The MINNESOTA TECHNO-LOG

VOLUME VI

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THE MINNESOTA TECHNO-LOG

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OCTOBER
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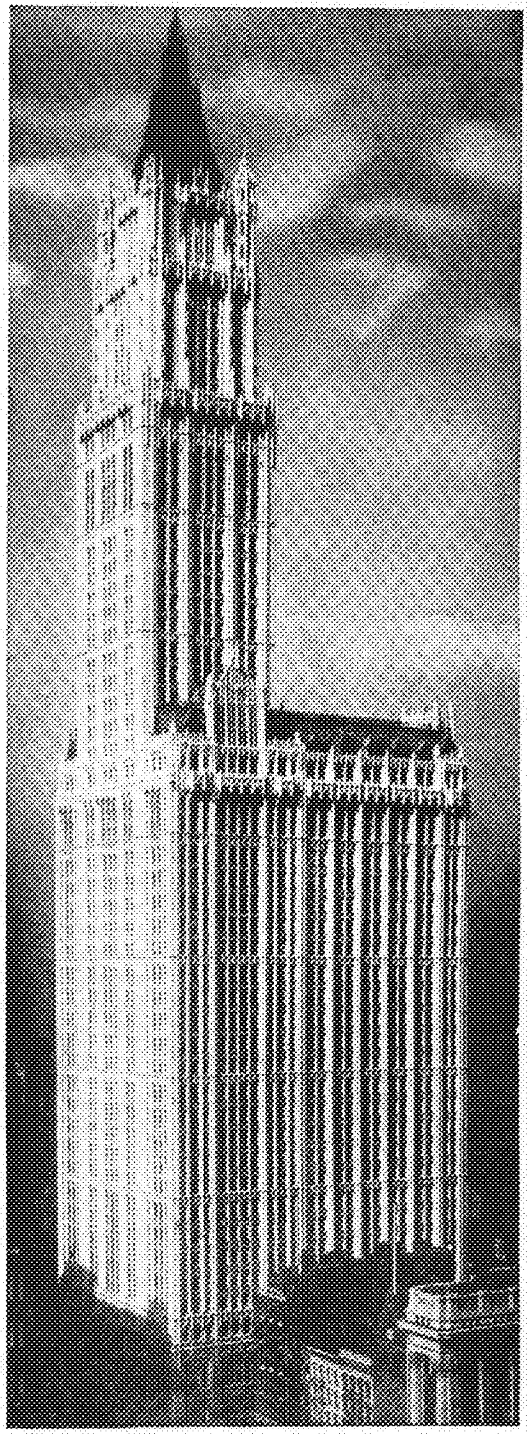
VOL. VI. PRICE 25 CENTS NO. 1.

He Believed a Lie and Scorned the Truth



A YOUNG PEASANT of Central Europe was eagerly questioning two Harvard men regarding the wonders of New York.

The first one told him that some of the New York buildings are so tall that they are snowcapped all the year. The peasant stared a moment at this, but decided it must be true.

Then the second Harvard man spoke of the great buildings equipped with dozens of elevators, some for local service, some for express to the twentieth and higher storeys. The peasant burst out laughing and said, "Now you are making fun of me!"

Strange but true, of the two marvels the real one was harder to believe. The identification of Otis Elevators with the buildings of New York and other great cities of the world is accepted quite casually by those who visit the important world centers.

THE WOOLWORTH BUILDING, *New York is the highest commercial building in the world. The Otis tower elevators travel a distance of 680 feet, running at a speed of 600 F. P. M., there being 26 Otis elevators in the building.*

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The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

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University of Minnesota

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Agricultural Engineering

A history and description of four year course recently approved by Regents for introduction into University curriculum

By Harry B. Roe, G '08

Associate Professor of Drainage Department of Agriculture, University of Minnesota.

AT their meeting in July, 1925, the Board of Regents approved the introduction into the University curriculum, beginning with the college year 1925-1926, of a four year technical engineering course leading to the degree of Bachelor of Science in Agricultural Engineering. This course will be jointly administered by the Dean of the College of Engineering and the Dean of the College of Agriculture. A discussion of the new course and its history is, therefore, of timely interest.

In the land grant colleges the curricula of the departments of agriculture generally provided, at the outset, for elementary instruction in physics of agriculture, drawing, mechanical training and land reclamation that would give to the farmer and to the investigator in agricultural science such knowledge of these fields as it was manifestly necessary for him to have.

In this, Minnesota has been no exception, but was, rather, a pioneer in this type of education. In 1888, when the School of Agriculture was established and the College of Agriculture was placed on a definite footing, elementary instruction in physics of agriculture, drawing and carpentry were definitely included in the curricula. Blacksmithing was added in 1893, power machinery in 1898, and mechanical training covering some cement, rope, and pipe work, etc., in 1906. Instruction in farm structures was included in 1907, and in 1908 drainage and tractor and auto work were similarly provided for. No provision was made for instruction in land clearing until 1918 when the distribution of cheap war-salvaged explosive was begun by the Federal department.

It should be remembered that, during this earlier formative period, instruction along these lines was purely elementary in character and that such subjects were not generally recognized as a related group but each was taken on individually as a necessary, unclassified adjunct to what were then considered the more fundamental and important lines of work. Even after it began to be recognized that the various lines of mechanical instruction and allied work could and should be conveniently grouped together as a class, this group was not called engineering and it was *not* engineering. Nevertheless it must be recognized that agricultural engineering as

PROFESSOR WILLIAM BOSS
Chief of the division of agricultural engineering, University of Minnesota

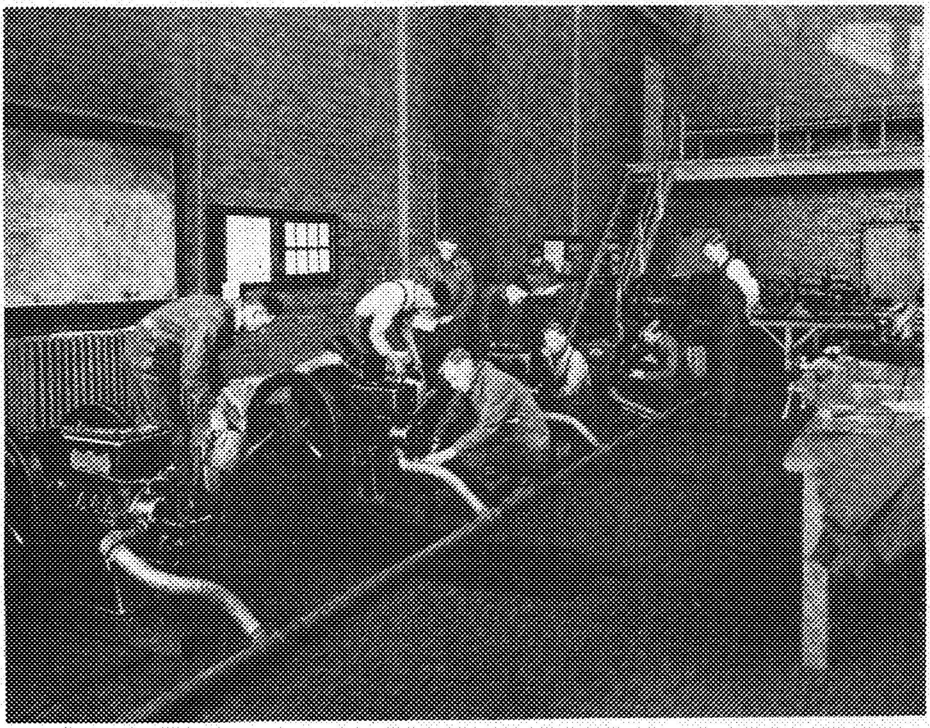
a profession is the direct outgrowth from this early group of mechanical activities.

