of emphasis on vertical lines.

Before 1900 the accepted design for a tall building was to pile a series of stories one upon the other each with its order, cornice and base. Then Bruce Price struck a new note when he disregarded stories as such and treated windows as mere incidents in the wall surfaces. From that time on the accepted idea was to have a base, and a cornice on each building much the same as on a column.

Just after the war, George B. Ford returned from Europe with the set-back principle, and the result was the New York Zoning Law of 1916. People have remarked on the radical departure this set-back style has, but the ancient Tower of Babel, and the Hanging Gardens of Babylon all had the same idea.

Then came the Chicago Tribune competition which attracted world famous artists, among whom was Saarinen, a Finnish architect who placed second. His design employed the new idea in a very convincing manner, and was a distinct advance toward the present step-back construction.

About the same time Mr. Goodhue designed the Nebraska capitol, and used ideas in the new style that have been copied all over the country.

So, as has every branch of the engineering profession, architecture has changed considerably in the past few years. The demand for thoroughly trained men has increased, and Minnesota is doing its share to supply this demand. The course in architecture has been one of the fastest growing courses in our institution. The number of students enrolled in the freshman class in architecture is second only to the number of students scheduled to take electrical engineering. Minnesota offers an exceptionally good course in this subject, and is becoming known as one of the best undergraduate schools in the country for architecture.

Faculty Sketches

JOHN H. KUHLMANN

JOHN H. KUHLMANN, assistant professor in electrical design, was born thirty-five years ago in a typical midwest town, Clinton, Iowa. He spent the greater part of his life in that vicinity, graduating from the public school and the Wartburg College at Clinton, where he received his Bachelor of Arts degree.

He registered in the electrical engineering college at the University of Iowa in the fall of 1913 and participated in numerous activities. Among these is that of bugle master in his sophomore year, and four years as a member of the rifle team, having won the Leeper trophy emblematic of the best rifleman during his freshman year. He also took an active part in the band at Wartburg College. It was during the summers of 1913 to 1916 inclusive that he assisted the city engineer of Clinton, Ia. The work consisted of lot surveys, street grading, paving and sewer inspections.

After graduation from the University of Iowa in June, 1917, he accepted a position as assistant engineer in the electrical department of the Electric Machinery company of Minneapolis, the work consisting of design of electric machinery and tests of motors and generators. Special investigations as to the nature of trouble in field apparatus were conducted throughout northern Minnesota, Michigan, Kansas and Nebraska.

In the fall of 1920 Mr. Kuhlmann came to the University of Minnesota but continued an outside practice of design in connection with the Electric Machinery and Manufacturing company for a period of four years. Since then he has been doing part time consulting engineering work and instructing senior electricals in machine design and alternating current laboratory work. A great deal of his time is now spent in writing a textbook on design of electrical machinery which will be published in the near future.

Mr. Kuhlmann married Thomasine Rosander of Minneapolis in June, 1919. His main hobbies are fishing, golf and tennis. He is a member of the A.I.E.E., Engineer's Club of Minneapolis, Minnesota Federation of Engineer's Societies, Tau Beta Pi, is counsellor for the Minnesota student branch of the A.I.E.E., and is connected with the Student Work Committee.

At a recent convention of Kappa Eta Kappa, professional electrical engineering fraternity, held at Madison, Wis., he was elected Executive Vice-President. He was instrumental in forming the Beta chapter of this fraternity at Minnesota.

It is interesting to note that Mr. Kuhlmann took an active part in Engineers Day, March, 1921, and was the last faculty member to take the part of St. Pat. In the role of the jolly Irishman he knighted President Coffman, Dean Leland, W. I. Nolan, Speaker of the House, and Lieutenant Governor Collins into the royal order of St. Pat.

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

Bryant Appointed New E. E. Head

Head of Electrical Department at University of Texas Will Undertake Duties Here Next Fall; Is Consultant and Author.

PROFESSOR J. M. Bryant, head of the department of electrical engineering at the University of Texas, has been appointed Professor of electrical engineering and Head of the department at the University of Minnesota. He will undertake his duties here in the fall of 1928.

Professor Bryant is a graduate of Worcester Polytechnic Institute where he received the degree of bachelor of science in Electrical Engineering in 1901 and the Electrical Engineer degree in 1909. He obtained his master's degree at the University of Illinois in 1911. He was a member of the staff of the department of electrical engineering at the University of Illinois from 1903 to 1914, leaving to accept the headship of the department at the University of Texas.

Immediately after graduation, he entered the service of the General Electric company. Also, for several years past he has been a member of the staff of that company as a consulting engineer. He has had a varied experience as a consultant in other branches of the field of electrical engineering.

During the World War, Professor Bryant was president of the Academic Board of the U. S. Army School of Military Aeronautics and Chairman of the Board of Control of the War Schools, at the University of Texas. These duties involved a large organization of faculty and students and the expenditure of large sums of money. The total enrolment of students in the various army schools under his direction amounted to about 25,000.

Professor Bryant is the author of various papers and articles relating to electrical engineering, and the joint author with J. A. Correll of a book entitled "Alternating Current Circuits."

Among the societies in which Professor Bryant holds membership are: The American Institute of Electrical Engineers (director), Illuminating Engineering Society, Society for the Promotion of Engineering Education (member of the Council), American Association of University Professors, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

First Headlamps Arrive For E. E. Dept. Test

The first of the automobile head lamps to be tested in the University of Minnesota's newest laboratory, the Motor Vehicle Light Testing Laboratory, have arrived. This laboratory is to be used for the purpose of testing motor vehicle lamps, including headlamps, auxiliary driving lamps, spot lamps, signal lamps and rear lamps submitted to the Commissioner of Highways for approval to be sold and used in the state of Minnesota.

Chevrolet head lamps, Ryan head lamps, some spot lights and tail lamps have arrived. These lamps will be tested in the order of their arrival as soon as the laboratory is completely equipped and in operation.

Alumnus Is Instructor in Flying School

A Minnesota alumnus, George A. MacDonald, M '27, is chief pilot and instructor for Air Service, Inc., of Minneapolis, a commercial flying school who are this summer going to offer a special course in aviation flight and ground school training to a limited group of 60 college students. The course will include 10 hours of flight training and instruction in special aviation subjects. It is to begin on Monday, June 18, according to announcement made by the Air Service, Inc.

Since graduation, MacDonald, who holds a commission as Ensign in the Naval Reserve as a Naval Aviator, has been working in the aviation profession. He has test flown the Mohawk plane, acting as test pilot and vice-president of the Mohawk Aircraft company, the first commercial airplane manufacturing company of Minneapolis. He also holds a transport pilot license.

Other instructors who will teach in the special summer pilots course offered to college students are Norman Worinski, president of Air Service, Inc.; Chet Cummings, engineer and designer of Mohawk plane; Harry P. Whittle, and A. P. McCullough, who has 15 years experience in aviation. The company has three planes for the purpose of instructing students.

Honorary Societies Initiate Men

Joint Banquet of Chi Epsilon, Eta Kappa Nu, and Pi Tau Sigma Conducted May 3; Tau Beta Pi Takes in Fourteen New Men.

AT the spring initiation banquet of Tau Beta Pi, held Thursday evening, April 19, in the Sun Room of the Curtis Hotel, Mr. T. D. Crocker, assistant general superintendent of the Northern States Power company, delivered an interesting talk on "The Engineer in Management." Professor William T. Ryan of the electrical department officiated as Toastmaster.

New initiates of Tau Beta Pi, who are all juniors, are: C. W. Anderson, Mines; R. C. Freeman, EE; F. M. Hakenjos, A; R. H. Heyer, ME; C. J. Johnston, EE; A. E. Lyden, Ch. E.; J. W. Millunchick, EE; L. W. Nelson, Ch.E.; W. H. Painter, EE; L. J. Rowell, ME; J. E. Specht, EE; E. C. Tanner, ME; C. I. Vigness, EE; and S. E. Wallin, CE.

Officers of the society elected for the coming year are: Erling Saxhaug, president; William Painter, vice president; Stanton E. Wallin, recording secretary; Frederick Hakenjos, corresponding secretary; and Elmer W. Johnson, assistant professor, treasurer.

Chi Epsilon, national honorary civil engineering fraternity, announces the initiation of J. Gunnarsson of Iceland, Theodore Jenson of Minneapolis, Kenneth Melin of Atwater, and Grant Waits of St. Paul. The formal initiation and banquet was held on Thursday, May 3, at the Radisson Hotel in conjunction with Eta Kappa Nu and Pi Tau Sigma.

Eta Kappa Nu took in seven men all of whom are juniors. They are: L. F. Borchardt, Edward Devoy, John W. Millunchick, Leo S. Ohman, William Painter, Erling Saxhaug and Glenn Williams.

Men taken into Pi Tau Sigma are: Richard E. Deschner, Donald G. Felthous, and C. Theodore Skanse.

Chemical Researches Being Conducted Include Study of Distilling Columns, Lacquers, and Alpha Rays

AN important piece of research conducted in the School of Chemistry has been the study of the efficiency of commercial distilling columns. Tests were run to determine the variation with the rate of distillation, and other factors affecting its output. It was found that it is important to consider the place where the feed enters the column; that is, the selection of the proper point will make hitherto unproducing parts of the column do useful work. A report of this work is now being written by Mr. J. L. Tronson.

Another promising line of research is the work being done on the changes occuring in lacquer solutions. Light rays have been passed through lacquers and the effects studied hoping to determine what causes the film to crack and go to pieces.

The physical chemistry department has been conducting experiments, under the direction of Dr. Lind, investigating the production of active molecules of various substances, and studying the nature of activation and the chemical actions that these chemically activated molecules can undergo with other substances. There are three ways that molecules may be activated; first, by an electric charge; second, by ultra-violet light; and third, by the action of alpha rays. The last method gives the most intense form of energy as a source for activation.

Dr. Lewis, national research fellow, has recently published a work on the "Photo-chemical Decomposition of Hydrogen Iodide" which has an important bearing on our conception of the mechanism of the reaction. He has also published a paper on the "Synthesis of Ammonia from Nitrogen and Hydrogen after these Gases have been Activated by the Electric Charge." Dr. Livingston, assistant professor in physical chemistry, is working on the synthesis of hydrochloric acid from the elements under the influence of alpha rays from radon. Dr. Glockler has continued his work on the synthesis of liquid hydrocarbons from ethane under the influence of a silent discharge. Doctors Lind and Glockler presented two papers jointly on this subject at the American Chemical Society meeting at St. Louis, April 16-21. Dr. Kolthoff, at the same meeting, presented a paper on the "Influence of Sucrose on the Dissociation Constant of Weak Acids in Aqueous Solutions."

Stevens Talks to A. S. C. E.; Officers Elected

John F. Stevens, noted civil engineer, by far the most important speaker to appear on the technical campus during this school year, spoke in the Minnesota Union at a banquet of the student branch of the American Society of Civil Engineers on April 18. He told of numerous experiences encountered and of conditions when he served as the Head of the American Railway Mission to Russia in 1917-18 and as the president of the Inter Allied Technical Board supervising the Siberian railways in 1919-23. Mr. Stevens was once the chief engineer of the Panama Canal and is known also for his activity in railroad construction and supervision. He was brought to Minneapolis in connection with the legal suit evolving from the construction of the Mendota bridge.

The officers of the student branch of the A.S.C.E. were elected for the next year and are as follows: Grant Waits, president; Nordahl Rykken, vice president; Theodore Jenson, secretary, and Victor Zeuthen, treasurer.

Hill Quits School to Work On Hastings Dam

William C. Hill, who has been associate editor of the TECHNO-LOG for the past several months has withdrawn from the university to take a position with the United States engineers who are constructing the new government dam in the Mississippi at Hastings, Minnesota.

"Bill," who has been made second in charge of the surveyors on the dam, writes: "On the job now at Hastings.—We are establishing a base line for the dam about a mile upstream from the spiral bridge. This dam will be 23 feet high, backing up a lake of 12,250 acres. The damned dam will be about 1200 feet long, containing a lock and sluice gates. Several Minnesota students are with the party so we feel quite 'at home.'"

Spring Elections Hotly Contested

Spring elections are over, and the smoke and din of battle has cleared. Leon Mears was elected the engineering college representative on the All-University council, and Louis Schaller has been elected to represent the technical colleges on the Board in Control of Student Publications.

The race for these two positions was particularly hot, the All-University council position being contested against Mears by Larry "Duke" Johnson and Frank Freeman. William Painter ran against Louis Schaller for the publications Board position.

The Techno-Log amendments to the constitution of the Techno-Log Association were passed by a large majority, and as a result of this action confusion in the election of members to the Techno-Log Board will be avoided. The constitution as revised will call for the election of six men to the Board, one from civil, electrical, architecture, and mechanical engineering, the School of Chemistry and the School of Mines, eliminating the member at large. Also the selection of the business manager of the Techno-Log will now be in the hands of the Board instead of in the hands of the newly elected managing editor.

Men elected to the Techno-Log Board for the coming year are: Dean Taylor, chemistry; Stanton Wallin, civil, Arthur Abrahamson, electrical; Realto Cherne, mechanical, and Marvin Fergestad, architecture.

New Drafting Space for Mechanicals

A complete rearrangement of the drafting space in the Mechanical building is now effected. The main drafting room is partitioned off making two shop lecture rooms and two small drafting rooms. In this way the lecture room congestion has been relieved and the increasing number of drafting sections were accommodated. For many months the embryo draftsmen have been attempting to work drafting problems to the tune of an anvil chorus from the Forge shop and the sound of the many marching feet of the students going to class on the second floor. Since the room has been partitioned off all this has been eliminated and the efficiency of the drafting rooms considerably increased.

Sport Jottings

By HAROLD R. SHANNON

OUR LIKEABLE Larry Johnson represented Minnesota in the Ohio State Track Meet in the discus throwing and gained fifth place. "Duke" also puts the shot on occasions. "Bill" McGinnity competed in the two mile relay race in the same meet. In the dual meets he also runs in the half event.

THE GOLFING brothers, Donald and Arthur Burris, are both out for the varsity golf team. William Norley and Harold Shannon are teaming together in the intramural golf doubles play. Rees Rosten and William Barstow, and George Burch and Ray Claggett have also entered and have announced their intentions of trimming the above mentioned team.

YOU WILL find the engineers represented in any sport, no matter what the obstacles. Page our baseball aspirants. After all eligibility reports are in we find the engineers still monopolizing the majority of the positions. Of the fourteen men making the trip three are engineers. Johnny Stark has the shortstop post cinched, and Winfred Hinderman has first call on the third base while George Langenberg is fighting for an outfield position with three academics so it is practically a cinched job for him.

"FUZZY" Riddell, St. Patrick himself, after the knighting ceremonies, will dash over to the stadium to get into his football togs and scrap against "Duke" Johnson, Lloyd Westin, and Fred Hovde of the varsity as a member of Joesting's All-American and former varsity men team.

KITTENBALL is all set to get under way with ten teams entered in the two divisions. As Hendrickson's two years champion team has disbanded this year the fight for the championship promises to be more interesting than ever.

YOU MISSED plenty of entertainment if you did not attend the Northwestern gym meet. There were over three hundred competitors from the various colleges, clubs, and high schools throughout the state and vicinity.

IT IS WORTH noting that our gym team copped the class "A" open event championship. Harvey Dartt gained second place in the all-event competition and first in tumbling while John Wald took fourth place in the all-events and first on the rings.

AMONG THE Big Ten wrestlers Louin Tiller again made an impressive showing when he displayed his best form this year in the light heavy-weight division, throwing Stickler of Purdue in eight minutes.

Around the World With Our Alumni

Chemists

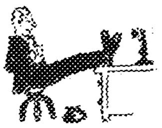
Several former students of the school of Chemistry are now on the faculty of Northwestern university. Charles D. Hurd (Gr. '19) and Clifford Hamilton, (Gr. '20), held professorships in the organic department. Frank C. Whitmore, who was formerly assistant professor of chemistry at Minnesota, is now head of the department of chemistry.

Paul Glasoe, who is the head of the department of chemistry at St. Olaf College of Northfield, Minnesota, has been granted a year's leave of absence. He will do research work at Oslo, Norway.

Jacob Cornog, who was at one time a student at Minnesota, is now professor of chemistry at the University of Iowa.

'08—Edward X. Anderson has recently been promoted to associate professor of chemistry at the University of North Dakota.

'10—Farrington Daniels, who is associate professor of chemistry at the University of Wisconsin at Madison, attended the recent meeting of the American Chemical Society, where he gave several papers, among which were: "Photochemical Measurements in the Ultra-Violet" and "A Study of Chemical Effects Produced by Cathode Rays." Dr. Daniels, it is interesting to note, is one of the "starred" men in "American Men of Science".



'12—R. A. Baker, who was formerly assistant professor of inorganic chemistry at Minnesota, is head professor of chemistry at Syracuse university.

'12—Mark W. Bray, who received his master's degree in 1914, is now employed at the Forest Products Laboratory at Madison, Wisconsin.

'17—William Higburg represented his company at the St. Louis meeting recently. He is sales manager for the charcoal products division of the Republic Creosoting company of Indianapolis, Indiana.

'25—Ernest Jewett, who has been employed in the research department of the Proctor and Gamble company at Ivorydale, Ohio, for the past two years gave a very interesting talk on his experiences in industrial chemistry before the newly organized Minnesota student chapter of the American Institute of Chemical Engineers on the afternoon of April 26.

'26—R. B. Whitney, who obtained his Ph. D. in organic chemistry last June, has accepted an instructorship at Harvard university. Mr. Whitney, who received his Ph.D. on his twenty-second birthday, was the only one of seven who received the degree of Ph. D. in chemistry last June to take a position in educational work. Mr. Whitney has spent the past year in doing advanced work in physics at Minnesota.

'27—Grant Merril has returned to the School of Chemistry where he is doing research work on analytical laboratory control problems for his master's degree.

'27—Marjorie Crawford, who received her Ph. D. degree last June, has accepted a position of assistant professor of organic chemistry at Vassar college.

'28—Elsie Kilbourne has been elected to a position on the faculty of Vassar college. Miss Kilbourne has spent the past year doing research work in the analytical department.

A few of the alumni, former students and instructors of the School of Chemistry who attended the seventy-fifth meeting of the American Chemical Society which was held at St. Louis, Missouri, recently were: R. C. Fuson ('24), who is now teaching organic chemistry at the University of Illinois, Lloyd Swearingen ('26), who is teaching physical chemistry at the University of Oklahoma, Herbert Hamilton (Ch. E. '97), who is in the medical research department of Parke, Davis and Company of Detroit, Michigan, Elwin E. Harris (Ph. D. '25), who is assistant professor of chemistry at the University of North Dakota, Horace Marr ('17), of Cleveland, Ohio, and Darwin R. May ('14), who is research chemical engineer for the Westinghouse company at East Pittsburgh, Pa. Alumni members of the faculty of the School of Chemistry who attended the meeting were Dr. Lillian Cohen, ('00) and Dr. N. C. Pervier.

Civils

'22—N. Severn Anderson has recently accepted a position with the Northern Pacific railroad company as a valuation engineer.

'23—Henry J. Manger has been transferred from the United States engineer's office in Milwaukee, Wisconsin, to the district engineer's office in St. Paul. Mr. Manger's address is Bremer Arcade, St. Paul, Minnesota.

'23—Harry E. Cribbs, we have heard, spends his off hours working for the Chicago, Milwaukee and St. Paul railway company at Mason City, Iowa. He is an instrument man in the engineering department.

'25—Dwight T. Burns, who is a building inspector for the Santa Fe railroad, has been transferred to Topeka, Kansas. He was formerly stationed at Fairfax, Oklahoma.

'25—Harry N. McAndrews is doing engineering work for the Chicago, Milwaukee and St. Paul railroad at Mason City, Iowa. We learn that Mrs. McAndrews is none other than Ursula Quinn, (Minnesota '25).

Electricals

'02—Wilhelm Nilson has left the ranks of the engineers and has become a tiller of the soil. Mr. Nilson, as one might deduce from the foregoing, is farming. He is located at Twin Valley, Minnesota.

'05—Emil Anderson, who for the first few years after his graduation was chief engineer for the Yellowstone Park association and later was electrical inspector for the underwriters, has for the past eleven years been in the electrical contracting business. During the first part of this year Mr. Anderson associated himself with the Langford Electric company of Minneapolis. In the summer, Mr. Anderson usually loads his car with his family and goes camping.

'13—William R. Everett, who was formerly with the Minneapolis Trust company, has taken a position with De Wolf and company of Chicago. Mr. Everett has been in the bond business since he received his degree of electrical engineer in 1915.

'14—Elmer W. Johnson, who is assistant professor of electric power in the department of electrical engineering, has acquired a beautiful new home at 5412 Clinton Avenue South, Minneapolis. Professor Johnson was formerly in the employ of the Northern States Power company at Minneapolis.

'14—James A. Colvin is superintendent of generation for the Minneapolis division of the Northern States Power company. Mr. Colvin has recently been elected to offices in the American Society of Mechanical Engineers and the Minneapolis Engineer's Club. Mr. Colvin took a trip east last fall to attend the N. E. L. A. "prime movers" convention. He is chairman of the prime movers committee of the North Central Electric Light association.

'19—Carrol E. Lewis, who is a member of the firm of Lang, Raugland and Lewis, architects of Minneapolis, has been working for some time on a humidifier for use in homes and offices. Mr. Lewis's new device, which is distinguished by its automatic temperature and humidity control, has been patented and is about ready for the market.

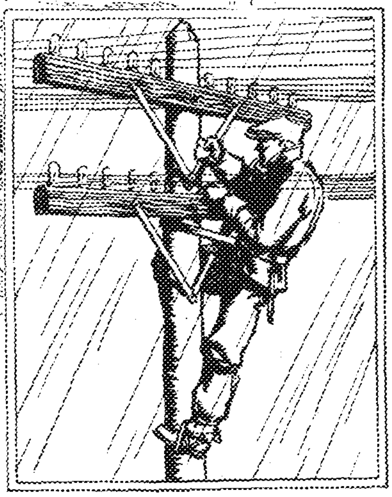
'23—Glenn W. Nordvall is now regular inspector and file clerk in the generation department of the Northern States Power company of Minneapolis. He was formerly with the Northwestern Bell Telephone company. He is the proud father of a baby girl. The Nordvalls make their home at 3328 Twenty-sixth Ave., Minneapolis.

'24—James A. Tyvand has recently changed his address from Barton, North Dakota, to Milwaukee. He can now be reached at 691 Cramer Street, Milwaukee, Wis.

'24—W. E. Carlson is assistant office engineer in the generating department of the Northern States Power company at Minneapolis. His work at present consist of working on equipment forms and files. He was formerly in charge of the apprentice engineering course given the company. According to our present information, Mr. Carlson was married recently.

'25—Robert E. Ludlum, who is the illuminating engineer in charge of the southern California district of the Southern California Edison company, a subsid-

Typical of the spirit of service among telephone personnel.



iary of the General Electric company, was married some time ago to Miss Lucille Doeblin of St. Louis, Missouri.

'25—Ira B. Garthus is office engineer in the generation department of the Northern States Power company at Minneapolis. Instead of getting married, Garthus possessed himself of a Chevrolet coupe. He has been checking construction work and working on a voltage survey of the interconnected system surrounding the twin cities.

'25—R. B. Johnson is an electrical engineer in the relay section of the generator department of the Northern States Power company at Minneapolis. He has done quite a bit of work recently on carrier current telephone transmission systems.

'25—A. D. McEwen, Norman Hussey, and M. N. Lanpher, '24, are all employed in the industrial sales department of the Westinghouse company. They have their headquarters at the Chicago sales office of the company.

'25—Franklin O. Knoll has recently been transferred to the St. Cloud division of the Northern States Power company where he is working as a distribution engineer. He was formerly stationed at Minneapolis.

'25—Roy D. Schuck was recently promoted to distribution engineer for the N. S. P. company and transferred to Stillwater, Minnesota.

'26—M. S. Boreen and Richard B. Robinson, '27, are in the engineering department of the Westinghouse Electric Products company of Mansfield, Ohio.

'26—F. D. Joesting is working on light traction apparatus in the railway engineering department of the Westinghouse Electric and Manufacturing company at East Pittsburgh, Pennsylvania.

'26—Henry Tholstrup has recently left his work in the electrical department to accept a position in the radio department of the Westinghouse Electric and Manufacturing company at Chicopee Falls, Massachusetts, where Jim Barton, E '27, and Henry Forbes, E '22, are now working. Henry Forbes was recently married and we understand that Jim Barton is engaged to be married in June to Rhoda Cote, interior decorator of '25.

'26—R. E. Burlingame, when he is not burning up the roads in his Chevrolet, works in the Byllesby resident electrical engineer's office at Minneapolis.

'27—Robert Gibson is taking the Westinghouse graduate student course and is going into the work management department of the Westinghouse company on completing the course. Mr. Gibson's address is 905 Roos Avenue, Wilkinsburg, Pennsylvania.

'27—Seth Witts is now assistant office engineer in the generator department of the Northern States Power company at Minneapolis. Seth is still single and has, we understand, become the proud possessor of a new Chevrolet coach. He is a Mason and a short time ago he received the thirty-second degree. For some time past he has been engaged in working on a voltage survey for the power company.

Mechanicals

'23—C. R. Marshall is occupied as a results engineer in the generating department of the Northern States Power company at St. Paul as is Ernest F. Carlson, '22.

'26—Wesley J. Anderson, who has been with the Westinghouse Air Brake company since his graduation in 1926, says of his work in a recent letter: "My work so far has consisted of plant lay-out and special test work on machines which are about to be put on production work. I am sort of a go-between for the foremen, being assistant to the shop engineer in the works manager's office." Letters will reach Anderson if sent in care of the Westinghouse Air Brake company at Wilmerding, Pa.

'27—Harold J. Lamon is dividing his time between working for the Chevrolet Motor company at Flint, Mich., and attending the General Motors Institute of Technology. He writes: "The work is plenty hard as we are making about 6,000 motors per day. Financially it's 'not so hot' but it's a great life if you don't weaken."

'27—Ralph Richardson is in the technical data department of the General Motors company with offices in the General Motors building in Detroit. We understand that, like all good engineers, he likes his work.

'27—George P. Vye is now in the last throes of thesis writing at Sheffield Scientific School of Yale University. His love for old New England is expressed in the following lines from a recent letter: "If you ever crash the higher realms of politics, introduce a bill in Congress to burn New England down for the welfare of the entire nation. I'll stick with you to the bitter end." He is located in the Mason laboratory of the mechanical engineering department.

'28—Irvine G. Sinnott, who left the university recently to take a position as combustion engineer with the Pittsburgh Coal company of Pittsburgh, Pa., sends back some interesting observations on the coal strike, his work, and things in general: "We people of the West don't realize the seriousness of the present coal strike. I think it is about the biggest industrial battle this country has ever seen. The other day on coming out of a mine after an inspection trip I was seized by some of the miner's 'peaceful pickets' and pretty nearly had to join the union to keep from being torn limb from limb. It gave me all the excitement that I want for some time! . . . I am as well satisfied with my work as one could be—and then some. I am doing something different every day. I have spent some time at the mines studying the mining and preparation of coal, a few days in the laboratory working on coal analyses, and about one week on the road running combustion tests. I have been running tests in laundries, potteries, foundries, bakeries, rubber plants, etc., and I have seen the making of everything from chewing gum to balloon tires. . . . As things now stand, I expect to return to Minneapolis before the fellows graduate."

How We Get Our Scientific Apparatus

(Continued from page 245)

mittee" takes up the question of mechanical design of an apparatus which will embody all of the essential features of the model, and which, at the same time, will be simple and economical to manufacture. A number of alternative designs are usually worked out by one of the designing engineers and submitted to the committee, and again the best features of each of them combined into one which approaches the best possible form. Usually a final model is then constructed in which the remaining defects, if any, will be minor ones; these can easily be corrected in the working design upon which quantity production is based.

THE design committee will, in general, include the development engineer, the chief designer, the production manager, and the chief inspector, together with a representative of the sales department, under the chairmanship of the manager of the division which includes these various activities. All of these men have intimate knowledge of the apparatus but they regard it from entirely individual and different points of view. It is hardly necessary to point out how advantageous it is if several or all of these individuals have, at one time or another, been purchasers and users of scientific apparatus. A conference of this kind saves much time, because by the elimination process, most rigorously and unsparingly applied, there is likely to be left a combination of features which will have merit because they have survived the criticism from so many different points of view. A design so evolved is therefore much more likely to find immediate favor with the buyer and escape his criticism than one which has been worked out from start to finish by an individual whose points of view may all have been condensed into a rather narrow angle of vision because he has lived with the job so closely. In the individual the problem usually becomes so much a part of him that he is unable to apply the sort of criticism that must be applied to a design before it can be successful.

Another complication of scientific apparatus manufacture results from the

(Continued on page 260)

St. Patrick Tells How We Got the Blarney Stone

(Continued from page 240)

that should the castle fall before the Og, never,—never let him gain possession of the Blarney Stone. A little later she died and her loyal subjects placed her, in eternal slumber, in the old castle below the Elm of Gadmot.

Shortly afterward Carmac McCarthy decided on a bold stroke. One dark night he removed the Blarney Stone, replacing it with a duplicate. Waking up Pat he gave him the stone, telling him to keep it for him until he should ask for it.

THE death of the Shee had destroyed the morale of her Clann and the next attack of Angus Og was successful. Blarney Castle, the home of the Lepracauns, fell and in the fray Carmac McCarthy received his death thrust. He had just strength enough left to stagger to Pat and to tell him to take the Blarney Stone to far countries and never let it get out of his possession unless it should fall into worthy and deserving hands.

So Pat left Ireland and traveled long and far, across mountain ranges, hills, and valleys; across great seas until finally his wanderings carried him to the junction of the Minnesota and the Mississippi rivers. Here the air was clear and fresh, here the country was green and verdant. At the site of what is now Minnehaha Falls, Pat took up his abode. Long happy years followed. Every year groups of Engineers in their study of the geological formations of the bed of the Minnehaha Creek would stop to talk to the old man of the falls. Pat used to tell them strange tales of Old Ireland, showed them the operation of the slide rule and learned to like them a great deal. Here, he thought, is a group of men worthy of the trust of the Blarney Stone when he should leave on his last great adventure. Here was a group who would cherish and uphold the traditions connected with the peculiar stone that always rested just outside of his door. But still Old Pat bided his time and held his tongue, he wanted to be sure. Pat's association with the Blarney Stone had bound him quite closely with the fairy Clanns and he learned about Progress stalking across the world erecting stern realities that completely displaced the traditions and beliefs of before. The power of the fairies was on the decline. Then came word of a mighty conclave.

The fairy Clanns of Kilomasheogue had met en masse to decide what to do. They met in the old Blarney Castle. They came, all of them, the people of the younger Shee members of the Tratha Da Danaan, the Sons of Milith, with the Queens of North and South Munster. There was Angus Og and his wife Caitilin, daughter of Pan and her sister, the Queen of Ormand. The five Guardians of Ulster arrived in power and splendor: Brien Mac Belgan of Dromma Breg, Tinnel Boclachthna of Slieve Edlison, Grici of Cruchan-Aigle, and Gulban Glas Mac Grici whose dun is in the Ben of Gulban. There came to the hosting, the Shee of Aine Ni Eogail of Cnoc Aine and Ivil of Croglea.

Among the early arrivals came Glombar O' Glomrach of the sea with the talisman of his Clann, the Pearl of Opar. Canan Mac Rihid, Goerku Mac Gairid, Mither Mac Mintan, and Esirt Mac Beg, son of Bucyene, all headed by their king Udan Mac Audain and his tanist Beg Mac Beg.

The Thin Woman of Inis Magrath with her son Seumos Beg. The Grey Woman of Inis Magrath and her daughter Clione Beg. Their husbands, the Two Old Philosophers, with whom they had lived in Wood of Gadmot were not there as they had both died during a frenzied argument concerning 'What is and what is not.'

Credh Mac Aidh of Roghery with his daughters Arife and Etain Fair-Hair. There came Cas Corach, son of the Great Allov. Lugh of the Long Hand filled with mysterious wisdom, Coll Cecht Mac Griena, Banba, Fodla, and Eire, all names of glory came to the hosting of the Clanns and each brought his talisman. Lastly came the Serene One, Dana, the Mother of the Clanns. All the Clanns were now all represented except the once powerful Lepracauns of Gort Na Cloca Mora. That Clann had perished with the death of its Shee and the last attack of Angus Og. While the Blarney Stone, the talisman of the Lepracauns was in a far country in the hands of St. Pat.

The Meeting of the Hosts did not last long. The tendency to abandon the earth and to return to the Country of the Gods was universal. So, shortly the exodus of the fairy hordes began. Taking their talismen and all of their possessions, the Clanns left, dancing and singing for the Country of the Gods. The only remnant of the fairy Hosts left on this earth was the Blarney Stone, safe in the hands of St. Pat in a distant hand.

When Old St. Pat heard about the departure he decided it was time to act and so he called a few of his closest friends together and told them his story. When he told them that he had, and was the possessor and keeper of the original Blarney Stone by appointment of the fairies, their amazement knew no bounds. He told them that he knew that his days on this earth were numbered and already he could hear the call from the Far Country, the Country of the Gods. His wish, he said, was that they assume the responsibility of keeping the Blarney Stone. A few days later Old St. Pat passed to the Beyond.

Pat's closest friends brought the stone to Minnesota where among the scattered population it was well protected. In time the University of Minnesota was established, and with it came the custom of Engineer's Day at which all true and loyal sons of the sod were wont to celebrate in honor of the first engineer, St. Pat. Seeing this, St. Pat's closest friends gave the Blarney Stone to the engineers who have since held it, and defended it from intruders. And every year in worthy recognition of the great gift, the senior engineers are allowed to kiss the faithful stone, and be knighted upon it.

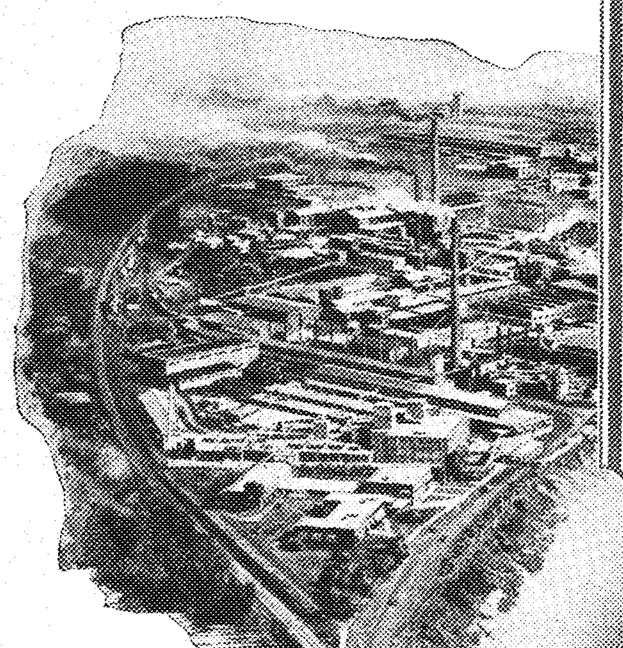
Salvo!

(Continued from page 243)

being a single-seated fighter attached to VF-2. By the time that the new motors were flight tested, radio and gunnery equipment was installed, compasses were calibrated, and the other many details of preparing a new plane for operation were completed, it was time to return to the Idaho. A minor duplication of the activity in transferring the squadron was then enacted when the Idaho aviation unit was loaded onto the tug for transport north. The five regular pilots flew the planes up, and Smalling and I went up by automobile.

IT was on a bright November day that we began the second leg of our year's duty. After reporting aboard the U.S.S. Idaho, we had the preliminary details of getting squared away to go through, after which we were free to look over our new abode and try to form an impression as to what it was all about.

The first attraction, naturally, was the quarterdeck, or after portion of the ship, from which the planes operated. The catapult was mounted near the stern where it could be trained to fire either to port or starboard, depending upon the direction of the wind. When not in operation, two of the planes were kept on the catapult and the third on a high handling truck which could be pushed anywhere on the quarterdeck out of the



way. Cockpit and engine covers served as protection against the weather.

The organization of an aviation unit aboard a battleship is not intricate. The senior aviator, Lt. R. L. Fuller, was in charge of our unit, which was included in the gunnery department in the ship's organization. The other two regular officers in the unit were Lt. J. E. Pixton and Lt. J. W. Harris. There were also two chief aviation pilots, J. C. Clark and T. W. Williams. In addition, there was a quota of enlisted personnel who were divided up on the plane crews of the three planes. Our flying equipment consisted of the two UO's, one of which was attached to VO-1 and the other to VO-2, and one FU-1. The latter, of which Williams was the sole pilot, was attached to VF-2. In that way, there were representatives of three squadrons aboard, and in group maneuvers each plane operated with its own squadron.

THE Idaho was one of the few battleships on this coast that was equipped with two UO-1 type planes instead of one UO-1 and an OL-6 (Loening amphibian). The latter type could not be catapulted with the usual air catapult and on those ships which had OL's, a powder catapult was mounted on top of No. 3 turret in addition to the air catapult on the quarterdeck.

Smalling and I soon discovered that operating from shipboard differs greatly from flying at an air station where all that is necessary in taking off is to be wheeled out of a hangar. In port during good weather, the planes are hoisted out over the side by a boom at the stern of the ship. The entire plane crew must needs be at hand with fending-off poles and wing lines, for it does not take much of a bump between a delicate wing and a steel hull to crack an entering edge or a wingtip. In addition to the aviation crew there must be several men from the deck force under a boatswain's mate to handle the winch, boom lines, and tackle for hoisting and lowering. Finally, after the plane is deposited in the water and shoved safely away, the pilot can start his motor and take off. Then in returning to the ship the process is reversed, but with greater difficulties from the pilot's point of view. The big objective in taxiing back after landing is to approach close enough to be hoisted aboard without driving the nose of the pontoon against the side of the ship, with much resulting grief for the mechanics who have to patch it up and the impatient flyers who are short a plane for a day or so.

As an air-going craft on the water is a tricky customer to handle at times, due regard must be given the wind direction so that the maximum control is available at low speed. The captain's gig, secured to the starboard quarterboom, close to the destination of the plane, is also a contributing factor, we found. Finally, if all the pilot's calculations are correct, he arrives close in and cuts his switch so that the plane will gently drift to the side, where fending off poles are ready to stop the wings and a heaving line attached to the hook comes sailing through the air. Hooking up to his hoisting cables and securing winglines is but the work of a moment, and another flight is then completed.

TAKING off at sea while underway provides the spectacular element to battleship aviation for it is here that the catapult comes into action. Sometime before taking off, the catapult check-off list is gone over to make sure that all parts are in perfect order. Life-lines and stanchions are lowered to the deck on the side that the shot is to be made. The plane is warmed up before hand and placed on its car, pushed by hand back into battery position, and the catapult is trained as nearly into the wind as the heading of the ship will permit. When the signal comes from the bridge that planes are to be catapulted, the pilot, with arm signals, informs the catapult operator of his readiness, the compressed

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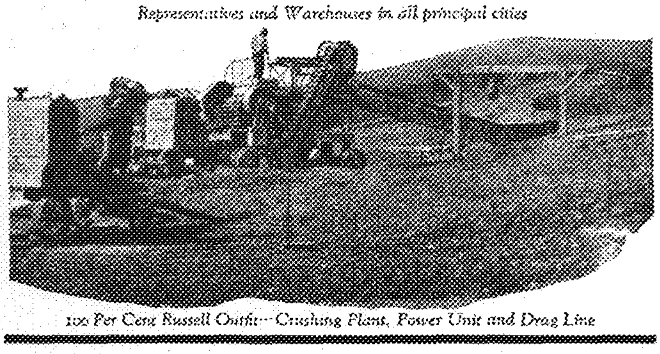

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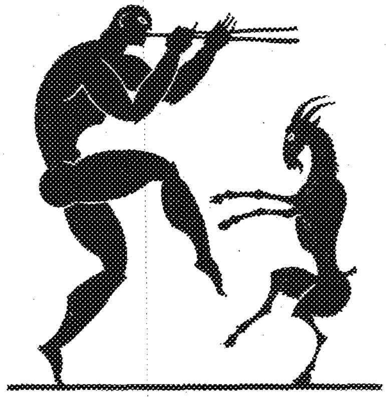

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MINNEAPOLIS

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air is turned into the cylinder, and off goes the plane on its mission.

Landing in the open sea is often rather difficult if a heavy swell is rolling or an unpleasant chop is present due to a strong wind. To smooth out a landing place, the ship usually turns ninety degrees through the wind and backs down smartly, thus making a fine "slick" upon which the plane can land with small danger of catching a wingtip float or smashing a pontoon.

OUR training as reserve officers, however, was not to be all aviation. There was not enough work to keep five aviation officers busy for full time on the Idaho, so Lieutenant Fuller made arrangements with the executive officer for Smalling and I to receive some special naval indoctrination in general service duties during our stay aboard. The plan was to rotate us in as many general service divisions as the time would permit, for training duty. We were to be installed as regular junior officers in those divisions and were responsible to the division officer. Our aviation duties, however, were paramount to our divisional duties and we could be called away by the senior aviator at any time. This seemed to be an ideal arrangement by which to give us as much of an insight as possible into the naval organization in the eight months that we were to be aboard.

Smalling's first assignment was the five-inch battery while I was placed in No. 1 turret division. We remained in those divisions until after short range battle practice was fired, but had no definite task except to learn as much as possible about the installation and operation of the ship's offensive equipment.

The firing of short range battle practice, as the first practice of the gunnery year, was an interesting procedure to a couple of newcomers. As the 3-gun turrets roared out their challenge with fire and smoke, the fourteen inch projectiles could be plainly seen as they hurtled through the air toward the target. Huge splashes, as high as the masts of a battleship, marked their arrival at the target, and as they ricocheted after striking the water other splashes sprang up as the projectiles bounded along like huge footballs, to finally sink beneath the waves when their force was expended.

After this practice had passed into history, I was transferred to the communication division for a second period of indoctrination. Smalling remained with the five-inch battery for a month or so longer until he requested transfer to the navigation department. Work in the communication division provides valuable training for a reserve officer whose period of duty is limited, for the entire naval organization revolves about the Naval Communication Service and there is much to be learned by merely keeping one's eyes open. After a short period spent in getting oriented, I was placed on the duty list to stand regular watches as communication duty officer and this work provided an excellent opportunity to learn something of how that huge organization which comprises our forces afloat carries on its business.

When the Battle Fleet starts on its cruise to the Hawaiian Islands, it is the plan that either Smalling or I will be placed in the engineering division to stand engine room watches on the way over while the other stands bridge watches as junior officer of the watch. When we return in June, we will exchange duties so that we will both have an opportunity to stand sea watches underway both in the engine room and on the bridge.

THE gunnery year of the fleet proved to be a spectacular display for us and the use of aircraft in connection with it made it all the more interesting. There were long range battle practice, during which the ships fired their main batteries and broadsides at extreme ranges; force practice, when all the battleships fired together at a theoretical enemy who was very effectively routed; night battle prac-

tice, where flaming broadsides combined with flaring star shells to make a brilliant display of sea power; anti-aircraft battle practices, where spitting sky-guns dotted the heavens with bursting shrapnel to make the air unsafe for any and all enemy aircraft.

There were also monthly tactical exercises when the entire Battle Fleet including battleship divisions, destroyer squadrons, submarine squadrons, aircraft squadrons, and train force engaged in a huge offensive against a theoretical enemy fleet of equal size. This was especially interesting as viewed from the air, for the battleships, in stately dignity, went through their various maneuvers, while destroyer divisions in the van and in the rear darted furiously about launching torpedo attacks on an unwary enemy and protecting the main body from surprise attacks. The observation wing of the air forces circled high above the enemy position and radioed back spots and information, while a squadron of fighting planes, higher yet, kept a sharp lookout for enemy aircraft.

All this was extremely interesting to us as reserves, and the flying operations during the gunnery period were divided up among the aviators aboard in such a manner that we were all able to partake in some of the practices.

The event that all are looking forward to, however, is still ahead—the cruise of the fleet to Hawaiian waters, where more tactical maneuvers will take place. The cruise will take approximately two months, and the fleet will return to home waters the latter part of June, the sea duty of these reserves completed, but a greater insight installed in them all as to what it means to be a part of that great organization, the United States Navy.

How We Get Our Scientific Apparatus

(Continued from page 252)

large number of shop orders which are in process at the same time. Most of them are for small quantities. The shop order for the smallest quantity of the cheapest item manufactured requires exactly the same amount of attention as does an order for a very large quantity of a high priced item. In all cases specifications must be carefully checked, materials must be provided so that they will be ready to use when needed, planning must be carefully done to insure

A PROGRESSIVE PUBLIC SERVANT

Year after Year, Northern States Power Company increases the scope of its usefulness to the communities and customers it is privileged to serve. Today, more than 436,000 customers in 524 cities and towns of the Central Northwest testify that the Company is faithfully and efficiently discharging its duties as a progressive public servant. Northern States Power Company steadily supplies more and more electric power for the development of the territory it serves. A new hydro-electric plant of 21,600 kilowatts capacity, under construction at Chippewa Falls on the Chippewa river in Wisconsin, is planned for completion early in the fall of 1928. With this development, and other additions now in progress, the Company will have installed 356,482 kilowatts of generating capacity.

Interconnection—the pooling of power resources to serve cities and towns and rural communities over a widespread territory—goes steadily forward.

Customer ownership—investment in preferred shares by users of the Company's service—has provided a large portion of the capital required to supply adequate electricity and gas to the territory served.

Rural electrification—supplying the farmer with the same public service facilities that his city brother has enjoyed for years—is still in the experimental stage, but investigation and research, it is hoped, will provide a solution of the problem satisfactory to Company and customers alike.

In all of these developments, as in many others of equal importance, college graduates . . . . experienced engineers, have made outstanding contributions.