For many years, however, the majority of people interested in agricultural development and education refused to recognize the birth, growth and importance of agricultural engineering.

An Economic Need. During those years filled with earnest effort in scientific agriculture, however, the farmer has profited by scientific methods in combating plant and animal diseases, by crop improvement through seed selection and plant breeding, by live stock improvement through good breeding and sire selection, and by good business methods based on sound agricultural economic principles. What he has been slow to recognize is that the improvement in crops and live stock would not have been possible without a parallel improvement in his buildings, machinery, and equipment, and in soil and tillage conditions resulting from intelligent reclamation methods. Hence the improvement in these mechanical lines has not in the past received anything like as much public expression of appreciation nor as much publicity as have the steps of progress along purely scientific lines in agriculture.

While the development in farm machinery and other farm equipment has been so great that the labor required to produce one bushel of wheat 75 years ago is sufficient to produce 43 bushels today, yet the greatest field for reducing the cost of production lies in reducing the costs of labor, power, and equipment. Professor Warren of Cornell tells us that the three items of labor, power, and equipment constitute about 30 per cent of the cost of production of hogs, 60 per cent of the cost of production of alfalfa hay and as high as 80 per cent for the cost of production of corn. The only way to reduce these items of cost is through better equipment, better buildings, more efficient farm machinery. A large part of the work of the agricultural engineer is the development of such equipment and such machinery. Good buildings and good farm machinery cannot be considered so much a luxury as a means of reducing the cost of production on the farm.

The investment in buildings and equipment for the farms in Minnesota is so large that it is a very influential factor in the cost of production on the farm. Of the total investment in farm property in Minnesota in 1920, 15 per cent is in buildings, and 5 per cent in machinery, these two items constituting one-fifth of the total investment. Unwise selection, inefficient operation and the large depreciation through poor maintenance of such costly equipment, may make the cost of production so high as to absorb all profits that may be secured by better seed bed preparation, high quality products, and good live stock. A similar result may follow neglect of proper drainage or its improper installation, in the treatment of soils and in the economy of field operations. The



MAKING PRONY BRAKE TESTS
In this laboratory, various makes of gasoline engines as used on the farm, are tested for their efficiencies. Note the ingenious manner of disposing of exhaust gases.

value of the land constitutes about 70 per cent of the total investment in the farm, yet drainage research at University Farm shows that almost one-third of this investment is for acres wholly unfit for tillage until reclaimed by drainage and that failure to drain these waste acres constitutes a standing menace to efficient field operation, the increase in cost of production from this cause alone often running as high as 33 per cent. The investment in live stock is only 8 per cent of the total farm valuation. This is one of the smallest items of investment made by the farmer, yet the farmer and the whole state have given much more scientific study to live stock than to that of agricultural engineering.

The following items concerning Minnesota farms will be of interest in showing some of the problems that the farmer meets in attempting to secure the large amount of equipment that is necessary for his farm in striving to operate the farm economically and at a profit.

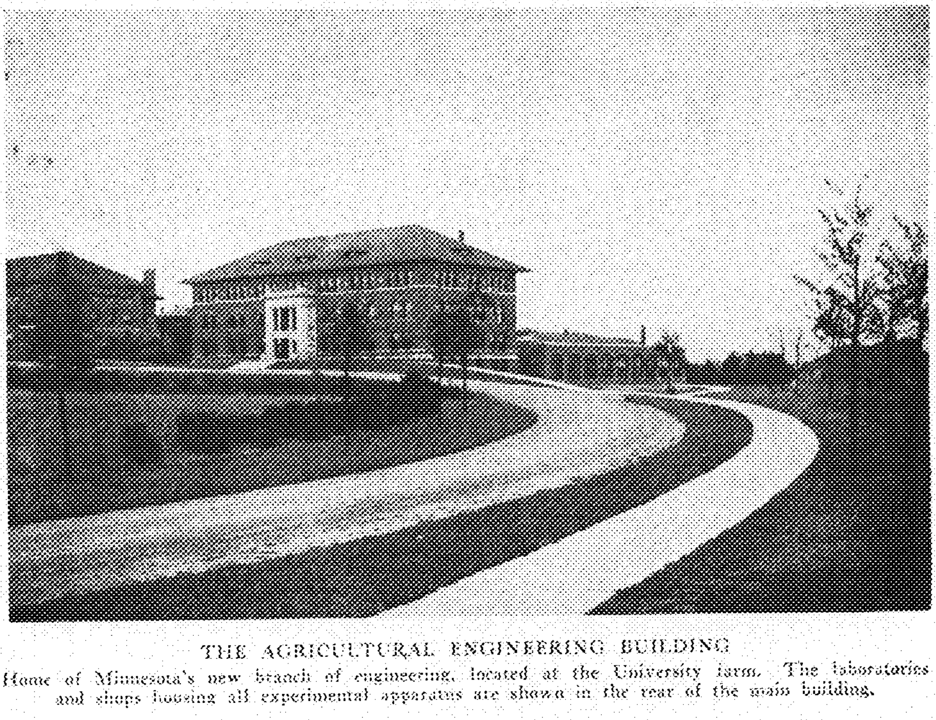
1. Approximately 30% of the area now in farms requires reclamation by drainage for economical operation.
2. There are about 20,000 tractors in use in the state representing over one hundred types of tractors manufactured by about 50 companies, ranging in H. P. from 1 H. P. to 85 H. P. Their use is increasing at the rate of about 9% each year.
3. There are 70,000 stationary engines in use on the farms represented by a greater number of models than are the tractors.
4. The average farm investment in buildings in Minnesota is $3,086.
5. The average investment *per acre* in tillable land is about $165.

Required an Agricultural Engineer. These few items show the situation that a farmer is in when he attempts to cut down his cost of production by the use of modern machinery or by the improvement of his farm and buildings. The farmer cannot expect to know much about the technical details of this equipment and must rely upon engineering experts for advice in the selection and their help in the production of efficient equipment. Many people think that a farmer might secure service and help from engineers of the old established types. While this may be possible it is highly improbable and has not worked out very well in the past. The engineer trained in other lines of endeavor seldom has a grasp of the agricultural problems or of the methods of agricultural production in such a way that he can be of much assistance to the farmers. His highly specialized training has been along lines entirely different from the engineering and production problems of the farm. The training that a man receives which enables him to design a large city office building, or a city sewer or water system, or a manufacturing plant, does not enable him intelligently to plan a dairy barn, a grain storage building, or a tile drainage system for the farmer. While he might make such plans, they certainly could be much more efficiently worked out by an engineer trained in agricultural engineering.