NORTHERN STATES POWER COMPANY

Every Sixth Customer a Shareholder

BYLLESBY · PIONEERS IN PUBLIC SERVICE · ENGINEERING · FINANCE · MANAGEMENT

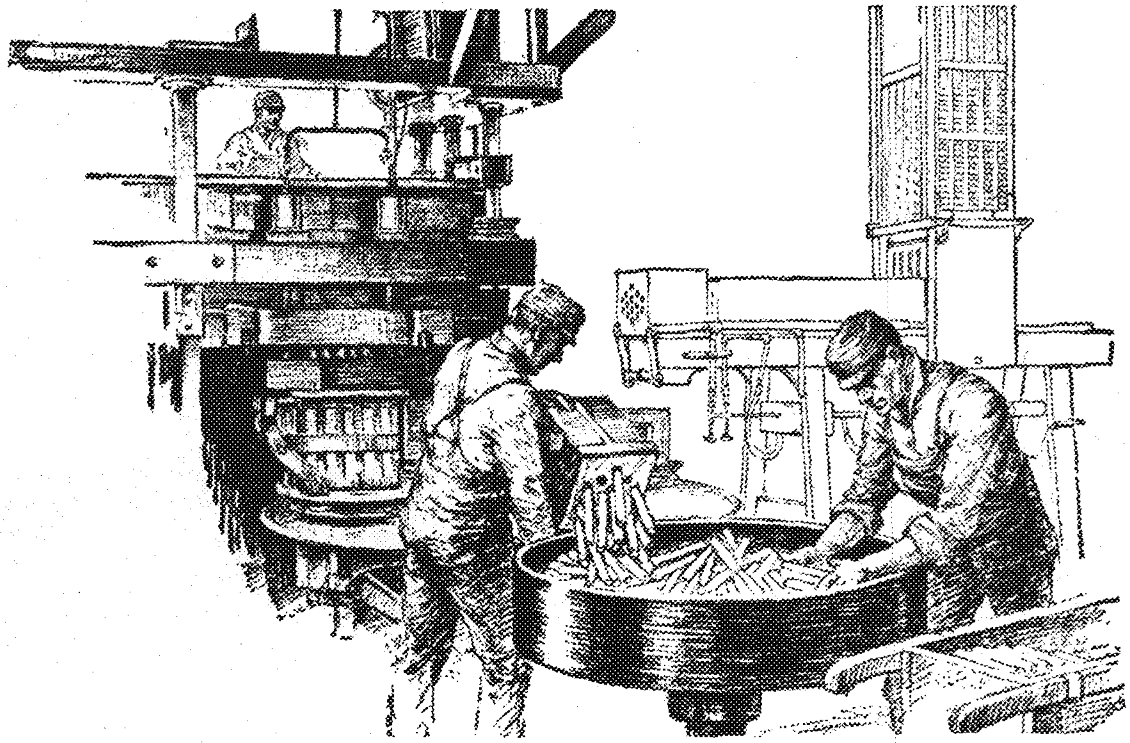
Personal Attention to Every Customer

smooth flow of production through the shops, and all records must be carefully kept so that the status of any order can be ascertained at any time. The storage and control of raw materials and processed parts is another important function in apparatus manufacture. The number of individual items in materials storage is somewhere near 10,000 and many of them are very small in quantity. Accurate control requires voluminous and carefully kept records to insure precise knowledge of the stock on hand of any item. The facts related above are perhaps not altogether peculiar to scientific apparatus manufacture, but it is probable that few other kinds of business are as complex. If the reader has followed the account thus far, and if he remembers that the examples given are typical of the problems which must be solved, it will be relatively easy for him to understand why scientific apparatus is necessarily expensive.

A compensating feature of the work is the fact that a great number of problems are constantly pressing for solution—a fact which makes this work extremely interesting. They are problems that challenge the ingenuity of the individuals engaged in development and engineering and of those who have charge of production. Cost reduction, in order to permit selling prices as low as possible, is one of the very important problems of the manufacturing department, and to its solution scientific methods find fruitful application.

The sale of scientific apparatus is, of course, one of the most important and necessary activities of the apparatus business. The very existence of any business depends on the possibilities of disposing of its products at a gross profit which will be sufficient to provide for suitable compensation of its employees and leave a safe margin with which to pay for the use of the invested capital. The principal field of sale is, as might be expected, the educational field, which includes the various scientific departments of universities, colleges, and high schools. Many industries have research and control laboratories and their number is growing; the industrial field from the standpoint of apparatus sales is therefore an expanding one. Hospital and government laboratories constitute a third group which uses scientific apparatus and instruments.

Because of the comparatively large sales to educational institutions, business is very seasonal. During the months beginning in mid-summer and extending well into autumn the schools are heavy buyers, as a consequence of which the volume of business which must be handled during this period may be more than three times as great as the volume during the quiet months. This necessitates careful management in order that a well trained personnel may be available to handle promptly the large volume of orders during the busy season, with recognition of the fact that during the quiet season only one-half of the same number



of people are required to take care of the orders.

Not the least interesting aspect of the apparatus business is the large number of suggestions for new apparatus which are submitted by teachers and others engaged in scientific work. Very few of the individuals who suggest ideals for new apparatus or instruments realize how very limited are the sales possibilities of any particular item. Neither do they realize the difficulties involved in establishing a new piece of apparatus in a line already very extensive and perhaps containing similar apparatus intended for the same purpose. The inventor, having lived with his idea for a long while to the exclusion of nearly all others naturally cannot be expected to have any other belief regarding his invention than that it will revolutionize the teaching of the particular subject to which it applies or the laboratory technique for which the device is intended. Many originators of what they believe to be original designs of apparatus have failed to make a careful survey of scientific literature or of patents in the field. It happens frequently that when a suggestion is sent in—with proposals for royalty payments—a brief search in a relatively small library reveals either the identical apparatus or a very similar piece in a publication many years old. Designers of "new" apparatus would save much time for themselves if before proceeding with their work they would investigate the "prior art" and thereby avoid the possibility of much unnecessary duplication.

Because of the great variety of its manufactured items, a scientific instrument factory is well equipped for all kinds of manufacturing processes, and its skilled workmen are able to construct almost any kind of apparatus, however complicated it may be. It is to be expected, then, that frequent inquiries are received to manufacture special apparatus for research purposes, and models for inventors. Some of the later are unusual indeed, not to say bizarre.

SEVERAL years ago, we were called upon to construct a model of an "unsinkable" ship. Usually the inventor of a "freak" device has little knowledge even of the simplest scientific laws, and in most cases he is too prejudiced to take sound advice. The ship model mentioned consisted of a vessel of standard design, to which were attached collapsible float chambers like inverted telescoping drinking cups. In normal operation these were collapsed; in an emergency, a release on each of these chambers was supposed to be operated by the ship's crew. Even when collapsed, the float chambers occupied most of the available space in the vessel and when opened, they left no room for passengers or cargo, except on the tops of the chambers. When the model was finished, the inventor, clad in a bathing suit, demonstrated his invention to prospective investors in the harbor of Lake Michigan, on which the factory happens to be located. What we expected—and he did not—happened. The "unsinkable" ship promptly sank, and, in diving after the model, the inventor was unfortunately injured. Needless to say, ship construction has not yet been revolutionized by this particular development.

To the unusual young man who is deeply interested in experimental science, who has trained himself thoroughly in the fundamentals of physics and chemistry, and who has the knack for mechanical designing of instruments and apparatus with pleasing lines and for low-cost production, the apparatus business holds out the prospect of a desirable career. He will never become wealthy, perhaps; but he can be reasonably certain of an income that will enable him to live comfortably, and he may be assured that, once he has made a good start in this business, he will have before him many years of activity, that, because the work is so out of the ordinary, will be pleasant indeed.

A New Development in Pumping Equipment

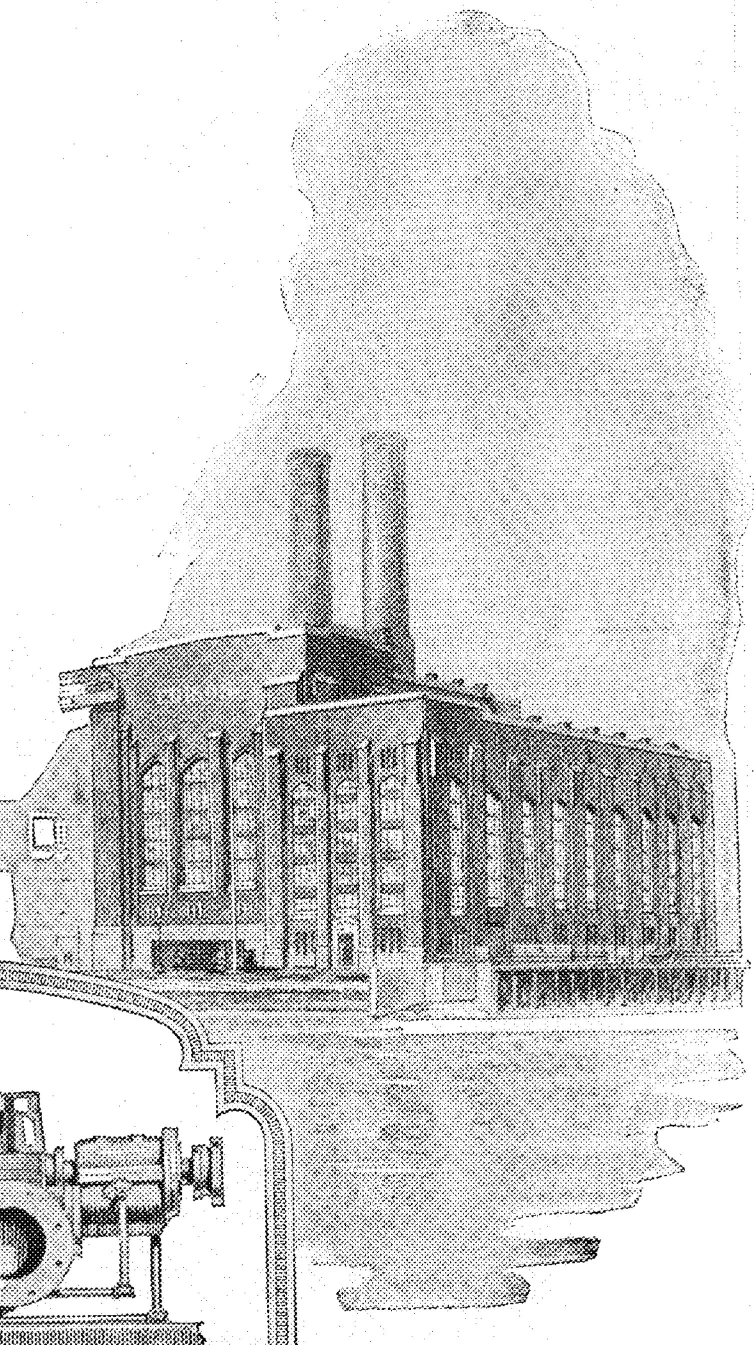
THE MOST POWERFUL centrifugal pump ever planned for boiler feeding has been built for the Edison Electric Illuminating Co., Boston, Mass., by the A. S. Cameron Steam Pump Works.

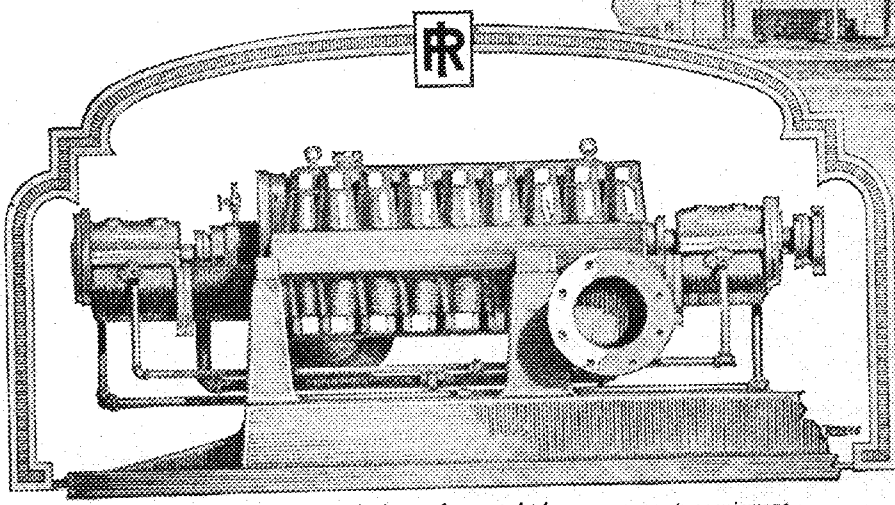
This pump, a six-stage unit, has a capacity of 1910 g. p. m. against 1600 lbs. pressure at 3670 r.p.m. It is direct-driven by a 2450-hp. steam turbine.

The casing is of cast steel. The thrust has been taken care of in accordance with the Company's standard practice, which employs a balancing drum supplemented by a Kingsbury Thrust Bearing.

The new Edison plant was designed and built by Stone & Webster, Inc., under the supervision of Mr. I. E. Moultrop, Chief Engineer of the Edison Company.

INGERSOLL-RAND COMPANY
A. S. Cameron Steam Pump Works
11 BROADWAY · · NEW YORK CITY
Offices in principal cities all over the world





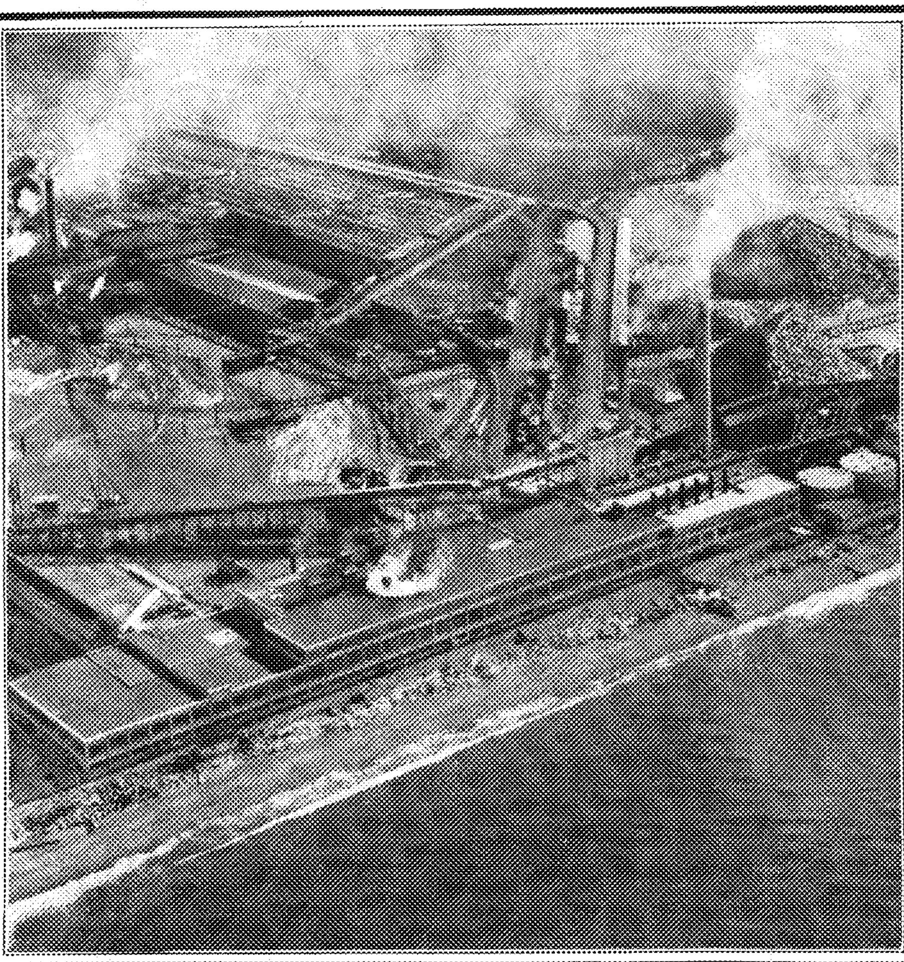
This type of unit represents the latest advance in high-pressure pumping equipment.

Ingersoll-Rand
A.S CAMERON STEAM PUMP WORKS

K. L. HOWE,
Seattle Office, Engineering Division,
University of Washington '23

J. S. ERICHSON
Interdepartmental Contract Administration,
University of Pennsylvania '19

E. R. STOLTZ,
Motor Apparatus Sales Department,
Rose Polytechnic Institute '16



W. LAUDENBERGER,
Control Engineering,
Penn State '23

R. R. BAKER,
General Engineering,
University of Michigan '17

G. FITCH,
Contract Administration,
Lehigh University '23

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

Photo by Brubaker Aerial Surveys, Portland, Oregon.

Washington Pulp *and* Paper Mill

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

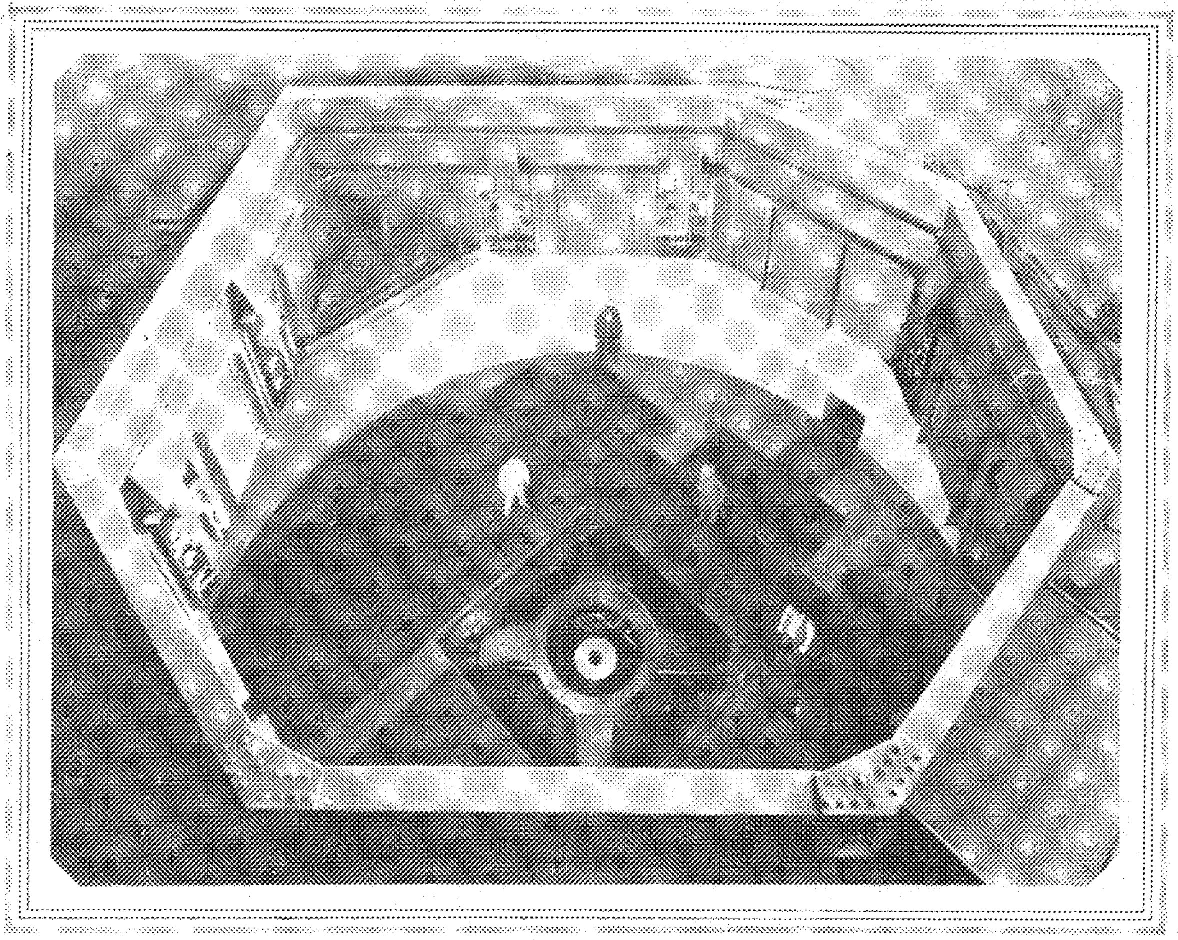
AT Port Angeles, Washington, stands the mill of the Washington Pulp and Paper Corporation—a mill that produces enough newsprint every day to make a sheet 10 feet wide and 1,000 miles long.

When this great industrial organization built a mill extension that almost doubled its capacity, Westinghouse, having already supplied electrical equipment for the original plant, was called on to electrify the new unit. Difficult driving problems were met and solved by Westinghouse engineers—with individual motor drives up to 1000 horsepower, with refined control mechanisms, with the sectional paper machine drive that has revolutionized the making of this important product.

Big jobs go to big organizations. Westinghouse attracts young men of enterprise and genius because it daily provides facilities and opportunities which smaller corporations can seldom offer.

The Washington Pulp and Paper Corporation's mill represents the most modern and scientific application of straight line production to the paper industry. Pulp wood enters one end of the long building on an electrically powered monorail carrier. It follows in a continuous line through the grinders, screens, mixers and jordans to the paper machine. At the other end the finished paper is rolled and wrapped for shipment. Power for every operation is supplied by electric motor.

Westinghouse



The Pit

Three feet of concrete—seven of sand—five more of concrete—all reinforced with steel—such are the walls of this underground chamber. The roof, a slab of steel rimmed with girders, is held in place by great steel wedges.

A military stronghold? No—a test pit at the Schenectady Works of the General Electric Company. Here the "test men", young engineers, most of whom were in college only last year, help test the rotors of waterwheel generators for safe operation under emergency conditions. These rotors—some as large as 40 feet in diameter—are revolved at double the speed which will be demanded of them in normal service.

The pit controls, located in a building 300 feet away, are supplemented by ingenious listening and visual devices which give accurate indication of conditions in the pit at any instant.

Such elaborate precautions have been devised because of the immense size and power of generating apparatus which is now being built to answer the general demand for more electric energy. Scientists and manufacturers are establishing new standards of electrical production—building a heritage which will aid the engineers of to-morrow to increase the usefulness of electricity far beyond to-day's limit.

General Electric's record for successful performance of its waterwheel generators is only one of the things that have given meaning and value to the G-E monogram, which appears on all the equipment built by the Company.

95-316DH

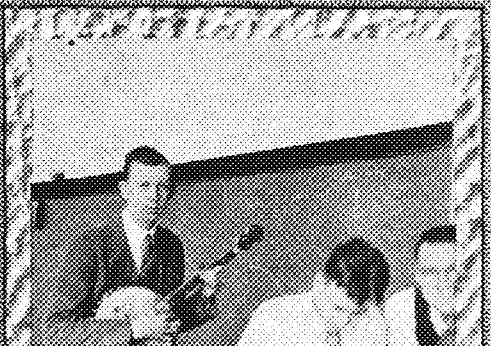
GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



SENIOR SINGS PARTING SONG

Volume VIII JUNE 1928 Number 9

Alumni Directory Number Testing Automobile Headlamps
Old Stories of Minneapolis Those Honored News Items


Re-mixed Concrete Endures
WHEN building for the future, an invaluable quality is sought—endurance. In endeavoring to capture it, every material is carefully selected to withstand the ravages of the elements and of time.
Just a glance at the new Elks Club building in Los Angeles, pictured above, gives evidence that the architect, engineer and contractor were striving for permanence as well as beauty. With these ideals the quality of the concrete did not escape their attention. Two Koehring mixers, a Heavy Duty 21-S Mixer and a Dandie 7-S Mixer, were used to mix the concrete for the foundation walls of this modern structure. Through the Koehring re-mixing action it was assured that every foot of concrete would be uniform and of dominant strength. Koehring re-mixed concrete endures.
The revised edition of "Concrete — Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, is now ready for distribution. To engineering students, faculty members and others interested we shall gladly send a copy on request.
KOEHRING COMPANY
MILWAUKEE, WISCONSIN
Manufacturers of
Pavers, Mixers — Gasoline Shovels, Cranes and Draglines.
KOEHRING HEAVY DUTY
KOEHRING

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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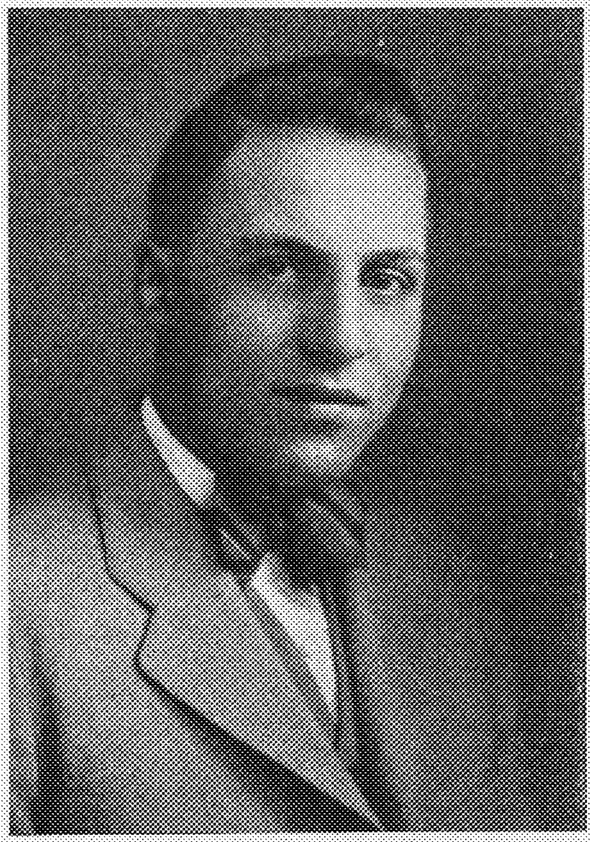


RICHARD L. ROHN

THE news of the death of Richard L. Rohn, who was killed in an automobile accident that occurred on July fourth, reaches us as this issue goes to press.

"Dick," who had just completed his junior year in electrical engineering, was recently appointed business manager of the 1928-29 TECHNO-LOG. Before coming to Minnesota, he spent two years at the University of Denver, where he was known as a campus leader. He was not long at Minnesota before he became well known on the technical campus for his energy, ability, and likable personality. He was an advertising representative on the Daily and Ski-U-Mah staffs, and in the spring quarter he was appointed chairman of the Engineers' Day parade committee. He was a member of the A. I. E. E., Chi Phi, and Theta Tau.

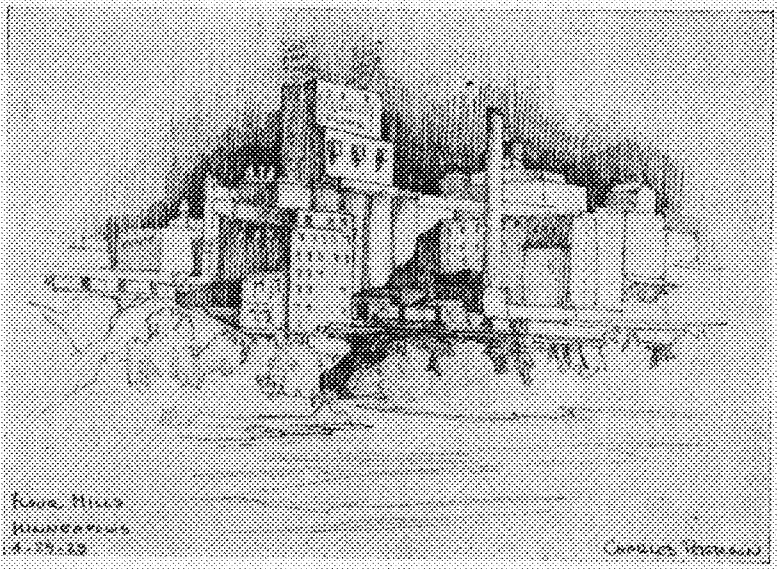
The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VIII — JUNE 1928 — Number 9

Old Stories of Minneapolis

By Charles E. Peterson, A '28



FLOUR MILLS OF MINNEAPOLIS FROM THE RIVER

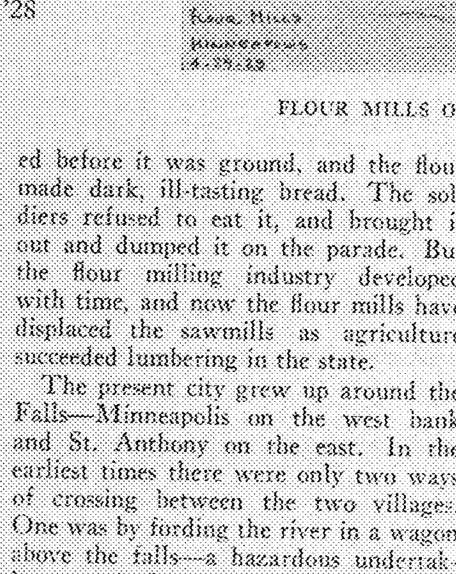
EVERY great city has something all its own, some claim to individuality, some mark of distinction. It is not its parks or its schools or its modern improvements,—every city boasts of these. It is something reminiscent of the history of its site—something characteristic of its people. It may be tangible or it may be only atmospheric, but it is there. It is not showmanship for sightseers—it is a natural growth. Minneapolis has this. It is St. Anthony Falls among the flour mills.

Father Hennepin, a Catholic priest of Flemish birth, was the first white man to discover the Falls. In 1680, with a party of Indians in canoes, he found the great cataract of the Mississippi, and named it after his patron saint—St. Anthony of Padua. At that time the water fell 65 feet over the limestone ledges with a wild and picturesque beauty which has long since been lost among the dams and aprons constructed across the river.

No sooner had the white man settled there than the Falls was used for power. In 1820 a sawmill was built for the use of Fort Snelling. The venture was successful, and was followed by the erection of many others. The lumber resources of the headwaters country were enormous, and huge booms of logs were run down to these mills for sawing.

Fort Snelling was also the first to build a flour mill there. In 1823 wheat was grown experimentally and ground in the local mill. The first trial was a failure. The grain mildewed and sprouted before it was ground, and the flour made dark, ill-tasting bread. The soldiers refused to eat it, and brought it out and dumped it on the parade. But the flour milling industry developed with time, and now the flour mills have displaced the sawmills as agriculture succeeded lumbering in the state.

The present city grew up around the Falls—Minneapolis on the west bank and St. Anthony on the east. In the earliest times there were only two ways of crossing between the two villages. One was by fording the river in a wagon above the falls—a hazardous undertaking even in low water. The other way was to patronize the canoe ferry run by an old Sioux squaw across the upper point of Nicollet Island. The first bridge was a toll viaduct built in 1852—a suspension structure of wood and steel on the site of the present Hennepin Avenue. Now there are five bridges crossing the Falls, making six with the completion of the new concrete Cedar Avenue Bridge. The only bridge of these having any architectural merit is the Third Avenue Viaduct with its long curved course of concrete arches. The picturesque old Stone Arch Bridge, although well-known and much admired, is badly misproportioned, the piers being so undersized as to give one the feeling that it is inadequately supported.



THE CEDAR AVENUE BRIDGE

THE only architectural pretensions lavished on the St. Anthony district are seen on the old Exposition Building. Its tall tower, numerous pinnacles and terra cotta ornaments must have caused quite a stir in the 80's when it was built. The Exposition turned out to be a failure, however, and was discontinued. One summer the building was used for the Republican National Convention.

The flour mills were built up as the industry grew. The first buildings were of native limestone—the latest of reinforced concrete. The mills have massed themselves into great monumental compositions, achieving a splendid effect seldom attained through conscious effort. These vast piles overhang the Falls and guard the river where it drips down to the Flats of the squalid little squatter's village. This is the part of Minneapolis that no other city can claim. It *is* Minneapolis.

Testing Automobile Headlamps

Electrical department as official state laboratory develops special test apparatus used in studying mechanical and optical features of lamps

By Elmer W. Johnson, E 14 EE '15
Assistant Professor Electrical Power Engineering, University of Minnesota.

UNDER one of the lighting provisions of the Uniform Highway Traffic Act passed by the Minnesota State Legislature in 1927, it is unlawful to sell or use any headlamp, rear lamp, signal lamp or any auxiliary driving lamp unless of a type that has been tested by the Official Testing Laboratory and approved by the Commissioner of Highways. Desiring to have the Official Testing Laboratory where it would be easily accessible for advice and cooperation, Commissioner C. M. Babcock, Department of Highways, requested the Department of Electrical Engineering, University of Minnesota, to act in that capacity. The Board of Regents approved the plans submitted by Dean Leland, and the Motor Vehicle Light Testing Laboratory was established.

To this laboratory samples of all types of lamps that are to be tested for approval, are sent. All lamps are tested mechanically and optically. The mechanical tests determine, as far as is possible, if the lamps will stand up under ordinary driving conditions. The optical tests determine if the lamps will perform the lighting functions required.

Spot lamps are required to throw a concentrated beam of light which is under control of the driver of the car.

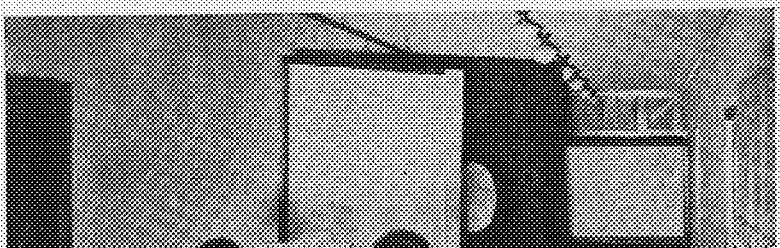
Signal lamps must project a red or yellow light which shall be plainly visible in normal sunlight for a distance of one hundred feet.

Rear lamps must give a red or yellow light plainly visible under normal atmospheric conditions from a distance of five hundred feet. They must also illuminate the number plate under like conditions so that it can be read at a distance of fifty feet.

Headlamps are required to throw sufficient light to make plainly visible persons or objects two hundred feet ahead of the car, and yet, no portion of the main part of the beam can rise above the horizontal level so as to cause it to be glaring to drivers approaching from the opposite direction.

Auxiliary lights must comply with the same requirements as the headlamps.

As can readily be understood the requirements for headlamps are the most exacting. To determine if the headlamps have a suitable beam for a good driving light, the candlepower intensity of the beam is obtained at enough points to give a complete detailed picture of the beam. For the standard test, one-half of the beam is usually explored. Readings are taken at each degree from two degrees above the horizontal line through the lamp centers to six degrees below, and from the vertical plane through the center of the headlamp to twelve degrees to the left, giving one hundred and seventeen readings for each beam.



LABORATORY FOR TESTING LAMP BEAMS
One screen at 100 feet distance and another at 25 feet are used in conducting tests in the basement hall of the Electrical building.

The same test is made at six one-hundredths of an inch above focal position and six one-hundredths of an inch below focal position on lamps having horizontal focusing mechanism, as most lamps do. This is to check the sensitiveness of the beam to small changes in the incandescent lamp position due to movement of the lamp in the socket or due also to the inaccuracies of filament construction.

To make these tests in a part of the beam that is representative, a distance of 100 feet from the lamps is chosen. In order to obtain this distance in a section comparatively free from light, the basement hall of the Electrical Engineering Building is utilized for this part of the work of the Motor Vehicle Light Testing Laboratory.

In order to eliminate stray light, all windows are covered with black curtains, and large black screens, which practically cover the width of the hallway, are placed between the lamps and the photometer. These screens have large holes cut in the center which allow the main beam to pass through while stray light striking the screens around the central hole is absorbed by the black material. By placing several of the screens in series, the stray light is eliminated.

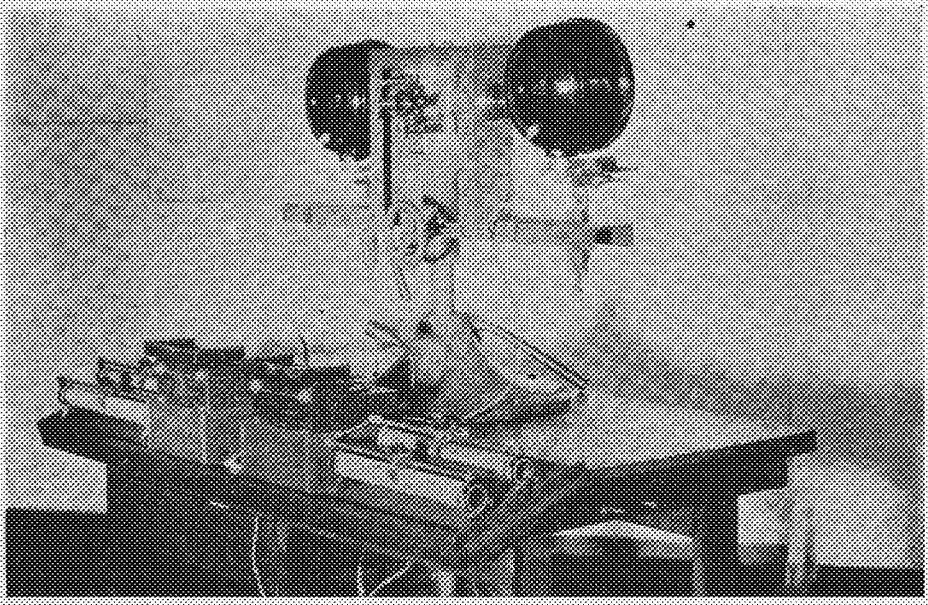
There are three units of equipment needed for this test besides the black screens. They are the stand for the headlamps, a large test screen used at twenty-five feet, and another test screen used at 100 feet.

The one hundred foot screen has the photometer opening located at its center point. The rest of the photometer is behind the screen so that the photometer and operator are entirely out of the beam.

THE twenty-five foot screen is used to focus the lights and also to mark the angles as will be explained in connection with the headlamp stand.

The headlamp stand is used for the mounting of the headlamps. The headlamps must be free to rotate about a horizontal axis which passes through the center of the filaments of the two incandescent lamps. It must also rotate independently about a vertical axis which intersects the horizontal axis at a point half-way between the two lamps. Then, for adjustment purposes it must be able to move up and down. These motions have been accomplished in the stand designed.

In order to facilitate the locating of each headlamp exactly in the proper position for test and to obtain the motion of six one-hundredths of an inch from focal position for the incandescent lamp, each headlamp is mounted on jeweler's lathe beds so arranged that three motions at right angles may be obtained. This greatly facilitates accurate alignment as with these lathe beds, the adjustments made in one direction are not dis



THE HEADLAMP STAND WITH HEADLAMPS
The headlamps are free to be placed in any position required for adjustment, and in order to obtain the precision motions necessary each lamp is mounted on jeweler's lathe beds.

turbed when the adjustments are made in the other two directions.

Exactly at the center of the headlamp pair, that is, at the intersection of the axes previously described, is a telescope. The purpose of this telescope, which has a set of vertical and horizontal cross hairs and a level, is to obtain the angles for measuring the beam.

This is accomplished by laying off the tangents of the angles one, two, three degrees, etc., as lines on the twenty-five foot screen. This is done for both the horizontal and vertical angles. Then the telescope cross hairs are set at the intersection of these tangent lines and the angles thus accurately located. This scheme is used instead of a protractor on the stand as it is more flexible and accurate.

The procedure in making the test is simple, but it requires considerable skill to obtain the adjustments with ease and speed.

THE headlamp stand is set at its location in the test range with the telescope set at level. Then the zero of the horizontal and vertical scale of the twenty-five foot screen, which must correspond exactly to the center of the head lamps, is set in position where it coincides with the intersection of two cross hairs of the telescope.

The lamps are now focused to obtain the normal vertical spread with the most distinct line of cut-off at the upper limit of the beam. This line of cut off is now set on the horizontal axis of the twenty-five foot screen. This screen has the center portion on hinges and this center section is now swung down. The beam then projects down the range through the holes in the large black screens onto the one hundred foot test screen.

The one hundred foot test screen is now adjusted until the center of the photometer opening is at the intersection of the telescope cross hairs thus placing all three screens in exact alignment. The first reading of the test, the zero position, is now taken.

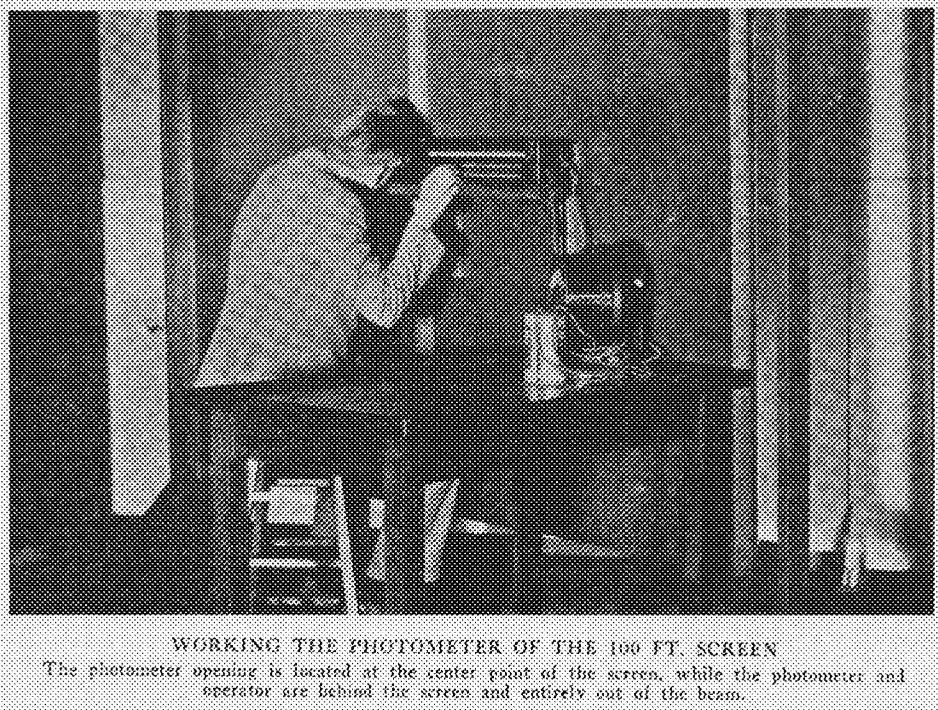
ON account of the extreme difficulty of moving the photometer accurately to the numerous positions of the beam, the photometer is kept stationary and the headlamps are moved so that the beam sweeps across the photometer and can be stopped accurately at any place desired. The design of the headlamp stand with its independent rotating motions makes this possible.

The cross hairs of the telescope are set on the next position desired and the reading taken. This is continued until the desired number of readings have been recorded. In this connection it is interesting to note that the telescope is set inverted to the reading desired. If, for example, we want to take a reading in the beam which is at an angle of two degrees below horizontal, we set the telescope on the tangent line of the twenty-five foot screen which corresponds to two degrees above horizontal. This projects the portion of the beam two degrees below the horizontal into the photometer opening which has remained stationary as the beam has moved upward across it.

ROTATING the headlamp up two degrees gives the same result on the photometer as moving the photometer down two degrees and can be done very much more conveniently and accurately.

The candle power readings of the beam must be accurate. Standard incandescent lamps, calibrated by the Bureau of Standards at Washington, have been obtained as reference standards. The working standard lamps that are used for the testing are checked frequently in our spherical photometer.

The Motor Vehicle Light Testing Laboratory is in full operation, and a number of types of each of the different kinds of motor vehicle lamps have been tested. Under the present arrangement samples of all types of headlamps, rear lamps, signal lamps, spot lamps and auxiliary driving lamps that can lawfully be sold and used in Minnesota will be tested in this laboratory.



WORKING THE PHOTOMETER OF THE 100 FT. SCREEN
The photometer opening is located at the center point of the screen, while the photometer and operator are behind the screen and entirely out of the beam.

The Electric Ship *California*

A Minnesota alumnus describes the initial voyage of the world's first large electrically propelled passenger vessel

BY LOUIS RASK,* '03 E. E.

A BLIZZARD was raging on January 28, 1928, when we left New York on the first regular trip of the new S. S. California, the first large electrically propelled passenger vessel in the world. In thirty hours we had left all wintry scenes and were entering the mild and quiet waters that stretched toward Havana and Panama. For two weeks there followed a continuous round of pleasurable travel without any undesirable noise or rolling or vibration. One who did not know that we were moving through the water would have wagered heavily that the vessel was anchored in a peaceful harbor.

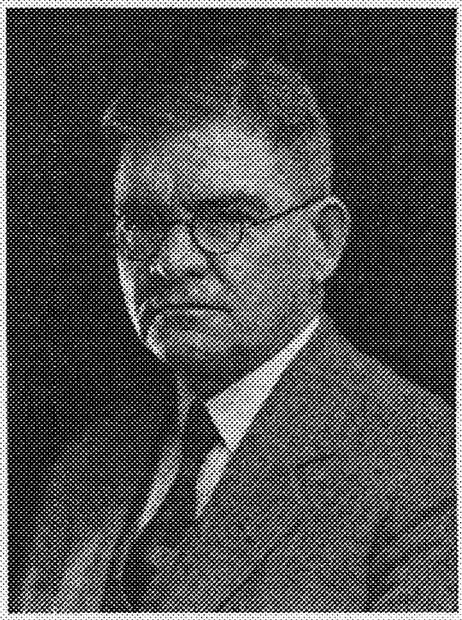
Through the courtesy of the operators, the Panama Pacific line, a fleet of limousines was awaiting the vessel at Havana, to take the passengers around the city and its environs.

*Marine Engineering Department, General Electric company.

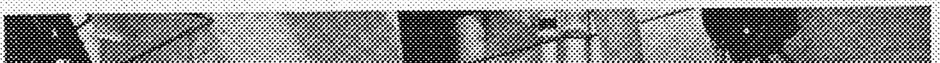
After a three-hour trip we set out for the Panama Canal and the Pacific Ocean, through which our voyage continued, as it began, in unbroken calm and quiet. It was most remarkable in that it was free from any accidental stops or lay-ups caused by breaking in the complicated power house machinery of a large passenger vessel.

It was my duty and pleasure to accompany the vessel as guarantee engineer for the General Electric company, which furnished practically all the electric machinery on board. Thanks to the successful operation of the apparatus, I had spare time in which to display and discuss the machinery with many passengers who were interested in this new application of electricity.

One of these was Dean F. S. Jones, my professor in physics at Minnesota back in 1901. When we met for the first time on the large promenade deck our recognition was mutual, although some 27 years had elapsed. The Dean was accompanied by his wife, and they were on their way to San Diego and Pasadena in sunny California. It was a pleasure to conduct the Dean and Mrs. Jones through the electric engine room and the electrically operated galley and to note their quick appreciation of the novel (to them) applications of electricity. The Dean was surprised to see the smallness of the two main turbine generators that were furnishing the power for driving the vessel through the water at 17 to 18 knots. Mrs. Jones was delighted to see the neat and clean galley where electricity was used for all purposes—cooking, baking, broiling, dish washing, potato peeling, knife sharpening etc., for 750 passengers and some 330 members of the crew.



LOUIS G. RASK



PORT SIDE PROPULSION TURBINE GENERATOR

The compactness and efficiency of the turbine generators on the S. S. California marks one of the greatest advances in marine engineering in years.

THE S. S. California is the first large electrically propelled passenger vessel in operation, although a sister ship, the S. S. Virginia, is being built. She will have the same kind of electric machinery as the California, and will go into commission in December this year. Every effort is being made by both the shipbuilders and the manufacturer of the electric machinery to incorporate in this new vessel the best and finest standards of design and workmanship.

The entire propulsion mechanism is fundamentally very simple. It consists of two entirely independent prime movers driving generators which furnish electric power to two 8500-horsepower, 120-r. p. m. 4000-volt, 3-phase, synchronous motors directly coupled to two propellers. The prime movers are steam turbines, the steam for which is generated in oil-fired boilers. The boilers, steam turbine-generators, motors, and controls are located amidships, the propellers of course being astern. All the control apparatus is in the engine room, the connection with the pilot on the bridge being the usual engine room telegraph, the same as is used on all other kinds of ocean-going ships.

Electrically operated vessels are noted for their powers of rapid maneuvering; and because of the availability of greater reversing torque than from any other form of drive (100% of forward torque can be obtained for reversing), the ship's movement can be controlled much more effectively than with other types of drive.

The control of the propelling machinery is based on the consideration of each steam turbine-generator and its propulsion motor as a unit. That is, electrically speaking, the motor is always in phase with its generator, and changes in speed are obtained by varying the frequency, i. e. by varying the turbine speed. In starting from rest, the propelling motor is brought to speed as an induction motor until it can be phased-in with the turbine-generator, which never operates below a certain minimum speed. In reversing, the propelling motor is first electrically disconnected, one phase is reversed, and then, operating as an induction motor, it is pulled into step with the turbine generator. Provision is made for the paralleling of both motors on one generator, or for the operation of either motor by either generator, in case of need.

All these operations are easily performed by means of three levers per prime mover. One lever is used to open and close the field excitation circuits, and one controls the main A. C. power circuits, which are opened only after the field circuit is broken. Assurance of this is obtained by suitable interlocks between the two levers. The speed of the turbine, which always revolves in the same direction, is varied by means of a third lever. The time required to bring the motor into step is but a few seconds, after which the turbine speed is increased as desired.

THE operating levers are mounted on a control panel, which also carries the gauges and instruments required by the operating engineer for the proper control of the vessel. There are ammeters, voltmeters, and wattmeters for the main power circuits, and ammeters for both the generator and motor field circuits. There are also on the panel steam-pressure gauges, vacuum gauges, revolution counters for both turbine generators and motors, and temperature indicators for the generators and motors. The ability to visualize the performance of the machinery at all times is of great assistance in maintaining the most satisfactory operation of the vessel. The power readings serve as a check on the performance of the vessel, and of the propellers as well, since any differences in their characteristics are readily discovered. So sensitive to small power changes are the line ammeters that faulty operation is quickly detected.

From the power expenditure at a given r. p. m. the torque characteristic of the propeller can be determined and thus its performance can be studied under varying weather conditions and drafts. The effect of even a dirty hull can be noted. Interesting data have been obtained by electric instruments, concerning the power absorption of the propellers during maneuvering, which could not have been obtained by any other means.

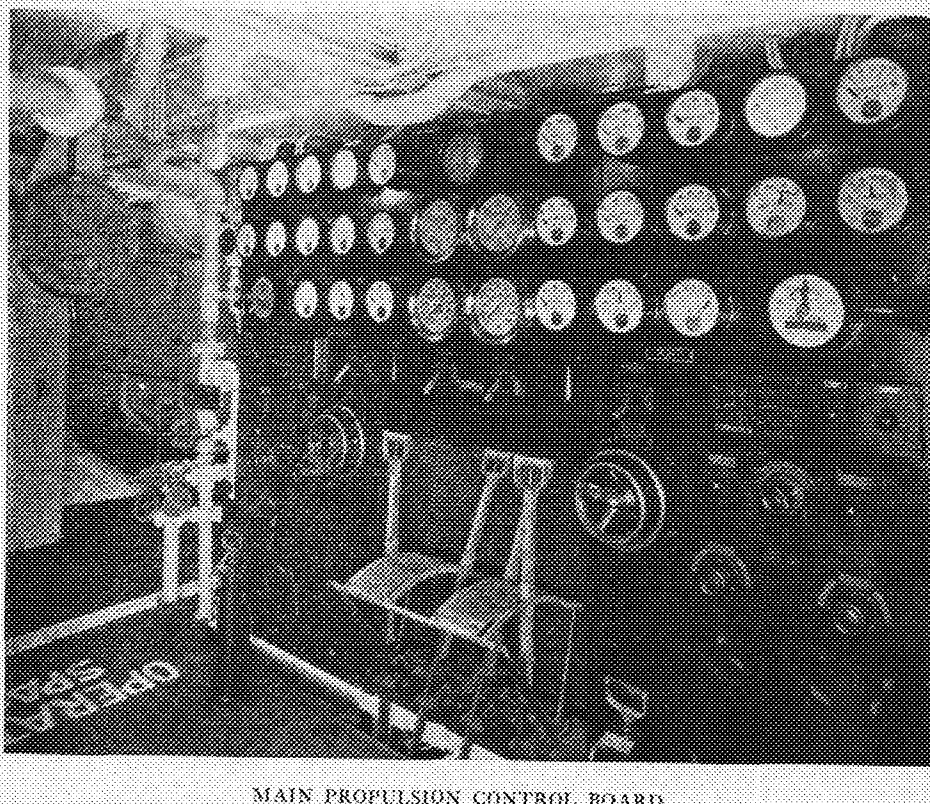
Over-all economy of a high-powered passenger vessel depends as much upon the efficiency of the auxiliary apparatus as it does upon the main propelling equipment. The S. S. California is almost completely electrified, and four 500-kw, turbine-driven direct-current generating sets are installed to furnish power for this purpose.

The entire refrigerating equipment, the main and auxiliary condenser circulating and condensate pumps, sanitary pumps, ship's hull ventilating fans, lighting and state room fans and heaters, galley and bake ovens, capstans and cargo winches, and numerous other minor auxiliaries are completely electrified.

The S. S. California is probably the most economical steam vessel of her size afloat today. The fuel consumption is said to be less than three-quarters of a pound of oil per shaft-horsepower-hour. The sister vessel, S. S. Virginia, now being built at the Newport News Shipbuilding Yard, will have slightly higher steam pressure and superheat which will result in an expected 5% better efficiency.

Four additional vessels of the same type are being contemplated by the owners, the International Mercantile Marine Company, for use in the service between New York and San Francisco. A similar electrically operated vessel is also being built in England for the Peninsular & Oriental Line, to carry mail between England and India.

IT is now almost ten years since I began working on the application of electric power for driving ships, and there has been a continuous struggle to break through the adamantine mechanical-mindedness of marine engineers and operators who appreciate and trust themselves to the mechanics of reciprocating engines, and steam turbines mechanically connected to propellers, but who cannot recognize the simplicity, reliability, and economy of electrically connected prime movers. However, now that the initial application has been successfully made, it is safe to prophesy that the maritime world will go through as steady and continued an economic advance both in size of power units and in economy of operation as that which our industries have experienced.



MAIN PROPULSION CONTROL BOARD
Simplicity with completeness and perfect accessibility of all apparatus characterizes the control panels. Note the grouping of the instruments.

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

Agricultural Engineers Publish Magazine

A publication of the students of agricultural engineering, "The Student Agricultural Engineer" has appeared on the campus. This, the first publication of the agricultural engineers, is in mimeograph form, and is "a venture into new experience for the students of Agricultural Engineering."

The publication includes news of the college and articles relative to agricultural engineering.

Parcel Takes Year's Leave of Absence

Professor J. I. Parcel is taking a leave of absence for the year 1928-29 and will be associated with L. J. Sverdrup, Minnesota graduate of 1921. They will serve as consulting engineers with the National Toll Bridge company of St. Louis, Missouri, in the design and construction of two large highway toll bridges over the Missouri river. Professor J. A. Wise will take charge of the structural engineering department in Professor Parcel's absence and a temporary assistant professor will be appointed.

GEORGE W. SWENSON

Swenson Resigns to Head E.E. Dept. at Mich.

Mr. George W. Swenson, assistant professor of electrical engineering at the University of Minnesota, has resigned to accept the position of professor of electrical engineering at the Michigan College of Mines and Technology and to become the head of the department at that school.

The Michigan College of Mining and Technology is an old established school of mining. The last legislature directed a widening of the scope of the school to include all of the engineering branches. The building of new Electrical and Mechanical engineering buildings is contemplated immediately. The college is located at Houghton, Michigan, in the copper mining district of the upper peninsula.

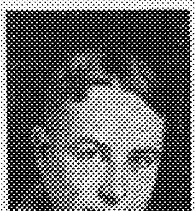
Before Professor Swenson goes to his new post, which will be about the first of September, he will work during the summer as a Transmission Engineer for the Northwestern Bell company.

Todd Elected Member of Phi Beta Kappa

Mr. M. E. Todd, assistant professor of electric power engineering at the University of Minnesota, was elected to Phi Beta Kappa at the University of South Dakota in 1927 soon after the chapter had been formed, according to recent announcements.

Professor Todd received his B. A. degree from the University of South Dakota in 1906, and then came to the University of Minnesota to take engineering.

STAFF APPOINTMENTS *for* 1928-1929



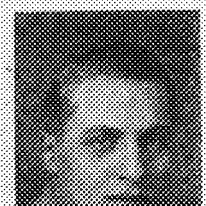
J. R. GINNATY

J. ROBERT GINNATY has been elected by the TECHNO-LOG Board as managing editor of the MINNESOTA TECHNO-LOG for the coming year, succeeding Lawrence A. Clousing. The business manager elected by the Board upon recommendation of Mr. Ginnaty is Richard Rohn. He succeeds Carl E. Swanson as business manager.

Both men have been active in many engineering functions. Mr. Ginnaty has been connected with the TECHNO-LOG for three years, serving first on the editorial staff, and during the past two years as an associate editor of the publication. He has also served as publicity man for the 1928 Engineer's Day, and the Arab's show "High Pressure." During the past two years the special engineering homecoming arrangements in the Engineering building have been under the charge of Ginnaty. He is a member of Kappa Eta Kappa, and Scabbard and Blade.

Richard Rohn served as parade chairman for the 1928 Engineer's Day, and was active in the 1928 Junior Ball. He is a member of Chi Phi and Theta Tau fraternities.

A special TECHNO-LOG banquet meeting was held on May 31 for the old and new TECHNO-LOG Boards and for members of the TECHNO-LOG staff, at which talks were given by the new and retiring heads of the TECHNO-LOG. At this time gold keys were presented to Lawrence A. Clousing, Carl E. Swanson, and Walter Huchthausen for the work and effort they had expended on the TECHNO-LOG during the past year, the gold keys being presented only to seniors. At the same time silver keys, awarded for meritorious work on the magazine, were given to Louis Schaller, advertising manager, Oscar Swenson, circulation manager, and Richard Rohn, newly elected business manager. Silver keys which have been awarded before are also held by Francis J. Fox, Donald Bohrer, Leon Mears, and J. Robert Ginnaty. Presentation of the keys was made by Dean Leland.



RICHARD ROHN

Introduction of next year's president of the TECHNO-LOG Board was made by George Ferguson, this year's president. The next year's president is Stanton Wallis who served on the TECHNO-LOG Board during the present year. Other officers of the Board for the coming year are Dean Taylor, vice president, Realto Cherne, secretary, and Arthur Abrahamson, treasurer. Marvin Fergestad, and one man yet to be elected from the School of Mines and Metallurgy complete the student members of the Board. The faculty members of the Board will continue to be Dean O. M. Leland from the School of Chemistry, Dean W. R. Appleby from the School of Mines, and Prof. A. S. Cutler from the College of Engineering and Architecture.

Those Honored

Many technical students are included in the annual announcement of prizes, awards and elections to scholastic fraternities

Tau Beta Pi

Tau Beta Pi, all engineering honorary fraternity, elected 12 juniors from the technical colleges this spring on the basis of high scholastic standing. The students are as follows: Carl W. Anderson, Raymond C. Freeman, Frederick M. Hakenjos, Robert H. Heyer, Clinton J. Johnston, Arvid E. Lyden, John W. Millunchick, Lawrence W. Nelson, William H. Painter, Lester J. Rowell, James E. Specht, Elo C. Tanner, Irwin Vigness, and Stanton E. Wallin.

Chi Epsilon

New members initiated into Chi Epsilon, honorary civil engineering fraternity, are: Theodore B. Jenson, J. Gunnarsson, Kenneth R. Melin, J. Grant Waits.

Eta Kappa Nu

Spring elections to Eta Kappa Nu, honorary electrical engineering fraternity include: L. F. Borchardt, Edward H. Devoy, John M. Millunchick, Lloyd L. Ohman, William H. Painter, Erling B. Saxhaug, and W. Glenn Williams.

Pi Tau Sigma

Pi Tau Sigma, honorary mechanical engineering fraternity, elected the following members this spring: Richard E. Deschner, Donald G. Felthous, and C. Theodore Skanse.

Tau Sigma Delta

Tau Sigma Delta, national honorary society in architecture, elected the following new members: Roy N. Thorshov, Bruce V. Wallace, and Jane West.

Phi Lambda Upsilon

New members elected to Phi Lambda Upsilon, honorary chemical society are: graduates, Sam I. Aronovsky, Henry B. Bull, Harold A. Bunger, Robert H. Hamilton, Mathew Kiess, Elmore H. Northey, Allen D. Robinson, Charles Rosenblum, Edward C. Truesdale, and Harold N. Wright; seniors, Walter F. Columbus, Howard C. Draper, Moses Gordon; juniors, David W. Glaser, Clarence E. Steinbauer; sophomore, Elmer S. Miller.

Pi Delta Epsilon

Engineers elected to Pi Delta Epsilon, honorary journalistic fraternity include: Lawrence A. Clousing, Sheldon F. Johnson, Albert W. Morse, and William H. Painter.

Sigma Xi

Members elected to Sigma Xi, honorary research fraternity, are elected on the merits of original scientific study. Those elected from the College of Engineering and Architecture this year include: Stuart L. Bailey, Marcus E. Fiene, Arne A. Jakkula, James R. Johnson, and Earl D. McKay.

Iota Sigma Pi

Iota Sigma Pi, honorary chemical sorority, have elected the following members: Beatrice Counts, Mrs. Sparkle Furnas, Doris Griffoul, Roselie Hirschfelder, Hope Hunt, Mrs. Florence Kelly, and Hilda Wiese.

Dupont Fellowship

The Dupont Fellowship in chemistry was awarded this year to Kenneth A. Kobe.

Iron Wedge

Iron Wedge, an organization of seniors chosen for their service to the University, have elected George Thwing to their society.

Silver Spur

Leon Mears has been admitted to membership in Silver Spur, honorary junior men's organization.

Plumb Bob

Plumb Bob reorganized in 1926 is an organization of senior men in the technical colleges who have assisted in the promotion of the general welfare of the university. The following students have been elected: Glendon Brown, Lawrence A. Clousing, Harold Ekman, Herbert F. Hathaway, Lloyd Hoover, Sheldon F. Johnson, Carlyle M. Linden, Irvine G. Sinnott, George W. S. Swenson, Homer W. Tatham, Frank A. Tebo, and George Thwing.

A. S. C. E. Prizes

The Northwestern Section of the American Society of Civil Engineers offer two prizes annually for the best papers submitted by members of the student chapter. The prizes this year were awarded to George J. Schroepher, first, and Theodore W. Thomas, second.

Colbert Ralph Bennet Prize

Robert A. McCullough was awarded the prize offered by C. Ralph Bennet to the student in the College of Engineering producing the most outstanding piece of imaginative writing.

Architectural Awards

The Moorman prize in architecture was awarded this year to Walter J. Huchthausen.

The Magney and Tusler prizes were awarded to Walter J. Huchthausen, first; and Harold Ekman, second.

The American Institute of Architects' medal was won by Walter J. Huchthausen.

The Minnesota Chapter of the American Institute of Architects awarded prizes as follows: first, Walter J. Huchthausen, second, Roy N. Thorshov.

The Scarab Medal in Architecture was won this year by Frederick M. Hakenjos.

Prizes offered by the School of Architecture faculty, include: first, Frederick M. Hakenjos, and second, Dudley Bayliss.

The prize offered by Alpha Alpha Gamma was awarded to Eugene A. Undine.

The William A. French prizes in Interior Decorating were awarded to the following: Jane West, first; and Ruth E. Von Sien, second.

Student Societies

The officers for the coming year of the engineering societies are as follows: A. S. C. E., J. Grant Waits, president; Nordahl T. Rykken, vice-president, Theodore B. Jenson, secretary, and Victor E. Zeuthen, treasurer; A. I. E. E., Carroll Elliot, president, Clinton J. Johnston, secretary, and Rudolph W. Bierwagen, treasurer; A. S. M. E., Donald G. Felthous, president, Albert F. Bauer, vice-president, William W. Martenis, secretary, and William H. Norley, treasurer; A. I. Ch. E., Carlyle M. Linden, president, Harold W. Rehfeld, vice-president, Hans Stromberg, treasurer, Jerome Ackerman, recording secretary, and Carroll Clark, corresponding secretary.

All University Council

The following men have been elected to represent the technical colleges on the All University Council for the next year: George C. McMillan, School of Mines and Metallurgy, Leon Mears, College of Engineering and Architecture, and Harold W. Rehfeld, School of Chemistry.

Board of Publications

Louis M. Schaller has been elected to represent the College of Engineering and Architecture, the School of Chemistry and the School of Mines on the Board in Control of Student Publications for next year.

Bookstore Board

The Board of Directors of the Engineers' Bookstore for next year include John C. Newhouse, president, Carroll Clark, secretary, James J. Hartigan, Chester L. Nelson, and Glynne W. Shifflett.

Technical Commission

The technical commission for next year will include the following students: Donald G. Felthous, president, Carroll L. Elliot, secretary-treasurer, Stowell D. Leach, Carlyle M. Linden, and J. Grant Waits.

Blanket Subscription Passes

AGAIN the technical colleges have led the university students into action. Mark up as a victory for the technical group the passage of the Blanket Subscription Plan for the Minnesota Techno-Log. Whenever things are to be done, it has been the custom in the past and still is the custom to see the engineers do it. Now the whole university is following in the footsteps of the Techno-Log, and there is talk of placing all of the university publications under a blanket tax, or of even including football, magazines, plays, etc., in a blanket tax.

And it is a good thing.

However, before such a ruling can pass it remains for the students to voice their favor of such an action with as much unanimity as the students of the technical colleges did for the passage of the Blanket Tax plan for the Minnesota Techno-Log. Ninety per cent of the technical college students signed up, showing the large number in favor of the adoption of this plan with the attendant increase in size and quality of the publication, and the means of placing the Techno-Log on a most secure foundation.

Our Alumni Directory

KARL Sommermeyer, who has been in charge of the corrections in addresses of the alumni, has gone to special work to insure this directory being the most accurate possible. In addition to the addresses received in response to the cards sent out by Dean Leland, addresses of alumni have been checked by many lists, and many alumni in Minneapolis have been called on phone. We hope that the alumni will apppreciate our endeavor in placing before them once again a complete directory. We feel this has a great effect in drawing the technical college graduates closer together, and serves as a strong bond between the graduates and the institution.

Retrospect

TODAY we lean back in our padded swivel chair. In through the window come cool and refreshing breezes, while outside the sky is blue and clear. Seniors promenade down the avenue, awkwardly swinging their senior canes.

As we looked through this same window last year we had a year ahead of us—now it is past, as are the hot sweltering summer months, the flies buzzing in through the open window and the perspiration rolling down our forehead. It was during those months that we planned and studied the magazine so that during this year we might give it the best we had.

Through it all there has come a satisfaction in knowing that the Techno-Log has again come out for the nine issues of the year, and more consistently on time with each issue than ever before—in knowing from letters and comments that many of our readers have appreciated the Techno-Log—and in realizing that we have actually served the students, faculty and alumni of the technical colleges.

The progress of the Techno-Log has been an evolution. We, the staff of this year, have but continued the work laid down by the previous staffs. Upon the solid foundation they have laid, we have tried to build higher—tried to place the Techno-Log unquestionably as the leader of any magazine of its type in the country. And we look to the future with even greater vision. We see a Techno-Log which is more filled than ever before with choice bits of reading, pictures and news.

All of this has been insured by the passage of the Blanket Subscription to the Minnesota Techno-Log of all the students in the technical colleges, in which the subscription price of the Techno-Log is to be added to the incidental fee of the students.

With every student reading the magazine and contributing to its support, with a staff for the coming year that is highly capable of turning out a splendid publication, and with the Techno-Log Board more firmly established—with all this in prospect, we cannot help but look with envy upon the opportunities afforded for next year's staff to put out a Techno-Log that is unsurpassed in the history of our institutions, and as we turn over the duties to them we wish them success in their undertaking.

Thanks Everybody

WE thank you everybody! Our most sincere feelings are expressed in these few words. There are so many friends of the Techno-Log who have helped us and worked with us during the past year that we cannot hope to thank each individually. Yet we would feel ungrateful if we did not especially acknowledge our pleasant relations with the departmental offices, the Dean's office and the staffs, "Sunny" in the electrical department, "Martin" and "Bill" from Lund Press, and "Art" O'Shea from the Bureau of Engraving. You have helped us, and we appreciate it.

THE 1928 ALUMNI DIRECTORY

of the

Technical Colleges *of the* University *of* Minnesota

ABBREVIATIONS

Courses

A, Architecture; AE, Architectural Engineering; I, Interior Decoration; C, Civil Engineering; E, Electrical Engineering; M, Mechanical Engineering; G, General Engineering; Ch, Chemistry; Ch. E., Chemical Engineering; E. M., Engineer of Mines; E. M. (Geol.), Engineer of Mines in Geology; Met. E., Metallurgical Engineer.

Advanced Degrees

CE, Civil Engineer; EE, Electrical Engineer; ME, Mechanical Engineer; MS, Master of Science; MS (Arch), Master of Science in Architecture; MS(CE), Master of Science in Civil Engineering; MS(EE), Master of Science in Electrical Engineering; MS(ME), Master of Science in Mechanical Engineering; Ch.E., Chemical Engineer.

*Deceased

CHRONOLOGICAL DIRECTORY

College of Engineering and Architecture

FROM 1875 to 1896 inclusive, the first degrees awarded for the regular four-year courses were Bachelor of Civil Engineering (1875), Bachelor of Architecture (1877), Bachelor of Mechanical Engineering (1878), and Bachelor of Electrical Engineering (1891). In this period, also, a few professional advanced degrees were given, as Civil Engineer in 1888, Mechanical Engineer in 1894, and Electrical Engineer in 1896.

From 1897 to 1911 inclusive, the degrees of Civil Engineer, Electrical Engineer, and Mechanical Engineer were regularly awarded at the close of the four-year courses, and a few were given in 1912 and 1913. In 1908, however, five-year courses were established and at the end of the first four years, the degree of Bachelor of Science in Engineering was awarded for each of the three courses, civil, electrical, and mechanical, and also for a general course in engineering, which last had begun in 1900. Upon completion of the fifth year's work the professional degrees, Civil Engineer, Electrical Engineer, and Mechanical Engineer were given, the first being awarded in 1913.

In 1921, the first degree became Bachelor of Science in Civil Engineering, Electrical Engineering, or Mechanical Engineering. The degree of Bachelor of Science in Architecture was established in 1916. The general engineering course was discontinued in 1923. The new requirements for the professional degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer were adopted in 1921 and these degrees were placed in the Graduate School.

In 1928, the form of the Bachelor's degree in this college was changed to the original one used prior to 1878, namely, Bachelor of Architecture, Bachelor of Civil Engineering, etc., and this form was used in June, 1928, and thereafter. Similar action was taken in the School of Chemistry.

New Courses were established as follows: Agricultural Engineering in 1926; and Aeronautical Engineering and Landscape Architecture in 1928.

1875

Bachelor of Civil Engineering

*Leonard, Henry C. (B. S. 1878)
Rank, Samuel A. (B. S. 1875)
*Stewart, Clark

1876

Bachelor of Civil Engineering

*Gillette, Lewis S. (B. S. 1877, C. E. 1898)
*Hendrickson, Eugene A.
Thayer, Charles E.

1877

Bachelor of Architecture

*Pardee, Walter S.

1878

Bachelor of Mechanical Engineering

Bushnell, Charles S.

1879

Bachelor of Civil Engineering

*Dawley, William S. *Furber, Pierce P., Sr.

1883

Bachelor of Civil Engineering

Peters, William G. *Smith, Louis O.

Certificate in Civil Engineering

Holcomb, Alexander M.

Bachelor of Mechanical Engineering

Barr, John H. (M. S. 1888)

1884

Bachelor of Civil Engineering

Hoag, William R. (C. E. 1888) *Loy, George J.
*Matthews, Irving W.

1885

Bachelor of Civil Engineering

*Fitzgerald, Patrick T. Reed, Albert I.

Bachelor of Mechanical Engineering

Bushnell, Elbert E.

1886

Bachelor of Architecture

*Woodmansee, Charles C.

1887

Bachelor of Mechanical Engineering

Crane, Fremont (B. S. 1886, C. E. 1898)

Bachelor of Mechanical Engineering

Andrews, George C.

1888

Bachelor of Civil Engineering

Andersen, Christian

Bachelor of Mechanical Engineering

Loe, Eric H.
Morris, John O. (M. E. 1903)

ADVANCED DEGREES

Civil Engineer

Hoag, William R. (B. C. E. 1884)

Master of Science

Barr, John H. (B. M. E. 1883)

1889

Bachelor of Civil Engineering

Coe, Clarence S.

1890

Bachelor of Civil Engineering

Burt, John L.
Dann, Wilbur W.
*Gilman, Fred H.
Greenwood, Williston
Hayden, John F.
Higgins, John T. (M. D. 1894)
*Hoyt, William H. (C. E. 1898)
*Smith, William C.
Trask, Birney E. (C. E. 1894)

Bachelor of Mechanical Engineering

Gerry, Martin H., Jr. (B. E. E. 1891) Nelson, Thorwald E.
Woodward, Herbert M.

1891

Bachelor of Civil Engineering

Chowen, Walter A. Douglass, Fred L. (C. E. 1899)

Bachelor of Electrical Engineering

Gerry, Martin H., Jr. (B. M. E. 1890)
Huhn, George P.

Bachelor of Mechanical Engineering

Aslakson, Baxter M.

1892

Bachelor of Architecture

Goodkind, Leo Plowman, George T.

Bachelor of Civil Engineering

Hankenson, John J. Higgins, Elvin L.

Bachelor of Electrical Engineering

Burch, Edward P. (E. E. 1898) Gray, William I. (E. E. 1898)
Burtis, William H. Howard, Monroe S.

Bachelor of Mechanical Engineering

Felton, Ralph P.
Gill, James H. (M. E. 1894)

1893

Bachelor of Architecture

Morse, George Washburn, Delos C.

Bachelor of Civil Engineering

*Anderson, Ole J. Hoyt, Hiram P.
*Batchelder, Frank L. Mann, Fred M.
*Erf, John W. (C. E. 1898)

Bachelor of Electrical Engineering

Chase, Arthur W.
Dewey, William H.
Guthrie, John D. (M. D. 1897)
Morse, George H. (E. E. 1911)
Reidhead, Frank E. (E. E. 1898)
Springer, Franklin W. (E. E. 1898)

Bachelor of Mechanical Engineering

Anderson, Ole A. (M. E. 1908)
Avery, Henry B. (M. E. 1898)
Couper, George B. (M. E. 1902)

1894

Bachelor of Civil Engineering

*Cunningham, Andrew O. Johnson, Noah
Gilman, James B. Weeks, William C.

Bachelor of Electrical Engineering

Chalmers, Charles H. (E. E. 1903)

Bachelor of Mechanical Engineering

*Bray, George E. (M. E. 1904)

ADVANCED DEGREES

Civil Engineer

Trask, Birney E. (B. C. E. 1890)

Mechanical Engineer

Gill, James H. (B. M. E. 1892)

1895

Bachelor of Civil Engineering

Bohland, John A.
Chapman, Leslie H.
*Casseday, George A.
Shenehon, Francis C. (C. E. 1900)

Bachelor of Electrical Engineering

Adams, George F.
Ford, Robert E. (E. E. 1903)
*Bishman, Adam E.
Eddy, Horace T. (E. E. 1896)
Rounds, Fred M.
*Tanner, Harry L.
Von Schlegell, Frederick

Bachelor of Mechanical Engineering

Shepherd, Burchard P.
Weaver, Albert C
*Tilderquist, William M.

1896

Bachelor of Civil Engineering

*Beyer, Adam C.
*Jones, C. Paul
Burch, Albert M.
Long, Fred W. (C. E. 1898)

Bachelor of Electrical Engineering

Erikson, Henry A. (Ph. D. 1903)
Magnusson, Carl E. (M. S. 1897, E. E. 1905)
*Wheeler, Herbert M.

Bachelor of Mechanical Engineering

Hastings, Clive
Hilferty, Charles D.
*Hugo, Victor
Lang, James S. (E. E. 1897, M. E. 1899)

Bachelor of Science (in Engineering)

Hickok, Jessie E. S. (M. S. 1904)

ADVANCED DEGREE

Electrical Engineer

Eddy, Horace T. (B. E. E. 1895)

1897

Civil Engineer

*Hewett, Frank M.
Walker, Frank R.
Lee, Engbret A.
Woodman, Howard H.

Electrical Engineer

Abbott, Arthur L.
Chestnut, George L.
Hibbard, Truman
Lang, James S. (B. M. E. 1896, M. E. 1899)
Markhus, Olaf G. F.
Miller, William L.
Myers, Mortimer

Mechanical Engineer

Blake, Robert P.
Louie, James H.
Craig, Robert E.
Savage, Edward S.
Cross, Charles H.
Silliman, Henry D.

ADVANCED DEGREE

Master of Science

Magnusson, C. E. (B. E. E. 1896, E. E. 1905)

1898

Civil Engineer

Glass, Clifton A.
Taylor, Edward W. D.

Electrical Engineer

*Dahl, Hans F. M.
McKellip, Frank W.
Gilchrist, Charles C.
Wagner, Adolph W.

Mechanical Engineer

O'Brien, John E.
Wright, Roydon V.
Willson, Manton F.
Zeleny, Frank

ADVANCED DEGREES

Civil Engineer

Crane, Fremont (B. S. 1886, B. C. E. 1887)
*Gillette, Lewis S. (B. C. E. 1876, B. S. 1877)
Hoyt, William H. (B. C. E. 1890)
Long, Fred W. (B. C. E. 1896)
Mann, Fred M. (B. C. E. 1893)

Electrical Engineer

Burch, Edward P. (B. E. E. 1892)
Gray, William I. (B. E. E. 1892)
Reidhead, Frank E. (B. E. E. 1893)
Springer, Franklin W. (B. E. E. 1893)

Mechanical Engineer

Avery, Henry B. (B. M. E. 1893)

1899

Civil Engineer

Anderson, John G.

Electrical Engineer

Artz, Emmanuel A. (B. S. 1897)
Huntoon, Milton B.
MacKusick, Elwood M.
Grafing, Verney
Pratt, Arthur K.
Hildebrandt, Henry A.

Mechanical Engineer

Bayless, Harry C.
Wennerlund, Elias C.
Richardson, Wilbur P.

ADVANCED DEGREES

Civil Engineer

Douglas, Fred L. (B. C. E. 1891)

Electrical Engineer

Huntoon, Milton B.

Mechanical Engineer

Lang, James S. (B. M. E. 1896, E. E. 1897)

1900

Civil Engineer

Grime, Edwin N.
Whitman, Edward A.
*Prendergast, Paul S.

Electrical Engineer

Dow, James C.
Stussy, William T.
*Johnson, Frank E.
Thaler, James A.
Kinsell, William L.
Thompson, Roy E.
Parkhurst, Harleigh
*Trace, Fred G.
Shumway, Ernest J.
Wiltgen, Edward

Mechanical Engineer

Ashbaugh, Lewis E. (C. E. 1907)
*Higgins, Charles C.
Johnston, William W.
Daniel, T. Lester
Newhall, William B.

ADVANCED DEGREE

Civil Engineer

Shenehon, Francis C. (B. C. E. 1895)

1901

Civil Engineer

Everington, James W.
Quense, John H. (M. E. 1902)
Gunstad, Paul I.
Klemer, Frank H.
Strate, Thomas H.
McKittrick, James

Electrical Engineer

Anderson, Martin E.
Houts, Guy J.
Blake, Henry B.
Reque, Styrk G
Danner, Jake
Tullar, Chas. E.
Houlton, Amos D.

Mechanical Engineer

Robertson, Philip W.
Wilson, Eliel F. (E. E. 1902)

Bachelor of Science (in Engineering)

Groat, Ben. F. (L. L. B. 1903, L. L. M. 1911)

1902

Civil Engineer

Allee, David A.
Lambert, Fred T.
Beaulieu, Richard L.
McClelland, Claude L.
Hallan, Christian
Shepley, Charles R.
Houston, George S.
Weston, William S.
*Knowlton, Warren C.

Electrical Engineer

Burns, Harvey L.
Nilson, Wilhelm
French, Edwin L.
Spence, William J.
McPherson, William B.
Wilson, Eliel F. (M. E. 1901)

Mechanical Engineer

Acomb, William E.
Quense, John H. (E. E. 1901)
Bean, William L.
Cook, Robertson
Ramstad, Edward C.
Grimshaw, William E.
Stone, Melvin O.
Herrick, Carl A.
*Sudheimer, Edwin L.
Taylor, Ralph G.

Bachelor of Science (in Engineering)

Graham, Eugene C.

ADVANCED DEGREES

Mechanical Engineer

Couper, George B. (B. M. E. 1893)
Quense, John (C. E. 1901)

1903

Civil Engineer

Barlow, Harry E.
Oltman, Charles A.
Bennett, Walter J.
Prendergast, Arthur A.
Beyer, Theodore A.
Robbins, Orison B.
Carr, Harvey C.
Smith, Leighton H.
Davison, Joseph H.
Smith, Paul S. (B. S. 1901)
Grow, Harry A.
Madden, Francis
Stewart, Clarence H.
*Novig, Ole S.

Electrical Engineer

Benedict, George F.
*Miller, Lucius W.
Dibble, Barry
Page, Mark L.
Eberhardt, Otto I.
Rask, Louis G.
Erickson, Carl G.
Rosok, Ingwald A.
Ireland, Roy R. (B. S. 1901)
Schumacher, John H.
Vincent, Jay C.
Laird, Lee R.

Mechanical Engineer

Hughes, Frank C.
Williams, Edward H.
Kiosness, Ingram G.

Bachelor of Science (in Engineering)

Crounse, Avery F.
Whitney, Alfred C.

ADVANCED DEGREES

Electrical Engineer

Chalmers, Charles H. (B. E. E. 1894)
Ford, Robert E. (B. E. E. 1895)

Mechanical Engineer

Morris, John O. (B. M. E. 1888)

1904

Civil Engineer

Bouge, Nathan H.
*Holland, Jay C.
Downing, Frank E.
Nelson, Nels B.
Fernald, Frank O.
Roth, Paul

Electrical Engineer

Bouman, Bernhard M.
Morton, Harry G.
Cheney, Edward J.
Otto, Frederick A.
Crabbe, George
*Rosok, Peter A. M.
Goodwin, Victor E.
Taplin, Robert B.
*Helms, Frank C.
Tomlinson, L. C.
Howatt, John
Wicks, John

Mechanical Engineer

Fager, Simon R.
Stanton, Raymond E.
Otto, Robert W.
Davis, Gilbert N.

Bachelor of Science (in Engineering)

Collins, Stewart G.

ADVANCED DEGREES

Mechanical Engineer

*Bray, George E. (B. M. E. 1894)

Master of Science

Hickok, Jessie E. S. (B. S. 1896)

1905

Civil Engineer

Bisbee, Elmer
Jensen, John A.
Brockway, Royden R.
Johnson, Nels
Burke, Roy L.
King, Wesley E.
Cutler, Alvin S.
McMillan, Franklin R.
Feyder, William H.
Mattison, Oliver
Finley, Joseph E.
*Mueller, Henry J.
Gillette, George L.
Nelson, Oscar B.
Hopeman, Albert M.
Smith, Donald T.

Electrical Engineer

Adams, William C.
Jones, Raymond L.
Anderson, Emil
Kuchendorfer, Milton J.
Billau, Louis S.
LeBlond, Edmond J.
Boman, Carl E.
LeTourneau, Edward H.
Coleman, Frank D.
Lundquist, Reuben A.
Davis, Charles A.
Morris, Robert
Ely, Irving R.
Ryan, William T.
Frankovitz, John J.
Simmon, Karl A., Jr.
Gibson, Charles B.
*Smith, Clinton R.
Jackson, Earl D.
Wood, John W.

Mechanical Engineer

Andrews, George L.
*Johnson, Ernest P.
Bates, Albert H.
Lewis, Edward B.
Clipfell, Carroll D.
*Pancratz, Alexander J.
Cutter, Francis C.
Rydeen, Francis G. A.
Gerrish, Harry E.
Sperry, Leonard B. (E. E. 1908)
Harris, Sigmund
Johnson, Austin G.
Tuck, George A.

Bachelor of Science (in Engineering)

Gregg, Treshame D. (C. E. 1906)

ADVANCED DEGREE

Electrical Engineer

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

1906

Civil Engineer

Adams, Elmer E.	Hayward, George I.
Alrick, Bannona G.	Malloy, Charles J.
Alsop, Ernest B.	*Murphy, John G.
Bowen, Fred P.	Norelius, Lewis M.
Childs, Hervey B.	Reed, Arthur L.
Childs, John C.	Wiesner, Frederick E.
Hanauer, Monroe H.	

Electrical Engineer

Albrecht, George M.	Lang, Charles A.
Bunce, Paul F.	Mowry, Harry W.
Calmeyer, John P.	Payne, Harold G.
Cohen, Nathan	Roepke, Otto B.
Cooper, Leo H.	*Schow, Harry A.
Cornelius, Martin	Schwedes, Walter F.
Dunn, Andrew P.	Shuck, Gordon R.
Englin, Charles F.	Stenger, Laurence A.
Finchy, Jacob O.	(M. S. 1916)
Glascock, Henry H.	Stone, Harris G.
*Gunther, Albert N.	Ungerman, Carl M.
Haeberle, Elmer H.	Weber, Erwin L. F.
Hoff, Christopher	(M. E. 1908)
Hokanson, Clarence E.	Wiggins, Gerald G.
Hubbard, Robert T.	Zimmer, William A.

Mechanical Engineer

Armstrong, Thomas S.	*Matteson, Frank E.
Crawford, Wallace T.	Ringsred, Arthur C.
Garber, Gabriel E.	Rose, Norman W.
Loye, Benjamin W.	

Bachelor of Science (in Engineering)

Swensen, Karl P. (M. S. 1907)

ADVANCED DEGREE

Civil Engineer

Gregg, Tresham D. (B. S. Eng. 1905)

1907

Civil Engineer

Batson, Charles D.	Hobart, Walter B.
Blomquist, Hjalmer F.	Huston, David B.
Cram, Clyde M.	Jones, Lewis A.
*Dougherty, Joe	Kelly, Earl W.
Dunham, John A.	Swenson, Charles A.
Grant, James A.	(L. L. B. 1910)
Green, Fred H.	Tendell, Mandel G.
Haverson, Henry D.	VanCleve, Horatio P.
Hawley, Harry G.	Yager, Louis

Electrical Engineer

Allen, Herbert D.	Pearce, John H.
Andrus, Raymond J.	Rezab, John J.
Baer, Louis E.	Schow, William P.
Countryman, Peter F.	Smith, Byron E.
Eddy, Lynne W.	Smithson, John E.
Fairchild, Albert R.	Sternberg, Carl
Kerns, Ralph W.	Uzzell, George W.
Norcross, Arthur F.	Woehler, William L.

Mechanical Engineer

Bell, Maurice D.	Meany, James M.
Birge, Oscar B.	Nekola, John W.
*Brown, Oliver L.	Rawson, Ralph H.
Buhl, Paul S.	Spring, Willis W.
Burwell, Loring D.	*Stacy, Elmer N.
Fee, E. Franklin	Stephenson, Oliver H.
Gessert, George R.	Tubby, Oliver G.
Gilman, Nicholas A.	Wagner, Otto H.
Krag, Walter C.	

ADVANCED DEGREES

Civil Engineer

Ashbaugh, Lewis E. (B. S. in Eng. 1900)

Master of Science

Swensen, Karl P. (B. S. in Eng. 1906)

1908

Civil Engineer

Ash, James W.	Hustad, Andrew P.
Bergquist, Oscar J.	Knowlton, Herbert H.
Borrowman, LeRoy F.	Krauch, William L.
Brenchley, Harry E.	Lang, Fred C.
Comstock, John W.	Longfellow, Dwight W.
Dallimore, Arthur N.	McCall, Harry J.
Doeltz, William F., Jr.	McCree, Andrew A.
Dougan, Henry K.	Mowery, Clarence W.
Fleming, Douglas R.	Norelius, Lewis M.
Forber, Pierre P., Jr.	Okes, Day J.
Gage, Hugh N.	Olson, Melvin S.
Quinn, John I.	Widell, Gustaf F.
Robertson, Charles N.	Willis, Roy
Schlattman, Edward C.	Woodrich, Oscar F.
Walker, George W.	

Electrical Engineer

Anderson, Frank A.	Peterson, Clarence A.
Bachrach, Alfred	Prentice, Robert S.
Brown, George J.	Schildt, William F. H.
Carter, Robert J. S.	Schoepf, Alfred W.
Casberg, James W.	Scobie, Francis G.
Currie, Neill, Jr.	Sperry, Leonard B.
Frahm, Alfred R.	(M. E. 1908)
Hoppin, Glenn H.	Sturtevant, Percy G.
*Hovelson, Henry	Svendsen, George P.
Kauffman, Roy	Swanstrom, Frank N.
King, Alfred B.	Sweningsen, Oliver
McAfee, Allan L.	Weibeler, William M.
Pancratz, Frank J.	Zimmerman, Louis P.

Mechanical Engineer

Anderson, Ole A.	Hetherton, Percival
Bingham, Stanley E.	Morris, Thomas C.
Councilman, Halstad P.	Norelius, Emil F.
(B. S. Eng. 1909)	Norton, Clyde W.
Cox, Richard F.	(M. E. 1909)
Estep, Harvey C.	Peterson, George T.
Fleming, Frank R.	Friedeman, George W.
(E. E. 1909)	Walsh, James
*Frary, Hobart D.	(E. E. 1909)
(M. S. 1909)	Weber, Erwin L. F.
Harwood, Stanley G.	(E. E. 1906)

Bachelor of Science (in Engineering)

Clarke, Charles P. (C. E. 1909)
Fruen, Arthur B. (C. E. 1909)
King, Robert N.
McKeehan, Louis W. (M. S. '09, Ph. D. '11)
Rowe, Harry B.
Schmid, Robert J.

1909

Civil Engineer

Childs, James A.	King, Lawrence W.
Ellison, Jay T.	Mitchell, John B.
Elisberg, N. W.	Nelson, Edward S.
Esser, Frank F.	Okes, Sidney B.
Fiske, F. William, Jr.	Paul, Frederick T.
Houston, Cecil C.	Sheffield, Fred W.
Hubbard, Fred A.	Shepard, George M.
Hubbard, Henry A.	Siverts, Samuel A., Jr.
Ingberg, Simon	Torrance, Eli
Jaques, Robert	

Electrical Engineer

Beckjord, Walter C.	Johnson, Herman R.
Brockway, Alvah E.	Kristy, George A.
Cobban, Rollo J.	Lindelof, Charles G.
Converse, Clovis M.	McKenzie, Lauren F.
Davies, Ralph M.	Murrish, Frederic E.
Fitts, Joel A.	Poore, Orson B.
Fleming, Frank R.	Robison, Archer R.
(M. E. 1908)	Stillman, Marcus H.
Gadsby, Lester H.	Todd, Milo E.
Grant, Fred R.	Turner, Leslie E.
Harris, Clayton	Vits, Theodore
*Hitzker, Albert J.	Walling, Benjamin B.
Hopkins, Mark L.	Walsh, James
Hornibrook, James W.	(M. E. 1908)
Japs, Bernard G.	Williams, Fred M.
	(B. A. 1905)

Mechanical Engineer

Beery, Charles B.	Mark, Walter J.
*Bieri, John B.	Morris, John E.
Birnberg, Zingel C. J.	Moyer, Malcolm B.
Buck, Frederick W.	Nemec, Frank L.
Buhl, John E.	Shippam, Willis
Forfar, Donald M.	Souba, William H.
Holmgren, Charles E.	Starrett, Howard M.
Kircher, Frank J.	Udell, Carl D.
Kircher, George A.	Williams, Wilbur S.
Knopp, William R.	Wright, Harris H.
Lambert, Edwin M.	