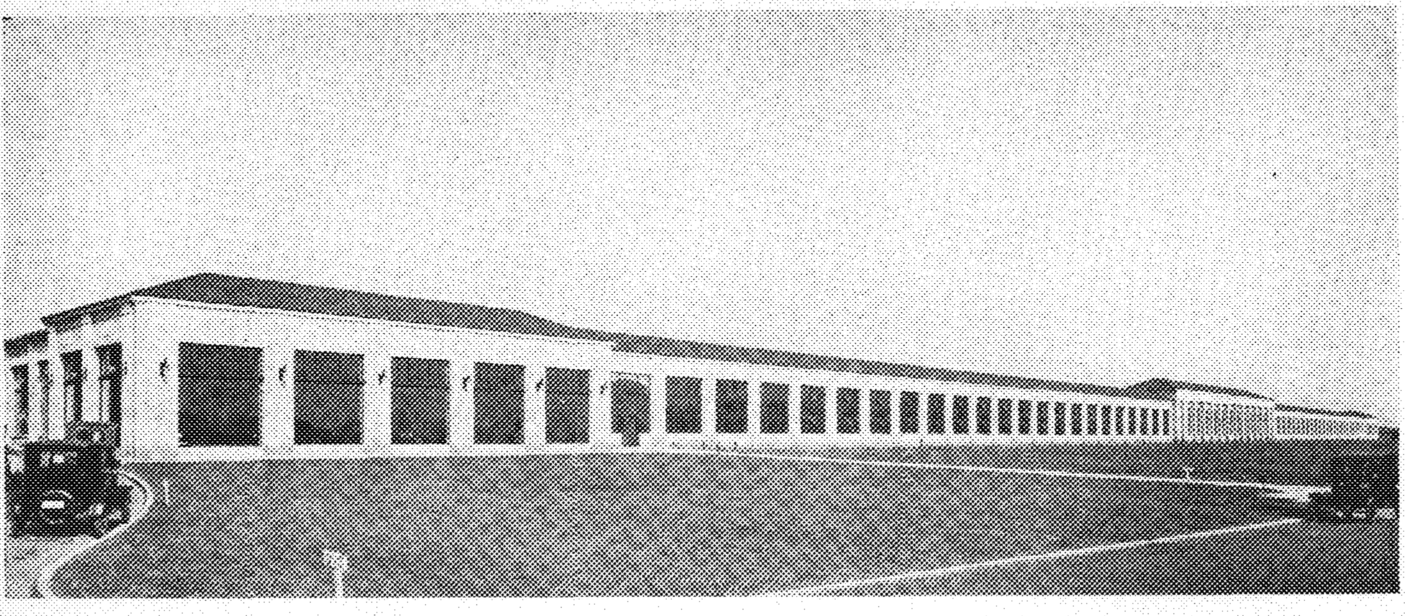
Because of a lack of mutual understanding and the absence of a sympathetic contact between the farmer and the engineer in the past there has been a great gap. It has been found necessary that that gap be bridged, for the farmer is beginning to realize that he needs engineering service.

The agricultural engineering field is not, at the present time, a highly specialized one. The agricultural engineer as quite generally needed today is a general practitioner. His prototype may be found in the country doctor of a generation ago, who was a transitional type but a very necessary and useful type, replaced almost wholly in these days of more advanced development by the great army of specialists in the practice of the art and science of healing. The men in this country who have a sufficiently broad knowledge of the whole field properly

(*Continued on page 20*)



THE AGRICULTURAL ENGINEERING BUILDING
Home of Minnesota's new branch of engineering, located at the University farm. The laboratories and shops housing all experimental apparatus are shown in the rear of the main building.



MAIN ASSEMBLING AND MANUFACTURING PLANT

The Twin Cities Ford Plant

Assembling building, hydro-electric station, and auxiliary steam plant comprise Northwest's largest recent industrial addition

By George A. Nelson, C '25
United States Coast and Geodetic Survey.

ONE of the latest additions to the industrial development of the Twin Cities is the plant of the Ford Motor Company at the site of the high dam in St. Paul. It marks the culmination of a long and varied three-cornered fight between the two cities, Minneapolis and St. Paul, and the University of Minnesota, to utilize the power at the government dam. The plant, which may be the forerunner of many others in the same vicinity, is one of the most complete ever built in the Twin Cities. It comprises the main assembling and manufacturing building, which covers nearly twenty acres, the oil house housing paint ingredients, the hydro-electric power house at the dam, and the auxiliary steam plant.

The problem of building an industrial plant at the site of the high dam was complicated by the existence of a boulevard and park system along the river bluff, and a well developed residential district toward the north. An industrial plant that would not mar the natural beauty of the river at this point required a large expenditure of money. That the plant enhances rather than detracts from the natural beauty of the river drive, anyone who has driven through there will agree. The main building is set back from the bluff about 600 ft. and has a wide expanse of lawn sloping down to the river drive. The building itself is of steel construction. It is faced with limestone and has a red tile roof. The building has a frontage of 1,400 ft. and is 600 ft. deep. The railroad serving the plant has its tracks running through and behind the building and so is hidden from view from the boulevard. The western side of the building is to be used for assembling cars and the eastern side for manufacturing, probably plate glass.

The primary power unit, the hydro-electric plant, is built of reinforced concrete and also has a red tile roof. It presents a most pleasing appearance when viewed from the Minneapolis side of the river with the varied foliage and creamy sandstone of the river bluff for a background. The interior is tastefully finished, if such a word may be applied to a utilitarian building. In the generator room are the four generators in line, each about twenty feet in diameter and about ten feet above the floor. They are finished in red enamel. The floor consists of large brick red tile with a baseboard of black tile. The walls are plastered and painted. The finishings are of marble and natural white oak.

The steam plant, about 800 ft. farther down the river, is constructed of structural steel with brick and limestone trim. The interior finishing is of the same high grade as that used throughout the rest of the plant. Floors are of red tile, walls of face brick, and all railings of solid Benedict nickel. The pulverized coal furnaces will so effectively dispose of about 200 tons of coal daily, that smoke will be hardly visible at the top of the 250 ft. brick stack.

While the primary function of the river is to furnish power, a secondary purpose and one that may become important, is that of river transportation. Congress recently appropriated several million dollars to create and maintain a six foot channel in the river from Minneapolis to St. Louis. While inland water transportation cannot compete with the railroads in most cases, bulky goods may be successfully carried on barges. In order that the plant may be fully prepared to take advantage of the development of this water transportation, two tunnels have been run from the main plant to the river wharf, which is between the two power plants. These tunnels are about 12 ft. high, 10 ft. wide, and about 700 ft. long. The first 100 ft. from the river opening is lined with reinforced concrete, while the remainder is through solid sandstone where the concrete was found to be unnecessary. However, a coat of gunnite was applied to protect the soft sandstone and seems to be very satisfactory. There is no evidence of spalling or failure of bond between the sandstone walls and the gunnite. The two tunnels intersect at the shaft leading to the interior of the plant and are served by two electrically driven elevators.

Returning again to the hydro-electric plant for a more detailed description, we find that four vertical turbines of the reaction type are used. The rated power of each is 4,500 h. p. These are connected to four generators, 100 r. p. m., 60 cycle, 3 phase, 4,500 kv-a. each. The generated voltage is 13,800, 600 volts higher than that generated by the steam plant. This additional voltage permits the sale of surplus power to the Northern States Power Company.

The speed of the generators is controlled by regulating the gate openings to the turbines, since the two are direct connected. The governors, one to each generator, are connected to the wicket gates admitting water to the turbines. They are so arranged that any fluctuation of speed in the generators opens or closes the gate openings as the case may be. In the generator room is also an automatically operated device which records the head on the turbines and the power generated. There is also a 40 ton overhead crane with which to facilitate any necessary repairs to the generators.

On the upstream side of the power house a boom is swung to deflect most of the large floating refuse which occasionally comes down the river. In addition, there is a screen on the inside of the power house, which holds back the floating material which escapes the boom. This screen is composed of bars about four inches apart and extends to the bottom of the intake. The gates for completely shutting off the water from the turbines, should repairs be necessary, are also at this point, back of the screens. They are raised and lowered by an overhead crane which also serves to pick up large objects, such as logs, which may become lodged in the openings. The water wheels operate on about 32 ft. of head.

The main switchboard in the hydro-electric station is located in an open gallery above the generator floor. It is of vertical type and controls the generators, exciters and feeders, as well as most of the station service equipment. There are two buses, one for the circuits delivering power to the Northern States Power Company and one to the Ford Motor Company steam power station.

Since the water available for running a turbine fluctuates with the seasons and the demand for power by an industry does not vary as the water supply, an auxiliary steam plant is needed to supply the deficiency. Where a hydro-electric plant impresses one with its simplicity, a steam plant impresses one equally with its complexity. The steam plant at the high dam has less space per H. P. than most such plants and the difficulty of getting the pipes in place and properly connected was correspondingly great.

A water power plant is usually built at the source of supply, but a steam plant can seldom be built over a coal mine. For this reason the ease with which fuel may be supplied is a vital factor in the economic operation of such a plant. In this case the topography of the land permitted a rather unique solution. The steam plant is below the bluff, close to the level of the river, while the railroad serving the plant, ran on the bluff back of the main building which faces the river. The distance separating the tracks and the steam plant is slightly over 1,000 ft. It was not possible to run a spur track to the edge of the bluff since a pleasure parkway winds along the edge. Accordingly a tunnel was constructed and the coal conveyed by means of an endless belt, 2,070 ft. long. It is of six ply rubber, 20 in. wide. The coal is dumped into a pit at the far end, run through a chusher, and dumped on the long belt, and is weighed on the belt while moving.

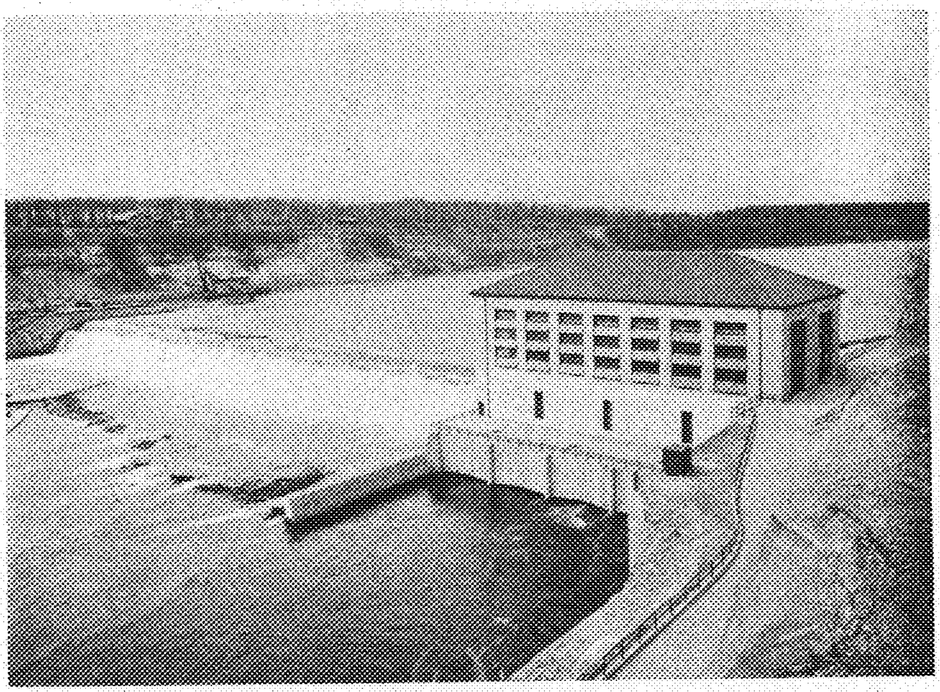
Upon arriving at the steam plant, it is transferred to a scraper conveyor and carried to the pulverizers. There are four of these, each with a capacity of six tons per hour. These pulverizers consist of six horizontal rollers revolving radially between two discs, the diameter of the discs being about eight ft. They are of the air separator type which means that by regulating the pressure with which the air is forced in, any desired fineness of coal dust may be obtained.

There are three passageways entering the crusher, one in which the unpulverized coal enters, one in which the powdered coal leaves, which is in the center, and the remaining one in which the air returns to complete the cycle. Each of these crushers is run by a 100 h. p. motor. The fineness of coal dust most suitable for use in the furnaces is such that 65 per cent passes a 200 mesh sieve and 98 per cent a 50 mesh sieve.

The necessary air pressure for operation of the pulverizers is furnished by a fan called an exhauster, run by a 50 h. p. motor. There are four of these, one to each pulverizer. The exhauster sends the air and coal dust to what is known as the cyclone separator. This is a conical shaped tank about 15 ft. high, small end at the bottom. The design is such that centrifugal force throws the particles of coal away from the center and allows them to slide down the sides into the storage bins. The air is forced upward by the pressure furnished by the exhauster and returns to the pulverizer, thereby completing its cycle.

Water for the operation of the plant is pumped directly from the river. It is forced through pressure filters and boiler feed make-up water is evaporated separately. Two boilers with a rated boiler h. p. of 1,361 each furnish the steam for the turbines and heat for manufacturing processes. They are remarkable in that they will carry 300 per cent of their rated capacity, although such an overload is uneconomical. Boiler pressure is 275 lbs. The boiler settings are of hollow wall construction, the walls comprising nine inch fire brick next to the fire, a 17 in. air space and a wall of insulating brick seven in. thick, all covered with a steel casing. Another feature worthy of note is that below the firing level the furnace and the turbine room are not separated from each other. About 10 per cent of the air necessary for combustion comes in with the pulverized fuel as it is blown in. The hollow space between the furnace walls is the duct through which the remainder of the air is supplied. This effects a decided economy since most of the heat taken up by this air would otherwise be lost by radiation.