Bachelor of Science (in Engineering)

Curtiss, Lindsley B.
Councilman, Halstad P. (M. E. 1908)
Norton, Clyde W. (M. E. 1908)

ADVANCED DEGREES

Civil Engineer

Anderson, Ole A. (B. S. M. E. 1893)
Clarke, Chas. P. (B. S. Eng. 1908)
Fruen, Arthur B. (B. S. Eng. 1908)

Master of Science

*Frary, Hobart D. (M. E. 1908)
McKeehan, L. W. (B. S. Eng. '08, Ph. D. '11)

1910

Civil Engineer

Adams, Benjamin W.	Jevne, George W.
Asleson, Hans	Leach, Edward W.
Bolme, Ole M.	Meyer, Carl F.
Boyum, Benjamin C.	Mott, Charles L.
Brownell, Otto E.	Nason, George L.
Chapman, Burton L.	Olsen, Arthur O.
Dahlquist, Philip L.	Overholt, Harley G.
Ekman, Claes T.	Sawyer, Emerson D.
Garen, George M.	Sommerfeld, Adolph A.
Godward, Alfred C.	Timperley, William D.

Electrical Engineer

Anderson, Oscar F.	Jesperson, Clarence M.
Anderson, Oscar V.	Johnson, Leonard T.
Beck, Vernon S.	Josephson, Eliot B.
Conley, Wilfred E.	Landeen, Arvid G.
Dahlstrom, Raymond E.	Nelson, Carl H.
Finke, Walter J.	Phelps, Ray R.
*Hagstrom, Herbert E.	Powles, James W.
Hansen, Christian	Reid, Harry A.
Hustad, Byron P.	Skytte, Ernest E.

Mechanical Engineer

*Atkinson, William B.	Martin, Wallace H.
Comb, Fred R.	Meixner, Bernard A.
Cook, Harry C.	Moyer, Amos F.
DuToit, George A., Jr.	Nichols, Browning, Jr.
Fleming, Laurence T.	Pease, Maynard W.
Frear, Jeaness B.	Wesbrook, Donald M.
Kaplan, Eugene V.	

Bachelor of Science (in Engineering)

Salisbury, Willis R.

1911

Civil Engineer

Ainslie, Arthur F.	Maney, George A.
Arnesen, Herbert P.	Mark, Reuben A.
Boerner, Francis C.	Mattison, George C.
Cottingham, William P.	Methven, Clyde L.
Croft, Ernest B.	Miller, Erwin J.
Elfstrum, Axel E.	Orbeck, Martin J.
Enger, Edward H.	Roth, Lewis M.
Fieldman, David P.	Siverson, Sigvel J.
Hodnett, Ralph M.	Smith, Sydney H.
Hoffman, Michael J.	Swedberg, M. Roy
Johnson, Carl A.	Walby, Arthur C.
Kvitrud, Ingvald	

Electrical Engineer

Ashworth, Roy H.	Lyford, Dartt H.
Blossom, George W.	McCoy, Ira C.
Burrows, Robert P.	McQuillin, Raymond E.
Butterworth, Allan C.	Markuson, Oscar S.
Chapman, Arthur G.	Mittag, Albert H.
Demarest, Charles S.	Nebel, Walter H.
Drinkall, Leon R.	O'Brien, Raymond J.
Emerson, Lynn A.	Pengilly, Joseph H.
Forsberg, William P.	Riegel, Louis F.
Fredrickson, Harry B.	Shepard, Donald D.
Hanson, Maurice J.	Soulek, Joseph H.
James, Henry C., Jr.	*Stinson, Will V.
Johnson, Edward J.	Walker, William A.
Jones, Watkin W.	Wilson, Glenn W.

Mechanical Engineer

Barnum, Marvin C.	Olstad, Oscar A.
Bishop, Ira L.	Oram, Robert C.
Farnum, Julian P.	Owens, Leo E.
Kasper, Walter F.	Sneve, Jack S.
Larson, Martin S.	Woodman, Joseph C.

Bachelor of Science in Science and Technology

Hoffman, Ralph M.
Klopsteg, Paul E. (M. A. 1913, Ph. D. 1916)

ADVANCED DEGREE

Electrical Engineer

Morse, George H. (B. E. E. 1893)

1912

Civil Engineer

Adams, John W., Jr.	Husfield, Raleigh W.
Curtis, Thomas H.	West, Robert W.
Flygare, August L.	

Bachelor of Science in Engineering (Civil)

Anderson, Harvey B. (C. E. 1913)
*Bailey, William H. (C. E. 1913)
Bingen, William J. (C. E. 1913)
Cummings, Elmer F. (C. E. 1913)
Diamond, Grover W.
Giertsen, Marcus O. (C. E. 1913)
Haberle, Edward L. (C. E. 1913)
Jorgens, Charles R. Danevin (C. E. 1913)
Kapphahn, Raymond J. (C. E. 1913)

Bachelor of Science in Engineering (Civil)

King, Forest V. (C. E. 1913)
Kriz, Joseph J. (C. E. 1913)
Pagenhart, Clarence C.
Pease, Raymond A. (C. E. 1913)
Peterson, Barney J. (C. E. 1913)
Ryan, Loiel S. (C. E. 1913)
South, Willard A. (C. E. 1913)
Souther, Morton E. (C. E. 1913)
Swenson, Hjalmer S. (C. E. 1913)
Torgerson, Irving E. (C. E. 1913)
Wangaard, Oscar H. (C. E. 1913)
Welin, Arthur G. (C. E. 1913)
Wolff, Henry E. (C. E. 1913)

Electrical Engineer

Anderson, Arthur R.
Bill, Earl McM.
Dorrance, Albert P.
*Purves, Leland E.
Streich, Harry C.
Young, Charles N.

Bachelor of Science in Engineering (Electrical)

*Avis, Samuel L. (E. E. 1913)
Benham, Claude F. (E. E. 1913)
Brewster, William E. (E. E. 1913)
Daum, H. Arno
Hedenstrom, Ernest A.
Herrmann, Raymond R. (E. E. 1913)
Hillman, Charles K.
Hoorn, Frederick W. (E. E. 1914)
Hovden, Conrad D. (E. E. 1913)
Knapp, Lester H.
Mathes, Robert C. (E. E. 1913)
Merriell, Elmer W. (E. E. 1913)
*Nelson, George A. (E. E. 1913)
Pardee, Charles A. (E. E. 1913)
Ringstrom, Ivan G. (E. E. 1913)
Swenson, Theodore J. M.
Thuras, Albert L. (E. E. 1913)
Towle, Neal C. (E. E. 1913)

Mechanical Engineer

Boyce, Leonard F.
Brown, William P.
*Johnson, Frank
Markoe, James C. P.
Thompson, Herbert L.

Bachelor of Science in Engineering (Mechanical)

Chapin, Harold S. (M. E. 1913)
Clark, William G. (M. E. 1913)
Crane, Eugene C. (M. E. 1913)
Crawford, Allen S.
Dinsmore, Arthur T. (M. E. 1913)
Donaldson, Frank A.
Hirleman, Clark W. (M. E. 1913)
Mikesh, Martin A. (M. E. 1913)
Morton, Harold S. (M. E. 1913)

Bachelor of Science in Engineering (Mechanical)

Rand, Lars (M. E. 1913)
Ruemmele, Albert E. (M. E. 1913)

Bachelor of Science in Science and Technology

Johnson, Paul A. (Lawrence)

1913

Bachelor of Science in Engineering (Civil)

Bergquist, John E.
Bradley, Byron H. (C. E. 1914)
Chilton, Edward G. (C. E. 1914)
Curtis, Benjamin J. (C. E. 1914)
Hewett, Maurice W. (C. E. 1914)
Koepke, Walter E. (C. E. 1914)
Kruse, Helmer V. (C. E. 1914)
Lovering, Harry D. (C. E. 1914)
Montgomery, Albertus
Morse, George A. (C. E. 1914)
Quiggle, Arthur W. (C. E. 1914)
Rolfe, West A.
Thurston, Harold H. (C. E. 1914)
Webster, Donald W. (C. E. 1914)
Wilk, Benjamin (C. E. 1914)

Electrical Engineer

White, Charles W.

Bachelor of Science in Engineering (Electrical)

Dewars, Allen G. (E. E. 1914)
Dow, Clarence A. (E. E. 1914)
Everett, William R. (E. E. 1915)
Goebel, Rudolph C. (E. E. 1914)
Goetzenberger, Ralph L. (E. E. 1914)
Haines, Allen K.
Irwin, Vincent H. (E. E. 1914)
Lagaard, Alexander S. T. (E. E. 1914)
Mahoney, William L. (E. E. 1914)
Miller, Hollis DeW.
Ramm, Theodore D.
Taylor, Lyman D. (E. E. 1916)
*Wilcox, Leslie W.

Bachelor of Science in Engineering (Mechanical)

Buenger, Albert (M. E. 1914)
Critchett, Edward F. (M. E. 1914)
McCartney, Floyd A.
Ovestrud, Melvin (M. E. 1914)
*Robertson, Soren M.
Sausen, Bert R.

ADVANCED DEGREES

Civil Engineer

Anderson, Harvey B. (B. S. Eng. 1912)
*Bailey, William H. (B. S. Eng. 1912)
Bingen, Wm. J. (B. S. Eng. 1912)
Cummings, Elmer F. (B. S. Eng. 1912)
Giertsen, Marcus O. (B. S. Eng. 1912)
Haberle, Edward L. (B. S. Eng. 1912)
Jorgens, Charles R. D. (B. S. Eng. 1912)
Kapphahn, Raymond J. (B. S. Eng. 1912)
King, Forest V. (B. S. Eng. 1912)
Kriz, Joseph J. (B. S. Eng. 1912)
Pease, Raymond A. (B. S. Eng. 1912)
Peterson, Barney J. (B. S. Eng. 1912)
Ryan, Loiel S. (B. S. Eng. 1912)
South, Willard A. (B. S. Eng. 1912)
Souther, Morton E. (B. S. Eng. 1912)
Swenson, H. Seymour (B. S. Eng. 1912)
Torgerson, Irving E. (B. S. Eng. 1912)
Wangaard, Oscar H. (B. S. Eng. 1912)
Welin, Arthur G. (B. S. Eng. 1912)
Wolff, Henry E. (B. S. Eng. 1912)

Electrical Engineer

*Avis, Samuel L. (B. S. Eng. 1912)
Benham, Claude F. (B. S. Eng. 1912)
Brewster, Wm. E. (B. S. Eng. 1912)
Herrmann, Raymond R. (B. S. Eng. 1912)
Hovden, Conrad D. (B. S. Eng. 1912)
Mathes, Robert C. (B. S. Eng. 1912)
Merriell, Elmer W. (B. S. Eng. 1912)
*Nelson, George A. (B. S. Eng. 1912)
Pardee, Charles A. (B. S. Eng. 1912)
Ringstrom, Ivan G. (B. S. Eng. 1912)
Thuras, Albert L. (B. S. Eng. 1912)
Towle, Neal C. (B. S. Eng. 1912)

Mechanical Engineer

Chapin, Harold S. (B. S. Eng. 1912)
Clark, Wm. G. (B. S. Eng. 1912)
Crane, Eugene C. (B. S. Eng. 1912)
Dinsmore, Arthur T. (B. S. Eng. 1912)
Hirleman, Clark W. (B. S. Eng. 1912)
Mikesh, Martin A. (B. S. Eng. 1912)
Morton, Harold S. (B. S. Eng. 1912)
Rand, Lars (B. S. Eng. 1912)
Ruemmele, Albert E. (B. S. Eng. 1912)

1914

Civil Engineer

Larson, Albin

Bachelor of Science in Engineering (Civil)

Brenchley, Walter C. (C. E. 1915)
Burnett, Harold V.
Dimond, Harvey G.
Doolittle, William Y.
Ekberg, Carl E. (C. E. 1915)
Hustad, John C. (C. E. 1915)
Johnson, Edgar W. (C. E. 1915)
Lagaard, Maurice B. (C. E. 1915)
Larson, Louis (C. E. 1915)
Mitchell, Lester M. (C. E. 1915)
Nordstrom, Carl T.
Ott, Leonard E. (C. E. 1915)
Price, John R.
Rankin, Renville S.
Rockwell, Harvard S.
Sears, Dow J.
Weatherill, Cedric S. (C. E. 1915)
Weigel, Howard N. (C. E. 1915)

Bachelor of Science in Engineering (Electrical)

Adler, Eugene H. (E. E. 1915)
Black, Peter P.
Chapman, Wendell P.
Dunham, Roy O. (E. E. 1915)
Elliott, A. Douglass (E. E. 1915)
Fallon, Eugene L. (E. E. 1915)
*Garvey, Walter S. (E. E. 1916)
*Gunnarson, Carl A.
Harris, Harold R. (E. E. 1915)
Jackson, Otto E. (E. E. 1915)
Johnson, Carl J. (E. E. 1915)
Johnson, Elmer W. (E. E. 1915)
Jones, George R. (E. E. 1915)
Layden, Arthur L.
Loeffler, Henry S. (E. E. 1915)
Mertz, Karl J.
Meyer, Herbert W.
Peterson, Andrew M.
Putz, John H. (E. E. 1915)
Robertson, Burton J. (E. E. 1915)
Schroeder, Carl W. (E. E. 1915)
Tallmadge, Everett S. (E. E. 1915)
Wentz, Walter W. (E. E. 1915)
Wilcox, Hugh B. (M. S. 1916)
*Wuest, Karl F. (E. E. 1915)

Bachelor of Science in Engineering (Mechanical)

Colvin, James A. (M. E. 1915)
Dorr, William R.
Gemmel, John H. (M. E. 1915, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (M. E. 1915, B. S. 1918, M. B. 1919, M. D. 1920)
Hartney, James L. (M. E. 1915)
Hubbell, Arthur C. (M. E. 1915)
Kopper, Edward, Jr. (M. E. 1916)
Mayer, Harris J. (M. E. 1915)
Peoples, John S.
Peterson, Albert L. (M. E. 1915)
Rockwood, Fletcher (M. E. 1915)
Snow, Clarence J. (M. E. 1915)
Thayer, Paul W. (M. E. 1915)

ADVANCED DEGREES

Civil Engineer

Bradley, Byron H. (B. S. Eng. 1913)
Chilton, Edward G. (B. S. Eng. 1913)
Curtis, Benjamin J. (B. S. Eng. 1913)
Hewett, Maurice W. (B. S. Eng. 1913)
Koepke, Walter E. (B. S. Eng. 1913)
Kruse, Helmer V. (B. S. Eng. 1913)
Lovering, Harry D. (B. S. Eng. 1913)
Morse, George A. (B. S. Eng. 1913)
Quiggle, Arthur W. (B. S. Eng. 1913)
Thurston, Harold H.* (B. S. Eng. 1913)
Webster, Donald W. (B. S. Eng. 1913)
Wilk, Benjamin (B. S. Eng. 1913)

Electrical Engineer

Dewars, Allen G. (B. S. Eng. 1913)
Dow, Clarence A. (B. S. Eng. 1913)
Goebel, Rudolph C. (B. S. Eng. 1913)
Goetzenberger, Ralph L. (B. S. Eng. 1913)
Hoorn, Frederick W. (B. S. Eng. 1912)
Irwin, Vincent H. (B. S. Eng. 1913)
Lagaard, Alexander S. T. (B. S. Eng. 1913)
Mahoney, William L. (B. S. Eng. 1913)

Mechanical Engineer

Buenger, Albert (B. S. Eng. 1913)
Critchett, Edward F. (B. S. Eng. 1913)
Ovestrud, Melvin (B. S. Eng. 1913)

1915

Civil Engineer

Cottingham, George, Jr.

Bachelor of Science in Engineering (Civil)

Aasland, Christopher
Anderson, George T.
Christianson, Hilmar B.
Croswell, Thomas L.
Cuddy, William A. (C. E. 1916
Dorsey, John G.
Handsith, C. E.
*Haynes, Stanley H. (B. S. 1917
Helmick, Dan S.
Johnson, Alexander B.
Jones, Idris V.
Jones, Ivor V.
Knight, Ralph J.
Laurence, Philip L. (Johnson
Leonard, Thomas K. (C. E. 1916
McKay, Earle D. (C. E. 1916
Ostad, Olaf L.
Pratt, Benjamin A.
Ruisvold, Olav M. (C. E. 1916
Scott, Elmer C. (C. E. 1916
Skurdalsvold, Peter (C. E. 1916
Swenson, Oscar E. (C. E. 1916
West, John C.
Wild, Carl D. (C. E. 1916
Withee, Warren

Bachelor of Science in Engineering (Electrical)

Anderson, Joseph W.
Eggers, Henry C. T. (E. E. 1916
*Garvey, Walter S. (E. E. 1916
Hjermstad, Harry M. (Webster
*Houghtaling, Elting W. (E. E. 1916, B. S. 1916
Jones, Robert A. (E. E. 1916
Lawrence, Scott W. (E. E. 1916
Lutz, Richard E.
Olsison, Clifford E. (E. E. 1916
Skagerberg, Rutcher (E. E. 1916

Bachelor of Science in Engineering (Electrical)

Thompson, Harry T. (E. E. 1916)
Turner, Roy H. (E. E. 1916)
Wilcox, Halsey H.

Bachelor of Science in Engineering (Mechanical)

Boyles, Ralph R. (M. E. 1916)
Crosby, Milton E.
Giltinan, David M. (M. E. 1916)
Holmberg, Abner W. (M. E. 1916)
Kerns, Clinton B.
Orr, George M.
Roberts, Earl H. (M. E. 1916)
Skon, Herman W. (M. E. 1916)
Tupper, Charles E.
Wolff, William S. (M. E. 1916)

ADVANCED DEGREES

Civil Engineer

Brenchley, Walter C. (B. S. Eng. 1914)
Ekberg, Carl E. (B. S. Eng. 1914)
Hustad, John C. (B. S. Eng. 1914)
Johnson, Edgar W. (B. S. Eng. 1914)
Lagaard, Maurice B. (B. S. Eng. 1914)
Larson, Louis J. (B. S. Eng. 1914)
Mitchell, Lester M. (B. S. Eng. 1914)
Ott, Leonard E. (B. S. Eng. 1914)
Weatherill, Cedric S. (B. S. Eng. 1914)
Weigel, Howard N. (B. S. Eng. 1914)

Electrical Engineer

Adler, Eugene H. (B. S. Eng. 1914)
Dunham, Roy O. (B. S. Eng. 1914)
Elliott, A. Douglass (B. S. Eng. 1914)
Everett, William R. (B. S. Eng. 1913)
Fallon, Eugene L. (B. S. Eng. 1914)
Harris, Harold R. (B. S. Eng. 1914)
Jackson, Otto E. (B. S. Eng. 1914)
Johnson, Carl J. (B. S. Eng. 1914)
Johnson, Elmer W. (B. S. Eng. 1914)
Jones, George R. (B. S. Eng. 1914)
Loeffler, Henry S. (B. S. Eng. 1914)
Putz, John H. (B. S. Eng. 1914)
Robertson, Burton J. (B. S. Eng. 1914)
Schroeder, Carl W. (B. S. Eng. 1914)
Tallmadge, Everett S. (B. S. Eng. 1914)
*Wuest, Karl F. (B. S. Eng. 1914)

Mechanical Engineer

Colvin, James A. (B. S. Eng. 1914)
Gemmell, John H. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hartney, James L. (B. S. Eng. 1914)
Hobbell, Arthur C. (B. S. Eng. 1914)
Mayer, Harris J. (B. S. Eng. 1914)
Peterson, Albert L. (B. S. Eng. 1914)
Rockwood, Fletcher (B. S. Eng. 1914)
Snow, Clarence J. (B. S. Eng. 1914)
Thayer, Paul Wm. (B. S. Eng. 1914)

1916

Bachelor of Science in Architecture

*Albee, Pierce
Heath, Donald C.
Liebenberg, Jacob J.
Tannehill, Louis Wm.

Bachelor of Science in Engineering (Civil)

Askew, Thomas A., Jr.
Biskup, William F.
Bruce, Hjalmar N. (C. E. 1917)
Carlson, Anders J. (C. E. 1917)
Doell, Chas. E. (C. E. 1917)
Ellingson, Elmer
Grew, Robert W.
Hendrickson, Norman E.
*Johnston, Ralph E. (C. E. 1917)
Kivley, Warren O.
Knauss, Archibald C. (C. E. 1917)
Larson, Carl
Lux, Arthur R.
McCullough, Bruce M.
Nortner, Sylvester E
Pan, Wen P.
Peterson, Harold L. (C. E. 1917)
Peterson, William W.
Watson, Fred O.
Weinke, Ernest H. (C. E. 1917)
Williams, Charles A.

Bachelor of Science in Engineering (Electrical)

Abbott, Amos H. (E. E. 1917)
Anderson, Frank L.
Arenson, Timothy G.
Bleecher, George W.
Blomberg, Evar H. (E. E. 1917)
Brown, Louis M.
Burt, Fred R.
Butterworth, Russell I. (E. E. 1917)
Covell, Russell O.
Creswell, Daniel R.
Dow, William G. (E. E. 1917)
Edelman, Philip (E. E. 1917)
Ellefson, Selmer
Fastenau, Karl DeV.
Gannett, Danforth K. (E. E. 1917)
Hult, George A.
Irwin, Frank H. (E. E. 1917)
Loye, Donald P. (E. E. 1917)
Russell, Carl A.
Schulz, Elton A.
Simons, Walter W.
Tallmadge, Hiram (E. E. 1917)
Teberg, Ernest J. (E. E. 1917)
Thompson, Jesse L. (E. E. 1917)
Turnquist, Axel A. (E. E. 1917)

Bachelor of Science in Engineering (Mechanical)

Corser, John
Dresser, Harry S.
Johnson, Ira L. (M. E. 1917)
*Mason, Arthur P.
Miller, William C.
Moody, Chester S. (M. E. 1917)
Ritchie, John R. (M. E. 1917)
Smart, George A.
Stone, Charles W. (M. E. 1917, M. S. 1919)

ADVANCED DEGREES

Civil Engineer

Cuddy, William A. (B. S. Eng. 1915)
Leonard, Thomas K. (B. S. Eng. 1915)
McKay, Earle D. (B. S. Eng. 1915)
Rufsvold, Olav M. (B. S. Eng. 1916)
Scott, Elmer (B. S. Eng. 1915)
Skurdalsvold, Peter (B. S. Eng. 1915)
Swenson, Oscar E. (B. S. Eng. 1915)
Wild, Carl D. (B. S. Eng. 1915)

Electrical Engineer

Eggers, Henry C. T. (B. S. Eng. 1915)
*Garvey, Walter S. (B. S. Eng. 1915)
*Houghtaling Elting W. (B. S. Eng. 1915, B. S. 1916)
Jones, Robert A. (B. S. Eng. 1915)
Lawrence, Scott (B. S. Eng. 1915)
Olaison, Clifford E. (B. S. Eng. 1915)
Scott, Walter L. (B. S. Eng. 1915)
Skagerberg, Rutcher (B. S. Eng. 1915)
Taylor, Lyman D. (B. S. Eng. 1913)
Thompson, Harry T. (B. S. Eng. 1915)
Turner, Roy H. (B. S. Eng. 1915)
Wentz, Walter W. (B. S. Eng. 1915)

Mechanical Engineer

Boyles, Ralph R. (B. S. Eng. 1915)
Giltinan, David M. (B. S. Eng. 1915)
Holmberg, Abner W. (B. S. Eng. 1915)
Kopper, Edward, Jr. (B. S. Eng. 1914)
Roberts, Earl H. (B. S. Eng. 1915)
Skon, Herman W. (B. S. Eng. 1915)
Wolff, William S. (B. S. Eng. 1915)
Wong, Jee K. (B. S. Armour Institute)

Master of Science

Stenger, Lawrence A. (E. E. 1906)
Wilcox, Hugh B. (E. E. 1914)

1917

Bachelor of Science in Architecture

Brown, Floyd W.
Buckhout, Donald H.
Gilman, Howard B.
Kreinkamp, Linton H.
Mixer, Walter R.
Paulsen, George F.
Prudden, George H., Jr.
Riedesel, George M.

Bachelor of Science in Engineering (Civil)

Boyce, Ellsworth R.
Brataas, Mark G.
Douglass, Addison H. (C. E. 1920)
Fossen, George
Linden, Henning
Luplow, Walter D.
Luxford, Ronald F.
Rader, Clarence McK. (C. E. 1917)
Rickman, Herman W.
Tryon, Philip D.
Wolfangle, Raymond J.

Bachelor of Science in Engineering (Electrical)

Becker, Ward E.
Boyum, Irvin L.
Carlson, Chauncy M.
Dunlap, Lemuel J.
*Ebert, Solomon B.
Eckenbeck, Evertt E.
Jacobs, Arthur R.
Juvrud, Edwin C.
Lilly, Clarence W.
Malmstrom, Axel L.
*McKibbin, Ray (E. E. 1918)
*Melby, Einar C.
Scott, Willard W.
Swenson, George W. (E. E. 1921)
Thomas, William A.
Wheeler, Herbert H.
Williams, Frederick J.
Willis, Benjamin S.

Bachelor of Science in Engineering (Mechanical)

Anderson, Edward I. (M. E. 1919)
Bachlein, Charles (M. E. 1919)
Bros, Ernest T.
Brown, Homer L.
Carlson, Arvid P.
Ek, Gustav A.
Eustis, Irving N. (M. E. 1918)
Gerlach, Arthur C.
Guggisberg, Charles F.
Hektner, Joel
Holmstine, Arthur G.
Hvoslef, Frederik W. (M. S. 1919)
Jones, Edwin F.
Knutson, Harry
Larson, Victor F.
Murray, John H.
Nelson, Otis S.
Romero, Cirilo L. P. Y. (M. E. 1918)
Rosenbloom, Abraham E.
Swenson, Clarence O. (M. E. 1920)
Taylor, Duane L.

ADVANCED DEGREES

Civil Engineer

Bruce, Hjalmar N. (B. S. Eng. 1916)
Carlson, Anders J. (B. S. Eng. 1916)
Doell, Charles E. (B. S. Eng. 1916)
*Johnston, Ralph E. (B. S. Eng. 1916)
Knauss, Archibald C. (B. S. Eng. 1916)
Peterson, Harold L. (B. S. Eng. 1916)
Rader, Clarence McK. (B. S. Eng. 1917)
Weinke, Ernest (B. S. Eng. 1916)

Electrical Engineer

Abbott, Amos H. (B. S. Eng. 1916)
Blomberg, Evar H. (B. S. Eng. 1916)
Butterworth, Russell I. (B. S. Eng. 1916)
Dow, William G. (B. S. Eng. 1916)
Edelman, Philip (B. S. Eng. 1916)
Gannett, Danforth K. (B. S. Eng. 1916)
Irwin, Frank H. (B. S. Eng. 1916)
Loye, Donald P. (B. S. Eng. 1916)
Mori, Nathaniel R. (B. S. Eng. 1915, University of Washington)
Tallmadge, Hiram (B. S. Eng. 1916)
Teberg, Ernest J. (B. S. Eng. 1916)
Thompson, Jesse L. (B. S. Eng. 1916)
Turnquist, Axel A. (B. S. Eng. 1916)

Mechanical Engineer

Johnson, Ira L. (B. S. Eng. 1916)
Moody, Chester S. (B. S. Eng. 1916)
Ritchie, John R. (B. S. Eng. 1916)
Stone, Charles W. (B. S. Eng. 1916, M. S. 1919)

1918

Bachelor of Science in Architecture

Forsberg, Enock E.
Kaplan, Seeman
King, Harvey M.
Moorman, Albert J.

Bachelor of Science in Engineering (Civil)

Battles, Leon E.
*Chamberlain, Herbert D.
Deutsch, Richard E.
Eliassen, Sigurd
*Gould, Reed D.
Konstantinopoulos, Nicholas (Konstants)
Nickerson, Neal C.
Smith, Cedric B. (B. A. 1914)
Smolensky, Martinian G.

Bachelor of Science in Engineering (Electrical)

Brooke, Harold L.
Gibbs, Clayton T.
Hartig, Henry E.
Hotchkiss, Fred W.
Levin, Jake M.
Ross, Russell H.
Schlenk, Hugo, Jr.
Smith, Donald C.
Smith, Hugh A.
Talbot, Thomas F.

Bachelor of Science in Engineering (Mechanical)

Abrahamson, Howard R.
Anderson, Hilder A.
Bierman, George H. (M. E. 1919)
Francis, Paul E.
Greenberg, Morris
Hagerman, Oliver S.
Kivley, Ray C.
Muller, Carl C.

Bachelor of Science in Engineering

Peterson, Harold R.
Putman, George W.

ADVANCED DEGREES

Electrical Engineer

*McKibben, Ray (B. S. Eng. 1917)

Mechanical Engineer

Eustis, Irving N. (B. S. Eng. 1917)
Romero, Cirilo L. P. Y. (B. S. Eng. 1917)

1919

Bachelor of Science in Architecture

Buenger, Edgar
Deane, George B.
Deneen, David J.
Emery, George C.
Frazer, George
Hamilton, Jefferson M.
Hammett, Ralph W.
Schwartz, John S.
Wright, Stewart V.

Bachelor of Science in Engineering (Civil)

Coe, Edward H.
Elstad, Rudolph T.
Hawlick, Henry I.
Rosenthal, Oscar L.
Susban, Harry M.

Bachelor of Science in Engineering (Electrical)

Christensen, Edgar W.
Cotton, Ernest H.
Driskall, John F.
Duncan, George R.
Grimes, David
Hartman, Walter K.
Heinemann, John R.
Jordan, Frank W.
Klass, Frederick
Langland, Harold S.
Lee, Oscar C.
Marshall, Donald E.
Nelson, Gustav A.
Olson, Richard H.
Peterson, Albert E.
Peterson, Arthur P.
Petrich, Alfred C.
Pierson, Joe W.
Reeve, Charles H.
Sander, Theodore, Jr.
Swanson, Edwin W.

Bachelor of Science in Engineering (Mechanical)

Baker, Arthur W.
Bros, Raymond J. (M. E. 1920)
Cosh, Richard A.
Dowd, Archie J.
Elliot, Harry C.
Foltz, Ross M.
Hartzberg, Edward M.
Moffat, George N. (M. E. 1920)
Pavek, William J. (M. E. 1920)
Williams, Arthur H.
Wunderlich, Milton S. (M. E. 1920)

Bachelor of Science in Engineering

Briggs, Hiram K.
Gee, Harry J.
Kapplahn, Ernest H.
Krueze, Herbert A.
Lewis, Carroll E.
Lilly, Eugene

ADVANCED DEGREES

Mechanical Engineer

Andersen, Edward I. (B. S. Eng. 1917)
Bierman, George H. (B. S. Eng. 1918)
Buchnlein, Charles (B. S. Eng. 1917)
Hvoslef, Fredrik W. (B. S. M. E. 1917)

Master of Science

Stone, Charles W. (B. S. Eng. 1916, M. E. 1917)

1920

Bachelor of Science in Architecture

Anderson, Milton J.
Kleinschmidt, Florian A.
Korslund, Harry J.
Lin, Shu M.
Love, Edwin M.
Lyon, Glenn H.
Kaugland, Arnold I.

Bachelor of Science in Engineering (Civil)

Alexander, George D.
Beneke, Walter E.
Berg, Karl A. E.
Berot, Hans E.
Bleifuss, Donald J.
Dever, Francis A.
Fitzgerald, William J.
Friar, Floyd M.
Gilbert, Roy
Gould, Edward S.
Hanke, Carl C.
Hansen, Carlos C.
Holm, Edwin R.
Johnson, Byron F.
Larson, Amandus C.
Lebeck, Carl E.
Lende, Henry M.
Malmberg, Victor A.
Nelson, Donald O.
Neville, Earle L.
Pless, Arnold G. M.
Purdy, Irving B.
Seemann, Ernest W.
Sherwood, Edward B.
Staehle, Gilbert C. (M. S. Eng. 1922)

Bachelor of Science in Engineering (Electrical)

Aske, Irving E.
Bauer, Ruben B.
Carlson, Victor H.
Ellsworth, Charles D.
Engquist, Victor E.
Goss, Harold R.
Groth, Arthur W.
Hunt, Gates E.
Janzen, William H.
Jules, Harold A.
Kingsley, Norman W.
Knowles, Everett H.
Kruse, Orlin O.
Larson, Walter J.
Lee, Walter J.
Lockwood, Raymond A.
McKenzie, Leonard F.
Mayer, Albert F.
Miller, George W.
Mitchell, Alexander C.
Molskness, Nels S.
Nelson, Clarence L.
Noel, Clay W.
Peterson, Peter I.
Peterson, Richard M.
Peterson, Vance C.
Price, Clarence R.
Siegmann, Chester W.
Strothman, Russell A.
Triem, Ralph H.
Waldron, Ralph E.
Westberg, Russell E.

Bachelor of Science in Engineering (Mechanical)

Anderson, Helmer N.
Ball, Hampton B.
Cerney, Glen C.
Curry, Ezra B. (M. E. 1921)
Czock, Jacob H.
Egilsrud, Fridtjof S.
Fortune, Harry G.
Gerow, Theron G.
Hayes, Edward J. (M. E. 1921)
Joachim, William F. (M. E. 1921)
Merrill, Lewis E. (M. E. 1921)
Odegaard, Harold T.
Powell, Knox A.
*Reasoner, Clayton M. (M. E. 1921)
Rhame, Paul W. (M. E. 1921)
Shellenberger, Hiram R.
Tuve, George L. (M. E. 1921)
Wallfred, John E.
Waterous, Fred A.
William, Myrl J.

Bachelor of Science in Engineering

Didriksen, Philip H.
Hanrahan, Edmund C.
Harris, Nathan
Madsen, Olav
Moore, Clarence F.
Swenson, Gustav A.
Vollacher, Theodore L.
Wyly, Lawrence T.

ADVANCED DEGREES

Civil Engineer

Douglass, Addison H. (B. S. 1917)

Mechanical Engineer

Bros, Raymond J. (B. S. 1919)
Moffat, George N. (B. S. 1919)
Pavek, William J. (B. S. 1919)
Swenson, Clarence Q. (B. S. 1917)
Wunderlich, Milton S. (B. S. 1919)

1921

Bachelor of Science in Architecture

Anderson, Milton L.
Dahl, George L.
Damberg, Rheuben P.
Gewalt, Carl H.
Larson, Edwin
Melander, Albin R.
*Thorshov, Olaf
Wills, Arthur D.

Bachelor of Science in Civil Engineering

Barber, Harold A.
Carpenter, Hugh W.
Christilaw, George M.
Daly, Richard T., Jr.
Dehn, Eltor A.
Del Plaine, Carlos W. (C. E. 1922)
Enke, Fred A.
Gruchau, Earl H.
Hallady, Leslie L.
Hanson, Edwin L.
Henry, Burt C.
Jensen, Cyril D.
Johnson, Alphonse N.
Johnson, Carl S.
McCubrey, Everett J.
Mackintosh, William S.
Muessel, Robert W.
Simmonds, Richard R.
Sverdrup, Leif J.
Weis, Wallace D.
Werdenhoff, James H.

Bachelor of Science in Electrical Engineering

Anderson, Edward S.
Austin, Paul D.
Barger, Harold L.
Barnes, Dean M.
Beardmore, Albert E.
Berg, Samuel A. (B. A. 1921) (E. E. 1922)
Briggs, William G.
Carlson, Carl P.
Colson, Lauren G.
Donahue, Robert E.
Hammerstrom, Aleck A.
Hayward, Laurence W.
Hougan, Sander
Johnson, Edgar F.
Johnston, Charles K.
Larson, Ludvig C. (E. E. 1923)
Love, Percival E.
McKibben, Lloyd S.
McVean, Norman S.
Maine, Basil C.
Manderfeld, Emanuel C.
Mengner, Elmer J.
Miller, Andrew L.
Nelson, Richard L.
Palmer, Roy A.
Pearson, Charles W.
Peterson, Harold W.
Podosin, John
Satori, Roy H.
Shuirman, Gabe
Stanius, Godfrey
Sweet, Ray R.
Wahlquist, Hugo W.
Wessale, George
Wilson, Paul R.

Bachelor of Science in Mechanical Engineering

Arneson, Lloyd O.
Elmer, Lloyd A.
Farmer, John W.
Forsberg, Elmer J. (M. E. 1922)
Gjesdahl, Maurice S.
Hamlin, Lehan H.
Johnson, Carl A. (M. E. 1922)
Lewis, George R.
Luce, Alexander W. (M. E. 1923)
Reuter, Peter T.
Roy, Milo C.
Umbehocker, Frank
Vaale, Sven A.
von Rohr, Herbert H.

Bachelor of Science in Engineering

Beeman, Harry J.
Carlton, Richard P.
Cowin, Clifford C.
Dills, Lyle A.
Godwin, Kenneth A.
Jacobson, Howard C.
Liddle, Ralph W.
McLean, Milton D.
McMeekin, Glenn D.
Martin, Curtis R.
Noble, John F.
Papenthien, Roy O.
Young, Joseph E.

ADVANCED DEGREES

Electrical Engineer

Swenson, George W. (B. S. Eng. 1917)

Mechanical Engineer

Curry, Ezra B. (B. S. Eng. 1920)
Hayes, Edward J. (B. S. Eng. 1920)
Joachim, William F. (B. S. Eng. 1920)
Merrill, Lewis E. (B. S. Eng. 1920)
*Reasoner, Clayton M. (B. S. Eng. 1920)
Rhame, Paul W. (B. S. Eng. 1920)
Tuve, George L. (B. S. Eng. 1920)

1922

Bachelor of Science in Architecture

Bakken, Laurence H.
Croft, Edna K.
Damberg, Paul S.
Dawson, John W.
Gerlach, Henry C.
Graf, Donald T.
Hahn, Stanley W.
Haines, Howard N.
Kreinkamp, Herbert A.
Little, Alice V.
Moorman, Frank S.
Smit, Catherine
Stewart, George A.
Willner, William E.

Bachelor of Science in Civil Engineering

Anderson, Nels S.
Andrus, Harry J.
Bailey, George R.
Berdan, Hubert J.
Chernus, Maurice
Cook, Walter K.
Cray, Seymour R. (C. E. 1923)
Erickson, Edwin C. O.
Espenett, Edward L.
Feder, Max
Fraser, Carlisle G.
Frost, Herbert J.
Greenberg, Jack
Hortskotte, Arthur E.
Johnson, Ellsworth
Keeler, Jasper F.
Kelley, William
Levens, Alexander S. (M. S. in C. E. 1924) (C. E. 1927)
Lund, Earl H. (C. E. 1923)
Markson, Christian O.
Mattson, Dewey F.
Morrison, John F.
Newberry, Lester W.
Ost, Roland E.
Palda, Chas. H.
Palmer, Howard B.
Paulson, Thorwald S.
Peterson, Neander E.
Pinska, Lawrence F.
Reardon, John M.
Rosenthal, Paul
Silverman, Emil M.
Slade, Loring
Soshnik, Edward J.
Stoutland, Oliver A.
Swanson, Clifford L.
Tarbell, William P.
Teberg, Lawrence E.
Thompson, Claudius A.
Tierney, Festus P.
White, Arden D.
Wilson, Charles A.
Wood, Victor R.

Bachelor of Science in Electrical Engineering

Aultfather, David H.
Bergstrom, Marlow B.
Bisbee, Bertin A.
Bjonerud, Earl S.
Bochus, Gerald H.
Bosshardt, Wilmert C.
Carlson, Richard E.
Conley, Gilbert
Dahl, Hjalmer A.
Downie, John M.
Drost, Henry F.
Dunnum, Orney E.
Ellestad, Irwin M.
Enger, Arne
Fiske, Harold C.
Forbes, Henry C.
Hagelin, Lawrence W.
Heidelberger, Roy J.
Hendrickson, Arnold B.
King, John E.
Lisshoff, Carl H.
McEachin, John
McMillen, James S.
Magnuson, John E.
Mentzer, Clarence A.
Merritt, Alva W.
Mintz, Nathaniel
Nielsen, Walter M.
Nordlien, Berger W.
Olson, Armin G.
Oscarson, Gerhard L.
Pangburn, Carroll G.
Plank, Howard G.
Ransom, Glen B.
Rome, Robert C.
Rood, Arnold E.
Sannicolo, Joseph F.
Selander, Karl W.
Sorensen, John E.
Steffens, Robert A.
Tuve, Merle A.
Wickman, Martin F.
Willard, Arthur C.
Williams, Percival H.
Wilson, Abner W.

Bachelor of Science in Mechanical Engineering

Aure, Roy
Bros, Chester W. (M. S. in M. E. 1924)
Carlson, Ernest F.
Clark, John S.
Curtis, Verne F.
Eddy, Clarence
Fahland, Frank, Jr.
Hemsey, Clayton E.
Hilgedick, Ralph V.
Hoffman, Richard H.
Holmsten, Victor T.
Katter, Calvin K.
Katter, Reuben L.
Kelsey, Howard C.
Kleinschmidt, Armin R.
Kumm, Arthur W.
Mikesh, Edward S.
Nordenson, Arnold
Nordstrom, Ernest A.
Olmstead, Charles F. (M. E. 1923)
Peters, Walter C.
*Rood, Olaf T. (M. E. 1923)
Rosendahl, Harold R.

Bachelor of Science in Engineering

Adams, Edward H.
Brown, Harry
Capetick, Donald
Dock, Chester
Forssell, William
Hayes, Harold
Meili, Rudolph E., Jr.
Olson, Clarence

ADVANCED DEGREES

Civil Engineer

Del Plaine, Carlos W.

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921, B. A. 1921)

Mechanical Engineer

Forsberg, Elmer J. (B. S. Eng. 1921)
Johnson, Carl A. (B. S. Eng. 1921)

Master of Science in Engineering

Stehle, Gilbert C. (B. S. 1920)

1923

Bachelor of Science in Architecture

Backstrom, W. A.
Holien, Edward O.
Johnson, Elving L.
Markuson, Miner J.
Nielsen, Eunice V.
Sime, Theodore L.
Strom, Arthur
Walquist, John A.

Bachelor of Science in Architectural Engineering

Luedeman, Clarence H.
Sutherland, Samuel J.

Bachelor of Science in Civil Engineering

Aasland, Arne
Abramson, Harry W.
Aldrich, Louis W.
Aslakson, Carl I.
Berg, Swan P.
Bergford, Lester M.
Bergford, Rolf E.
Buhr, Leo
Christlieb, Frank B.
Cribbs, Harry E.
Curry, Byron K.
Darrell, James E.

Bachelor of Science in Civil Engineering

DeFreece, Paul R.	Nelson, Elmer A.
Dindorf, Edward C.	Nelson, Glenn
Flindt, Richard H.	Odquist, Carl
Hill, Hibbert M.	Olson, Elmer J. E.
Hiner, Walter G.	Peck, Lloyd A.
Hosmer, Orville H.	Sauer, Arthur A.
Johnson, Albert W.	Schaller, George C.
Johnson, Nels	Schienk, John J.
Judd, Maurice D.	Sclarow, Abraham M.
Katz, Walter E.	Spencer, Raymond D.
Lazarus, Morris W.	Stephens, Clifford S.
Leonard, Aubrey C.	Swanson, Paul H.
Maiser, Walter L.	Tennstrom, Carl H.
Manger, Henry J.	Thompson, Everett
Meskal, George A.	Villaume, Walter F.
Mitchell, Lloyd S.	Zimmerman, Arthur C.

Bachelor of Science in Electrical Engineering

Babcock, Vernon M.	McCullough, Robert T.
Bouquet, Otto T.	Meserve, Ralph H.
Braden, Rene A.	Moreno, Gerardo
(M. S. 1925)	Nash, Russell O.
Bumgardner, Louis T.	Newman, John M.
Burrill, Charles M.	Nordvall, Glenn W.
Case, Gerald F.	Olin, Henry A.
Clausen, Elmer W.	Olson, Roy H.
Dunnavan, Ralph B.	Pause, Harold A.
Elwood, Daniel H.	Pulver, Richard F.
Engstrom, Elmer W.	Rath, Harvey C.
Fairbanks, George W.	Reeve, Howard E.
Ferney, Wayne I.	Russell, Winfred W.
Fischer, Harold W.	Ryan, Robert M.
Friedman, Edwin A.	Sampson, Clifford L.
Goldberg, Maurice G.	(M. S. 1925)
Grettum, LeRoy Atwood	Schottler, George J.
Hargraves, Robert A.	Schweiss, Clifford C.
Hawkins, Harvey C.	Scott, Herbert L.
Heidelberger, Otto F.	Sickel, Edwin C.
(M. S. 1925)	Swift, George E.
Helwig, William F.	Thorne, Donald E.
Johnson, Gustaf A.	Trask, Alfred S.
Johnson, James P.	Ward, Alvin C.
Kammenberg, Walter F.	Wellisch, Walton
(M. S. 1925)	Wiggins, John B.
Kearney, Adrian A.	Williams, Roy N.
Koch, Karl L.	Wills, David C.
Lambie, Horace H.	Wilson, Frank W.
Lieberman, Henry	Zimmerschied, Clarence R.
Lundquist, John V.	

Bachelor of Science in Mechanical Engineering

Acker, Sidney H.	*Keizer, Karl W.
Amidon, Lee L.	(M. S. in M. E. 1924)
Ascher, Raymond C.	Kuhlman, Rudolph H.
Bachmann, Graydon A.	Larson, Glen M.
Bergsland, Grant C.	Lindelien, Eugen
Bros, Bernard M.	Marshall, Chester R.
Brossard, Edward V.	Messer, Harold D.
Copeland, Floyd E.	Parkin, Orrin G.
Cross, Roland E.	Peckham, Harold E.
Eige, Elmer H.	Ransom, Ralph W.
Gilstad, Arthur	Sear, Arthur W.
Halden, Herbert O.	Swanson, Philip G.
Hibbard, Shelden S.	Waby, Delton T.

ADVANCED DEGREES

Civil Engineer

Cray, Seymour E.	(C. E. 1922)
Lund, Earl H.	(C. E. 1922)

Electrical Engineer

Larson, Conrad L.	(B. S. E. E. 1922)

Mechanical Engineer

Luce, Alexander W.	(B. S. M. E. 1921)
Olmstead, Charles F.	(B. S. M. E. 1922)
*Rood, Olaf T.	(B. S. M. E. 1922)

1924

Bachelor of Science in Architecture

Backstrom, Emil F.	Kraft, Edwin W.
Barnum, Charles R.	Magoon, Herbert A.
Bonsall, Wallace C.	Nelson, Mark L.
Hawkins, Edward W.	Nystrom, Paul E.
Hinman, Charles H.	Rosenberg, Rahil A.
Johnson, Anton A.	Silverman, Isadore W.