There are two feed water pumps to each boiler, one 200 gal. per min. motor driven, and one 300 gal. per min. turbine driven. There are also two separate water feed pipes to each boiler. This is



HYDRO-ELECTRIC STATION AND DAM ACROSS MISSISSIPPI

This plant houses four vertical turbines, each with a rating of 4,500 h. p., which are connected to generators capable of 4,500 kv-a. each. All additional energy is sold to the Northern States Power company for distribution.

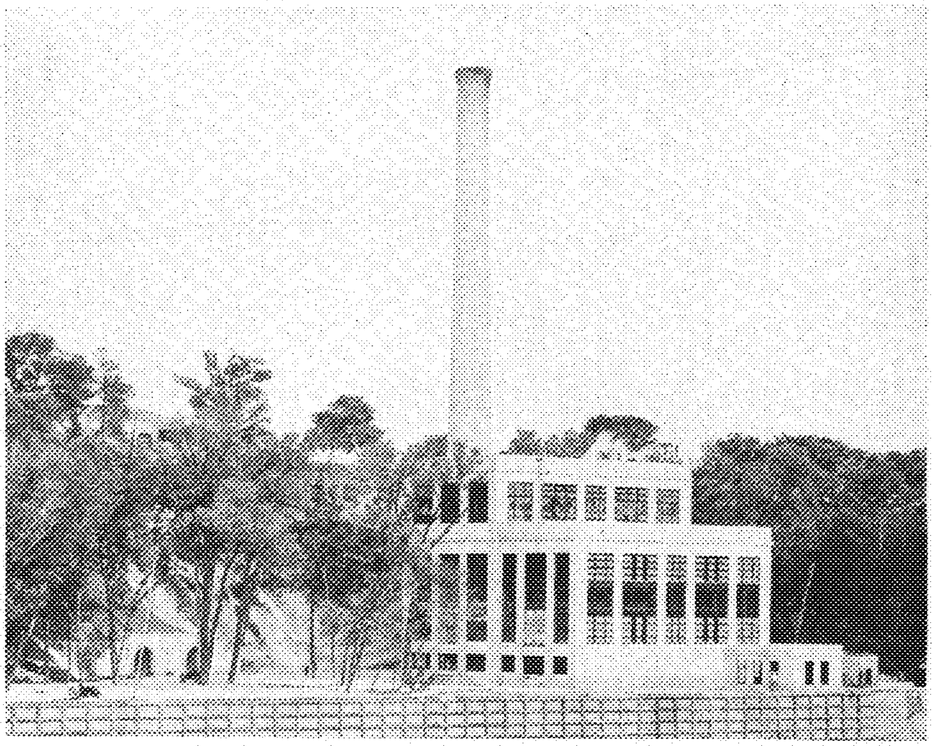
a safeguard against a forced shut down of the boiler due to lack of water. In addition to being evaporated the feed water is also deaerated before injection into the boiler, to prevent corrosion.

A superheat of 100 degrees is given to the steam by means of a superheater. This auxiliary is of the convection type; its tubes are in the first bank of the boiler tubes. This combination was designed to give steam at about 514 deg. total; actual tests to date show a steam temperature of 550 deg.

As said before, the furnaces burn pulverized fuel. There are six burners to each furnace. They consist of a pipe about four in. in diameter through which the fuel is blown, and they enter the furnace from the top. The pressure at which the fuel is supplied is not high, about 15 in. of water or .54 lb. per square inch. This is normal pressure but it may be varied as desired. This type of furnace is especially adaptable to variable loads. There are three methods of regulating the feeding of the fuel; first, by cutting out a burner, second by throttling it by means of a friction clutch, and third, cutting down the speed of the fan supplying the air. Any one or a combination of all three may be used. However, not more than four burners may be cut out simultaneously since the furnace will not operate properly with less. The power operating the fan is a d-c. motor, which permits a variable speed. The volume of each furnace above the ash cooling tubes is 6,570 cu. ft. or about 4.82 cu. ft. per rated h. p. Each furnace under normal operation will consume about 100 tons of coal per day. So efficient is the combustion, however, that smoke is barely visible at the top of the 250 ft. stack while running at about half of the designed capacity. Working under full load the smoke will be even less.

The mechanism for controlling the operations of the boilers is concentrated at one point. The controls for the various units are ultimately to be automatically operated.

As might be expected from the method of firing the fuel, very little ash results. The ash is disposed of in a manner that raises no dust whatsoever; an improvement that anyone familiar with an old type of power house will appreciate. The ash pits have a hopper bottom which is directly connected to a 24 in. pipe. This pipe is connected to a three stage centrifugal pump at one end and empties into a well at the other end. When it is desired to clean out the ash, the pump is started which injects river water into the ash pipe at a high velocity. The hoppers are opened and the ashes are carried into the well. Two 800 gal. per min. centrifugal pumps are connected to the well and these complete the operation of ash disposal by sending the water and ashes out to a low section of river land



THE AUXILIARY STEAM PLANT

Note the tunnels through which fuel is conveyed on belts, 1,000 ft. from the tracks above, to the boilers. This plant is situated 800 ft. further down the river and supplies heat and steam for the entire system.

not far from the plant. The impellers of these ash disposal pumps are subject to severe usage since the ash passes through them. An ordinary impeller would be quickly ruined, so an alloy of manganese is used. Should a large clinker be present in the ash, even these would be liable to damage. Accordingly precautions are taken to keep the ash pit temperature below the fusing point of the ash. This is accomplished by water pipes between the furnace and ash hopper. These pipes are connected to the mud drum of the boiler. Thus a twofold object is accomplished: the ash is kept from fusing and part of the residual heat in the ash is used in heating the water.

Leading from the steam plant to the manufacturing plant, through the same tunnel as the coal is brought in, are numerous pipes. There are fire supply pipes, condensate return pipes, and two steam mains. When the steam turbines are in operation, the necessary steam for heating and process work is supplied by the exhaust from the turbines through a 24 in. main at 10 lbs. pressure. During periods when the hydro plant supplies all the needed electric power, the heat is furnished by 125 lb. steam sent through a 12 in. main. Since the boilers furnish steam at 275 lbs. and from 514 to 550 deg., some device is necessary for removing the superheat and lowering the pressure. This is accomplished by passing the steam through nozzles to which water sprays are attached. These sprays are automatically operated; just enough water is fed into the main to remove the original, or boiler superheat, and the superheat caused by lowering the steam pressure. When the steam finally passes into the main leading to the plant, it is dry, saturated steam at 125 lbs.

The steam used for heating the main building and office is not directly so used. The heating apparatus uses hot water. A feature of this heating system is the fact that the office heating system is entirely separate from the shop system. It is common knowledge that a person engaged in manual labor would be uncomfortably warm at a temperature which an office worker would declare just right. The separate heating systems thus justify themselves in economy and comfort. The pumps and equipment necessary for a large hot water heating system are located underneath the main building, near the center.