Bachelor of Science in Architectural Engineering

Person, Otto C.	Tvedt, Lawrence A.
Root, Frank R.	

Bachelor of Science in Civil Engineering

Bachelder, William H.	Bevan, R. Louis
Bauer, Roscoe W.	Braddock, Edward
Bergquist, Edwin T.	Brody, Mace F.
Bergquist, Philip L.	Bullis, Everard J.
Bestor, George C.	Chapin, S. Caryl
Dedic, Richard J.	McCrady, Archie R.
Erickson, Carl E.	Nelson, Martin E.
Garron, Julian R.	Normann, Rolf A.
Gillard, Herbert W.	Olson, C. Milford
Grant, Elberth R.	Parker, Robert M.
Guerin, George V., Jr.	Peterson, Lloyd L. H.
Guesmer, George O.	Powell, Louis H.
Gustafson, Reuben W.	Ranger, Donald R.
Hankins, Nathaniel R.	Roos, Frank T. W.
Hartington, Marzy V.	Somero, Waino M.
Hayden, Claude E.	Sprehn, George H.
Herberg, Sanford	Stoddart, Hugh A.
Holder, Laurance E.	Stoner, Clifford M.
Johnson, Raymond V.	Tews, Arthur W.
Kaufman, Morris B.	Thompson, Theodore S.
Larson, Peter L.	Velz, Clarence J.
Liese, Herbert W.	Wilson, Walter E.
Lund, Roy V.	

Bachelor of Science in Electrical Engineering

Anderson, Emil G.	Little, LeRoy C.
Anderson, Fayette C.	McConnell, E. S.
Anderson, Matthew A.	McGregor, F. A.
Appleman, Frank C.	McLeland, Lyle K.
Arstad, Leonard O.	Mabbott, Leonard E.
Carlson, Warren E.	Mangney, Hilding O.
Cass, Hoyt R.	Marcroft, Harold C.
Cassidy, Walter J.	Marshman, Irving C.
Dahl, Harold W.	Mathes, Richard E.
Diment, J. Morton	Mayer, Joseph S.
Dunlap, George M.	Miller, Archibald T.
Eckberg, Curtis R.	Miller, William J.
Frazee, Leonard M.	Monsen, Manley A. B.
Furber, John R.	Monseth, Ingwald T.
Garthus, Ira B.	Morton, Lysle W.
Greene, Alfred B.	Nee, Harold E.
Greene, Chauncey L.	Nelson, Edgar M.
Greiner, Harry S.	Pelley, Lloyd L.
Grettum, Walter A.	Schilling, Theodore F.
Harrington, Russell A.	Schow, Garfield G.
Hecht, Henry W.	Sheekman, Harvey Z.
Heggen, Reuben	Skarolid, Charles T.
Holbeck, John I.	Stimart, Elwood L.
Huseby, Gisle E.	Stiege, Henry W.
Jacobson, Frank H.	Swift, Donald C.
Johnson, Iver W.	Taplin, George C.
Juran, Joseph M.	Teal, Clarence W.
Kapple, Frederick R.	Trcka, Benjamin C.
Kator, Josef J.	Tunell, Robert H.
Kline, Frank W.	Tyvand, James A.
Krause, Fred E.	Waligoski, Adam A.
Lampher, Murray N.	Warren, Laurence C.
Lauritzen, Carl W.	Weber, Hanard P.
Lebeck, Torarin E.	Wolfe, George E.
Lewis, John G.	

Bachelor of Science in Mechanical Engineering

Anderson, Joseph A.	Moore, John H.
Berry, George F.	Morris, Frank A.
Blodgett, Charles R.	(M. S. M. E. 1925)
Borst, Wellington L.	Nelson, Edward K.
Boyd, Paul M.	Nelson, Einer
Collis, Norman S.	*Olien, Hamlet C.
Dale, Dallas W.	Olson, Arthur L.
Darmody, William J.	Peterson, Arthur S.
Earl, Donald F.	Rathburn, George A.
(M. S. M. E. 1925)	Ross, Kenneth R.
Engh, Harris S.	Rosseau, Clifton C.
Erskine, Robert K.	Saltwick, Andrew
Estabrooks, Clyde F.	Sartell, Page M.
Grobel, Lloyd P.	Sebo, Arthur O.
Hiers, Charles R.	Sesseng, Gunnar
Holmstine, Ralph D.	Simms, Charles G.
Kiezner, Frank C.	Stacidle, Haswell E.
Koehler, Edwin F.	Stauffacher, Edward L.
Langford, George, Jr.	Thomas, W. Alan
Langman, Harley R.	Tuttle, Stanley B.
Logue, John F.	Wagner, John W.
Mehandru, Behari L.	Willson, Stuart V.
Montgomery, Ralph M.	Woolman, Harry D.

ADVANCED DEGREES

Master of Science in Civil Engineering

Levens, Alexander S.	(B. S. C. E. 1922)

Master of Science in Mechanical Engineering

Bros, Chester W.	(B. S. M. E. 1922)
*Keiser, Karl W.	(B. S. M. E. 1923)

1925

Bachelor of Science in Architecture

Bross, Peter P.	Lumm, Allan G.
Erickson, Clarence P.	Molander, Edwin W.
Freeberg, George	Olson, Edwin E.
Kendall, Walter A.	Peterson, Everett L.
Lantz, Reuben S.	Rigg, Alwin E.

Bachelor of Science in Architectural Engineering

Brimeyer, Ferdinand J.	Pesek, Cyril F.
Eimburg, LeRoy M.	Vaudreuil, Lionel H.
Grisson, Aubrey H.	Rankin, Dean W.
Larson, Emil L.	Wicklund, Paul E.

Bachelor of Science in Interior Decoration

Cote, Rhoda H.	Slocumb, Mary G.
MacGregor, Helen J.	Smith, Verna G.
Parker, Helen R.	

Bachelor of Science in Civil Engineering

Auxer, William L.	Kroll, Arthur J.
Banovetz, John A.	LaBonte, Anton E.
Bartholomew, Neal W.	Larson, Fred H.
Beese, Harold D.	Lushene, Joseph P.
Berg, Thorsten H.	McAndrews, Harry N.
Bertossi, Clarence F.	Macgowen, Irvin S.
Bird, Harold E.	Mark, Max B.
Blue, Clarence W.	Moore, Norman R.
Bonner, Donald E.	Morris, Russell F.
Brose, William C.	Nelson, Edwin W.
Burns, Dwight T.	Nelson, George A.
Carlhom, Leonard H.	Nichol, Frank E.
Cornell, George M.	Nordstrom, Milton E.
Craig, Hamilton S.	Nutting, Horace W.
Donahue, Stephen	O'Brien, Thomas E.
Dungay, Herbert F.	Olson, Kenneth M.
Duval, Arndt J.	Olson, Vernon H.
Elers, Baldwin C.	Peterson, Clarence R.
Frantz, Willard F.	Peterson, Harold C. E.
Fulton, Edwin G.	Prichard, Charles E.
Galanter, Samuel S.	Quinn, Edward J.
Gerdes, Carl H.	Quinn, Ursula R.
Gobeli, Arthur W.	Schmidt, Roland L.
Haims, Mark	Skrukrud, Odean M.
Hausen, Arthur A.	Sullivan, Frederick V.
Hartman, Philip F.	Swanberg, John H.
Hendricks, Clifford L.	Thompson, Clarence W.
Hendrickson, C. Edward	Walder, N. T.
Imsande, Fred L. C.	Ward, John, Jr.
Jones, Harold W.	Wald, Milton C.
Knudsen, Esther M.	Youngquist, Eder B.

Bachelor of Science in Electrical Engineering

Albrecht, Ernest G.	Ludlum, Robert V.
Albrecht, Karl J.	Lund, Jeffery L.
Anderson, Arthur P.	McClung, Karl R.
Benson, Ikel C.	McCully, James P.
(M. S. E. E. 1927)	McEwen, Alexander D.
Boe, Lester L.	Malmgren, Richard V.
Borchert, Oscar H.	Meagher, Joseph E.
Bordeau, Sanford P.	Nelson, Carl C.
Brossard, Henry F.	Nelson, Clarence H.
Burlingame, Robert E.	Nickerson, Edward
Cameron, Harry D.	Nierling, Grant C.
Childs, Morris P.	Parsons, Sidney A.
Christensen, Arthur L.	Peterson, Lewis E.
Cosandey, Charles J.	Postma, John
Countryman, M. Alden	Reed, Henry R.
Cousins, Van M.	(M. S. E. E. 1927)
Edwards, Richard G.	Richardson, Philip E.
Ellis, Carl E.	Robertson, Kenefick
Franzen, Roy O.	Schenckloth, Harry H.
Gilman, Gaylord	Schuck, Roy D.
Hammer, Harold E.	Shaver, George J.
Hanft, Hugo H.	Smith, Harold D.
Heins, Harold H.	Solomonsen, Lawrence D.
Hill, Edward L.	Steinert, Emil
Holmes, Raymond H.	Taylor, Richard G.
Hussey, Norman W.	Thomas, Richard L.
Jacobsen, Arthur C.	Thomson, Andrew
Johnson, Enan C.	Thyberg, Clarence W.
Johnson, Robertson B.	Tunell, Clement R.
Kauppinen, Heino	Untinen, August L.
Keller, Raymond W.	Upton, Albert P.
Knoll, Franklin O.	Westigard, Glenn A.
(B. S. C. E. 1922)	Wieland, Willard W.
(St. Thomas)	Winslow, Harry J.
Koch, Winfield R.	Wurzbach, Henry A.
Lewis, Berkeley R., Jr.	

Bachelor of Science in Mechanical Engineering

Algren, Axel B.	Jacobi, Alfred J.
Backstrom, Russell E.	Jacobson, Reuben A.
(M. S. M. E. 1927)	Jenkins, Clifford H.
Beseler, Herman F.	Ludvigsen, Elliot L.
Bjerre, Folmar I.	Lundquist, C. D. Vernon
Boss, Ronald W.	Martino, Anthony D.
Caswell, Thomas B.	Mills, Hartzel
Donnelly, William H.	Pendergast, Webster G.
Eggleston, Smith	Peterson, Laurence L.
Erskine, Lawrence F.	Robinson, Parke D.
Forseth, George O.	Souba, John I.
French, William O.	Stevens, Everett B.
Heath, Arthur C., Jr.	Whitten, Robert C.
Hoisveen, Leonard F.	Wilson, Roy A.
Holmes, Roland W.	

ADVANCED DEGREES

Master of Science in Architecture

Dayu, Doon (B. S. 1924)

Master of Science in Electrical Engineering

Braden, Rene A. (B. S. E. E. 1923)
Heidelberger, Otto F. (B. S. E. E. 1923)
Kannenberg, Walter F. (B. S. E. E. 1923)
Sampson, Clifford L. (B. S. E. E. 1923)

Master of Science in Mechanical Engineering

Earl, Donald E. (B. S. M. E. 1924)
Morrill, Raleigh D. (B. S. M. E. 1909, E. E. 1922, Maine)
Morris, Frank A. (B. S. M. E. 1924)

1926

Bachelor of Science in Architecture

Frenzel, Herman
Kronick, T. Gerald
Lighter, Clyde W.
Naslund, Gustave A.
Potter, Robert P.
Stageberg, Oswald C. R.

Bachelor of Science in Architectural Engineering

Kranzfelder, Robert H.
Rasey, Raymond F.
Redin, R. Kenneth

Bachelor of Science in Interior Decoration

Ehrenberg, Muriel L.
Guesmer, Marie W.
Snyder, Dorothy E.

Bachelor of Science in Civil Engineering

Balkin, Samuel W.
Bolstad, Roswell C.
Breeden, James R.
Bunnell, Charles W.
Comfort, Thomas H.
Cooper, R. Conrad
Croswell, Leslie D.
Deegan, Raymond C.
Drdla, Robert L.
Fenton, Paul C.
Flaaten, Percy H.
Foster, Kenneth W.
Gould, Edward C.
Haakensen, N. Theodore
Halbkat, Franklin J.
Hoffman, John R.
Jakkula, Arne A. (M. S. C. E. 1927)
Johnson, Clifford S.
Johnson, James R.
Johnson, Raymond A.
Juell, Barton
Kelly, Raymond R.
Krefting, Arthur S.
Lewin, Sherman W.
Liese, Carl R.
Lindstedt, Philip C. A.
Lipchick, Alex A.
Lorens, Edward R.
Lund, Clarence V.
Manson, Philip G.
Meyerdick, Clarence E.
Nasvik, Adolph C.
Neubauer, Loren W.
Nyvall, Clifton S.
Ohman, Uno G.
Peterson, Garvin E.
Sandberg, Clifford H.
Schulz, Alex A.
Young, Edward F.
Young, Truman P.

Bachelor of Science in Electrical Engineering

Ageton, Edwin O., Jr.
Anderson, Lowell W.
Ayshford, Loren C.
Barron, John H.
Berghs, Charles J.
Bergman, Hilder W.
Beveridge, Robert A.
Bullard, Henry M.
Carman, Willard J.
Christen, Roy L.
Coen, Lawrence C.
Dahl, Merle G.
Deinema, George R.
Deterling, Edward A.
Dimmick, Merton A.
Etem, Victor
Faulkner, Louis L.
Feldman, Carl B. H.
Ferguson, Kenneth R.
Fene, Marcus
Forsmark, Ulrik E.
Gazlaas, George L.
Gemmell, Robert W.
Getchell, Earl
Graf, Alois W.
Gross, Leon A.
Haedecke, August D.
Hafstad, Lawrence R.
Hammond, Joseph A.
Hargrave, William A.
Hart, Maurice W.
Hertley, Lowell J.
Hilgedick, Winfred C.
Holcomb, Harry S.
Hummel, Carl
Irons, George R.
Jenzen, Otto L. (B. A.)
Joesting, Frederick D.
Johnson, Clarence A.
Johnson, Welton V.
Jones, Richard W.
Kelly, William J.
Larsen, Einar H.
Lee, Albert A.
LeVesconte, Lester B.
Levy, Max L.
Lindquist, Oliver J.
Lostrom, Herbert W.
Lyberg, Verele C.
Lynskey, Joseph F.
Mackey, Donald H.
Mahachek, Ross
Mann, Alvin K.
Meader, Glenn S.
Mindrum, Arthur I.
Murdock, George B.
Nelson, Paul B.
Nelson, Robert B. D.
Nimmer, Walter B.
Orning, Harold
Parry, John E.
Quine, William M.
Rhoades, Herbert E.
Robinson, Lawrence T.
Salstrom, Paul S.
Schroeder, Clarence A.
Schweppe, Walter A.
Scott, Franklin B.
Sjoberg, Roy H.
Slaggie, Eucharius L.
Tholstrup, Henry L.
Tighe, James S.
Walters, Robert P.
Wenrich, James R.
Wentz, Edward C.
Williams, William R.

Bachelor of Science in Mechanical Engineering

Anderson, Wesley J.
Bancroft, Henry K.
Beek, Hiram D.
Bennett, John C. (M. S. M. E.)
Bohannon, George W.
Burt, Paul R.
Cole, Ernest C.
Comfort, Clifford E.
Corbett, Theodore R.
Dewaji, Gunaker
DuBois, N. Warren
Fornfeist, Carl H.
Grant, Russell S.
Hanna, Cyril C.
Hass, Paul O.
Kleinfeld, Leonard S.
Letson, Donald E.
Lundgren, Carl W.
Maney, James E.
Mork, George W.
Norrbom, Oscar E.
Nordenson, Willard H.
O'Donnell, Lawrence
Pierce, Walter H.
Pike, Jay B. (M. S. M. E. 1927)
Roberts, Norman A.
Rollin, Harold E.
Slaby, Louis J.
Tucker, Carl W.

ADVANCED DEGREES

Civil Engineer

Coe, Edward H. (B. S. C. E. 1919)
Luxford, Ronald F. (C. E. 1917, M. S. 1925, Wisconsin)

Master of Science in Civil Engineering

Nichol, Frank E. (B. S. C. E. 1925)

1927

Bachelor of Science in Architecture

Anderson, Lawrence B.
Backstrom, K. A. W.
Broderick, Vere H.
Cameron, Lester W.
Close, Winston A.
Eaton, Paul Frederick
Edwards, William H.
Flegal, Al Claude
Gustafson, Robert F.
Havens, Paul Maynard
Castner, Arthur Henry
Kilpatrick, Porter Warren
McCan, Realino Vincent
Melius, Arnold A.

Bachelor of Science in Architectural Engineering

Bull, Alvah Stanley
Davidson, Henry A.
Gilfillan, Donald Wm.
Nelson, Neal N.
Nyquist, Roy L.
Park, James Injun
Sorenson, Russell L.
Stoltz, Sidney L.

Bachelor of Science in Interior Decoration

Cameron, Grace
Wilkinson, Gladness B.
Grafslund, Geneva Louise

Bachelor of Science in Civil Engineering

Bolnick, Harry Wm.
Borne, Floyd O.
Borrowman, John Keeley
Brattlof, Clifford
Briggs, Lured E.
Brohaugh, Gustave C.
Campbell, Douglas M.
Carlson, Elmer W.
Christianson, Elmer John
Clark, Kenneth Miles
Crowell, Sidney Howe
Engler, Myer
Elland, Roy Clinton
Gehring, Lester George
Hagman, Walter Fred
Hoving, John E.
How, Francis Waldo
Johnson, Kenneth A.
Johnson, Laurence Victor
Castner, Roy W.
Lande, Clarence C.
Loethi, Carl Francis
Loucks, Roger Brown
Lundsten, Frank Rueben
Lund, Stanley D.
Marcroft, John Clifford
Morris, George Edward
Murray, Harold E.
Norman, Henry Robert
Pajari, Tauno
Paulson, Joseph Bernard
Pearson, Einar Otto
Pearson, Harold Theodore
Peterson, Frederick G.
Platzer, George John
Pohl, Loren Frank
Preus, Christian K.
Riedesel, Russell Irving
Rosing, Donald Clay
Ruth, Fred Louis
Smeelman, Ralph Henry
Sperling, Abe J.
Teske, Frederick Carl
Turrittin, Hugh Lonsdale
Wentz, Clarence Arthur
Witt, Edward John
Youngquist, C. Vernon
Zuckman, George J.

Bachelor of Science in Electrical Engineering

Anders, Milton F.
Anderson, Henry Alvin
Asphalt, Filip Johanson
Bailey, Stuart Lawrence
Barton, James Parker
Beach, George
Berglund, Erick Bernard
Berkner, Lloyd Biel
Byer, Randall R.
Bezek, Albert
Banner, Arthur Lee
Bottemiller, Edward L.
Boyce, Harold J.
Brandt, Clifford Alois
Brayden, Giles William
Brightfelt, John Charles
Buccowich, Paul
Burmeister, Charles H.
Clark, Charles Stevens
DuBois, John Harry
Edgar, Robert Ferguson
Farmer, Herbert Fred
Gibson, Robert
Heimer, Amos Kingsley
Hortberg, Reynold Olof
Hoves, Bertram Kelsey
Johnson, Gustave F.
Lange, George M.
Lee, Albert Christian
Lee, Paul Raymond
Leider, Albert E.
Lewis, Lloyd W.
McDonnell, Lawrence P.
McKesson, Lewis James
Miller, William S. E.
Moore, Gordon B.
Moosbrugger, Frank John
Moses, Marlowe Grant
Nelson, Clarence Enoch
Nergaard, Leon Severin
Nielsen, Andres H.
Nolan, George Charles
Norberg, Hans A.
Ofelt, George R.
Osburn, Roy Wesley
Peters, Charles Max
Pilger, Clarence L.
Prehn, Victor Nicholas
Rauscher, Paul Frank
Redding, James A.
Ringstrom, George H.
Robinson, Richard Burton
Rogers, H. Barrett
Scholz, Edmund Henry
Schultz, Albert W.
Schulze, LeRoy Edward
Smith, Jerome Conrad
Speer, Paul E.
Sunblad, Everts William
Swanson, Carl Everett
Thompson, Niles J.
Valkenant, Gordon W.
Wald, Joseph Harold
Ward, Stanley A.
Weber, Clyde
Weeks, Leonard H.
Wehlitz, Hubert Frank
Wenn, Laurel Allan
Whiteley, Howard Orville
Witts, Seth Newton
Woloshin, Boris

Bachelor of Science in Mechanical Engineering

Akins, Clifford Miller
Bliven, Paul
Boyce, Norman Elliott
Bros, Kenneth Donald
Carlson, Clifton Conrade
Chapman, Wilbur J.
Coates, Joseph Edwin
Cook, Lyle M.
Dacanay, Lino P.
Dixon, Donald Kenneth
Evans, Ralph B.
Giessel, Paul Albin
Hall, John Whitmore
Hutchinson, Edwin T.
Irons, Roy Cecil
Isaacson, Arthur M.
Lamon, Harold Joseph
Little, Fred Wellington
Loo, Yuson
Lowther, Wilfred Wesley
McNeill, Lyle D.
MacDonald, George A.
Mongren, Richard Vern
Munger, Maurice
Parten, Carl Darius
Richardson, Ralph Arthur
Roberts, Dimon Albert
Schneider, Frank Mahlon
Spehr, Peter Eldon
Spencer, John Boyd
Trexler, Richard Rollo
Tubbesing, Norman F.
Vye, George Parks

ADVANCED DEGREES

Civil Engineer

Levens, Alexander Sander (B. S. C. E. 1922, M. S. C. E. 1924)

Master of Science in Civil Engineering

Jakkula, Arne Arthur (B. S. C. E. 1926)

Master of Science in Electrical Engineering

Benson, Ikel (B. S. E. E. 1925)
Reed, Henry Rouse (B. S. E. E. 1925)

Master of Science in Mechanical Engineering

Pike, Jay Becker (B. S. M. E. 1926)

School of Chemistry

THE first degree was that of Chemical Engineer, granted in 1897, at the close of the regular four-year course. In 1902, the present degree of Bachelor of Science in Chemistry was conferred and has continued except for the two years, 1905 and 1906, when the degree was Analytical Chemist. For the course in chemical engineering, the corresponding degree of Bachelor of Science in Chemical Engineering was used.

In 1912, the degree of Chemical Engineer was granted at the close of the four-year course, as had been the custom for several years in the College of Engineering and Architecture, but in 1913 the new plan in that college was followed in the School of Chemistry as far as chemical engineering was concerned, and the degree of Chemical Engineer was granted at the end of the fifth year's work after the Bachelor of Science in Chemical Engineering had been obtained for the four-year course.

The present plan of conferring the professional degree of Chemical Engineer as a graduate degree based upon graduate study, experience, and a thesis was established in 1923.

In 1928 the form of the Bachelor's degree was changed to Bachelor of Chemistry and Bachelor of Chemical Engineering, taking effect in June, 1928. Similar action was taken at the same time by the College of Engineering and Architecture.

1897

Chemical Engineer

*Chapin, Lewis P. — Linton, James H.
Hamilton, Herbert C. — Webber, Frederick W.

1902

Bachelor of Science in Chemistry

Benner, Raymond C. — Rice, Edgar W.
*Lando, Maximillian N.

1903

Bachelor of Science in Chemistry

Bakke, Oliver M.

1904

Bachelor of Science

Grout, Frank F. — Hopkins, Joseph I.
Gutsche, Edward J. — Rose, Anton R.

1905

Analytical Chemist

Burrowman, George L. — Jackson, Myron B.
Dahlberg, Arnold V. — Longworth, Fred J.
Frary, Francis C. (M. S. 1906, Ph. D. 1912) — Pennock, Edward M.
Pouze, Charles D.

1906

Analytical Chemist

Bernhagen, Lewis O.

Master of Arts in Chemistry

Wilhoit, Albert D. (B. A. 1905, Macalester)

Master of Science in Chemistry

Frary, Francis C. (A. C. 1905, Ph. D. 1912)

1907

Bachelor of Science in Chemistry

Doran, James M. — Manuel, Earle V.
Halvorson, John O. — Von Kuster, Edith I.
Kennedy, William W. — (Mrs. W. Johnson)

Bachelor of Science in Chemical Engineering

Davies, Edwin T.

1908

Bachelor of Science in Chemistry

Anderson, Edward X. (M. S. 1909)
Badger, Walter L. (B. A. 1907, M. S. 1909)
*Cressy, Charles R. (M. S. 1913)
Lowe, John M.
McBride, Russell S.
Porter, Allen H.
Whited, Oric O.

1909

Bachelor of Science in Chemistry

Bacon, Charles B. — Selvig, Walter
Dresser, Eva L. (Alves) — Sterling, Faith (Sterling)
Kueffner, Otto K. — Walker, George W.

Bachelor of Science in Chemical Engineering

Barnaby, William E.
Morey, George W.
Roehrich, Victor H. (M. S. 1910)

Bachelor of Science in Chemistry

Anderson, Edward X. (B. S. 1908)
Badger, Walter L. (B. A. 1907, B. S. 1908)

1910

Bachelor of Science in Chemical Engineering

Bicknell, Henry R.
Daniels, Farrington (M. S. 1911)
De Witt, Joseph Henri
Dietrichson, Gerhard
Finke, Wilbur W. M.
*Peterson, Andrew P. (M. S. 1911)
*Smith, Carolyn H.
*Stone, George H.
Taylor, Carl A.
Trousen, Carl A.
Woodett, Guy H. (M. S. 1916, Ph. D. 1918)

Bachelor of Science in Chemical Engineering

Dahlberg, Henry W.
Gutsche, Frank Carl
Smith, Sheldon H.

Master of Arts in Chemistry

Nye, Lillian L. (B. A. 1909)

Master of Science in Chemistry

Pitchford, G. Leonard (B. S. 1907, Nebraska)
Roehrich, Victor H. (B. S. 1909)

1911

Bachelor of Science in Chemistry

Cantwell, William F.
Halvorson, Henry A.
Hartnett, John G.
Hennessy, Hugh J.
Johnson, Einer (M. S. 1912)
Leavenworth, Francis M.
McMiller, Paul R.
Olson, Arthur O.
Pettijohn, Earl (M. S. 1912, Ph. D. 1918)
Stoppel, Ernest A.

Bachelor of Science in Chemical Engineering

Baker, Russell E.
*Bolton, John B.
Callaway, Roy S.

Master of Science in Chemistry

Bell, Grace M. (B. A. 1909)
Daniels, Farrington (B. S. 1910)

Master of Science in Chemistry

Kepner, Ben-Hur (B. A. 1910)
Peterson, Andrew P. (B. A. 1910)
Poppe, Frederick W. (B. A. 1910, Lawrence)

1912

Bachelor of Science in Chemistry

Brinton, Paul H. M.-P. (M. S. 1913, Ph.D. 1916)
Daniels, Elmer A. (M. S. 1913, Ph.D. 1917)
Hoffman, Henry J. (M. S. 1914)
Karatz, Lucian
*McLeod, John R.
Mitchell, Ralph W.
Nesse, Charles O.
Parkin, Guy G. (M. S. 1913)
Robinson, Rhea B.
Rockwood, Ralph H.
Schmidt, George H.
*Spriestersbach, David O. (M. S. 1915)
Wanless, Lynn A.

Bachelor of Science in Chemical Engineering

Edwards, Junius D. (Ch. E. 1913)
Goldstein, Milton M. (Ch. E. 1913)
Harshaw, John R.

Chemical Engineer

Brunkow, Herbert E.
Martin, Edmund W.

Master of Science in Chemistry

Johnson, Einer (B. S. 1911)
Pettijohn, Earl (B. S. 1911, Ph. D. 1918)

Doctor of Philosophy

Frary, Francis C. (A. C. 1905, M. S. 1906)

1913

Bachelor of Science in Chemistry

Felion, Arthur J.
Mastin, Marion G.
Miller, Ralph H.
O'Connell, Thomas C. (M. S. 1914)
Otterstein, Earl F.
Sutter, Hedwig M. (Mrs. R. Wilson)
Taylor, Cyril Stead
Yngve, Victor

Bachelor of Science in Chemical Engineering

Anderson, Fredolf T. (Ch. E. 1914)
Katz-Nelson, William
Kern, Herbert A. (Ch. E. 1914)
Peterson, Henry (Ch. E. 1914)
Porter, Ralph E. (Ch. E. 1914)

Chemical Engineer

Edwards, Junius D. (B. S. 1912)
Goldstein, Milton M. (B. S. 1912)

Master of Arts in Chemistry

Beck, Maud G. (B. A. 1905)
Skartvedt, Peter M. (B. A. 1906, St. Olaf)

Master of Science in Chemistry

Brinton, Paul H. M.-P. (B. S. 1912, Ph.D. 1916)
Cressy, Charles R. (B. S. 1908)
Daniels, Elmer A. (B. S. 1912)
Parkin, Guy G. (B. S. 1912)

Doctor of Philosophy

Cohen, Lillian (B. S. 1900, M. S. 1901)

1914

Bachelor of Science in Chemistry

Gauger, A. W. — Merton, Howard V.
Juvrud, Ingvald O. — Tibbling, Ernest F.

Chemical Engineer

Anderson, Fredolf T. (B. S. 1913)
Bierman, Harry C. (B. S. 1914)
Kern, Herbert A. (B. S. 1913)
May, Darwin R. (B. S. 1914, Ch. E. 1915)
Peterson, Henry (B. S. 1913)
Porter, Ralph E. (B. S. 1913)
Tinkham, Willis M. (B. S. 1914)

Bachelor of Science in Chemistry

Bray, Mark W. (B. A. 1912, Lawrence)
Hoffmann, Henry J. (B. S. 1912)
Kokatnur, Vaman R. (B. A. 1912, Bombay, India, Ph. D., 1916)
Yngve, Victor (B. S. 1913)

Doctor of Philosophy

Brown, Harold H. (B. A. 1909, M. A. 1910, Syracuse)

1915

Bachelor of Science in Chemistry

Fegan, Elmer T. (M. S. 1916)
Olsen, Leslie R.
Kingstrom, Hugo (M. S. 1917)
Toncheff, Stanil

Bachelor of Science in Chemical Engineering

Morse, Guilford A. (Ch. E. 1915)

Master of Science in Chemistry

Nietz, Adolph (B. A. 1913)
*Spriestersbach, David O. (B. S. 1912)
Ziegler, Mildred R. (B. A. 1914)

Doctor of Philosophy

Temple, Sterling N. (Ph. D. 1905, M. A. 1906, Hamline)

1916

Bachelor of Science in Chemistry

Dunningham, Merton
Southet, Benjamin L.
Morrow, Leon W.

Bachelor of Science in Chemical Engineering

Bell, Alexander D. (Ch. E. 1917)

Master of Science in Chemistry

Fegan, Elmer T. (B. S. 1915)
May, Darwin (B. S. Ch. Eng. '14, Ch. E. '15)
Newman, Allen T. (B. S. 1912, Nebraska)
Stenger, Lawrence A. (B. S. E. E. 1906)
Woolett, Guy H. (B. S. 1910, Ph. D. 1918)

Doctor of Philosophy

Brinton, Paul H. M.-P. (B. S. 1912, M. S. 1913)
Kokatnur, Vaman R.
(B. S. 1912, Bombay, M. S. 1914)

1917

Bachelor of Science in Chemistry

Carson, Benjamin L. Marr, Horace S.
Durham, Samuel W. Marshall, Olive W.
*Eckman, Lawrence R. Owens, Jay C.
*Egge, Walter Rask, Olaf S.
Markus, Benjamin

Bachelor of Science in Chemical Engineering

Burningham, Foster A. Luft, Oscar W.
(Ch. E. 1918) Strong, Frank D.
Demovsky, Aaron Washburn, Frederick M.
Higburg, William Widell, Gideon
Kuentzel, Ward E.

Chemical Engineer

Bell, Alexander D. (B. S. 1916)

Master of Science in Chemistry

Barrows, Vera (B. A. 1906)
Cade, Arthur R.
(B. S. Worcester Polytechnic Inst. 1915)
Joyce, Floyd E. (B. S. 1912, Iowa)
Lauer, Walter M.
(B. S. 1913, Ursinus College, Ph. D. 1924)
Ringstrom, Hugo (B. S. 1914, B. S. 1915)
Seyfried, Lillian M. (B. A. 1915)

Doctor of Philosophy

Daniels, Elmer A. (B. S. 1912, M. S. 1913)

1918

Bachelor of Science in Chemistry

Joselowitz, Goodwin Nelson, Harry G.
Keszelman, Leo Pan, Wen Ping

Bachelor of Science in Chemical Engineering

Donauer, Max (Ch. E. 1925)
Hogness, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 1919)
Kessel, Herbert (Ch. E. 1919)
Neilson, Chris

Chemical Engineer

Burningham, Foster A. (B. S. 1917)

Master of Science in Chemistry

Schultz, Peter D. (B. A. 1914, Bethel College)

Doctor of Philosophy

Pettijohn, Earl
(B. A. 1906, B. S. 1911, M. S. 1912)
Sternberg, Woldemar M.
(B. S. 1908, Petrograd, Russia)
Wooflett, Guy H. (B. S. 1910, M. S. 1916)

1919

Bachelor of Science in Chemistry

Beckel, Arthur C. Heck, Frank J.
Brooks, Leslie C. Thorson, Stuart J.
Engstrom, Leslie G.

Bachelor of Science in Chemical Engineering

Fischer, Earl B. (Ch. E. 1923)
Greenlaw, Charles E.
Hawkey, Harold K. (Ch. E. 1919)
Koch, Arthur
Reu, Albrecht H. (Ch. E. 1920)
Winslow, Raymond (Ch. E. 1920)

Chemical Engineer

Hogness, Thorfin R. (B. S. 1918)
Hawkey, Harold K. (B. S. 1919)
Johnson, Donald Lee (B. S. 1918)

1920

Bachelor of Science in Chemistry

Hull, John E.
Korfhage, Roy F.
Matthews, Glenn E. (M. S. 1921)
Moe, Claude P.
Pippel, Herbert A.

Bachelor of Science in Chemical Engineering

Anderson, Minton M. (Ch. E. 1921)
Busch, John S.
Fieger, Ernest A. (Ch. E. 1921)
Hammer, George E.
Jones, Ernest J. (Ch. E. 1921)
Kracek, Frank C. (Ph. D. 1924)
Mitchell, Donald F. (Ch. E. 1921)
Parrett, Arthur N. (Ch. E. 1921)
Pearson, Elmer A. (Ch. E. 1921)
Reck, Robert C. (Ch. E. 1921)
Sternberg, Heime A. (Ch. E. 1921)
Stoppel, Arthur E. (Ch. E. 1921, Ph. D. 1924)
Wallfred, Carl L. (Ch. E. 1921)
Weber, Ludwig J. (Ch. E. 1921, Ph. D. 1924)

Chemical Engineer

Reu, Albrecht H. (B. S. 1919)
Winslow, Raymond M. (B. S. 1919)

Master of Science in Chemistry

Morse, Minerva (B. A. 1915, Ph. D. 1925)
Plummer, Clayton E.
(B. C. E. 1914, Michigan)

1921

Bachelor of Science in Chemistry

Corl, Cady S. Riley, Philip J.
Epstein, Hymen (M. S. 1924)
Kryger, Edward R. Seymour, Merrill W.
Nygard, Edwin M. Westerberg, Carl G.

Bachelor of Science in Chemical Engineering

Aronovsky, Samuel I. (Ch. E. 1922)
Boxell, Morris L.
Cornell, Reuben W. (Ch. E. 1922)
Lee, Melville R. (Ch. E. 1922)
Lerskov, Gerhard W.
Nicholson, Harry G.
Peterson, Marshall A. (Ch. E. 1922)
Ramsey, Selmer
Riddington, Frederick W. (Ch. E. 1922)
Roberts, Wesley J. (Ch. E. 1922)
Ruchhoft, Clarence
Schermer, Oscar C. (Ch. E. 1922)
Swart, Richard H.

Chemical Engineer

Anderson, Minton M. (B. S. 1920)
Fieger, Ernest A. (B. S. 1920)
Jones, Ernest J. (B. S. 1920)
Mitchell, Donald F. (B. S. 1920)
Nicholson, Harry G. (B. S. 1921)
Parrett, Arthur N. (B. S. 1920)
Pearson, Elmer A. (B. S. 1920)
Reck, Robert C. (B. S. 1921)
Sternberg, Heime A. (B. S. 1920)
Stoppel, Arthur E. (B. S. 1920, Ph. D. 1924)
Wallfred, Carl L. (B. S. 1920)
Weber, Ludwig J. (B. S. 1920, Ph. D. 1924)

Master of Science in Chemistry

Hauge, Sigired M. (B. A. 1918, St. Olaf)
Hovland, Clifton R. (B. A. 1919, St. Olaf)
Kohlhase, Arthur H.
(B. S. 1919, Hamline, Ph. D. 1924)
Matthews, Glenn E. (B. S. 1920)

1922

Bachelor of Science in Chemistry

Darling, Stephen F. (M. S. 1924)
Ellestad, Reuben (M. S. 1924)
Hammond, Kathryn D. (Mrs. K. E. Kelley)
Sullivan, Betty
Tappan, Ruth W. (Mrs. Joseph Dowling)

Bachelor of Science in Chemical Engineering

Barrett, Joseph O. (Ch. E. 1923)
Busch, William A.
Cassel, Norman S. (Ch. E. 1923)
Chadbourne, L. Rodney (Ch. E. 1923)
Halvorson, Halvor O. (Ch. E. 1923)
Langseth, Axel O. (Ch. E. 1923)
Livermore, Harvey J.
Luger, Karl E.
Manuel, Douglas R.
Morin, William T. (Ch. E. 1923)
Morken, Carl H.

Bachelor of Science in Chemical Engineering

Schwartz, Marcel M.
Stone, Leslie F. (Ch. E. 1923)
Wyman, LeRoy L. (Ch. E. 1923)

Chemical Engineer

Aronovsky, Samuel I. (B. S. 1921)
Cornell, Reuben W. (B. S. 1921)
Lee, Melville R. (B. S. 1921)
Peterson, Marshall A. (B. S. 1921)
Riddington, Frederick W. (B. S. 1921)
Roberts, Wesley J. (B. S. 1921)
Schermer, Oscar C. (B. S. 1921)

Master of Science in Chemistry

Fulermer, Jervis M.
(B. S. 1920, Washington State College)
Harris, Elmin E. (B. S. 1921, Hamline)
Heisig, Lucille Krantz (B. A. 1919)

Doctor of Philosophy

Hartshorn, Elden B. (B. S. 1912, Dartmouth)

1923

Bachelor of Science in Chemistry

Kampa, Edmund Webster, Cora H.

Bachelor of Science in Chemical Engineering

Bostwick, Ross D.
Bruce, G. Norman
Eck, Lester J. (M. S. 1924)
Edgar, Donald E. (M. S. 1925)
Firth, Charles V.
Frederickson, Hubert M.
Hatch, Lloyd
McMillen, Elliott L. (M. S. 1927)
Paulson, Paul M. (M. S. 1924)
Peterson, Clifford E.
Rademacher, Richard L. (M. S. 1924)
Sorenson, Ben. E. (M. S. 1924, Ph. D. 1927)
Thordarson, William (M. S. 1924)
White, Robert H. (M. S. 1924)

Chemical Engineer

Barrett, Joseph O. (B. S. 1922)
Cassel, Norman S. (B. S. 1922)
Chadbourne, L. Rodney (B. S. 1922)
Halverson, Halvor O. (B. S. 1922)
Langseth, Axel O. (B. S. 1922)
Morin, William T. (B. S. 1922)
Stone, Leslie F. (B. S. 1922, Ph.D. 1927)
Wyman, LeRoy L. (B. S. 1922)

Master of Science in Chemistry

Anderson, Winslow S. (B. S. 1921, Bates College)
Bakken, Adolph C. (B. A. 1919, St. Olaf)
Pagel, Herbert A. (B. A. 1922)

Bachelor of Science in Chemical Engineering

Ernst, Robert C.
(B. S. 1921, N. C. State College)
Kester, Ernest B. (B. A. 1922)

Doctor of Philosophy

Levine, Arthur (B. A. 1916, Augustana College)

1924

Bachelor of Science in Chemistry

Fredrickson, Edna M. Ludwig, Llewellyn G.
Humphrey, Gertrude J.

Bachelor of Science in Chemical Engineering

Bache, Edmund
Dahlen, Miles A.
Fuhrman, Alvin O.
Glenn, Harry W.
Krantz, Rudolph W. (B. A. 1923, M. S. 1925)
Lavine, Irvin
Luft, Hans L. (M. S. 1924)
Paul, Karl F.
Roque, Feliciano T.
Zima, Albert G.

Master of Science in Chemistry

Bauer, Esther E. (B. A. 1921)
Darling, Stephen F. (B. S. 1922)
Dobrovolny, Frank J.
(B. A. 1920, Dakota Wesleyan)
Ellestad, Reuben B. (B. S. 1922)
Elmquist, Ruth E. (B. A. 1921)
Riley, Philip J. (B. S. 1921)

Master of Science in Chemical Engineering

Eck, Lester J. (B. S. 1923)
Hartkemeier, Leonard (B. S. 1921, Louisville)
Luft, Hans L. (B. S. 1924)
Nelson, Ernest W. (B. A. 1920)
Paulson, Paul M. (B. S. 1923)
Rademacher, Richard L. (B. S. 1923)
Sorenson, Ben E. (B. S. 1923, Ph. D. 1927)
Thordarson, William (B. S. 1923)
White, Robert H. (B. S. 1923)

Doctor of Philosophy

Fuson, Reynold C.
(B. A. 1920, Montana, M. A. 1921, Calif.)
Kohlhase, Arthur H.
(B. S. 1919, Hamline, M. S. 1921)
Kracek, Frank C. (B. S. 1920)
Lauer, Walter M.
(B. A. 1913, Ursinus College, M. S. 1917)
Sarver, Landon E. (B. A. 1915,
Randolph Macon, M. A. 1919, Lafayette)
Stoppel, Arthur E. (B. S. 1920, Ch. E. 1921)
Weber, Ludwig J. (B. S. 1920, Ch. E. 1921)

1925

Bachelor of Science in Chemistry

Anderson, Alvin P.
Ayers, Ellsworth B.
Brinker, Howard C.
Galvez, Nicolas L.
Gillman, Hyam
Hamm, Homer A.
Vievering, William A.

Bachelor of Science in Chemical Engineering

Bekkedahl, Norman P.
Coult, Lyman H.
Covell, Paul L.
Edmunds, Alvin M.
Jewett, Ernest E. (M. S. 1926)
Johnson, Lester L. (M. S. 1927)
Johnston, Charles L.
McKee, John B. (M. S. 1926)
Reiter, Alfred A.
Scandling, Joseph E.
Sprung, Murray M.
Stier, Ruth I. (Mrs. Cecil Mayo)
Zeidlik, William J. (M. S. 1926)

Chemical Engineer

Donaner, Max (B. S. 1918)

Master of Science in Chemistry

Chaney, Albert L. (B. A. 1920, Washington Missionary College)
Freche, Hertha R. (B. A. 1919)
Underhill, Editha (B. A. 1916, Vassar)

Master of Science in Chemical Engineering

Edgar, Donald E. (B. S. 1923)
Krantz, Rudolph W. (B. A. 1923, B. S. 1924)

Doctor of Philosophy

Morse, Minerva (B. A. 1915, M. S. 1920)

1926

Bachelor of Science in Chemistry

DeVaney, Grace M.
Dysterheft, George A.
Johnson, Waldo C.
Thompson, Warren L.
Westman, Bruce

Bachelor of Science in Chemical Engineering

Bunger, Harold A.
Haugsrud, Parmalee S.
Jerabek, Henry S.
Kobe, Kenneth A.
Kugler, Joseph H.
Lewenstein, Abraham
Murray, Robert
Reiter, Alfred A. (M. S. 1926)
Rogers, Marvin
Schlafge, William H. (M. S. 1927)
Shirk, Loren H. (M. S. 1926)
Smith, Allen S.
Sverdrup, Edward F. (M. S. 1927)
Trouson, John L.
Rauen, Theodore
Jordan, Wallace E.

Master of Science in Chemical Engineering

Jewett, Ernest E. (B. S. 1925)
Kameda, Tohru (1925, Tokio Technical School)
McKee, John B. (B. S. 1925)
Reiter, Alfred A. (B. S. 1926)
Shirk, Loren H. (B. S. 1926)
Tindall, Jesse E. (B. A. 1919, Denver)
Zeidlik, William J. (B. S. 1925)

Doctor of Philosophy

Barber, Hervey H. (B. A. 1918)
Dobrovolny, Frank J. (A. B. 1920 Dakota Wesleyan; M. S. 1924)
Morris, Vlon N. (B. S. 1922; M. S. 1924, Purdue)
Sweatingen, Lloyd E. (B. S. 1920; M. S. 1921, Oklahoma)

1927

Bachelor of Science in Chemistry

Anderson, Edgar G.
Dumke, Walter H.
Lux, Lester

Bachelor of Science in Chemical Engineering

Arnold, Jerome H.
Beal, John L.
Bercovitz, Henry
Cornell, L. Wallace
Elston, Arthur A.
Gerlicher, Harold W.
Holst, James E.
Languth, Karl H.
Maehl, Kenneth A.
Moffat, Harold A.
Murray, Robert C.
Ohlweiler, William
Wheeler, Roger B.

Master of Science in Chemistry

Kilburn, Elsie I. (B. A. 1924)
Lampert, Kenneth C. (B. S. '25)
Lohman, Anne L. (B. A. 1922)
Wernlund, Christian J. (Ph. B. 1913, Hamline; M. S. 1916, Northwestern)
Willman, August (B. A. Rude College)

Master of Science in Chemical Engineering

Johnson, Lester L. (B. S. '25)
McMillen, Elliot L. (B. S. 1923)
Schlafge, William H. (B. S. '26, M. S. '27)
Sverdrup, Edward F. (B. S. '26)

Doctor of Philosophy

Crawford, H. Marjorie (B. A. '20, Miami; M. S. '22, Iowa)
Pagel, Herbert A. (B. A. '22; M. S. '23)
Sly, Caryl (B. S. '23; M. S. '24, Nebraska)
Sorensen, Ben E. (B. S. '23, M. S. '24)
Stone, Leslie F. (B. S. '22, ChE. '24)
Whitney, Robert B. (B. A. '24)

School of Mines and Metallurgy

In 1887 the General Faculty of the University recommended that the Board of Regents establish a "College of Mines and Metallurgy."

The "School of Mines and Metallurgy" was formally opened in January, 1892, with William R. Appleby in charge. Near the end of that year a reorganization was effected whereby the School of Mines and Metallurgy was temporarily affiliated with the College of Mechanic Arts, to form the College of Engineering, Metallurgy and Mechanic Arts. This organization continued until 1897. In March of that year the dissolution of the School of Mines from the Engineering College took place and from then on the school was known as "The School of Mines" until the present year when the name was changed to the "School of Mines and Metallurgy."

From 1894 to 1897 inclusive, the school granted to its graduates the respective degrees of Bachelor of Mining Engineering and Metallurgy. The year 1897 marked the beginning of the granting of the degree of Engineer of Mines and Metallurgical Engineer. Those men who had previously received the bachelor degrees were given, upon presentation of a satisfactory thesis, engineers' degrees.

In 1911 a new course leading to the Degree of Engineer of Mines in Geology was established.

Beginning with the year 1927-1928 a student in the School of Mines and Metallurgy may work toward a degree recently established, that of Engineer of Mines in Petroleum, bringing the total number of degrees granted by the School of Mines and Metallurgy to four, namely, Engineer of Mines, Metallurgical Engineer, Engineer of Mines in Geology, and Engineer of Mines in Petroleum.

1894

Engineer of Mines

Christianson, Peter

1895

Engineer of Mines

Wilkinson, Charles D.

1896

Engineer of Mines

May, Albert E.
Tanner, Wallace N.

1897

Engineer of Mines

Becker, George
Mills, Eugene C.
Wales, Roland T.

1898

Engineer of Mines

Brackenbury, Cyril
McIntosh, Joseph B.
Walker, Clinton L.

1899

Engineer of Mines

Bass, William C.
Peterson, Andrew Y.
Warren, Frank M.

1900

Engineer of Mines

Campbell, William L.
Chandler, Eugene D.
Egleston, Olver J.
Hunt, Walter E.
McCarthy, Edward P.
Teague, Harold W.
Toll, Rensselaer H.

1901

Engineer of Mines

Burgess, Thomas O.
Clapp, W. Howard
Gholz, Arthur L.
Smith, Hoval A.
Taresh, John

Metallurgical Engineer

Sanderson, Henry S.
Smith, Elmo V.

1903

Engineer of Mines

Cohen, Samuel W.
Field, Edward M.
Flynn, John G.
Hoard, Harold J.
Holden, Henry H.
Rait, Donald M.
Smith, Franklin W.
Sowle, Lawrence K.
Truesdale, William H. (M. S.)
Whiteley, Eugene E.
Winther, Arno

1904

Engineer of Mines

Bowman, Frank A.
Devereux, Francis C.
Hale, William H.
Houlton, Lewis K.
Keene, Amor F.
Kingston, Merton S.
McCarty, Andrew L.
Merritt, Lucien
Shouts, Sydney L.

Metallurgical Engineer

Brosius, Harold I.

1905

Engineer of Mines

Angst, Harry H.
Boyd, Robert R.
Cadwell, W. Chauncey
Calhoun, Allan R.
Curry, Duncan E.
Field, Therold F.
Gulick, Hervey
Keller, Orrin E. M.
Loye, Henry E.
Lytzen, Walter W.
McKay, Henry S.
Merriam, Robert S.
Minder, Emil G.
Schrader, Erick J.
Ziesemer, Ralph A.

1906

Engineer of Mines

Brandt, John
Clement, Lester L.
Harrington, Guy P.
Howes, Frank T.
Kurtzman, Paul S.
Moenke, William F.
Morgan, Charles
Neustadt, Berthold R.
O'Connor, Edward S.
Rawson, Horace C.
Rose, William A.
Wallace, George W.
Wheeler, Walter H.

1907

Engineer of Mines

Bassett, Robert H.
Cowin, James
Gillan, Silas L.
Jackson, Charles F.
McRae, Randolph J.
Oberg, Anton C.
Olund, Henning E.
Parker, Walter H.
Probst, Elmer A.
Reed, Olaf
Smith, Edgar W.
*Steele, Charles W.
Swensen, Karl P.
Wiest, Michael A.
Ziesemer, Harry M.

1908

Engineer of Mines

Boyle, Patrick J.
Cullyford, James A.
Deichen, William A.
Edwards, Frank R.
Goodwin, William B.
Grimes, John A.
Haass, Ole G.
Kennedy, John J.
Knickerbocker, A. K.
Locke, Alfred M.
Olmstead, John S.
Peterson, Joseph S.
Strong, John L.

1909

Engineer of Mines

Cole, Willard A.
Crowley, Jay
Gavin, Lawrence T.
Grant, Roy C.
Hognason, Geo. B.
Hoyt, Samuel L.
Rood, Lynn
Santo, Julius H.
Taylor, Harold G.
Williams, Homer A.

1910

Engineer of Mines

Bischoff, Harry R.	Holler, Frederick W.
Conkey, Charles R.	Johnson, Algot F.
Devereux, Lawrence	Jones, Philo E.
Duncan, Kenneth J.	Larson, Clarence L.
Farnam, Henry E.	Leonard, Forest M.
Fritzberg, Ernest A.	McKenzie, James R.
Giltinan, George M.	Moody, Revillo G.
Goodrich, Norman P.	Newell, John R.
Harmon, Benjamin G.	Ostrand, Peter M.
Heath, Clarence L.	Stewart, G. Gordon
Heidel, C. Sumner	Strane, Archie J.
Herring, William E.	Swanson, Axel H.

1911

Engineer of Mines

Abbott, Theodore S.	Elliott, Jay R.
Anderson, Joseph	Fixen, Victor L.
Anderson, Walter C.	Jahn, William F.
Bailey, Paul T.	Kingsley, Neil S.
Baker, Emery F.	Lindholm, Milton S.
Beck, Charles S.	Rahilly, Harold J.
Borgeson, Ansheim C.	Tetlie, John R.
Burgess, Robert J.	Walker, E. Harold
Crouse, Charles S.	Walters, Charles W.
Drake, George M.	Wehr, Arthur J.
Ekloff, Victor E.	Whitson, Lloyd R.

Metallurgical Engineer

McCullough, Ervin W.

1912

Engineer of Mines

Bjorge, Guy N.	Martin, Lynn
Coventry, Edward D.	O'Brien, J. Charles
Dickson, Robert H.	Olson, Walter S.
Hagstrom, Leonard J.	Perry, Joe B.
Harrington, George L.	Pronty, Roswell W.
Hewitt, Ezra A.	Quinn, Max F.
Knox, La Fayette	Stevens, Howard E.
Kremer, Edward G.	Taylor, William L.
Lea, John	Wallinder, Arthur
Lewis, John W.	Walter, Rollie B.
McAdams, Howard R.	Woodis, Clark N.

1913

Engineer of Mines

Coady, Leo J.	Ladd, Greeley
Ely, Robert H.	Michie, Roy G.
Fosness, Arthur W.	Nissen, Arvid (M. S.)
Hammond, Arthur H.	Ofsthun, Norman
Hanson, J. Bernard	Walker, Chas. A.
Hondrum, Olaf	

1914

Engineer of Mines

Anderson, Arthur P.	Quinlan, Howard
Bierman, Alfred C.	Raviez, Louis G.
Eidemiller, Howard N.	Robertson, John H.
Larson, Ernest L.	Wasson, Harold J.
Potter, Orrin W.	

1915

Engineer of Mines

Butler, William V.	Neerland, Herman
Christenson, Alfred	Ramsing, Fred C.
Coller, Walter A.	Sanchez, Richard M.
Collins, Leon T.	Urquhart, George K.
Haugen, Albert C.	Wade, Henry H.
Heilig, Louis S.	Williams, Paul S.
Kerr, Charles D.	

1916

Engineer of Mines

Aronson, Sam.	Lee, Oscar
Craig, John J.	McDermid, Archie J.
Davies, Fred A.	McHardy, Roy H.
Dovre, Adolph	Nord, Harry H.

Metallurgical Engineer

Krogh, Alvin T.

1917

Engineer of Mines

Anderson, Edwin H.	Ernster, Omer F. (M. S.)
Buresch, Charles E.	Fearing, Edward J.
Dennis, Richard C.	Harmon, Sydney
Dopp, J. Lawrence	Levorsen, A. Irving
Elson, Richard H.	Woodruff, John J.

Metallurgical Engineer

Peterson, Paul A.

Engineer of Mines in Geology

Coryell, Lewis S.	Sweetman, Edwin A.
Hubbard, W. Earle	Wallace, Carleton S.
Kwong, Yih Kun	

1918

Engineer of Mines

Armstrong, Harold K.	Jerrard, Walther L.
Cowin, Percy G.	Moga, John A.
Hsieh, Chung	

Metallurgical Engineer

Allard, Raymond W.	Dowdell, Ralph L. (M. S.)

Engineer of Mines in Geology

Foley, Lyndon L.	Ingersoll, Guy E.
Gannett, Roger W.	Quinn, Howard E.

1919

Engineer of Mines

Frellsen, Sidney A.	Goldberg, Samuel B.
Goldberg, Bert	Mellem, Walter R.

Metallurgical Engineer

Pan, Wen Ping

Engineer of Mines in Geology

Hosted, Joseph O.

1920

Engineer of Mines

Ainsworth, Robert E.	Johnson, Axel L.
Arnold, Lewis E.	Kersten, Erwin H.
Bailey, A. K., Jr.	Mark, Israel
Clark, Fred E.	Nichols, Clifford R.
Donaghue, Abner J.	Peterson, Clarence D.
Edwin, John	Raiter, Clifford R.
Frank, Harry O.	

Engineer of Mines in Geology

Copeland, Wm. A.	Wheeler, James D.

1921

Engineer of Mines

Butler, Roy G.	Johnston, Kenneth A.
Chadbourn, Charles H.	Sebenius, Carl H.
Frank, Elden	Sponberg, Edwin C.
Gandrud, Bennie W.	Zanger, Eugene

Metallurgical Engineer

Hamernik, Frank J.	Wenger, Frank B.
Dawson, Loren W.	West, Herbert S.
Nichols, William J.	

Engineer of Mines in Geology

Carlson, Edwin N.	Walz, C. M.
Davies, Herman F.	

1922

Engineer of Mines

Adams, E. Maurice	Johnson, Ralph C.
Anderson, Oscar B.	Kilp, Raymond G.
Barker, Clifton T.	Lin, Sze Chen
Barr, J. Carroll	Lovering, Thomas S.
Chang, Chen Ping	M. S., Ph. D.
Echeharria, Luis de U.	McKenzie, Frederick R.
Gustafson, Arnold A.	Moga, Gregory M.
Hansen, Mayer G.	Plut, Frank J.
Hoffman, Louis	Thoeni, Victor T.
Hope, Lawrence I.	Wilson, J. Byron

Metallurgical Engineer

Johnsen, Trygve

Engineer of Mines in Geology

Patton, Richard C.

1923

Engineer of Mines

Anderson, Alfred T.	Gallagher, Luke J.
Brawley, John N.	Gow, Alexander M.
Brenner, Walter W.	Hawlick, Hartley H.
Calhoun, Robert A.	Hezzelwood, George
Chang, Chi	Jeffers, G. B. (M. S.)
DeVaney, Fred D.	Kwong, Shou Kun
Erickson, Arthur C.	Levy, Julian H.
Dinmore, Harry C.	Lundquist, O. William
Pabst, Henry A.	Swenson, Clifford H.
Ridgway, Robert H.	Thellin, Herbert E.
Russell, Charles B.	Tollefson, Everett H.
Searles, John N.	Vivian, Edgar W.
Sjolander, Anthony	Winter, William M.
Smith, Carl James	Wrbitzky, Harry M.

Metallurgical Engineer

Mooney, Frank E.	Queneau, Roland B.
Persons, Robert W.	Scheid, Adolph J.

Engineer of Mines in Geology

Clay, J. Withers	Kegler, Vern L.
Conhaim, Howard J.	LaTendresse, H. E.
Erdmann, Chas. E.	Lilly, Richard J.
Foss, Adolph L.	Middleton, John L.
Friedl, Arthur J.	Wilcox, Fred H.
Griswold, Willis R.	Wolfer, Donald H.
Henkel, Howard	

1924

Engineer of Mines

Ballard, John A.	Larsen, Raymond M.
Brunner, Donald G.	Lee, Clarence O.
Case, Leslie M.	Moe, Cecil J.
Huang, Ta Heng	*Olson, Stanley G.
Hutchinson, Bernard C.	Oscarson, Philip E.
Jensen, Willard C.	Sung, Kuo Hsiang

Metallurgical Engineer

Curran, Francis J.	Forsyth, Arthur C.

Engineer of Mines in Geology

Graeber, Clyde P.	Nelimark, John H.
Knutson, Clarence J.	Stewart, James L.

1925

Engineer of Mines

Haley, A. J.	Mann, Victor I.
Hennen, E. H.	Sherman, Howard P.
Kamb, Hugo R.	Trulander, William
Kendrick, W. L.	

Metallurgical Engineer

Johnson, George A.	Runke, D. H.
Winter, Harry	Scheid, C. F.
Larpenteur, Bernard J.	Sodoma, J. L.

Engineer of Mines in Geology

Olson, Walter S.

1926

Engineer of Mines

Alexander, J. W.	Johnson, A. M.
Bodal, Emil K.	Martin, H. K.
Griffith, E. H.	Studer, R. J.
Haase, C. C.	Van Duzen, E. N.

Metallurgical Engineer

Boreen, M. S.	Thomassen, M. W.
Huck, G. M.	Wiley, R. E.
Johnson, R. L.	

Engineer of Mines in Geology

Andrews, T. F.

1927

Engineer of Mines

Aanes, Ole O.	Moyle, Robert M.
Arnold, Lowell W.	Nelson, Evald W.
Caddy, Howard T.	Sylvester, Robert E.
Coolidge, Marshall H., Jr.	

Metallurgical Engineer

Deringer, Paul J.	Gow, James T.
Durfee, John C.	Jerabek, Theophil E.

Engineer of Mines in Geology

Armstrong, Lee C.	Hendry, Lynne D.
Bloom, John R.	Pixley, Everett T.

1928

Engineer of Mines

Brace, H. L.	Trengove, S. A.
Hedlund, Wilber	

Metallurgical Engineer

Bunger, H. S.	Helbling, J. A.
Eick, E. H.	Johnson, W. S.
Finberg, M. J.	

Engineer of Mines in Geology

Heins, M. E.	Walsh, R. P.
Tousley, R. M.	

ALPHABETICAL DIRECTORY

College of Engineering and Architecture

Alumni, help us keep these lists correct. In spite of our efforts we realize that there are errors and old and incorrect addresses. Those graduates whom we have not heard from have been listed with their addresses the same as last year. We would appreciate having corrections sent to the Dean's Office.

Aasland, Arne '23 C
620 S. 9th St., Minneapolis.
Estimator and Salesman, Harrison & Smith Co.

Aasland, Christopher '15 C
1406 Thomas Ave. N., Minneapolis.
Resident Engineer,
Minnesota Highway Department.

Abbott, Amos H. '16 E '17 EE
Northern States Power Co., Minneapolis,
Asst. Gas Engr.

Abbott, Arthur L. '97 E
Technical Director, Assoc. of Electragists, International. 15 West 37th St., New York City.

Abrahamson, Howard B. '18 M
St. Paul, Minn.
Northern States Power Co., Engineering Department.

Abramson, Harry W. '23 C
Chelsa Hotel, Sheridan Rd., Chicago, Ill.

Acker, Sidney H. '23 M
314 Frisco Bldg.
St. Louis and San Francisco Ry.,
Springfield, Mo.
Assistant Engineer of Tests.

Acomb, William E. '02 M
Waukegan, Illinois.
American Steel & Wire Company.
Supt., Waukegan Works.

Adams, Benjamin W. '10 C
604 N. Mead Ave.,
Glendive, Mont.

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District Engineer, Great Northern Ry.

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2213 Grand Ave., Minneapolis, Minn.

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Chief Engr., Northern Electric Co.
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Hot Springs, S. D.
Water, Light and Power Co.

Ageton, Edwin O. '26 E
General Electric Co., Minneapolis.

Ainslie, Arthur F. '11 C
Staples, Minn.

Akins, Clifford M. '27 M

Albrecht, Ernest G. '25 E
St. Paul, Minn.
Tri-State Tel. and Telg. Co.
Trans. Inspr.

Albrecht, George M. '06 E
Allis-Chalmers Manufacturing Co.,
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Patent Attorney.

Albrecht, Karl J. '25 E
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Engineering Dept., City of L. A.
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Research Work in Eng. at U. of M.

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Morrison-Knudsen Co., Engr. and Supt.

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Electrical Contractor.

Amidon, Lee L. '23 M
Morgantown, W. Va.
Instructor, Dept. Steam and Exp. Eng'g, W. Va. University.

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Andersen, Christian '88 C
New Post Office Bldg., Portland, Ore.
Engineer, Bureau of Public Roads.

Andersen, Edward I. '17 M '19 ME
Dept. of Chemistry, University of N. Dak.

Anderson, Arthur P. '25 E
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Anderson, Edward S. '21 E
International Falls, Minn.
Minnesota and Ontario Paper Co.
Elect. Const. Engr.

Anderson, Emil '05 E
Langford Electric Co.,
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Anderson, Emil G. '24 E
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Anderson, Fayette C. '24 E
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National Appliance Co.

Anderson, Frank L. '16 E
Minneapolis, Minn.
Testing Department, Elec. Machinery and Manufacturing Co.

Anderson, George T. '15 C
City Engineer, Chisholm, Minn.

Anderson, Harvey B. '12 C '13 CE
Hopkins, Minn.

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220 E. 5th St., St. Paul, Minn.
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Anderson, John G. '99 C
Minneapolis, Minn., M. St. P. & S. Ste. M. R. R., Asst. Engr., Structural Design.

Anderson, Joseph A. '24 M
Flint, Mich.
A. C. Spark Plug Co.

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111 E. 36th St., Equity Life Ins. Co.

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Instructor, University of Virginia,
University, Virginia.

Anderson, Lowell W. '26 E
Schenectady, New York. General Electric Co.

Anderson, Martin E. '01 E
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Denver, Colo.
c-o A. J. O'Brien, Patent Attorney.

Anderson, Matthew '24 E
N. S. Power Co., Special Const. Dept.,
308 Lincoln Bank Bldg., Minneapolis, Minn.
Cost Engineer.

Anderson, Milton J. '20 A
421-422 Bradley Bldg., Duluth, Minn.
c-o W. C. Agnew, Architect.
Draftsman.

Anderson, Milton L. '21 A
603 Natl. City Bank Bldg.,
Los Angeles, Calif. Architect.

Anderson, Nels J.
N. P. R. R., St. Paul (Main office),
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Anderson Show Case Mfg. Co.

Anderson, Ole A. '93 M '08 ME
Buhl, Minnesota.

*Anderson, Ole J. '93 C

Anderson, Oscar P. '10 E
Harrison, N. J.
Edison Lamp Works, Director of Commercial Engineering.

Anderson, Oscar V. '10 E
Toronto, Ontario, Canada.
Duncan and Nelson,
Toronto Hydro Electric System.

Anderson, Wesley J. '26 M
Wilmerding, Pa.
Westinghouse Air Brake Co.,
Production Engineer.

*Andrews, George C. '87 M

Andrews, George L. '05 M
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Andrus, Harry J. '22 C
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Arenson, Timothy G. '16 E

Armstrong, Thomas S. '06 M

Arnesen, Herbert P. '11 C
Toltz, King & Day, St. Paul, Minn.
Office Engineer.

Arneson, Lloyd O. '21 M
Bailey Meter Co., Cleveland, Ohio.
Engineer.

Arstad, Leonard O. '24 E
420 3rd Ave. S., Minneapolis.
Northwestern Bell Tel. Co., Engineer.

Arzt, Emmanuel A. '97 BS '99 E
211 5th St., Sioux City, Ia.
Electrical Contractor.

Ascher, Raymond C. '23 M
Detroit, Mich.
Republic Flow Meters Co., Sales Agent.

Aspalt, Filip J. '27 E
Distribution Dept., Northern States Power Co.,
Minneapolis, Minn.

Ash, James W. '08 C
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American Horticulture Co.
Landscape Arch.

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Ambassador Hotel, Denver, Colorado.

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Pres.-Gen'l. Mgr., Aske-Fuemer Co.
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Consulting Engineer.
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Army and Navy Club, Manila, P. I.
Askew, Thomas A., Jr. '16 C
Plainview, Minn.
Thomas Askew Co., General Merchandise Manager.
Asleson, Hans J. '10 C
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*Atkinson, William B. '10 M
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St. Paul, Minn. N. P. Ry., General Office Bldg., Draftsman.
Austin, Paul D. '21 E
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Iowa State Highway Commission.
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Salesman.
*Avis, S. L. '12 E '13 EE
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Chicago, Ill.
Western Electric Company.
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14-230 General Motors Bldg.,
Detroit, Mich., General Motors Corp.
Bachelder, William H. '24 C
Exp. Eng. Building, Univ. of Minn.
Minn. Dept. of Highways.
Bachmann, Graydon A. '23 M
1420 H Street, Fresno, Calif.
Technical Engineer.
Bachrach, Alfred '08 E
5201 Santa Fe Ave., Los Angeles, Calif.
General Elec. Co.
Backstrom, Emil F. '24 A
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New York, N. Y.
Backstrom, Kenneth A. '27 A
Long and Thorshov
1028 Andrus Bldg., Minneapolis, Minn.
Draftsman.
Backstrom, Russell E. '25 M
Cloquet, Minn.
Balsam Wool Co.
Backstrom, Wilburg A. '23 A
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Tyrie & Chapman, Arch., Minneapolis, Minn.
Arch. Draftsman.
Baer, Louis E. '07 E
Farming, Humbolt, Minn.
Bailey, George R. '22 C
231 S. La Salle, Chicago, Ill.
Bailey, Stuart L. '27 E
Department of Commerce, Bur. of Lighthouses.
Detroit, Mich.
*Bailey, William H. '12 C '12 CE
Baker, Arthur W. '19 M
Deerlodge, Montana.
Bakken, Lawrence H. '22 A
Wood Conversion Co., Des Moines, Iowa.
Balkin, Samuel W. '26 C
250 Security Bldg., Minneapolis, Minn.
Balkin Construction Co.
Ball, Hampton B. '20 M
Troy, Mo.
Farmer and Poultryman.
Bancroft, Henry K. '26 M
Airline Co. of Milwaukee.
5426 Dupont Ave. S., Minneapolis, Minn.
Banovetz, John A. '25 C
St. Paul, Minn.
Engr. Dept., N. P. R. R. Co.
Barber, Harold A. '21 C
Box 172, Big Creek, Calif.
Southern Calif. Edison Co. Asst. Chief.

Barger, Harold L. '21 E
511 Third St. S., Minneapolis, Minn.
Langford Electric Co.
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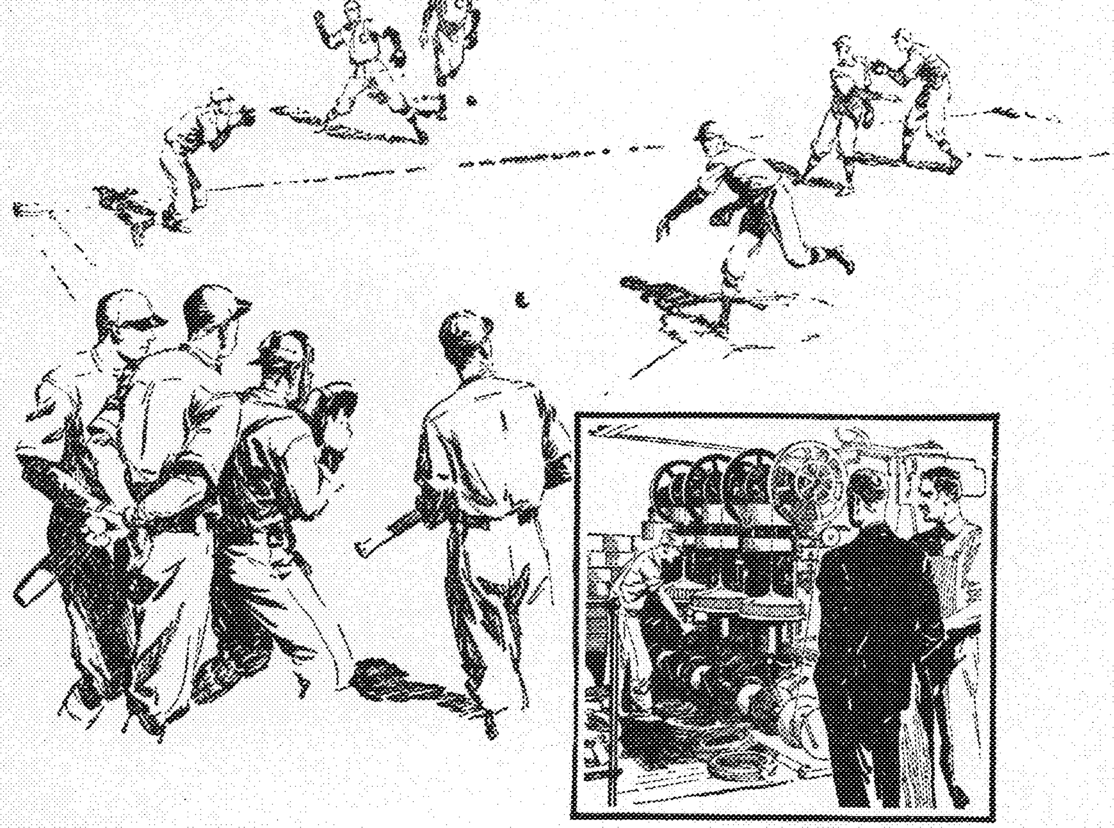

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Staehle, Gilbert C. '20 C, '22 MS
Stoner, Clifford M. '24 C
Strate, Thomas H. '01 C
Strom, Arthur '23 A
Swift, George E. '23 E
Taylor, Richard G. '25 E
Thompson, Everett '23 C
Thompson, Harry T. '15 E, '16 EE
Turner, Leslie E. '09 E
Waby, Delton '23 M
Ward, Alvin C. '23 E
Weber, Hanard P. '24 E
Wehlitz, Hubert F. '27 E
Wenrich, James R. '26 E
Wentz, Clarence A. '27 C
Wenn, Laurel A. '27 E
Wicklund, Paul E. '25 AE
Widell, Gustaf F. '08 C
Williams, Fred M. '05 E, '09 EE
Williams, Myrl J. '20 M
Williams, Percival H. '22 E
Willis, Arthur D. '21 A
Willis, David C. '23 E
Wilson, Frank W. '23 E

CHICAGO HEIGHTS
Anderson, Arthur P. '25 EE
Heggen, Reuben '24 E

CICERO
Holmstine, Ralph D. '24 M
Pavek, William J. '19 M, '20 ME

DECATUR
Elwood, Daniel H. '23 E

ELGIN
Johnson, Kenneth A. '27 C

EVANSTON
Eckenbeck, Everett E. '17 E
Maney, George A. '11 C

GENEVA
Kapphahn, Ernest H. '19 G

HOMEWOOD
Sommerfeld, Adolph A. '10 C

HYLAND PARK
Krause, Fred E. '24 E

JOLIET
Davis, Charles A. '05 E
Emerson, Lynn A. '11 E
Halbkat, Franklin J. '26 C
McCoy, Ira C. '11 E
Meyerdick, Clarence C. '26 C

LA SALLE
Peck, Lloyd '23 C
Pierce, Walter H. '26 M

MAYWOOD
Kruse, Orlin O. '20 E

OAK FOREST
Gilman, Gaylord '25 EE

OAK PARK
Cottingham, George, Jr. '15 C
Forsmark, Ulrik E. '26 E
Kelly, Raymond R. '26 C
Olson, Arnim G. '22 E
Sausen, Bert R. '13 M
Wicks, John '04 E

PARK RIDGE
Teberg, Ernest J. '16 E, '17 EE

PEORIA
Havens, Paul M. '27 A
Kastner, Roy W. '27 C
Pearson, Einar O. '27 C

RIVERSIDE
Bergquist, John E. '13 C
Williams, Arthur H. '19 M

ROBINSON
Uzzell, George W. '07 E

ROCKFORD
Bates, Albert H. '05 M
Harwood, Stanley G. '08 M
Stimart, Elwood L. '24 E

SPRINGFIELD
Carlson, Warren E. '24 E
Peterson, Neander E. '22 C
Zuckman, Geo. J. '27 C

THOMPSONVILLE
Kroll, Arthur J. '25 C

URBANA
Larson, Louis J. '14 C, '15 CE

WAUKEGAN
Acomb, William E. '02 M
Mossbrugger, Frank J. '27 E
Umbehocker, Frank '21 M

XENIA
Weis, Wallace D. '21 C

INDIANA

BOONEVILLE
Johnson, Clarence C. '26 E

EVANSVILLE
Winslow, Harry J. '25 E

FORT WAYNE
Beveridge, Robert A. '26 E
Ellis, Carl E. '25 E
Richardson, Philip E. '25 E

GARY
Cotthingham, William P. '11 C

INDIANAPOLIS
Prentice, Robert S. '08 E
Skytte, Ernest E. '10 E
Wagner, Adolph '98 E

SOUTH BEND
Mehandru, Behari L. '24 M
Muessel, Robert W. '21 C

VALPARAISO
Lauritzen, Carl W. '24 E

IOWA

BOONE
Lantz, Reuben '25 A

CEDAR RAPIDS
Blomquist, Hjalmar '07 C

CHARLES CITY
Fiske, Walter J. '10 E

DAVENPORT
Auxer, William L. '25 C
Lanpher, Murray N. '24 E

DAYTON
Harris, Clayton '09 E

DES MOINES
Ash, J. Wesley '08 C
Bakken, Lawrence H. '22 A
Reeve, Howard E. '23 E
Rome, Robert C. '22 E

DUBUQUE
Madden, Francis '03 C

FORT MADISON
Burns, Dwight T. '25 C

HUMBOLT
Christen, Ray L. '26 E

INDEPENDENCE
Dunlap, Geo. M. '24 E

JANESVILLE
Wild, Carl D. '15 C, '16 CE

MARSHALLTOWN
Weatherill, Cedric '14 C, '15 CE

MASON CITY
Cribbs, Harry E. '23 C
Judd, Maurice D. '23 C

OTTUMWA
Triem, Ralph H. '20 E

REDFIELD
Olson, Arthur O. '10 C

SIOUX CITY
Arnt, Emmanuel A. '97 E, '99 EE
Christiansen, Hilmer B. '15 C
Mitchell, Lloyd S. '23 C
Ward, John, Jr. '25 C

WATERLOO
Nordenson, Willard '26 M
Stanius, Godfrey '21 E

WAVERLY
McMeekin, Glenn D. '21 G

KANSAS

ARKANSAS
Werdenhoff, James H. '21 C

ATCHISON
Hastings, Clive '06 M

FT. LEAVENWORTH
Grow, Robert W. '16 C

KANSAS CITY
Langman, Harley R. '24 M

MANHATTAN
Graham, Eugene C. '02 B
Kleinschmidt, Florian A. '22 M

PITTSBURG
Woodman, Howard H. '97 C

KENTUCKY

DUBLIN
Donahue, Stephen '25 C

LOUISVILLE
Haines, Howard N. '22 A
King, Harvey '18 A

SO. LOUISVILLE
Wright, Stewart V. '19 A

PADUCAH
Knapp, Lester '12 E

LOUISIANA

HAMMOND
Gewalt, Carl H. '21 A

MARRENO
Fleming, Douglas R. '08 C

MERRARO
Mills, Hartzell '25 M
Schienk, Hugo '18 E

MARYLAND

BALTIMORE
Billau, Lewis S. '05 E
Peterson, Arthur F. '19 E

TAKOMA PARK
Jones, Lewis A. '07 C
Roepke, Otto R. '06 E

MASSACHUSETTS

AMHERST
Markuson, Miner J. '23 A

BOSTON
Bjerre, Folmar I. '25 M
Damberg, Paul S. '22 A
Damberg, Rheuben P. '21 A
Emery, George C. '19 A
Lang, James S. '96 M, '97 EE, '99 ME
McVean, Norman S. '21 E
Nebel, Walter H. '11 E
Paulsen, Thorwald '22 C
Payne, Harold G. '06 E
Reuter, Peter T. '21 M
Walker, Frank R. '97 C
Webster, Harry M. '15 E
Woodward, Herbert M. '90 M

CAMBRIDGE
Plowman, George T. '92 A

CHICOPEE FALLS
Burton, James P. '27 E
Forbes, Henry C. '22 E
Tholstrup, Henry L. '26 E

FRANKLIN
Tomlinson, L. C. '04 E

NORWOOD
Korslund, Harry J. '20 A

PITTSFIELD
Currie, Neill, Jr. '08 E
Goodwin, Victor E. '04 E

SPRINGFIELD
Jones, Ivor Vaughan '15 C

WALPOLE
Forssell, William O. '22 G

WINTHROP
Haakenson, N. Theodore '26 C

MICHIGAN

ANN ARBOR
Barnum, Charles R. '24 A
Dow, William G. '16 E, '17 EE
Orbeck, Martin J. '11 C

BESSEMER
Holmberg, Abner W. '15 M, '16 ME

DEARBORN
Hoppin, Glenn H. '08 E

DETROIT
Ascher, Raymond C. '23 M
Babcock, Vernon M. '23 E
Brooke, Harold L. '18 E
Bull, Alvah Stanley '27 A
Dale, Dallas W. '24 M
Dedic, Richard J. '24 C
Elliot, Harry C. '19 M
Grisson, Aubrey '25 AE
Huntoon, Milton R. '99 E
Loye, Benjamin W. '06 M
Malmstrom, Axel L. '17 E
Nelson, Elmer A. '23 C
Rand, Lars '12 M, '13 ME
Shepard, Donald D. '11 E
Staehle, Haswell E. '24 M
Wennerlund, Elias C. '99 M
Wilk, Benjamin '13 C, '14 CE
Young, Edward F. '26 C

FLINT
Anderson, Joseph A. '24 M
Murray, John H. '17 M
Rhame, Paul W. '20 M
Shulman, Gabe '21 E
Simms, Charles G. '24 M
Wagner, John W. '24 M

GRAND RAPIDS
Lyon, Glenn H. '20 A
Mahoney, William L. '13 E, '14 EE
Murray, H. E. '27 C
Nelson, Edwin W. '25 C
Tallmadge, Hiram '16 E, '17 EE

IRONWOOD
Sears, Dow I. '14 C

JACKSON
Briggs, William G. '21 E

MANOMINEE
Peterson, Lewis E. '25 E

MUSKEGON
Olsen, Arthur O. '10 C

PONTIAC
Pike, Jay R. '26 M

SAULT ST. MARIE
Fenton, Paul C. '26 C

SOUTH HAVEN
Smith, Sidney H. '11 C

THREE RIVERS
Chapin, S. Caryl '24 C

MINNESOTA

ALBERTA
Schlattman, Edward C. '08 C

ALBERT LEA
Carlson, Chauncy M. '17 E
Dock, Chester '22 G
Pless, Arnold '20 C

ANOKA
Reed, Arthur L. '06 C
Thurston, Harold H. '13 C, '14 CE

ATWATER
Swenson, Charles '07 C, '10 LLB

BARNUM
Wood, Victor R. '22 C

BELLINGHAM
Strege, Henry '24 E

BLOOMINGHAM
Scott, Elmer C. '15 C, '16 CE

BRAINERD
Anders, Milton '27 E
Croswell, Leslie D. '26 C
Davison, Joseph H. '03 C
Halladay, Leslie L. '21 C
Lewis, Lloyd '27 E
Jones, Harold W. '25 C

BRECKENRIDGE
Bratnas, Mark '17 C
Holmgren, Charles E. '09 M

Buhl
Anderson, Ole A. '93 M, '08 ME
O'Donnell, Lawrence '26 M
Woehler, William L. '07 E

Carlton
Nickerson, Neal C. '18 C

Chippewa Falls
Ranger, Donald R. '24 C

Chisholm
Anderson, George T. '15 C
Elstad, Rudolph T. '19 C
Hammerstrom, Aleck A. '23 E
Olson, Elmer J. '23 C

Cloquet
Backstrom, Russell E. '25 M
Bergquist, Philip L. '24 C
Schlenk, John J. '23 C

Cokato
Peterson, Richard M. '20 E

Coleraine
Battles, Leon E. '18 C

Detroit Lakes
Gunstad, Paul I. '01 C
Hvoslef, Frederick W. '17 M, '19 MS

Duluth
Anderson, Milton J. '20 A
Bergford, Lester M. '23 C
Bergquist, Edwin T. '24 C
Berry, George F. '24 M
Bishop, Ira L. '11 M
Buck, Frederick W. '09 M
Burke, Roy L. '05 C
DeFreece, Paul K. '23 C
Dinsmore, Arthur T. '12 M, '13 ME
Dorsey, John G. '15 C, '16 CE
Elleison, Selmer '16 E
Fee, E. Franklin '07 M
Flasten, Percy H. '26 C
Grettum, Walter A. '24 E
Hart, Maurice W. '26 E
Hibbard, Sheldon S. '23 M
Holbeck, John I. '24 E
Helmes, Raymond H. '25 E
Hoyt, William H. '90 C, '98 CE
Hustad, Byron P. '10 E
Jaques, Robert '09 C
Kapphahn, R. J. '12 C, '13 CE
Kelly, Earl W. '07 C
Knutson, Harry '17 M
Larson, Victor F. '17 M
Lostrom, Herbert W. '26 E
McEachin, John L. '22 E
Martino, Anthony '25 M
Meinander, Albin R. '21 A
Mitchell, L. Morris '14 C, '15 CE
Nelson, Edward K. '24 M
Nelson, Einer '24 M
Olin, Henry A. '23 E
Peterson, George T. '08 M
Pulver, Richard F. '23 E
Quinn, John '08 C
Ringsred, Arthur C. '08 M
Rose, Norman W. '06 M
Ross, Kenneth R. '24 M
Ross, Russell H. '18 E
Roy, Milo C. '21 M
Saltwick, Andrew '24 M
Schwedes, Walter F. '06 E
Seemann, Ernest W. '20 C
Simmonds, Richard R. '21 C
Sneve, Jack S. '11 M
Spring, Willis W. '07 M
Tennstrom, Carl H. '23 C
Tondell, Mandell '07 C
Turnquist, Axel A. '16 E, '17 EE
Williams, Roy N. '23 E
Wilson, Walter E. '24 C

Elk River
Longfellow, Dwight W. '08 C
Normann, Rolf A. '24 C
Washburn, Delos C. '93 A

Ely
Kauppinen, Heino '25 E

Eveleth
Nastlund, Gustave A. '26 A

Fairmont
Curtis, Thomas H. '13 C
Eustis, Irving N. '17 M, '18 ME
Kasper, Walter '11 M
Krafft, Edwin A. '24 A
Starrett, Howard M. '09 M

Faribault
Brossard, Edward V. '23 M
Crawford, Wallace '06 M
Klemer, Frank H. '01 C
McKellip, Frank W. '98 E

Federal Dam
Poore, Orson B. '09 E

Fergus Falls
Frankovitz, John J. '05 E
Hallan, Christian '02 C

Ft. Snelling
Linden, Henning '17 E

Frazee
Chilton, Edward G. '13 C, '14 CE

Gaylord
Deterling, Edward W. '26 E
Hecht, Henry W. '24 E

Glencoe
Hankenson, John J. '92 C

Granite Falls
Leade, Henry M. '20 C

Grove City
Nelson, Richard L. '21 E

Halstad
Forseth, George O. '25 M

Hastings
Howard, Monroe S. '92 E
Manger, Henry J. '23 C

Hibbing
Blomberg, Evar H. '16 E, '17 EE
Friedman, Edwin A. '23 E
Little, Fred W. '27 M
Pan, Wen P. '16 C
Reeve, Charles H. '19 E
Scott, Franklin B. '26 E

Hopkins
Anderson, Harvey B. '12 C, '13 CE

Humboldt
Baer, Louis E. '07 E

Hutchinson
Higgins, Elvin L. '92 C

International Falls
Anderson, Ed. S. '21 E
Borrowman, John K. '27 C
Hass, Paul O. '26 M
Wilson, Roy A. '25 M

Keewatin
Bingen, William J. '12 C, '13 CE
Leach, Edward W. '10 C

Lake City
Christilaw, George '21 C
Martin, Curtis R. '21 G
Tews, Arthur W. '24 C

LeSueur
Cromell, Sidney '27 C
Odquist, Carl '23 C

Litchfield
Gehring, Lester G. '27 C

Little Falls
Donahoe, Robert E. '21 E, '22 EE
Merritt, Alva W. '22 E
Ryan, Loiel S. '12 C, '13 CE

Long Lake
Kelley, William '22 C

Mankato
Gerlach, W. D. '26 A
Kleinschmidt, Armin R. '22 M
Mabbott, Leonard E. '24 E

Mapleton
Borchert, Oscar H. '25 E

Maynard
Johnson, Alexander R. '95 C

Mendota
Braddock, Edward '24 C

Minneapolis
Abbott, Amos H. '16 E, '17 EE
Aasland, Arne '23 C
Adams, Edward H. '22 G
Adams, John W. '13 C
Ageton, Edwin O. '26 E
Alexander, George D. '20 C
Algren, Axel B. '25 M
Alrick, Bannona G. '06 C
Anderson, Clifford H. '25 C
Anderson, Emil '05 E
Anderson, Frank L. '16 E
Anderson, Helmer N. '20 M
Anderson, Hilder A. '18 M
Anderson, John G. '99 C
Anderson, Joseph W. '15 E
Anderson, Matthew '24 E
Anderson, Nels S. '22 C
Andrus, Raymond J. '07 E
Arstad, Leonard O. '24 E
Asfalt, Filip J. '27 E
Aske, Irving E. '20 E
Asleson, Hans '10 C
Austin, Paul D. '21 E
Avery, Henry B. '93 M, '98 ME
Bachelder, William H. '24 C
Backstrom, Kenneth A. '27 A
Backstrom, Wilburg A. '23 A
Balkin, Samuel W. '26 C
Bancroft, Henry K. '26 M
Barger, Harold L. '21 E
Barnum, Marvin C. '11 M
Beck, Bernon S. '10 E
Beery, Charles B. '09 M
Bell, Maurice D. '07 M
Benson, Ikel C. '25 E
Berg, Swan P. '23 C
Berg, Thorsten H. '25 C
Bergford, Rolf E. '23 C
Bergstrom, Marlow B. '22 E
Beseler, Herman F. '25 M
Bestor, George C. '24 C
Bevan, R. Louis '24 C
Bind, Harold E. '25 C
Biskup, William F. '16 C
Bleecker, George W. '16 E
Blue, Clarence W. '25 C
Bucholein, Charles '17 M, '19 ME
Boerner, Francis C. '11 C
Bordeau, Sanford P. '25 E
Bouquet, Otto T. '23 E
Boyum, Irvin '17 E
Braddock, Edward '24 C
Bradley, Byron H. '13 C, '14 CE
Brenchley, Harry E. '08 C
Bros, Bernard M. '23 M
Bros, Chester W. '22 M
Bros, Ernest T. '17 M
Bros, Raymond J. '19 M, '20 ME
Brossard, Henry F. '23 E
Brown, Floyd W. '17 A
Brownell, Otto E. '10 C
Bruce, Hjalmar N. '16 C, '17 CE
Bullis, Everard J. '24 C
Burch, Albert M. '96 C
Burch, Edward P. '92 E, '98 EE
Burlingame, Robert E. '25 E
Burnett, H. V. '14 C
Burt, Paul R. '26 M
Capstick, Donald W. '22 G
Carlbom, Leonard H. '25 C
Carr, Harvey '03 C
Carter, Robert J. '08 E
Caswell, Thomas B. '25 M
Cerney, Glen C. '28 M
Chalmers, Charles H. '94 E, '03 EE
Childs, James A. '09 C
Christensen, Arthur L. '25 E
Clarke, Charles P. '08 C, '09 CE
Collins, Stewart G '04 G
Colvin, James A. '14 M, '15 ME
Comb, Fred R. '18 M
Cooley, Gilbert '22 E
Cooper, Leo H. '06 E
Cooper, R. Conrad '26 C
Corbett, Theodore K. '26 M
Corser, John '16 M
Cosandey, Charles J. '25 E
Crane, Eugene C. '12 M, '13 ME
Critchett, Edward F. '13 M, '14 ME
Croft, Edna K. (Miss) '22 A
Croft, Ernest B. '11 C
Crounse, Avery F. '03 G
Cutler, Alvin S. '05 C
Dahlstrom, Raymond E. '10 E
Davies, Ralph M. '09 E
Dawson, John W. '22 A
Deane, George B. '19 A
Deinema, George K. '26 E
Del Plaine, Carlos W. '21 C, '22 CE
Deneen, Davis J. '19 A
Diment, J. Morton '24 E
Doell, Charles E. '16 C, '17 CE
Donaldson, Frank A. '12 M
Doolittle, William Y. '14 C
Dorrance, Albert P. '12 E
Douglass, Addison H. '17 C, '20 CE
Dresser, Harry S. '16 M
Drinkall, Leon R. '19 E
DuToit, George A. '10 M
Edgar, Robert F. '27 E
Eggers, Henry C. T. '15 E, '16 EE
Ehrenberg, Muriel L. (Miss) '26 ID
Ek, Gustaf A. '17 M
Ekman, Claes T. '10 C
Elliott, A. Douglass '14 E, '15 EE
Ellsworth, Charles D. '20 E
Elmburg, LeRoy M. '25 AE
Elsberg, Nels W. '09 C
Enger, Edward H. '11 C
Erickson, Clarence P. '23 A
Erickson, Edwin C. O. '22 C
Erickson, Henry A. '96 E
Erskine, Robert K. '24 M
Estabrooks, Clyde F. '24 M
Everett, William R. '13 E, '15 EE
Fager, Simon R. '04 M
Farmer, John W. '21 M
Farnam, Julian P. '11 M
Felton, Ralph P. '92 M
Fiske, Harold C. '22 E
Fitzgerald, William J. '20 C
Flindt, Richard H. '23 C
Ford, Robert E. '95 E, '03 EE
Fortar, Donald M. '09 M
Forsberg, Enock E. '18 A
Fossen, George '17 C
Foster, Kenneth W. '26 C
Frantz, Willard F. '25 C
Freeberg, George '25 A
Fruen, Arthur B. '08 G, '09 CE
Furber, J. Roscoe '24 E
Garber, Gabriel E. '06 M
Garthus, Ira B. '24 E
Garzon, Julian R. '24 C
Gee, Harry J. '19 G
Gemmell, John H. '14 M, '15 ME
Gerlach, W. D. '26 A
Gerrish, Harry E. '05 M
Gillete, George L. '03 C
Gilman, James B. '94 C
Godward, Alfred C. '10 C
Gould, Edward S. '20 C
Gray, William I. '92 E, '98 EE
Green, Chauncy L. '24 E
Greiner, Harry S. '24 E
Guesmer, Geo. O. '24 C
Guesmer, Marie W. (Miss) '26 ID
Guggisberg, Charles F. '17 M
Hagelin, Lawrence W. '22 E
Hammer, Harold E. '25 E
Hammond, Laurence D. '14 M, '15 ME, '19 MB, '20 MD
Hankins, Nathaniel R. '24 C
Hansen, Christian, Jr. '10 E
Harrington, Russell A. '24 E
Harris, Nathan '20 G
Harris, Sigmund '05 M
Hartig, Henry E. '18 E
Hartzberg, Edward M. '19 M
Hawkins, Harvey C. '23 E
Hayden, John F. '90 C
Heath, Donald C. '16 A
Heidelberger, Otto F. '23 E, '24 MS
Heidelberger, Roy J. '22 E
Helmick, Dan S. '15 C
Herberg, Sanford '24 C
Herrick, Carl A. '02 M
Herrmann, Raymond R. '12 E, '13 EE
Hibbard, Truman '97 E
Hickok, Mrs. Harvey (Miss Jesse E. Stevens) '96 G, '04 MS
Hildebrandt, H. A. '99 E
Hill, Edward L. '25 E
Hill, Hibbert M. '23 C
Hirleman, Clark W. '12 M, '13 ME
Hobart, Walter B. '07 C
Hoffman, John R. '26 C
Holcomb, Harry S. '26 E
Hopkins, Mark L. '09 E
Hotchkiss, Fred W. '18 E
Houlton, Amos D. '01 E
Houston, George S. '02 C
Hubbard, Henry A. '09 C
Huhn, George P. '91 E
Hustad, Andrew F. '09 C
Hustad, John C. '14 C, '15 CE
Hutchinson, Edwin T. '27 M
Jackson, Otto E. '14 E, '15 EE
Jacobsen, Arthur C. '25 E
Jacobson, Frank H. '24 E
Jacobson, Howard C. '21 G
Jacobson, Reuben A. '25 M
Jakkula, Arne A. '26 C
Jensen, John A. '05 C
Johnson, Alphonse N. '21 C
Johnson, Clifford S. '26 C
Johnson, Edgar W. '14 C, '15 CE
Johnson, Elmer W. '14 E, '15 EE, '23 ME
Johnson, Enan C. '25 E
Johnson, Gustave F. '27 E
Johnson, Ira L. '16 M, '17 ME
Johnson, James R. '26 C
Johnson, Nels '23 C
Johnson, Raymond V. '24 C
Johnson, Robertson B. '25 E
Johnston, Charles K. '21 E