Three 500 kv-a. transformers are used to step the voltage down to 440. Remote control is used to operate the high tension mechanism. The switchboard itself is on the same floor as the generators, while the mechanism, which operates the oil, is below. In the generator room is also a small d-c. generator, motor driven, which supplies current at 230 volts to the boiler feed pumps and to the pulverized coal feeders.

The total cost of the plant was nearly $10,000,000. Stone & Webster, Inc., of Boston, Massachusetts, are the contractors and engineers. Mr. G. I. James is superintendent of construction while Mr. H. J. Klotz has charge of putting the plant into operation.

Moving Pictures by Radio

New developments make possible sending of "movies" through the ether by methods used previously for photo-transmission

By C. Francis Jenkins

President of the Jenkins Laboratories, Washington, D. C.

THE earliest attempts to send pictures and to see electrically, date back some fifty years, being practically coincident with efforts to transmit sound electrically.

At first a metallic circuit was employed to carry the impulses representing picture values, but when radio was available several workers immediately began the adaptation of their apparatus to radio circuits. Some remarkably fine examples of pictures transmitted by both wire and radio have been produced in recent months: most of them showing the lines, but some of them without lines at all, i. e., true photographic results.

As the transmission of images from living objects in action differs from "still" pictures only in that they are more rapidly formed, it naturally followed that the solution of this problem should also be undertaken. When radio service to the eye shall have a comparable development with radio service to the ear, a new era will indeed have been ushered in, when distance will no longer prevent our seeing our friend as easily as we hear him. The new machine will come to the fireside as a fascinating teacher and entertainer, without language, literacy, or age limitation; a visitor to the old homestead with photoplays, the opera, and a direct vision of world activities, without the hindrance of muddy roads or snow blockades, making farm life still more attractive to the clever country-bred boys and girls. It is not a visionary, or even a very difficult thing to do; speech and music are carried by radio, and sight can just as easily be so carried.

To get music by radio, a microphone converts sound into electrical modulation, which, carried by radio to distant places, is then changed back into sound and we hear the music. To get pictures by radio, a sensitive cell converts light into electrical current, and at radio distances changes these currents back into light values, and one may see the distant scene; for light is the thing of which pictures are made, as music is made of sound.

Already radio vision is a laboratory demonstration, and while it is not yet finished and ready for general public introduction, it soon will be, for it should be borne in mind that animated pictures differ from still pictures only in the speed of presentation, and the sending of still pictures by radio is now an accomplished fact, radio photographs of no mean quality, examples of which appear as illustrations in this article.

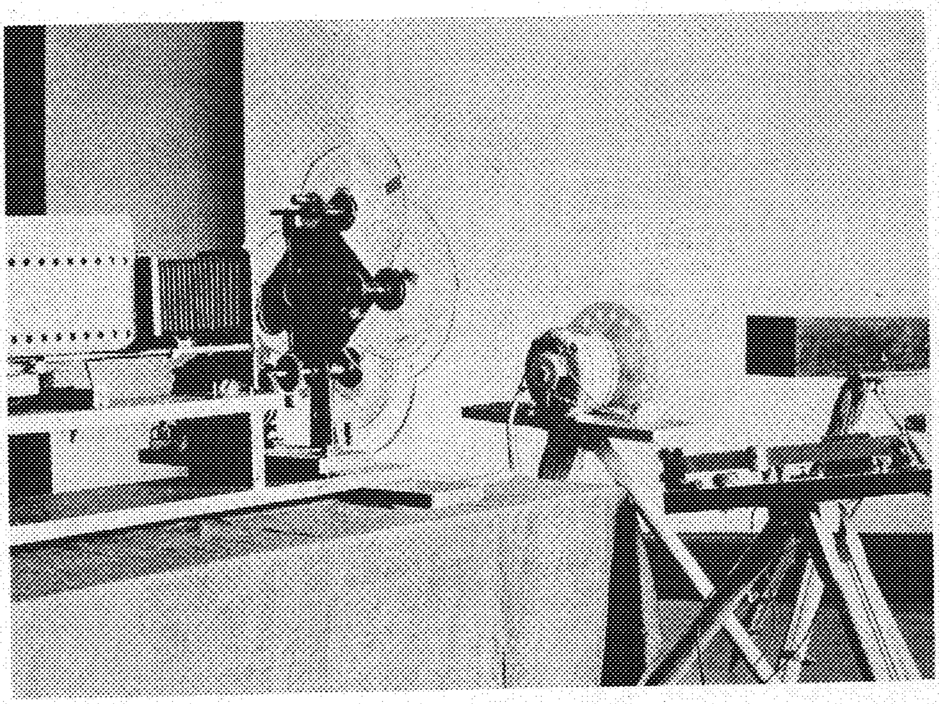
Just as is done in radio photographs the picture surface is traversed by a small spot of light moving over the picture surface in successive parallel adjacent lines, with the value of the lines changed by the incoming radio signals to conform to a given order, the order being controlled by the light values of the scene at the distant sending station.

In sending pictures electrically, there have been but two methods employed, perhaps the only methods possible; namely (a) a cylinder mechanism; and (b) a flat surface. Without exception, every scheme which had attained any degree of success, before the author adopted flat surfaces, has depended upon synchronous rotation of two cylinders, one at the sending station with the picture thereon to be sent; and the other at the receiving station where the picture is to be put.

Perhaps the very obviousness of the cylinder scheme, and that there are no patents to prevent, explains why it has been employed by so many. All these many workers have adopted the cylinder method of sending and receiving, and all have arrived at approximately the final stage of development permitted by concurrent science. It may be well to explain that, in these older schemes, the picture to be sent is wrapped around the cylinder, usually a cylinder of glass where light sensitive cells are employed, mounted on a rotating shaft, which also has longitudinal displacement.

The light values which make up the picture are converted into electrical current of corresponding values and put upon a wire or other channel which delivers them to the distant receiving station. At the receiving station a suitable film-like sheet (paper, for example) is wrapped around a cylinder similar to that at the sending station. As this cylinder is rotated and longitudinally advanced under a stationary point in contact with the paper on the cylinder, a spiral is traced thereon. As the incoming electrical current represents picture values, and as the two cylinders are turning in exact synchronism, a picture duplicate of that at the sending station appears thereon. After the picture is completed the paper sheet can then be taken off the cylinder and flattened out for such use as may be desired.

It is quite obvious that vision by radio and radio movies can never be attained by a cylinder method, for as the picture must appear to the eye complete, by reason of persistence of vision, it naturally follows that the eye must make up the whole picture from a single focal plane. These flat planes may, of course, be the focal planes of the lenses employed at the receiving station, and from the focal depth of the lens at the sending station where the picture may, perhaps, be taken from living actors in the studio or from an outdoor scene. At the



RADIO PHOTO TRANSMITTER

At the left is shown the lamphouse for illuminating the picture. The four prismatic rings in the left foreground move the picture over the light-sensitive cell in the elongated box at the right.

receiving station the flat surface may be a photographic plate, a white wall, or a miniature of the usual silver sheet of the motion picture theatre.

It may aid in a clearer and quicker understanding of the text if the words

PHOTOGRAPH OF BRYAN
Sent through the air (100 lines to inch).

telephone and television be limited to metallic circuit service, while radio phone and radio vision is aplied to radio carried signals, and this designation will be employed in the following pages.

The author's work began with the publication in the Motion Picture News, of October 4, 1913, of an article entitled Motion Pictures by Wireless. This contemplated the employment of a flat receiving surface, but in the light of subsequent experience the scheme proposed therein is believed to be impractical. It did, however, provoke discussion of the subject and initiated the work which was thereafter rather continuously prosecuted, except for interruption to aid in the great World War. After failure to find a practical, workable mechanism made up of devices already in use in applied science, diligent effort was made to discover the necessary, missing part.

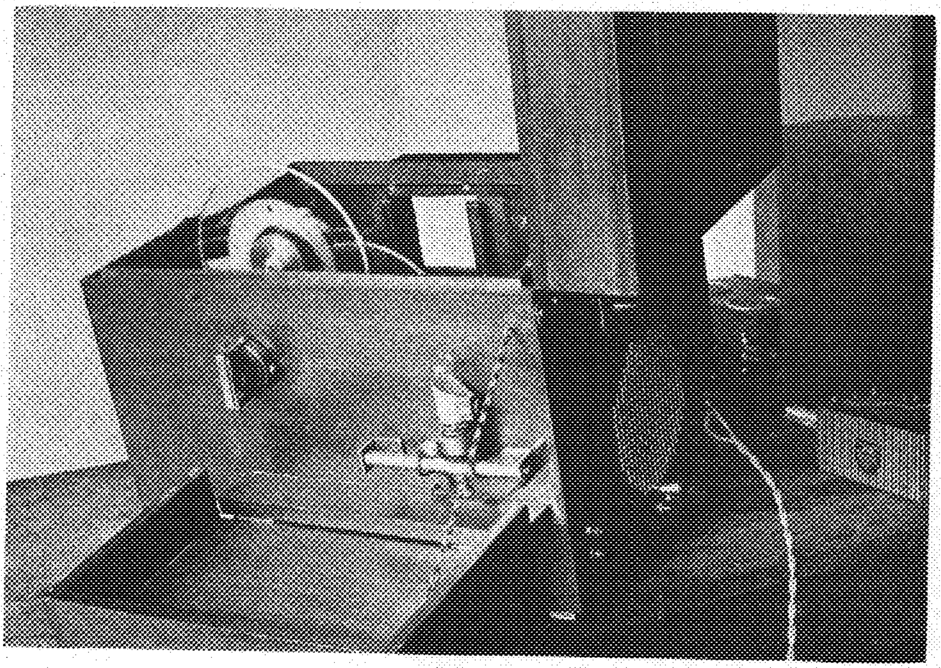
At length a device described as a prismatic ring was developed, a new contribution to optical science. In use it is comparable to a solid glass prism which changes the angle between its sides, giving to a beam of light passing therethrough a hinged or oscillating action on one side of the prism while maintaining a fixed axis of the beam on the other side of the prism. Success in sending pictures by radio from flat photographs and receiving them on flat photo negative plates (and subsequently of radio vision), really began with the perfection of automatic machines for the making of these prismatic rings, for by means of these prisms and a light sensitive cell at the sending station the light values which make up the picture are converted into electrical values and broadcast. So to put this picture on a radio carrier wave we simply slice up the picture (figuratively) into slices one-hundredth of an inch in width, in the best pictures, by sweeping the picture across the light sensitive cell by means of these rotating prismatic rings. With each downward sweep the picture is moved one-hundredth of an inch to the right until the whole picture has crossed the cell, the cell converting the light strengths of the different parts of each slice into corresponding electrical values.

The process very much resembles a bacon slicer in the market, each slice showing fat and lean. Similarly these imaginary slices of our picture show light and dark parts, and these lights and shadows moving across the sensitive cell produce corresponding strength of electric current, modulating the radio carrier wave of the broadcasting set accordingly. Further, of course, it is immaterial whether the current modulation is taken directly from a flat photograph, from a solid object, or from an out-door scene at which the transmitter is pointed. To put these light values back together again at the distant receiving station to make up a negative of the picture being broadcast from the sending station, it is only necessary to reverse the process; first, with a point of light to draw lines across a photographic plate, which the rotating prismatic rings do; and second, to vary the density of the different parts of the successive lines corresponding to lights and shadows of the picture at the sending station, and this the varying strength of the incoming radio signal does by varying the intensity of the light.

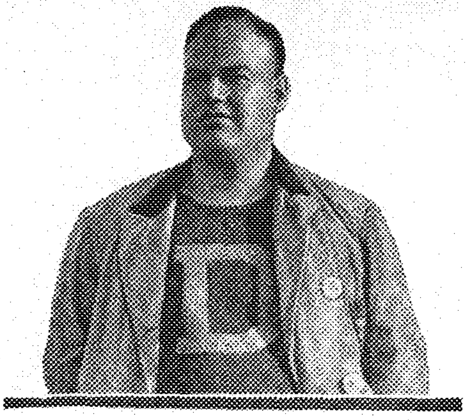
It is thus the lights and shadows which make the picture are built up, line by line, for when this negative is developed, and paper prints made therefrom, the dense areas produce highlights in the picture; the less dense areas the halftones; and the thin areas the shadows of the picture, person or scene broadcast at the sending station. It is simply that a photographic negative has been made of what the lens at the sending station is looking at. If one puts a nickel under a piece of paper and draws straight lines across it with a dull pencil, a picture of the Indian appears. And that is exactly the way photographs by radio are received, except that a photographic plate is used instead of a piece of white paper, and a pencil of light instead of a pencil of lead, the light pencil changing the exposure in various parts of the successive adjacent parallel lines by reason of the variation of the incoming radio signals.

The scheme is just a long camera with miles instead of inches between lens and plate. For example, the lens in Washington and its photographic plate in Boston; with this exception that the one lens in Washington can put a negative on one, ten or one hundred photographic plates in as many different cities at the same time, and at distances limited only by the power of the broadcasting station, radio instead of light carrying the image from lens to plate. The time for transmitting a picture depends upon the size of the picture and strength of light, say, from three to six minutes, using a filament lamp as a source. For the light source for radio photographs a filament lamp is employed, and in a single turn coil enclosed in a hydrogen atmosphere. This miniature filament coil is imaged on a photo negative plate, and the variation in the light is caused by putting the incoming radio signals

(*Continued on page 24*)



THE RADIO-PHOTO SENDING CAMERA
Lid is raised to show the prismatic rings and plate upon which the photograph is received; also small lamp and lens and mirror on the near side.



Our New Coach—

Clarence W. Spears

Condition of players, knowledge of fundamentals factors of Doc's fighting teams

BY LEE A. AMIDON, M '23

Assistant Professor, University of West Virginia, Morgantown, West Virginia

ALUMNI, students, and friends of Minnesota, we of West Virginia extend to you the heartiest of greetings. Having had the pleasure of watching him and his West Virginia teams in action for the last two seasons, I feel that Minnesota is gaining a real citizen and coach when Dr. Clarence W. Spears takes up his duties there this fall.