Minneapolis

Jones, George R. '14 E, '15 EE
Kaplan, Seeman '18 A
Kapple, Frederick R. '24 E
Katter, Reuben L. '22 M
Keeler, Jasper F. '22 C
Kelly, Wm. J. '26 E
Kinsell, William L. '00 E
Kline, Frank W. '24 E
Knoll, Franklin O. '25 E
Kotz, Walter F. '23 C
Kreiting, Arthur S. '26 C
Kronick, T. Gerald '26 A
Kumm, Arthur W. '22 M
Kvitrud, Ingwald '11 C
Lagaard, Alex S. '13 E, '14 EE
Lambert, Edwin M. '09 M
Lang, Charles A. '06 E
Lang, Fred C. '08 C
Langland, Harold S. '19 E
Larson, Amandus C. '20 C
Larson, Carl '16 C
Lebeck, Carl E. '20 C
Lee, Oscar C. '19 E
Leonard, Thomas K. '15 C, '16 CE
Levens, Alexander S. '22 C
Levin, Jake M. '18 E
Lewin, Sherman W. '26 C
Lewis, Berkeley R. '25 E
Lewis, George R. '21 M
Lighter, Clyde W. '26 A
Lindstedt, Philip G. '26 C
Lipchick, Alex A. '26 C
Lobeck, Tararin '24 E
Lowther, Wilfred W. '27 M
Loye, Percival E. '21 E, '22 EE
Lund, Clarence V. '26 C
Lund, Roy V. '24 C
Lund, Stanley D. '27 C
Lundgren, Carl W. '26 M
Lundquist, C. Vernon '25 M
Lutz, Richard E. '15 E
Lyberg, Verele C. '26 E
McClung, Karl '25 E
McCullough, Bruce M. '16 C
McKay, Earle D. '15 C, '16 CE
McKenzie, Leonard F. '20 E
McLeland, Lyle K. '24 E
MacGregor, Helen '25 ID
Magney, Hilding O. '24 E
Mann, Alvin K. '26 E
Mann, Fred M. '93 C, '98 CE
Markoe, James C. '12 M
Marshall, Chester R. '23 M
Mattison, Oliver '05 C
Mayer, Harris J. '14 M, '15 ME
Meader, Glenn S. '26 E
Meili, Rudolph E. '22 G
Mentzer, Clarence A. '22 E
Merrill, Lewis E. '20 M, '21 ME
Meyer, Herbert W. '14 E
Mindrum, Arthur I. '26 E
Mixer, Walter R. '17 A
Molsknes, Nels S. '20 E
Moore, Clarence '20 G
Morris, Frank A. '24 M
Moore, Gordon B. '27 E
Mork, George W. '26 M
Morse, George '93 A
Morton, Harold S. '12 M, '13 ME
Morton, Harry G. '04 E
Mowery, Clarence W. '08 C
Moyer, A. F. '10 M
Nash, Russell O. '23 E
Nason, George L. '10 C
Nelson, Clarence E. '27 E
Nelson, Clarence H. '25 E
Nelson, Clarence L. '20 E
Nelson, Gustaf A. '19 E
Nelson, Nels B. '04 C
Nelson, Oscar B. '05 C
Nelson, Richard L. '21 E
Nelson, Robert B. '26 E
Nemer, Frank L. '09 M
Neubauer, Loren W. '26 C
Newhall, William B. '00 M
Nickerson, Edward '25 E
Nielsen, Eunice V. '23 A
Noble, John F. '21 G
Nordenson, Arnold '22 M
Nordlien, Berger W. '22 E
Nordstrom, Milton E. '25 C
Nordvall, Glenn '23 E
Norrbom, Oscar '26 M
Nyvall, Clifton S. '26 C
Olmstead, Charles '22 M, '23 ME
Olsen, Melvin S. '08 C
Olson, Edwin E. '25 A
Oram, Robert C. '11 M
Orning, Harold '26 E
Orr, George M. '15 M
Osburn, Roy W. '27 E
Otto, Robert W. '04 M
Parker, Helen R. '25 ID
Parker, Robert M. '24 C
Parry, John E. '26 E
Paul, Frederick T. '09 C
Pelley, Lloyd L. '24 E
Pendergast, Webster G. '25 M
Peack, Cyril P. '25 AE
Peterson, Everett L. '25 A
Peterson, Harold W. '21 E
Platzer, Geo. J. '27 C
Powell, Louis H. '24 C
Pratt, B. A. '15 C
Prendergast, Arthur '03 C
Prichard, Charles E. '25 C
Priedeman, George W. '08 M
Quiggle, Arthur W. '13 C, '14 CE
Quinn, Edward J. '25 C
Rasey, Raymond R. '26 C
Raugland, Arnold I. '20 A
Reid, Harry A. '10 E
Reidhead, Frank E. '93 E, '98 EE
Rhoades, Herbert E. '26 E
Ritchie, John R. '16 M, '17 ME
Rockwell, Harvard S. '14 C
Robertson, B. J. '14 E, '15 EE
Robinson, Parke D. '25 M
Roos, Frank T. '24 C
Rosenberg, Rahil A. '24 A
Rosendahl, Harold R. '22 M
Rosey, Raymond R. '26 C
Ryan, Robert M. '23 E
Ryan, W. T. '05 E
Salisbury, Willis R. '10 G
Schaller, George C. '23 C
Schlenk, John J. '23 C
Schilling, Theodore '24 E
Schow, Garfield G. '24 E
Schultz, Albert W. '27 E
Schmidt, Roland L. '25 C
Schwartz, John S. '19 A
Schweiso, Clifford C. '23 E
Scott, Herbert L. '23 E
Sebo, Arthur O. '24 M
Shavor, George J. '25 E
Shenehon, Francis '95 C, '00 CE
Shepley, Charles R. '02 C
Shippam, Willis '09 M
Siegmann, Chester W. '20 E
Silverman, Emil '22 C
Silverman, Isadore W. '24 A
Siverson, Sigvel J. '11 C
Siverts, Samuel A. '09 C
Sjoberg, Roy H. '26 E
Skurdalsvold, P. '15 C, '16 CE
Smith, Harold D. '25 E
Snyder, Dorothy E. '26 M
Sochnik, Edward J. '22 C
South, W. A. '12 C, '13 CE
Springer, F. W. '93 E, '98 EE
Stephens, Clifford '23 C
Stephenson, Oliver H. '07 M
Sternberg, Carl '07 E
Stoltz, Sidney L. '27 AE
Stone, Charles W. '16 M, '17 ME, '19 MS
Sundblad, Everts W. '27 E
Svendsen, George P. '08 E
Swanberg, John H. '25 C
Swanson, Edwin W. '19 E
Swanson, Paul H. '23 C
Swanson, Philip G. '23 M
Swanstrom, Frank N. '08 E
Swedberg, M. Roy '11 C
Sweet, Ray R. '21 E
Swenson, George '17 E, '21 EE
Swenson, Gustav A. '20 G
Swenson, H. Seymour '12 C, '13 CE
Taplin, George C. '24 E
Thayer, Charles E. '76 C
Thayer, Paul W. '14 M, '15 ME
Tholstrup, Henry L. '26 E
Thomas, Richard L. '25 E
Thomson, Andrew '25 E
Thorshov, Olaf '21 A
Thyberg, Clarence W. '25 E
Tighe, James S. '26 E
Timperley, William D. '10 C
Todd, Milo E. '09 E
Torrance, Eli '09 C
Trask, Alfred S. '23 E
Trask, Birney E. '90 C, '94 CE
Treka, Benj. C. '24 E
Tryon, Philip D. '17 C
Tupper, Charles E. '15 M
Turner, Roy H. '15 E, '16 EE
Ungerman, Carl M. '06 E
Untinen, August L. '25 E
Upton, Albert '25 E
Vaule, Sven A. '21 M
Vincent, Jay C. '03 E
Walby, Arthur C. '11 C
Walker, George W. '08 C
Walling, Benjamin B. '09 E
Walquist, John A. '23 A
Wangaard, Oscar H. '12 C, '13 CE
Watson, Fred G. '16 C
Weeks, Leonard H. '27 E
Weigel, Howard N. '14 C, '15 CE
Wentz, Walter W. '14 E, '16 EE
Werdenhoff, James H. '21 C
Westigard, Glenn A. '25 E
Whitney, Alfred C. '03 G
Wichman, Martin F. '22 E
Wilcox, Hugh B. '14 E, '16 MS
Williams, Charles A. '16 C
Williams, Roy N. '23 E
Willson, Stuart V. '24 M
Wilson, Eliel '01 M, '02 E
Woodrick, Oscar '08 C
Young, Joseph '21 G

Montevideo

Scott, Lawrence '15 E, '16 EE

Montgomery

Smisek, Joseph H. '11 E

Moorhead

Hopeman, Albert M. '05 C

Moose Lake

Handschu, C. E. '15 C

Mora

Hanna, Cyril C. '26 M

New Germany

Groth, Arthur W. '20 E

Newport

Knight, Ralph J. '15 C

New Ulm

Bockus, Gerald H. '22 E
Haeberle, Elmer H. '06 E
Robertson, Charles N. '08 C

North Hibbing

Lundquist, John V. '23 E

Oak Terrace

Greene, Alfred B. '24 E
Rathburn, George A. '24 M

Olivia

Kircher, Frank J. '09 M
Kircher, Geo. A. '09 M
McAubrey, Everett J. '21 C

Owatonna

Aultfather, David '22 E
Hosfield, Raleigh '12 C
Souba, John L. '25 M

Perham

Hayden, Claude E. '24 BS (CE)

Peterson

Boyum, Benjamin C. '10 C

Pine City

Nutting, Horace W. '25 C

Pine Island

Parkin, Orrin G. '23 M

Pine River

DuBois, N. Warren '26 M

Plainview

Askew, Thomas A. '16 C

Proctor

Bohannon, George W. '26 M
Maney, James E. '26 M

Raymond

Haima, Mark '25 C

Red Wing

Cook, Harry C. '10 M
Josephson, Eliot B. '10 E

Red Wood Falls

Clipfell, Carroll D. '05 M

Robbinsdale

Shumway, Ernest J. '00 E

Rochester

Boyne, Ellsworth R. '17 C
Brose, Peter P. '25 A
Buenger, Edgar '19 A
Leonard, Aubrey C. '23 C
Pagenhart, Clarence C. '12 C

Rushford

Engh, Harris S. '24 M

St. Cloud

Jorgens, C. R. D. '12 C, '13 CE

St. James

Slaby, Louis J. '26 M
West, John C. '15 C

St. Paul

Abrahamson, Howard B. '17 M
Albrecht, Ernest G. '25 EE
Andrews, George L. '05 M
Arnesen, Herbert P. '11 C
Aure, Roy '22 M
Banovetz, John A. '25 C
Barlau, Harry E. '03 C
Bartow, Harry E. '03 C
Beek, Hiram D. '26 M
Bennett, John C. '26 M
Bingham, Stanley E. '08 M
Bird, Harold E. '25 C
Bisbee, Bertin A. '22 E
Blake, Robert P. '97 M
Bliven, Paul '27 M
Bohland, John A. '15 C
Borst, Wellington L. '24 M
Boss, Ronald W. '25 M
Boyles, Ralph R. '15 M, '16 ME
Brandt, Clifford A. '27 E
Brockway, Royden R. '05 C
Brohaugh, Gustave C. '27 C
Buenger, Albert '13 M, '14 ME
Bumgardner, Louis T. '23 E
Calmeyer, John P. '06 E
Carlson, Arvid P. '17 M
Carlson, Ernest '22 M
Carlton, Richard P. '21 G
Chapman, Leslie H. '95 C
Chapman, Wendell P. '14 E
Chapman, Wilbur J. '27 M
Christenson, Elmer J. '27 C
Christlieb, Frank B. '23 C
Collis, N. Stuart '24 M
Comfort, Clifford E. '26 M
Comfort, Thomas H. '26 C
Cornell, George M. '25 C
Cowin, Clifford C. '21 G
Crawford, Allen S. '12 M
Cummings, Elmer '12 C, '13 CE
Curry, Ezra Benham '20 M, '21 ME
Curtiss, Lindsley B. '09 G
Darrell, James E. P. '23 C
Daum, H. Arne '12 E
Davis, Gilbert M. '04 M
Deegan, Raymond C. '26 C
Dehn, Elter '21 C
Deutsche, Richard E. '18 C
Dewars, Allen G. '13 E, '14 EE
Diamond, Grover W. '12 C
Dills, Lyle A. '21 G
Dimond, Harvey G. '14 C
Dougan, Henry K. '08 C
Dungay, Herbert F. '25 C
Dunnavan, Ralph R. '23 E
Duvall, Arndt J. '25 C
Eggleston, Smith '25 M
Egilsrud, F. S. '20 M
Ellison, Jay '09 C
Engquist, Victor E. '20 E
Erskine, Lawrence '25 M
Feyder, William H. '05 C
Finley, Joseph E. '05 C
Fiske, Frederick W. '09 C
Fleming, Frank R. '08 M, '09 EE
Flygare, August L. '12 C
Forsberg, Elmer J. '21 M, '22 ME
Francis, Paul E. '18 M
Fraser, Carlisle G. '22 C
Fraser, George '19 A
Frenzel, Herman '26 A
Gage, Hugh N. '08 C
Gaten, George M. '10 C
Gessert, George R. '07 M
Giertsen, Marcus O. '12 C, '13 CE
Gilstad, Arthur '23 M
Goebel, Rudolph C. '13 E, '14 EE
Goldberg, Maurice '23 E
Goodkind, Leo '92 A
Greenberg, Morris '18 M
Grime, Edwin M. '00 C
Guerin, George V. '24 C
Gustafson, Reuben W. '24 C
Haberle, Edward '12 C, '13 CE
Hansen, Carlos C. '20 C
Harris, Harold R. '14 E, '15 EE
Hayes, Edward J. '20 M
Hedenstrom, Ernest A. '12 E
Hendricks, Clifford '25 C
Hendrickson, C. Edward '25 C
Hendrickson, Norman '16 C
Hewett, Maurice W. '13 C, '14 CE
Hiner, Walter G. '23 C
Hoff, Christopher '06 E
Hoffman, Michael J. '11 C
Hoisveen, Leonard '25 M
Holder, Laurence E. '24 C
Hosmer, Orville H. '23 C
Hovden, Conrad D. '12 E, '13 EE
Hoving, John E. '27 C
How, Francis W. '27 C
Irons, George '26 E

St. Paul
Jackson, Earl D. '05 E
Jenkins, Clifford H. '25 M
Johnson, Carl A. '21 M, '22 ME
Johnson, Laurence V. '27 C
Jones, Edwin F. '17 M
Jones, Richard W. '26 E
Katter, Calvin K. '22 M
King, Lawrence W. '09 C
King, Wesley '05 C
Klass, Frederick '19 E
Koch, Karl L. '23 E
Kochendorfer, Milton J. '05 E
Kopper, Edward '14 M, '16 ME
Krauch, William '08 C
LaBonte, Anton '25 C
Larson, Albin '14 C
Larson, Martin S. '11 M
LeBlond, Edmond J. '05 E
Levy, Max L. '26 E
Lewis, Edward R. '05 M
Liebenberg, Jacob J. '16 A
Lieberman, Henry '23 E
Liese, Carl R. '26 C
Liese, Herbert W. '24 C
Lighter, Clyde W. '26 A
Lilly, Clarence W. '17 E
Lilly, Eugene '19 G
Lindquist, Oliver J. '28 E
Loeffler, Henry S. '14 E, '15 EE
Logue, John F. '24 M
Lovering, Harry D. '13 C, '14 CE
Lux, Arthur E. '16 E
McCartney, Floyd A. '13 M
McCree, Andrew A. '08 C
McCubrey, Everett J. '21 C
McPherson, William B. '02 E
Macgowan, Irvin '25 C
Mackintosh, William S. '21 C
Mangney, Elmer J. '21 E
Malloy, Charles J. '06 C
Manson, Philip W. '26 C
Markson, Christian O. '23 C
Mattson, Dewey F. '23 C
Mayer, Albert F. '20 E
Mayer, Joseph S. '24 E
Meixner, Bernard A. '10 M
Mertz, Karl J. '14 E
Meserve, Ralph H. '23 E
Meskal, George '23 C
Methven, Clyde '11 C
Mikesh, Edward S. '22 M
Miller, Erwin J. '11 C
Miller, George W. '20 E
Miller, William C. '16 M
Miller, William J. '24 E
Mitchell, John B. '09 C
Moore, John H. '24 M
Moorman, Albert J. '18 A
Moorman, Frank S. '22 A
Moul, Charles L. '10 C
Muller, Carl C. '18 M
Nelson, Edward S. '09 C
Nelson, Mark L. '24 A
Neville, Earle L. '20 C
Nordstrom, Carl T. '14 C
Norton, Clyde W. '08 M, '09 ME
Okes, Day I. '08 C
Okes, Sidney R. '09 C
Olson, Clarence E. '22 G
Oltman, Charles A. '03 C
Ott, Leonard E. '15 C
Owens, Leo E. '11 M
Palda, Charles H. '22 C
Pause, Harold A. '23 E
Peckham, Harold E. '23 M
Person, Otto C. '24 AE
Peters, Walter C. '22 M
Peterson, A. M. '14 E
Peterson, Harold C. E. '25 C
Pinska, Lawrence F. '22 C
Pohl, Loren F. '27 C
Poulsen, George F. '17 A
Powles, James W. '01 E
Quinn, Ursula R. '25 C
Reardon, John M. '22 C
Redin, R. K. '26 AE
Rigg, Alvin E. '25 A
Ringstrom, Ivan G. '12 BS, '13 EE
Rockwood, Fletcher '14 M, '15 ME
Roe, Harry B. '08 E
Roth, Lewis M. '11 C
Rutsveld, Olav M. '15 C, '16 CE
Santelman, Ralph H. '27 C
Shepard, George M. '09 C
Sickel, Edwin C. '23 E
Skon, Herman W. '15 M, '16 ME
Slade, Loring '22 C
Snow, Clarence J. '14 M, '16 ME
Souther, M. Edwin '12 C, '13 CE
Speer, Paul E. '27 E
Stanton, Raymond E. '04 M
Stevens, Everett R. '25 M
Stewart, Clarence H. '03 C
Stewart, George A. (Garnet) '22 A
Streich, Harry C. '12 E
Swenson, Theodore J. M. '12 E
Swift, Donald C. '24 E
Tallmadge, Everett S. '14 E, '15 EE
Teberg, Lawrence E. '22 C
Teske, Frederick C., Jr. '27 C
Thomas, William A. '17 E
Thompson, Claudius '22 C
Thompson, Niles J. '27 E
Thompson, Theodore S. '24 C
Villaume, Walter F. '23 C
Walder, Ted N. '25 C
Waldron, Ralph E. '20 E
Walters, Robert P. '26 E
Waterous, Fred A. '20 M
Webster, Donald W. '13C, '14 CE
Weinke, Ernest '16 C, '17 CE
Welin, Arthur G. '12 C, '13 CE
Wellisch, Walton '23 E
Whitman, Edward A. '00 C
Williams, Fred J. '17 E
Willis, Roy '08 C
Witt, Edward J. '27 C
Wolf, Milton C. '25 C
Wolfangle, Raymond J. '17 C
Wolff, William S. '15 M, '16 ME
Woolman, Harry D. '24 M
Wunderlick, Milton S. '19 M, '20 ME
Wurzbach, Henry A. '25 E
Yager, Louis '07 C

Slayton
Price, John R. '14 C

Staples
Ainslie, Arthur F. '11 C

Stevenson
Quine, William M. '26 E

Stillwater
Englin, Charles F. '06 E
Ovestrud, Melvin '13 M, '14 ME
Schuck, Roy D. '25 E
Tierney, Festus P. '22 C

Tracy
Peterson, Garvin E. '26 C

Twin Valley
Croswell, Daniel R. '16 E
Croswell, Thomas L. '15 C
Nilson, Wilhelm '02 E

Two Harbors
Johnson, Austin G. '05 M

Tyler
Johnson, Anton A. '24 A

Virginia
Sannicola, Joseph F. '22 E
Whitten, Robert C. '25 M

Waconia
Wessale, George '21 E

Wadena
Hayden, Claude E. '24 C
Imsande, Fred '25 C

Warren
Friar, Floyd M. '20 C

Waseca
Johnson, Edgar F. '21 E
Zimmerman, Louis F. '08 E

Washtucna
Bouge, Nathan H. '04 C

Willmar
Besse, Harold U. '25 C
Bergquist, Philip L. '24 C

Winona
French, William O. '23 M
Grettum, Leroy A. '23 E
McAndrews, Harry '25 C
Miller, Archibald T. '24 E
Miller, William L. '97 E

Winthrop
Haakenson, N. Theodore '26 C
Malmberg, Victor A. '20 C

MISSISSIPPI

Jackson
Kroeze, Herbert A. '19 G

Laurel
Nee, Harold E. '24 E

MISSOURI

Gasconade
Chapman, Burton L. '10 C

Jefferson Barracks
Russell, Carl A. '16 E
Sullivan, Frederic V. '25 C

Jefferson City
Espenett, Edward L. '22 C
Sverdrup, Leif J. '21 C

Kansas City
Glass, Clifton A. '98 C
Koehler, Edwin F. '24 M
Swanson, Clifford L. '22 C
Luoleman, Clarence H. '23 AE
Wright, Harris H. '09 M

Knob Lick
Rydeen, Francis G. '03 M

Mt. Grove
Hummell, Carl A. '26 E

New London
Glascock, Henry H. '06 E

St. Joseph
Grant, Elberth R. '24 C

St. Louis
Erickson, Carl G. '03 E
Haines, Allen K. '13 E
Johnson, Noah '94 C
McCann, Realino V. '27 A
Olson, Richard H. '19 E
Oscarson, Gerhard L. '22 E

Troy
Ball, Hampton B. '20 M

MONTANA

Billings
Berg, Karl A. E. '20 C.
Coleman, Frank D. '05 E

Bozeman
Thaler, James A. '00 E

Bridger
Coon, Lawrence C. '26 E

Butte
Jordan, Frank W. '19 E
Pratt, Arthur C. '99 E
Rolfe, West A. '13 C
Stussy, William '09 E

Deerlodge
Baker, Arthur W. '19 M

Glendive
Adams, Benjamin W. '10 C

Great Falls
Dow, James C. '00 E
Hougan, Sander '21 E

Havre
Haverson, Henry D. '07 C

Helena
Kivley, Warren O. '16 C

Miles City
Aasland, Christopher '15 C

NEBRASKA

Omaha
Bunce, Paul F. '06 E
Christensen, Edgar W. '19 E
Clark, John S. D. '22 M
Eddy, Horace T. '95 E, '96 EE
Ellestad, Irwin M. '22 E
Fischer, Harold W. '23 E
Johnson, Gustav A. '23 E
Johnson, James P. '23 E
Kingsley, Norman W. '20 E
Lund, Earl H. '22 C, '23 CE
Sampson, Cliff. L. '23 E, '25 EE
Schneckloth, Harry H. '25 E
Skarolid, Charles J. '24 E
Teal, Clarence W. '24 E
Wallfred, John E. '20 M
Weibler, William M. '08 E
Wilcox, Halsey H. '15 E
Wilson, Paul R. '21 E
Zimmer, William A. '06 E

University Place
Japs, Barney G. '09 E

NEW JERSEY

Bayonne
VanCleve, Horatio P. '07 C

Carteret
Kerns, Clinton B. '15 M

Crawford
Steffens, Robert A '22 E

Harrison
Anderson, Oscar P. '10 E

Irvington
Frehn, Victor N. '27 E

Kearney
Dowd, Archie J. '19 M
Mikesh, Martin A. '12 M, '13 ME
Franzen, Roy O. '25 E
Pangburn, Carroll '22 E
Peterson, Vance C. '20 E
Waligoski, A. Arnold '24 E

Monmouth
Hoorn, Frederick W. '12 E, '14 EE

Newark
Frederickson, Harry B. '11 E
Johnson, Welton V. '26 E
Koepke, Walter E. '13 C, '14 CE

Phillipsburg
Brayden, Giles W. '27 E
Etem, Victor '26 E
Wald, Joseph H. '27 E

New Brunswick
Moore, Norman '25 C

NEW MEXICO

Albuquerque
Larson, Fred '25 C

NEW YORK

Bay Shore
McCullough, Robert T. '23 E

Brooklyn
Daly, Richard T. '21 C
Ely, Irving R. '05 E
Sushan, Harry M. '19 C

Buffalo
Crook, Jacob H. '20 M
Johnson, Carl S. '21 C
Jules, Harold A. '20 E
Kelsey, Howard C. '22 M
Kiesner, Frank C. '24 M
Schildt, William F. '08 E
Swanson, Oscar E. '15 C, '16 CE

Ithaca
Barr, John H. '83 M, '88 MS

Jersey City
Mikesh, Martin A. '12 M, '13 ME

Long Island City
Boyd, Paul M. '24 M
Wagner, Otto H. '07 M

Mt. Vernon
Hiers, Charles R. '24 M
Loye, Edwin M. '20 A

New Brighton, Staten Island
Grimes, David '19 E
Marshall, Donald E. '19 E

New York City
Abbott, Arthur L. '97 E
Backstrom, Emil F. '24 A
Bauer, Ruben R. '20 E
Beckjord, Walter C. '09 E
Berg, Samuel A. '21 BA, '21 E, '22 EE
Bolme, Ole N. '10 C
Bonner, Arthur L. '27 E
Bonson, Carl E. '05 E
Boshardt, Willmert C. '22 E
Bouman, Bernard M. '04 E
Braden, Rene A. '23 E, '25 MS
Brattloi, Clifford '27 C
Buhl, John E. '09 M
Burns, Harvey L. '02 E
Case, Gerald F. '23 E
Cheney, Edward J. '04 E
Covell, Russell O. '16 E
Crabbe, George N. '04 E
Craig, Robert '97 M
Dahl, Harold W. '24 E
Demarest, Charles S. '11 E
Dewey, William H. '93 E
Elmer, Lloyd A. '21 M
Feldman, Carl B. H. '26 E
Gannett, Danforth '16 E, '17 EE
Gerlach, Henry C. '23 A
Gilmen, Howard B. '17 A
Gregg, Freshame D. '05 G, '06 CE
Hagerman, Oliver S. '15 M
Hahn, Stanley W. '22 A
Hillerty, Charles D. '96 M
Hokanson, Clarence E. '06 E
Holien, Edward O. '23 A
Houts, Guy J. '01 E
Ireland, Ray R. '03 E
Johnson, John E. '11 E
Kannenberg, Walter F. '23 E
Keller, Raymond W. '28 E
King, Alfred R. '08 E
Kuhlman, Rudolph H. '23 M
Laird, Lee K. '03 E
Landeen, Arvid G. '10 E
LeTourneau, Edward H. '05 E
Lockwood, Raymond '20 E
Loye, Donald P. '16 E, '17 EE
Magoon, Herbert A. '24 A
Manderfeld, Emanuel '21 E
Markuson, Oscar S. '11 E
Mathes, Robert C. '12 E, '13 EE
Mitchell, Alexander C. '20 E
Morris, John E. '09 M
Mowry, Harry W. '06 E
Myers, Mortimer '97 E
Norcross, Arthur F. '07 E
Olstad, Oscar A. '11 M

New York City
Otto, Frederick A. '04 E
Robertson, Phillip W. '01 M
Sander, Theodore, Jr. '19 E
Schottler, George J. '23 E
Schroeder, Carl W. '14 E, '15 EE
Simons, Walter W. '16 E
Smith, Donald C. '18 E
Strothman, Russell A. '20 E
Swenson, Clarence Q. '17 M, '20 ME
Swenson, Karl P. '06 G, '07 MS
Taylor, Duane L. '17 M
Thorne, Donald '23 E
Thuros, Albert L. '12 E, '13 EE
Tullar, Charles E. '01 E
Tunell, Robert H. '24 E
Wahlquist, Hugo W. '21 E
Wheeler, Herbert H. '17 E
Wiggins, Gerald G. '06 E
Willner, William E. '22 A
Wright, Roydon V. '98 M
Zimmerschied, Clarence R. '23 E
Niagara
French, Edwin L. '02 E
Graling, Verney '99 E
Norwich
Moris, Russel F. '25 C
Poughkeepsie
Mann, Alvin K. '26 E
Rochester
Savage, Edward S. '97 M
Schenectady
Allee, David A. '02 C
Anderson, Lowell W. '26 E
Beardmore, Albert '21 E
Bill, Earl M. '12 E
Boe, Lester L. '25 E
Bottemiller, Edward L. '27 E
Burrill, Charles M. '23 E
Downie, John M. '22 E
Dunham, Roy O. '14 E, '15 EE
Engstrom, Elmer W. '23 E
Fallon, Eugene L. '14 E, '15 EE
Fiene, Marcus '26 E
Forsberg, Peter W. '11 E
Frazee, Leonard M. '24 E
Grant, Fred R. '09 E
Grobel, Lloyd P. '24 M
Haedecke, August D. '26 E
Hargrave, William A. '26 E
Hargraves, Robert A. '23 E
Hartley, Lowell J. '26 E
Heinemann, John R. '19 E
McCully, James '25 E
Marshman, Irving H. '24 E
Mittag, Albert H. '11 E
Murdock, George B. '26 E
Nergaard, Leon S. '27 E
Nierling, Grant C. '25 E
Parsons, Sidney A. '25 E
Rask, Louis G. '03 E
Robinson, Laurence T. '26 E
Satori, Roy H. '21 E
Tunnell, Clement R. '25 E
Warren, Laurence C. '24 E
Wiltgen, Edward '00 E
Woodman, Joseph C. '11 M
Syracuse
Jones, Robert A. '15 E, '16 EE
Linhoff, Carl H. '22 E
Morris, Thomas C. '08 M
Moyer, Malcolm B. '09 M
West New York
Velz, Clarence '24 C
White Plains
Adams, George F. '95 E

NORTH CAROLINA

Durham
Nielsen, Walter M. '22 E
Greensboro
Little, Alice V. '22 A

NORTH DAKOTA

Carrington
Cousins, Van Meter '25 E
Crosby
Rosseau, Clifton C. '24 M
Elkton
Kelly, William J. '26 E
Fargo
Anderson, Edward I. '17 M, '19 ME
Bertossi, Clarence F. '25 C
Grafsland, Geneva '27 I
Juvrud, Edwin C. '17 E
Peterson, Albert L. '14 BS, '15 M
Peterson, Lloyd L. '24 C
Sheffield, Fred W. '09 C
Stoutland, Oliver A. '22 C
Tarbell, William P. '22 C
Grand Forks
Schulz, Elton A. '16 E
Jamestown
McCall, Harry J. '08 C
Minot
Huston, David B. '07 C
Molander, Edwin '25 A
Peterson, William W. '16 C
Williams, William R. '26 E
Stanley
McGregor, Frazer A. '24 E
Velva
Gerow, Theron G. '20 M
Wyndmere
Miller, Andrew L. '21 E

OHIO

Canton
Hektner, Joel '17 M
Lang, George M. '27 E
Letson, Donald E. '26 M
Cincinnati
Young, Truman P. '25 C
Cleveland
Arneson, Lloyd O. '21 M
Bierman, George H. '18 M, '19 ME
Brewster, William E. '12 E, '13 EE
Briggs, Hiram K. '19 G
Conley, Wilfred E. '10 E
Cowin, Clifford Cecil '21 G
Drinkall, John F. '19 E
Estep, Harvey C. '08 M
Hinman, Charles H. '24 A
Johnson, Leonard T. '10 E
Larson, Walter J. '20 E
Lee, Albert A. '26 E
Ludvigsen, Elliot '25 M
Lund, Jeffery L. '25 E
Maiser, Walter S. '23 C
Nelson, Edgar M. '24 E
Ransom, Glen B. '22 E
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Lima
Cutter, Francis C. '06 M
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Buckhout, Donald H. '17 A
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Buhl, Paul S. '07 M
Ramm, Theodore D. '13 E

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Meyer, Carl F. '10 C

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Hansen, Arthur A. '25 C
Schultz, Alex A. '26 C

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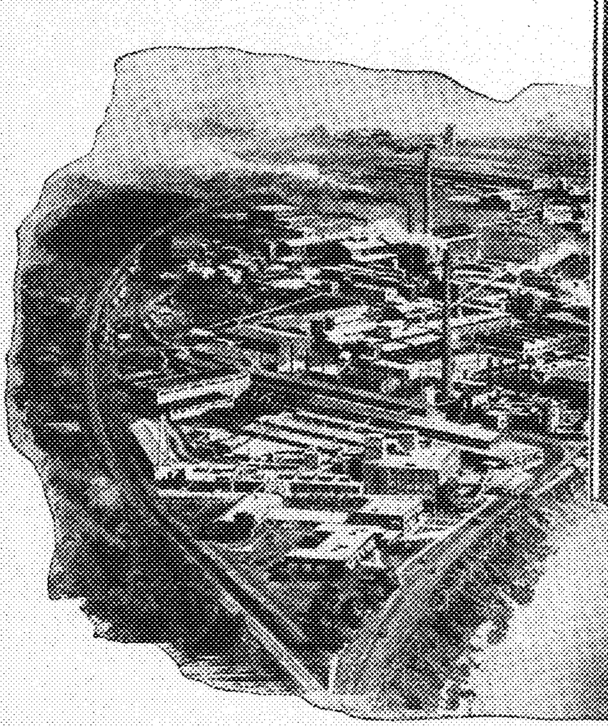

Harlingen
Henry, Burt C. '21 C
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Downing, Frank E. '04 C
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Robison, Archer R. '09 E
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Lupiow, Walter D. '17 C
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Jacksonville
Furber, Pierce P., Jr. '08 C
Newport
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Quantico
Johnson, Byron F. '20 C
Roanoke
Fahland, Frank, Jr. '22 M

WASHINGTON

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Smith, Leighton '03 C
Easton
Pearson, Harold T. '27 C
Everett
Beaulieu, Richard L. '02 C
Kelso
Phelps, Ray R. '10 E
Leavenworth
Paulson, Joseph B. '27 C
Longview
Hetherton, Percival '08 M
Smith, Hugh A. '18 E
No. Yakima
Gilman, Nicholas A. '07 M
Oroville
Norelius, Emil F. '08 M
Norelius, Lewis M. '06 C
Pasca
Acker, Sidney H. '23 M
Puget Sound
Benedict, Geo. F. '03 E
Seattle
Bennett, Walter J. '03 C
Bowen, Fred P. '06 C
Bushnell, Chas. S. '78 M
Grimshaw, William E. '02 M
Guthrie, J. De Mott '03 E
Hayward, George I. '06 C
Hillman, Chas. K. '12 E
Hoffman, Ralph M. '11 Sc. & Tech.
James, Henry C. '11 E
Lumm, Gordon '25 A
McKenzie, Lauren F. '09 E
Magnusson, Carl F. '96 E, '97 MS, '05 EE

Markhus, Olaf G. F. '97 E
Pearce, John Henry '07 E
Petrick, Alfred C. '19 C
Quenet, John '01 C, '02 ME
Schow, William P. '07 E
Shuck, Gordon R. '06 E
Silliman, Henry D. '97 M
Steinberg, Carl '07 E
Weber, Erwin L. F. '06 E, '08 ME
Westbrook, Donald McD. '10 M
Westberg, Russell E. '20 E
Spokane
Adams, Elmer E. '06 CE
Alton, Herbert D. '07 E
Wiesner, Frederick E. '06 C
Tacoma
Peters, William G. '83 C

WEST VIRGINIA

Charleston
Giltinan, David M. '15 M, '16 ME
Fairmont
Schoepf, Alfred W. '08 E
Morgantown
Amidon, Lee L. '23 M
Gill, James H. '92 M, '94 ME
Wheeling
Root, Frank R. '24 AE

WISCONSIN

Beloit
Cole, Ernest C. '26 M
Tuttle, Stanley B. '24 M
Bruce
Brownell, Edward '26 C
Buhr, Leo '23 C
Chaten
Weston, Wm. S. '02 C
Chippewa Falls
Berdan, Hubert J. '22 C
Gray, Seymour R. '22 C, '23 CE
Vaudreuil, Lionel '25 AE
Eau Claire
Cotton, Ernest H. '19 E
Dow, Clarence A. '13 E, '14 EE
Fairbanks, Geo. W. '23 E
Frahm, Alfred R. '08 E
Holm, Edwin R. '20 C
McMillan, James S. '22 E
Mossen, Manley A. B. '24 E
Fond du Lac
Nimmer, Walter R. '26 E
Grantsburg
Nelson, Martin E. '24 C
Green Bay
Hartney, James L. '14 M, '15 ME
Hurley
Butterworth, Allan C. '11 E
Ost, Roland E. '22 C
Kimberly
Lande, Clarence C. '27 C
La Crosse
Bergsland, Grant C. '23 M
Nordstrom, Ernest A. '22 M
Madison
Hubbard, Robert T. '06 E
Knudsen, Esther M. '25 C
Larson, Ludvig C. '21 E, '23 EE
Luxford, Ronald F. '17 C
Nystrom, Paul E. '24A
Riedesel, George M. '17 A
Turtittin, Hugh L. '27 C
Manitowoc
Olson, Arthur L. '24 M

Marinette
Hornibrook, James W. '09 E
Neenah
Palmer, Howard B. '22 C
Milwaukee
Albrecht, George M. '06 E
Bauer, Roscoe W. '24 C
Brimeyer, Ferdinand J. '25 AE
Chapin, Harold S. '12 M, '13 ME
Cote, Rhoda H. '25 ID
Hansen, Maurice J. '11 E
Hemsey, Clayton E. '22 M
Johnson, Elving L. '23 E
Johnson, Herman B. '09 E
Kendall, Walter '25 A
Lundsten, Frank R. '27 C
Mahachek, Ross F. '26 E
Newman, John M. '23 E
Norman, Henry R. '27 C
Ohman, George U. '26 C
Papenthien, Roy O. '21 G
Peterson, Laurence L. '25 M
Peterson, Peter I. '20 E
Potter, Robert P. '26 A
Preus, Christian K. '27 C
Price, Clarence R. '20 E
Reed, Albert I. '85 C
Roberts, Earl H. '15 M, '16 ME
Roberts, Norman A. '26 M
Sesseng, Gunnar '24 M
Skrukrud, Odean M. '25 C
Sutherland, Samuel J. '23 AE
Thomas, W. Alan '24 M
Tyvand, James A. '24 E
Williams, Wilbur S. '09 M
Oconomowoc
Flank, Howard G. '22 E
Portage
Odegaard, Harold T. '20 M
Racine
Rood, Arnold E. '22 E
Wyly, Lawrence T. '20 G
Shell Lake
Cameron, Harry D. '25 E
Spooner
Putz, John H. '14 BS, '15 EE
Superior
Scobie, Francis G. '08 E
Wauwatosa
Cross, Chas. H. '97 M
West Allis
Foltz, Ross Melton '19 M
Smart, George A. '16 M
West Salem
Sprehn, George H. '24 C

WYOMING

Casper
Fulton, Edw. G. '25 C
Shell
Rosing, Donald C. '27 C
Yellowstone Park
Lindelef, Charles '09 E

ALASKA

Alaska
Asiaksen, Carl I. '23 C
Valdez
Smith, Byron E. '07 E

CANADA

Edmonton
Morris, Robert '05 E
Ft. Frances, Ont.
Hess, Paul O. '26 M
Laurence, Paul A. '12 G
Montreal
Adams, Wm. C. '05 C
Spence, William J. '02 E

Port Arthur
Souba, William H. '09 M
St. Catharines
Noel, Clay W. '20 E
Toronto
Anderson, Oscar V. '10 E
Weyburn, Sask.
Cosberg, James W. '08 E
Winnipeg
Borrowman, Leroy F. '08 C
Brown, Geo. J. '08 E
Schumacher, John H. '03 E

CHINA

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Lin, Shu Ming '20 A
Tientsin
Eliassen, Sigurd '18 C

CUBA

Havana
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GERMANY

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Honolulu
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Thompson, Herbert L. '12 M

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Knowles, Everett H. '20 E
Tocopilla
Carlson, Victor H. '20 E
Maine, Basil '21 E

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Busch, John S. '20 ChE
Cantwell, William F. '11 Ch
MANKATO
Neilson, Chris '18 ChE
MINNEAPOLIS
Anderson, M. M. '20 ChE
Arnold, Jerome H. '27 ChE
Barber, Harvey H. '26 PhD
Beal, John L. '27 ChE
Beck, Maud G. '13 Ch
Brooks, Leslie C. '19 Ch
Bruce, G. Norman '23 Ch
Bunger, Harold A. '26 ChE
Busch, William A. '22 ChE
Cade, Arthur R. '17 Ch
Calloway, R. S. '11 ChE
Cohen, Lillian '00 Ch
Cori, Cady S. '21 ChE
Cornell, L. Wallace '27 ChE
Covell, Paul L. '25 ChE
Davies, Edwin T. '07 ChE
Dunnigan, Merton A. '16 Ch
Eck, Lester J. '23 Ch
Elmquist, Ruth E. '24 Ch
Fegen, Elmer T. '15 Ch, '16 Ch
Firth, Charles V. '23 ChE
Fischer, Earl B. '19 ChE
Freche, Hertha B. '25 Ch
Goldstein, Milton M. '12 ChE
Grout, Frank F. '04 Ch
Halvorson, Halvor O. '22 ChE
Hammer, George F. '20 ChE
Haugsrud, Parmalee S. '26 ChE
Hawkey, Harold K. '19 ChE
Heisig, Lucille K. '22 Ch
Hopkins, Joseph T. '04 Ch
Hoist, James E. '27 ChE
Jerabek, Henry S. '26 ChE
Kameda, Tohru '26 ACh
Kampa, Edmund P. '23 Ch
Karatz, Lucian '12 Ch
Kobe, Kenneth A. '26 ChE
Langaas, Karl H. '27 ChE
Lauer, Walter M. '24 PhD
Lee, Melville R. '21 ChE
Leerskov, Gerhard W. '21 ChE
Lowe, John M. '08 Ch
Ludwig, Llewellyn G. '24 Ch
Lux, Lester L. '27 Ch
Marshall, Olive Wadleigh '17 Ch
Mitchell, Donald F. '20 ChE
Nelson, Harry G. '18 Ch
Olsen, Leslie R. '15 Ch
Olson, Arthur O. '11 Ch
Otterstein, Earl F. '13 Ch
Pennock, Edward M. '05 AC
Peterson, Henry '13 ChE
Rademacher, Richard L. '23 ChE
Riley, Philip J. '21 Ch
Robinson, Rhea B. '12 Ch
Scandling, Joseph E. '25 ChE
Schermer, Oscar C. '21 ChE
Seyfried, Lillian M. '17 Ch
(Mrs. W. H. Hunter)
Sprung, Murray M. '25 ChE
Stoppel, Arthur E. '20 ChE
Sullivan, Betty '22 Ch
Tindall, Jesse E. '25 ChE
Tinkham, Willis M. '14 ChE
Tronson, John L. '26 ChE
Wallfred, Carl L. '20 ChE
Wanless, Lynn A. '12 Ch
Webber, Fredrick W. '97 ChE
Webster, Cora H. '23 Ch
Westerberg, Carl George '21 Ch
White, Robert H. '23 ChE
Whited, Otis O. '08 Ch
Wilhoit, Albert D. '06
Woolett, Guy H. '10 Ch
Ziegler, Mildred R. '15 Ch
Zims, Albert G. '24 ChE
RED WING
Cornell, Reuben W. '21 ChE
ROBBINSDALE
Busch, William '20 ChE
ROCHESTER
Heck, Frank J. '19 Ch, '25 MS
SAUK RAPIDS
Ramsay, Selmer '21 ChE
ST. PAUL
Aronovsky, Samuel Isaac '21 ChE
Bachke, Edmund '24 ChE
Baker, Russel F. '11 ChE
Barrett, Joseph O. '22 ChE
Bell, Alexander D. '16 Ch, '17 ChE
DeWitt, Joseph H. '10 Ch
Dysterheft, George A. '26 Ch
Felton, Elmer T. '13 Ch
Fuhrman, Alvin O. '24 ChE
Halvorson, Henry A. '11 Ch
Hatch, Lloyd '23 ChE
Hennessy, Hugh J. '11 Ch
Hoffman, Henry J. '12 Ch
Johnson, Einer '11 Ch
Johnson, Waldo C. '26 Ch
Joyce, Floyd E. '17 Ch
Kennedy, Wm. W. '07 Ch
Koch, Arthur Louis '19 ChE
Kryger, Edward R. '21 Ch
Kugler, Joseph H. '26 ChE
Livermore, Harry J. '22 ChE
Luft, H. W. '24 ChE
Luft, Oscar W. '17 Ch
Lux, Albert '28 OrgCh
McMiller, Paul R. '11 Ch
Maehl, Kenneth A. '27 Ch
Murray, Robert '26 ChE
Nicholson, Harry G. '21 ChE
Nye, Lillian L. '10 Ch
Parkin, Guy G. '12 Ch, '13 Ch
Peterson, Marshall A. '21 ChE
Rauen, Theodore '26 ChE
Roehrich, Victor '09 ChE
Rockwood, Ralph H. '12 Ch
Smith, Sheldon H. '10 ChE
Tancheff, Stand T. '15 Ch
Vievering, Wm. A. '25 Ch
Winslow, Raymond M. '19 ChE
ST. PETER
Skartvedt, Peter M. '06 Ch, '13 Ch
TWO HARBORS
Jordan, Wallace E. '26 ChE
VIRGINIA
Barrows, Vera '17 Ch

MISSOURI

KANSAS CITY
Tibbling, Ernest F. '14 Ch
MARSHALL
Pettijohn, Earl
'11 Ch, '12 Ch, '19 PhD

MONTANA

GREAT FALLS
Jufrud, Ingvald O. '14 Ch

NEBRASKA

LINCOLN
Pagel, H. Armin '23 Ch

NEW HAMPSHIRE

BERLIN
Burningham, F. A. '17 ChE
HANOVER
Hartshorn, Elden B. '22 PhD

NEW JERSEY

BLOOMFIELD
Widell, E. Gideon '17 ChE
CAMDEN
Corson, Benjamin L. '17 Ch
HARRISON
Wyman, LeRoy Linwood '22 ChE
KENVIL
Paul, Karl F. '24 ChE
MONTCLAIR
Cassel, Norman S. '22 ChE
NEW BRUNSWICK
Von Kuster, Edith I. '07 Ch
(Mrs. W. Johnson Kenyon)
NEWARK
Rose, Anton R. '04 Ch
PERTH AMBOY
Johnson, Lester L. '25 ChE
Johnston, Charles L. '25 ChE
Kohlhase, Arthur H. '31 Ch
Paulson, Paul M. '23 ChE
Temple, Sterling N. '05 PhB
Wernlund, Chris '27 PhD

NEW YORK

BROOKLYN
Stoppel, Ernest A. '11 Ch
BUFFALO
Bakken, Adolph C. '23 Ch
Sverdrup, Edward F. '26 ChE
CHENANGO FORKS
Harshaw, John R. '13 Ch
FULTON
Korfhage, Roy F. '20 Ch
NEW YORK CITY
Bierman, Harry C. '14 ChE
Kokatnur, Vaman R. '14 Ch
Luger, Karl E. '22 ChE
Moe, Claude P. '20 Ch
Thordarson, Wm. '23 ChE
NIAGARA FALLS
Benner, Raymond C. '02 Ch
Dobrovolny, Frank J. '24 Ch
POUGHKEEPSIE
Crawford, Marjorie '27 PhD
ROCHESTER
Matthews, Glenn E. '20 Ch
Nietz, Adolph '13 Ch
Seymour, Merrill W. '21Ch
SYRACUSE
McKee, John B. '25 ChE
Smith, Allen S. '26 ChE
UTICA
Sternberg, Woldemar M. '18 PhD
YONKERS
Rice, Edgar W. '02 Ch

NORTH CAROLINA

RALEIGH
Halvorson, John Oliver '07 Ch

NORTH DAKOTA

FARGO
Berkel, Arthur C. '19 Ch
Sunde, Conrad J. '26 OCh
GRAND FORKS
Anderson, Edward X. '08 Ch
DeVaney, Grace M. '26 Ch
Gauger, A. W. '14 Ch
Harris, Elwin E. '22 Ch
Lavine, Irvin '24 ChE
WILLISTON
Jackson, Myron B. '05 A. C.