His coaching record is one of fighting teams, though not always winning championships, always near the top, pushing the leaders. He coached Dartmouth elevens during 1918, 1919, and 1920. In 1919, they came within one game of being the eastern leaders, but as luck would have it Brown, after a bitter fight, took the last game of the season by a 7 to 6 count. Cornell, Pennsylvania, and Penn State, the high ranking teams of the east, had all fallen before the Spears coached eleven. In spite of injuries to several of his best men in the opening games of 1920, Dartmouth scored victories over Tufts, Cornell, Pennsylvania, and Brown, and were again victorious in an invitation post season game with the University of Washington, lowering them by a 28 to 7 score. All of these games were played on consecutive Saturdays, which is a huge enough task when the team is at home, but is generally considered too great a performance when such a long trip as the trip to the University of Washington on the west coast is taken. The first two games of the season were the only defeats suffered; Penn States excelling 17 to 7, and Syracuse shutting out the Green by a score of 10 to 0.

In 1918, Dr. Spears' first year of coaching at Dartmouth, the war was still raging, so little progress was possible.

It was in 1921 that he came here to West Virginia. He suffered a 13 to 0 defeat at the hands of Washington and Jefferson and fell before Rutgers 17 to 7. However, this was no disgrace, as both of the opposing teams were considered banner teams by sports experts. Washington and Jefferson was recognized as the champions for 1921, and in a post season game went to the West Coast and held the great University of California to a tie game.

In 1922 West Virginia defeated such noted schools as Rutgers, Virginia, Indiana, Washington and Jefferson, and Pittsburgh. Not once during the season was the team the loser. In a post season game with Gonzaga at San Diego, California, West Virginia again demonstrated their superiority by a score of 21 to 13. Football at West Virginia had now become established on a firm basis.

Big scores for West Virginia are the outstanding thing about the 1923 season. Rutgers, undefeated until playing us and conceded to be the strongest eleven in the east, was slaughtered by a count 27 to 7. Washington and Lee, also the winner of all their games so far and one of the most prominent elevens of the South, was humiliated 63 to 0. St. Louis, a noted team because they had held Notre Dame to a 13 to 0 count, were the losers to West Virginia by the lop-sided score of 48 to 0. West Virginia, however, lost the last game of the season and the championship to our traditional foe, Washington and Jefferson, by a score of 7 to 2. The game was played on Thanksgiving Day in a mud covered field too heavy and slippery for real football.

The 1924 season was marred by one defeat, that being to Pittsburgh by a count of 14 to 7. The rest of the games were again won by high scores, such as 55 to 0, 71 to 6, 34 to 3, and 40 to 7. The 40 to 7 score was made in the game with Washington and Jefferson, the ancient rivals of West Virginia, and which unknowingly concluded Doc's coaching career here.

Dr. Spears' services as coach have been much sought after by other colleges. After his successful 1920 season at Dartmouth, many offers were tendered. The University of Washington on the Pacific Coast, the University of Nebraska, West Virginia, and Purdue all made him splendid offers, and as things at Dartmouth were somewhat unsettled, Spears concluded to accept the offer given by West Virginia. Here at West Virginia, he received a salary of $10,000, which was one of the best salaries received by any eastern football coach. Besides this, he had several business enterprises and practiced his profession of medicine. Although he had received offers every year from institutions larger than West Virginia, he seemed to show no interest in them until the offer came from Minnesota.

Your offer was attractive to him not because of the salary offered, which is less than what he received at West Virginia, but because of other features. Spears is, as his nickname indicates, a doctor, a graduate of Rush Medical school and has often told faculty members here that he has more ambition of being a surgeon than a successful football coach. At Minnesota he will be a member of the faculty, something not allowed him previously, and will have the opportunity of furthering his studies in medicine.

The lack of appropriate facilities at West Virginia for general physical education of the students, something in which the Doctor is strongly in favor, also was a reason for his leaving. Football conditions or salary had nothing to do with the making of his decision.

The essential features of Spears' coached teams are condition and absolute knowledge of fundamentals.

To achieve condition, Dr. Spears has developed his famous grass drill: The men are lined up as for calisthenics in the army and then Spears demonstrates the drill to his men. In spite of his bulk he can probably get around faster than most of his men and keeping them jumping is one of the best things he does. The exercise consists of falling straight forward on the hands with the feet stretched out behind and knees stiff, then either rolling the shoulders over to right or left, leaving the feet in the original position, or jumping upright again. The same movements are again gone through, falling to the rear instead of to the front. When executed rapidly, the athlete is developed physically and in addition learns to fall from any position, evade a tackler, get on his feet, and go forward again.

As to the fundamentals, the men are told the correct method of playing their position and given to understand that co-operation of eleven men is desired rather than the individual brilliance of any one man. If a player makes a mistake once, Spears asks him where he learned his system and he is quizzed

(*Continued on page 20*)

The Engineers' Bookstore

Student organization pays $5,317 out in dividends to its members as sixth year of existence is started

By Lawrence A. Clousing, E '28

ENGINEERS, during the last five years, have proven to the University the value of co-operative spirit. Last year the Engineers' Bookstore, a purely student organization, saved its members $5,317.24, and in the five years of its existence has paid back dividends amounting to a sum total of $21,402.16 on books and supplies.

It was in 1914, when the enrollment in the college was only 400, that any spirit of co-operation was first shown. Attempts were made by the Engineering Student Council to purchase books and supplies at lower prices through the University purchasing department. In 1915 the Student Council, by purchasing books in large quantities through the Co-Op., effected a 15 per cent discount off list prices. This system proved cumbersome and inconvenient to handle. Accounts were seldom closed satisfactorily.

The necessity for advance orders made it impossible to care for the freshmen — the students who have the greatest expense. Many upper classmen preferred to spend the full list price to avoid the red tape of the system.

This system, nevertheless, was used until 1919, by which time, the increased enrollment of the Engineering Colleges presented more serious difficulties. Under the leadership of Howard Jacobson, the Association of Engineering Students, which was the forerunner of what is now the Technical Commission, faced this problem, and following out engineering ideals in true style, did not try to dodge or evade the situation, but took the bull by the horns, and from their results it is apparent that they grappled successfully. After looking up data available from other schools, and after giving due consideration to the problem, the association founded the Engineers' Bookstore and elected the first board of directors in May, 1920, organizing them under an amendment to the by-laws of the association.

After being founded, the Engineers' Bookstore developed almost immediately, as is shown from the first year's dividends of $2,127.98. The average dividend returned to each member for the year 1925 was $4.77, which is obtained by dividing the total dividend of $5,317.24 by 1113, the number of members who made purchases during the year. In 1922 the Engineers' Bookstore expanded and set up a branch store in the School of Business. However, the branch store proved a losing proposition, and so was closed this spring to the regret of all concerned.

The policy of the bookstore has always been one of service to its customers, and as there is no personal gain, low prices have generally prevailed. Most students laud generously the bookstore, and expound its benefits vigorously.