OHIO

AKRON
Morris, Vlon N. '26 PhD
CLEVELAND
Anderson, Winslow S. '23 Ch
Marr, Horace S. '17 Ch
Yngve, Victor '13 Ch, '14 MS
IVORYDALE
Jewett, Ernest E. '25 ChE
Krantz, Rudolph W. '24 ChE
Pagnucco, John W. '23 Ch
Shirk, Loren H. '26 ChE
MANSFIELD
Langseth, Axel O. '22 ChE
Morken, Carl H. '22 ChE
TOLEDO
Donauer, Max '18, '25 ChE

OKLAHOMA

NORMAN
Swearingen, Lloyd E. '26 PhD
PONCA CITY
Nelson, Ernest W. '20BA, '24 ChE

OREGON

PORTLAND
Curtiss, Faith (Sterling) '09 Ch

PENNSYLVANIA

BETHLEHEM
McMillen, Elliot L. '23 ChE
BRADFORD
Leavenworth, Francis M. '11 Ch
DONORA
O'Connell, Thomas C. '13 Ch
EAST PITTSBURGH
May, Darwin R. '14 ChE
NEW CASTLE
Taylor, Carl A. '10 Ch
NEW KENSINGTON
Edwards, Junius D. '12 ChE
Frary, Francis C. '05AC
Pippel, Herbert A. '20 Ch
Taylor, Cyril S. '13 Ch
Weber, Ludwig J. '20 ChE
PHILADELPHIA
Bercovitz, Henry '27 ChE
Manuel, Douglas R. '22 ChE
Roberts, Wesley J. '21 ChE
PITTSBURGH
Selvig, Walter A. '09 Ch
Souther, Benjamin L. '16 Ch

RHODE ISLAND

PROVIDENCE
Tappan, Ruth W. '22 Ch
(Mrs. Joseph Dowling)

SOUTH DAKOTA

MITCHELL
Miller, Ralph Harrison '13 Ch

TENNESSEE

COPPERHILL
Longworth, Fred James '05 A. C.

TEXAS

BEAUMONT
Bernhagen, Lewis O. '06 A. C.
MT. PLEASANT
Bakke, Oliver M. '03 Ch
FT. WORTH
Zeidlick, Wm. J. '25 ChE

VIRGINIA

QUANTICO
Strong, Frank D. '17 ChE

WASHINGTON

PULLMAN
Levine, Arthur '23 PhD
SEATTLE
Durham, Samuel W. '17 Ch
Gillman, Hyam '25 Ch
Linton, James H. '97 ChE
Ringstrom, Hugo '15 Ch, '17Ch
SPOKANE
Bostwick, Ross D. '23 ChE

WISCONSIN

APPLETON
Lewenstein, Abraham '26 ChE
Poppe, Frederick W. '11 Ch
MADISON
Bray, Mark W. '14 Ch
Daniels, Farrington '10 Ch
Peterson, Clifford E. '23 ChE
Reiter, Alfred A. '25 ChE
MENOMONIE
Mitchell, Ralph W. '12 Ch
MILWAUKEE
Epstein, Hymen '21 Ch
Muffat, Harold A. '27 ChE
STEVENS POINT
Hammond, Kathryn D. '22 Ch
(Kelley)

CANADA

Ontario

FORT COLBURN
Kepner, Ben-Hur '11 Ch

Manitoba

WINNIPEG
Joselowitz, Goodwin '18 Ch

ENGLAND

FELSTEAD, ESSEX
Tronson, Carl A. '10 Ch

FRANCE

PARIS
Sarver, Landon A. '24 PhD

TURKEY

CONSTANTINOPLE
Fulmer, Jervis M. '22 Ch

PHILIPPINE ISLANDS

BAY, LAGUNA
Galvez, Nicolas L. '25 Ch
MALABON, RIZAL
Roque, Feliciano T. '24 ChE

School of Mines and Metallurgy

ALABAMA

BESSEMER
Morgan, Charles '06 E.M.
BIRMINGHAM
Cowin, Percy G. '18 E.M.
TUSCALOOSA
DeVaney, Fred D. '23 E.M.
Gandrud, Bennie W. '21 E.M.
UNIVERSITY
Lee, Oscar '16 E.M.

ARIZONA

AJO
Olmstead, John S. '08 E.M.
BISBEE
Oscarson, Philip E. '24 E.M.
Smith, Franklin W. '03 E.M.
Ziesemer, Harry M. '07 E.M.
CALUMET
Rait, Donald M. '03 E.M.
CASA GRANDE
Chandler, Eugene D. '00 E.M.
CLARKDALE
Ekloff, Victor E. '11 E.M.
INSPIRATION
Donaghue, Abner J. '20 E.M.
JEROME
Bloom, John R. '27 E.M. Geol
Hansen, Maver G. '23 E.M.
Hendrum, Olaf '13 E.M.
MIAMI
McDermid, Archie J. '16 E.M.
Robertson, John H. '14 E.M.
MORENCI
Beck, Charles S. '11 E.M.
Becker, George '97 E.M.
RAY
Hewitt, Ezra '12 E.M.
Truesdale, Wm. H. '03 E.M.
WARREN
Brace, H. L. '28 E.M.
Lindholm, Milton S. '11 E.M.
Smith, Hoval A. '01 E.M.
Whiteley, Eugene E. '03 E.M.

CALIFORNIA

BELLFLOWER
Bowman, Frank A. '04 E.M.
BERKELEY
Bjorge, Guy N. '12 E.M.
BEVERLY HILLS
Boyd, Robert R. '05 E.M.
GLENDALE
Gillan, Silas L. '87 E.M.
Hunt, Walter F. '00 E.M.
GRAFTON
Crowley, Jay '09 E.M.
HOLLYWOOD
Barker, Clifton T. '22 E.M.
JACKSON
Nichols, Clifford R. '20 E.M.
LODI
Cullyford, James A. '08 E.M.
LONG BEACH
Wallace, C. S. '17 E.M.
Ziesemer, Ralph A. '05 E.M.
LOS ANGELES
Ainsworth, Robert E. '20 E.M.
Armstrong, Harold K. '18 E.M.
Arnold, Lewis E. '20 E.M.
Bass, William C. '99 E.M.
Clark, Fred E. '20 E.M.
Collins, Leon T. '15 E.M.
Friedl, A. '23 E.M.Geol.
Gulick, Hervey '05 E.M.
Henkel, Howard L. '23 E.M.
Jerrard, Walther L. '18 E.M.
Lea, John '12 E.M.
McIntosh, Joseph B. '98 E.M.
Olsthun, Norman '13 E.M.
Olund, Henning E. '07 E.M.
Patton, Richard C. '22 E.M.
Smith, E. W. '07 E.M.
OAKLAND
Walker, Clinton L. '98 E.M.
Wallace, George W. '06 E.M.
OCEAN PARK
Curry, Duncan E. '05 E.M.
PASADENA
Clapp, W. Howard '01 E.M.
PORTERVILLE
Perry, Joe B. '12 E.M.
RIO OSO
Taresh, John '01 E.M.
RIVERSIDE
Prouty, Roswell W. '12 E.M.
SACRAMENTO
Mills, Eugene C. '97 E.M.
SAN BERNARDINO
Stewart, G. G. '10 E.M.
SAN DIEGO
Holden, Henry H. '03 Met.E.
SAN FRANCISCO
Ingersoll, Guy E. '18 E.M.Geol.
SIERRA CITY
Lytzen, W. W. '05 E.M.
YANKEE JIMS
Bailey, Paul T. '11 E.M.

COLORADO

DEER TRAIL
Woodis, Clark N. '12 E.M.
DENVER
Sanderson, Henry S. '01 Met.E.
GILMAN
Brunner, Donald G. '24 E.M.
Tousley, R. M. '28 E.M.Geol.
SMUGGLER
Peterson, Joseph S. '08 E.M.

CONNECTICUT

WESTPORT
Larpenteur, B. J. '25 Met.E.

DISTRICT OF COLUMBIA

WASHINGTON
Erdmann, Charles E. '23 E.M.
Grimes, John A. '08 E.M.
Hoass, Ole G. '08 E.M.
Leonard, Forest M. '10 E.M.
Lovering, Thos. S. '22 E.M.Geol.
Rawson, H. C. '06 E.M.
Ridgeway, Robert H. '23 E.M.

IDAHO

CONDA
O'Brien, J. Charles '12 E.M.
WALLACE
Merriam, Robert S. '05 E.M.
Shonts, Sydney L. '04 E.M.

ILLINOIS

CHICAGO
Baker, Emory P. '11 E.M.
Bodal, Emil K. '26 E.M.
Hamernik, F. J. '21 Met.E.
Harmon, Benjamin G. '10 E.M.
Hutchinson, Bernard C. '24 E.M.
Johnson, Alfred M. '26 E.M.
Keller, Orin '05 E.M.
Lundquist, O. W. '25 E.M.
McKenzie, James R. '10 E.M.
Newell, J. R. '10 E.M.
Smith, Elmo V. '01 Met.E.
Thoeni, Victor T. '22 E.M.
Wasson, Harold J. '14 E.M.
Winter, Harry '25 Met.E.
CHICAGO HEIGHTS
Scheid, Adolph J. '23 Met.E.
LASALLE
Heller, Frederick W. '10 E.M.
Neustadt, Berthold R. '06 E.M.
PEORIA
Wrbitzky, Harry M. '25 E.M.

INDIANA

GARY
Mooney, Frank E. '23 Met.E.

IOWA

AMES
Clement, Lester L. '06 E.M.
SIOUX CITY
Heard, Harold J. '03 E.M.
WATERLOO
Locke, Alfred M. '08 E.M.

KANSAS

FORT RILEY
Wehr, Arthur J. '11 E.M.
WICHITA
Carlson, Edwin N. '21 E.M.

KENTUCKY

LEXINGTON
Crouse, Charles S. '11 E.M.

MARYLAND

EDGEWOOD ARSENAL
Nissen, Arvid '13 E.M.

MASSACHUSETTS

BROOKLINE
May, Albert E. '96 E.M.

MICHIGAN

CRYSTAL FALLS
Anderson, Edwin H. '17 E.M.
Christenson, Alfred '15 E.M.
HOUGHTON
Hamernik, Frank J. '21 Met.E.
RAMSAY
Eidemiller, Howard N. '14 E.M.
Foss, Adolph L. '23 E.M.

MINNESOTA

BUHL
Johnston, Kenneth A. '21 E.M.
CHISHOLM
Borgeson, Anshelm C. '11 E.M.
Duncan, K. J. '10 E.M.
Nord, Harry H. '16 E.M.
CLINTON
Finberg, M. J. '28 Met.E.
COLERAINE
Chang, Chi '18 E.M.
Peterson, Andrew Y. '99 E.M.
CROSBY
Fearing, Edward J. '17 E.M.
Mellem, Walter R. '19 E.M.
Nelson, Evald V. '27 E.M.
Thellin, Herbert E. '23 E.M.
DEERWOOD
Wenger, Frank B. '21 Met.E.
DETROIT
Teague, Harold W. '00 E.M.
DULUTH
Dawson, L. W. '23 Met.E.
Farnam, Henry E. '10 E.M.
Field, Thorold F. '05 E.M.
Frank, Elden '21 E.M.
Gavin, Lawrence T. '09 E.M.
Gustafson, Arnold A. '22 E.M.
Jeffers, Gordon B. '23 E.M.
Oberg, Anton C. '07 E.M.
Rose, William A. '07 E.M.
Stevens, Howard E. '12 E.M.
Strane, A. J. '10 E.M.
Strong, John L. '08 E.M.
EASTON
Herring, William E. '10 E.M.
ELCOR
Anderson, Alfred T. '23 E.M.
ELK RIVER
Houlton, Lewis K. '04 E.M.
Johnson, Ralph C. '22 E.M.
ELY
Santo, Julius H. '09 E.M.
EVELETH
Boyle, Patrick J. '08 E.M.
Ely, Robert H. '13 E.M.
Johnson, Axel L. '20 E.M.
Kerr, Charles D. '15 E.M.
Kingston, Merton S. '04 E.M.
Moyle, Robert M. '27 E.M.
FARIBAULT
Gallagher, Luke J. '23 E.M.
GLENWOOD
Martin, Lynn '12 E.M.

ALUMNI!

Do you like to hear what your old classmates are doing? Of course you do! The TECHNO-LOG has tried in the past to give you accurate and interesting news of friends you had at Minnesota and next year we want to have a bigger and better alumni column than *ever before.*

When you get a letter from some old grad or hear of some of his doings that you think might interest other alumni, please give us the "dope" so that we can pass it on. *And,* some day, crawl out of the ol' shell and write us a long letter about yourself, for your classmates will be as interested to hear of you as you are to hear about them.

Hanska
Haugen, Albert C. '15 E.M.
Hibbing
Anderson, Walter C. '11 E.M.
Bassett, Robert H. '07 E.M.
Brandt, John '06 E.M.
Kurtzman, Paul S. '06 E.M.
Loye, Henry E. '03 E.M.
Sponberg, E. C. '21 E.M.
Taylor, William L. '12 E.M.
Vivian, Edgar W. '23 E.M.
Ironton
Angst, Harry H. '05 E.M.
Deichen, William A. '08 E.M.
Plut, Frank J. '22 E.M.
Lakefield
Buresch, Charles E. '17 E.M.
Minneapolis
Allard, Raymond W. '18 Met.E.
Bailord, John A. '24 E.M.
Chadbourn, Charles H. '21 E.M.
Christianson, Peter '94 E.M.
Cole, Willard A. '09 E.M.
Conkey, Charles R. '19 E.M.
Cowin, James '07 E.M.
Craig, John J. '16 E.M.
Curran, Francis J. '16 Met.E.
Devereux, Lawrence '19 E.M.
Elliott, Jay R. '11 E.M.
Erck, E. H. '28 E.M.
Fixen, V. L. '11 E.M.
Forsyth, A. C. '24 Met.E.
Field, Edward M. '03 E.M.
Frellsen, Sidney A. '19 E.M.
Kersten, Erwin H. '20 E.M.
Kilp, Raymond G. '22 E.M.
Kingsley, Neil S. '11 E.M.
Kremer, Edward G. '12 E.M.
Ladd, Greeley '13 E.M.
McHardy, Roy H. '16 E.M.
McKenzie, F. R. '22 E.M.
Mark, Israel '20 E.M.
Merritt, Lucien '04 E.M.
Moody, Reville G. '10 E.M.
Reed, Olaf '07 E.M.
Runke, Donald H. '25 Met.E.
Sung, Kuo Hsiang '24 E.M.
Taylor, Harold G. '09 E.M.
Trengrove, S. A. '28 E.M.
Trulander, Wm. '25 E.M.
Wade, Henry H. '15 E.M.
Wheeler, Walter H. '06 E.M.
Wiest, Michael A. '07 E.M.
Wilson, J. Byron '22 E.M.
Minnesota
Hegnason, George B. '09 E.M.
Montevideo
Aanes, Ole O. '27 E.M.
Michie, Roy G. '13 E.M.
North Hibbing
Anderson, Oscar B. '23 E.M.
Olivia
Winter, William M. '23 E.M.
Red Wing
Hedlund, Wilmer '28 E.M.
St. Paul
Abbott, Theodore S. '11 E.M.
Brawley, John N. '23 E.M.
Coller, Walter A. '15 E.M.
Dowdell, Ralph L. '18 Met.E.
Drake, George M. '11 E.M.
Goldberg, Bert '19 E.M.
Harmon, Sydney '17 E.M.
Howes, Frank T. '06 E.M.
Johnson, Trygve '22 Met.E.
McAdams, H. R. '12 E.M.
Moga, John A. '18 E.M.
Neerland, Herman '15 E.M.
Olson, Walter S. '12 E.M.
Quinlan, Howard '14 E.M.
Raiter, Clifford R. '20 E.M.
Rood, Lynn '09 E.M.
Sjolander, A. '23 E.M.
West, Herbert S. '21 Met.E.
Williams, Homer A. '09 E.M.
Wolfer, Donald H. '23 E.M.
Slayton
Minder, Emil G. '05 E.M.
Spring Valley
Kendrick, William L. '25 E.M.
Virginia
Erickson, Arthur C. '23 E.M.
Nelimark, John H. '24 E.M.
Sweetman, Edwin A. '17 E.M.
Wabasha
Searles, John N. '23 E.M.
Willmar
Coventry, Edward D. '12 E.M.

MISSOURI

Annapolis
Schenius, Carl H. '21 E.M.
St. Louis
Boeger, H. S. '28 Met.E.

MONTANA

Anaconda
Jensen, Willard C. '24 E.M.
Ramsing, Fred C. '15 E.M.
Billings
Davies, Fred A. '16 E.M.
Davies, Herman F. '21 E.M.Geol.
Stewart, James L. '24 E.M.
Walsh, R. P. '28 E.M.Geol.
Butte
Brenner, Walter W. '23 E.M.
Coady, Leo J. '13 E.M.
Haley, A. J. '25 E.M.
Rahilly, Harold J. '11 E.M.
Sherman, Howard P. '25 E.M.
Studer, Ralph J. '26 E.M.
Tanner, Wallace N. '96 E.M.
Fairview
Frank, Harry O. '20 E.M.
Helena
Heidel, C. Sumner '10 E.M.
Phillipsburg
Fritzberg, Ernest A. '10 E.M.

NEBRASKA

Crete
Hawlick, Hartley H. '23 E.M.

NEVADA

Comstock
Winther, Arno '03 E.M.
Goldfield
Wilkinson, Charles D. '95 E.M.
Gold Hill
Goodrich, Norman P. '10 E.M.
Tetlie, John R. '11 E.M.
Las Vegas
Toll, Rensselaer '00 E.M.
Reno
Schrader, Erick J. '05 E.M.
Virginia City
Burgess, Robert J. '11 E.M.

NEW JERSEY

Phillipsburg
Haase, Conrad C. '26 E.M.
Persons, R. W. '23 Met.E.
Rutherford
Butler, Roy G. '21 E.M.

NEW MEXICO

Hurley
Knox, LaFayette '21 E.M.
Santa Fe
Harrington, Guy P. '06 E.M.
McCarty, Andrew L. '04 E.M.
Valedon
Dickson, Robert H. '12 E.M.

NEW YORK

Albany
Dinmore, Harry C. '23 E.M.
New York City
Hennen, Edward H. '25 E.M.
Keene, Amor F. '04 E.M.
Kennedy, John J. '08 E.M.
McRae, Randolph J. '07 E.M.
Persons, Robert W. '23 Met.E.
Queneau, Roland B. '23 Met.E.
Ravicz, Louis G. '14 E.M.
Swenson, Karl P. '07 E.M.
Walters, Charles W. '11 E.M.
New Rochelle
Wales, Roland T. '97 E.M.
Niagara Falls
Woodruff, John J. '17 E.M.
Painted Post
Case, Leslie M. '24 E.M.
Schenectady
Hoyt, Samuel L. '09 E.M.

NORTH DAKOTA

Mandan
Olson, Walter S. '25 E.M.Geol.
Sylvester, Robert E. '27 E.M.

OHIO

Cleveland
Jerabek, Theophil E. '27 Met.E.
Sowle, Lawrence K. '03 E.M.
Lorain
Wiley, R. E. '26 Met.E.
Mansfield
Boreen, Milden S. '26 Met.E.
Marion
Johnson, Ralph L. '26 Met.E.
Massillon
Hebling, J. A. '28 Met.E.
Middletown
Johnson, W. S. '28 Met.E.

OKLAHOMA

Cardin
Winther, Arno '03 E.M.
Muskogee
Larson, Clarence L. '10 E.M.
Oklahoma City
Edwards, Frank R. '08 E.M.
Okmulgee
Levorsen, A. Irving '17 E.M.
Ponca City
Knutson, Clarence J. '24 E.M.
Tulsa
Conheim, Howard J. '23 E.M.
Elson, William H. '17 E.M.
Foley, Lyndon L. '18 E.M.Geol.
Giltinan, George M. '10 E.M.
Kamb, Hugo R. '25 E.M.Geol.
Williams, Paul S. '15 E.M.

OREGON

Linnton
Larson, Ernest L. '14 E.M.

PENNSYLVANIA

Bethlehem
Deringer, Paul J. '27 Met.E.
Durfee, J. C. '27 Met.E.
Huck, George M. '26 Met.E.
Johnson, George A. '25 Met.E.
Russell, Charles B. '23 E.M.
Swenson, Clifford H. '23 E.M.
East Pittsburgh
Krogh, Alvin T. '16 Met.E.
Easton
Thomassen, Mark W. '26 Met.E.
New Castle
Barr, J. Carroll '22 E.M.
Griswold, Willis R. '23 E.M.
Pittsburgh
Copeland, William A. '20 E.M.
Scranton
Caddy, H. T. '27 E.M.

TENNESSEE

Copperhill
Sodoma, Joseph '25 Met.E.
Isabella
Alexander, James W. '26 E.M.
Kegler, Vern L. '23 E.M.
Martin, Henry K. '26 E.M.
Knoxville
Arnold, Lowell W. '27 E.M.
Memphis
Hanson, J. Bernard '13 E.M.

TEXAS

Amarillo
Hubbard, William E. '17 E.M.
Brownwood
Clay, J. Withers '23 E.M.
Cisco
Dovre, Adolph '16 E.M.
Lewis, J. Whitney '12 E.M.
Wilcox, Fred H. '23 E.M.
Dallas
Aronson, Sam '16 E.M.
Bierman, Alfred C. '14 E.M.
Whitson, Lloyd R. '11 E.M.
Eastland
Olson, Walter S. '25 E.M.Geol.
El Paso
Quinn, Howard E. '18 E.M.
Fort Worth
Coryell, Lewis S. '17 E.M.Geol.
Freeport
Lee, Clarence O. '24 E.M.
San Angelo
Van Duzee, Everett N. '26 E.M.
Wichita Falls
Adams, E. Maurice '22 E.M.
Tollefson, E. H. '23 E.M.

UTAH

International
Nichols, William J. '21 Met.E.
Iron Springs
Urquhart, George K. '15 E.M.
Salt Lake City
Larsen, R. M. '24 E.M.

WASHINGTON

Davenport
Campbell, William L. '00 E.M.
Kelso
Jones, Philo E. '10 E.M.
Montesano
Levy, J. H. '23 E.M.

WEST VIRGINIA

Clarksburg
Moga, Gregory '22 E.M.

WISCONSIN

Mayville
O'Connor, Edward S. '06 E.M.
Mellen
Sponberg, Edwin C. '21 E.M.
Milwaukee
Coolidge, Marshall H. '27 E.M.
Scheid, Carl F. '25 Met.E.
Superior
Moe, Cecil J. '24 E.M.

WYOMING

Laramie
McCarty, Edward P. '00 E.M.
Salt Creek
Walter, Rollie B. '12 E.M.
Sunrise
Moenke, William F. '06 E.M.

AFRICA

Congo-Belge

Elizabethville, Katanga
Walker, E. Harold '11 E.M.

North Rhodesia

N. Changa
Andrews, Thomas F. '26 E.M.Geol.
Armstrong, Lee C. '27 E.M.Geol.
Heins, M. E. '28 E.M.Geol.
LaTendresse, H. E. '23 E.M.Geol.

Portuguese West Africa

Angola
Ernster, Omer F. '17 E.M.

ALASKA

Fairbanks
Egleston, G. J. '00 E.M.

AUSTRALIA

Melbourne
Mann, Victor I. '25 E.M.

BELGIUM

Brussels
Butler, William V. '15 E.M.
Grant, Roy C. '09 E.M.
Middleton, John L. '23 E.M.

CANADA

British Columbia

Kamloops
Wallinder, Arthur '12 E.M.
Porteau
Burgess, Thomas O. '01 E.M.

Manitoba

Winnipeg
Fosness, Arthur W. '13 E.M.

Ontario

Gowganda
Swanson, Axel H. '10 E.M.
Haileybury
Bischoff, Harry E. '10 E.M.
Kirkland Lake
Heath, Clarence L. '10 E.M.
South Porcupine
Jackson, C. F. '07 E.M.

Quebec

Montreal
Cohen, Samuel W. '03 E.M.

CENTRAL AMERICA

Honduras

Minas De Oro
Brosius, Harold I. '04 Met.E.
San Juancito
Zanger, Eugene '21 E.M.

CHINA

Changsha, Hunan
Huang, Ta Heng '24 E.M.
Mukden, Manchuria
Hsieh, Chung '18 E.M.
Peking
Chie, San Sieh '22 E.M.
Shanghai
Kwong, Yih Kun '17 E.M.

CUBA

Province Pinar-Del-Rio
Devereux, Francis C. '04 E.M.

ENGLAND

Newton Abbot, Devonshire
Brackenbury, Cyril '98 E.M.

INDIA

Burma
Calhoun, Allan B. '05 E.M.

MEXICO

El Oro, Ostado De Mexico
Flynn, John G. '03 E.M.
Arizpe, Sonora
Hammond, Arthur H. '13 E.M.
Jahn, William F. '11 E.M.
Cananea, Sonora
McKay, Henry S. '05 E.M.
Chihauhau
Calhoun, Robert A. '23 E.M.
Durango
Hezzelwood, G. W. '23 E.M.
Sierra Mojada
Quinn, Max F. '21 E.M.

SOUTH AMERICA

Buenos Aires, Argentine
Harrington, George L. '12 E.M.
Llallagua, Bolivia
Bailey, A. K., Jr. '20 E.M.
Chuquicamata, Chile
Dopp, J. Lawrence '17 E.M.
Pabst, Henry A. '23 E.M.
Amalfi, Colombia
Probst, Elmer A. '07 E.M.
Barranquilla
Wheeler, James D. '20 E.M.
Paramaribo, Dutch Guiana
Edwin, John '20 E.M.
Casapalca, Peru
Sanchez, Richard M. '15 E.M.
Cerro De Pasco
Hosted, Joseph O. '19 E.M.
Quiruvilca, Via Trujillo
Goldberg, Samuel B. '19 E.M.
Maracaibo, Venezuela
Dennis, Richard C. '17 E.M.
Echebarria, Luis de U. '22 E.M.

Once upon a time

THERE WAS an old
MAN WHO LIVED in Ireland
ST. PATRICK by name
AND ONE DAY he drove
ALL OF the snakes out
OF THE PLACE and was loudly
ACCLAIMED as the first engineer
BECAUSE OF his
INVENTION of the worm drive
WHEREFORE IN Honor of him
ENGINEERS every year have an
ENGINEER'S DAY
AND CALL themselves loyal
SONS OF St. Patrick
AND EVERY fall have scraps and
GO TO THE GAYETY
AND MORE THAN THAT
HAVE ESTABLISHED the
TECHNO-LOG to carry
ST. PATRICK'S spirit to every
GRADUATE so that
DURING the passing
YEARS they could keep fresh their
MEMORIES of classmates and college.

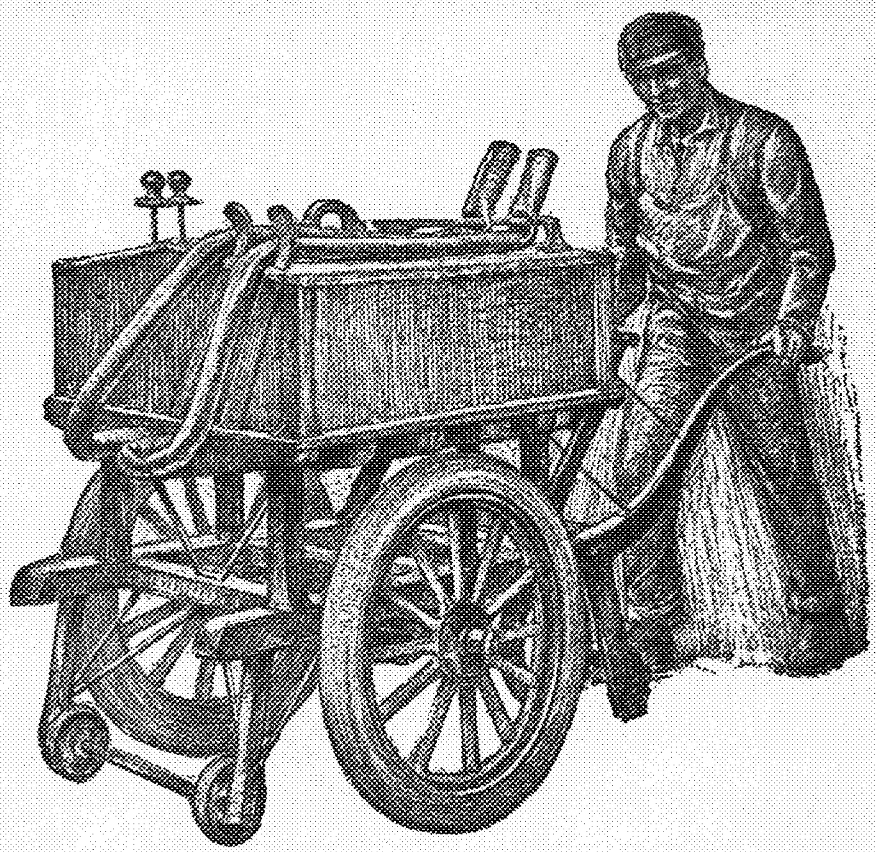
Every alumnus should subscribe to the "Techno-Log."

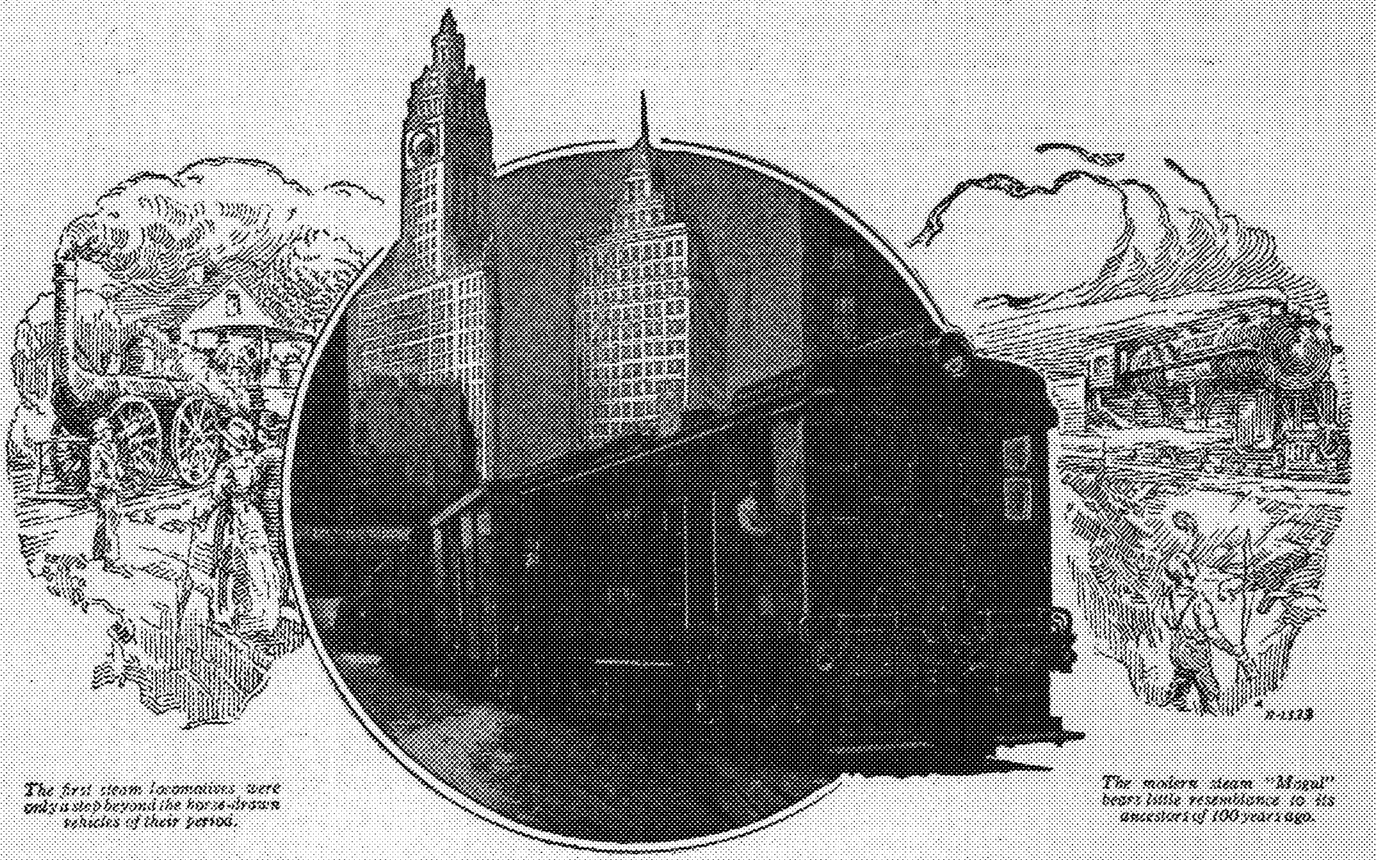
Here's my buck and a half! Send nine issues of the "Techno-Log"

to . . . .

. . . .

. . . .





The first steam locomotives were only a step beyond the horse-drawn vehicles of their period.

The modern steam "Mogul" bears little resemblance to its ancestors of 100 years ago.

An Industrial Pace-Maker

THE last century has witnessed American transportation grow from a modest stripling into a full-fledged giant with more than his share of responsibilities. Regarded with skepticism a hundred years ago, this unpromising infant has gradually welded the country into an industrial unit that has no peer the world over. And he is only just beginning!

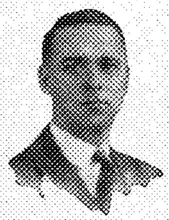
As a matter of history, the interval between the earliest and the most recent developments in railroading is not so great. To be sure, there is a vast mechanical difference between the "Tom Thumb" of 1830 and the massive locomotives of our own inventive age. But the "Puffing Billies," the "Tom Thumbs," the "Stourbridge Lions" were, in their day, advance agents of steam locomotion—ancestors of the modern engines that now haul some two-score cars with perfect ease. They were ancestors, too, of the powerful oil-electric, with its low-cost fuel, quiet operation, and unrivalled flexibility under varying loads.

Briefly, the oil-electric locomotive is one in which an Ingersoll-Rand engine operates a high-capacity generator, the latter furnishing power to several electric motors. By the adaptation of its oil engines to railroad uses, Ingersoll-Rand Co. has again contributed to industry, and has sponsored an idea which is as sound in principle and application as the I-R developments of other years.

INGERSOLL-RAND COMPANY
11 Broadway - New York City
Offices in principal cities the world over

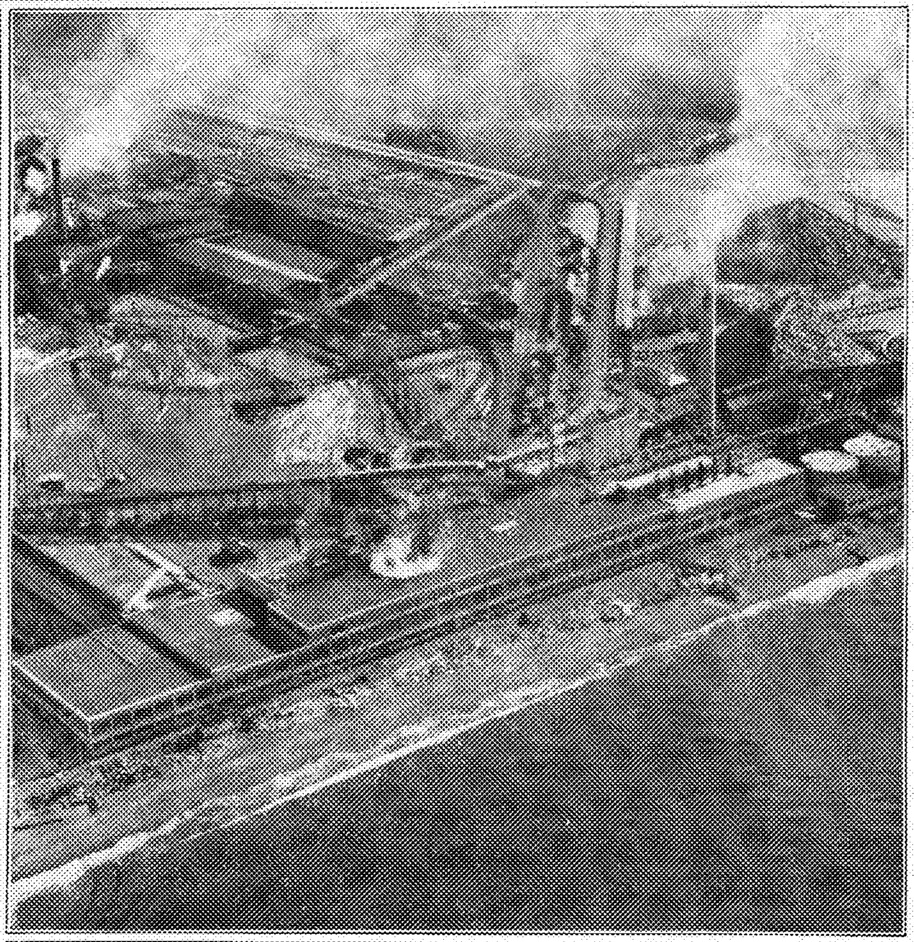
Ingersoll-Rand

K. L. HOWE,
Seattle Office, Engineering Division,
University of Washington '23

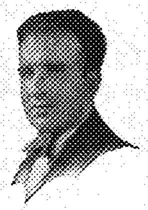


J. S. ERICHSON
Interdepartmental Contract Administration,
University of Pennsylvania '19

R. R. STOLTZ,
Motor Apparatus Sales Department,
Rose Polytechnic Institute '16



YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS



W. LADDENBERGER,
Control Engineering,
Penn State '23

R. R. BAKER,
General Engineering,
University of Michigan '17

G. FITCH,
Contract Administration,
Lehigh University '23

Photo by Brubaker Aerial Surveys, Portland, Oregon.

Washington Pulp *and* Paper Mill

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

AT Port Angeles, Washington, stands the mill of the Washington Pulp and Paper Corporation—a mill that produces enough newsprint every day to make a sheet 10 feet wide and 1,000 miles long.

When this great industrial organization built a mill extension that almost doubled its capacity, Westinghouse, having already supplied electrical equipment for the original plant, was called on to electrify the new unit. Difficult driving problems were met and solved by Westinghouse engineers—with individual motor drives up to 1000 horsepower, with refined control mechanisms, with the sectional paper machine drive that has revolutionized the making of this important product.

Big jobs go to big organizations. Westinghouse attracts young men of enterprise and genius because it daily provides facilities and opportunities which smaller corporations can seldom offer.

The Washington Pulp and Paper Corporation's mill represents the most modern and scientific application of straight line production to the paper industry. Pulp wood enters one end of the long building on an electrically powered monorail carrier. It follows in a continuous line through the grinders, screens, mixers and jordans to the paper machine. At the other end the finished paper is rolled and wrapped for shipment. Power for every operation is supplied by electric motor.

Westinghouse

When Dad was a "Modern Youth"

BICYCLES, stereopticon lectures, and the "gilded" youths with their horses and carts; at night the midnight oil burning in student lamps while the gas lights glared and flickered across the campus—the gay nineties when Dad was in college seem primitive to us to-day.

Now it's sport roadsters, the movies, and radios. At night the MAZDA lamp replaces the midnight oil in dormitory rooms, while modern street lighting sheds its friendly glow over the campus.

Without electricity we would have none of these improvements. To-day's marvel of electrical invention becomes to-morrow's accepted utility. In the coming years, by taking advantage of new uses of electricity you will be able to go so much farther that the "tearing twenties" will seem just as primitive as the "gay nineties".

Scientists in the research laboratories of the General Electric Company keep G.E. a leader in the field of electrical progress. Skilled G-E engineers develop each latest invention. The G-E factories carry out the engineers' designs with high-quality material and expert workmanship.

95-538DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK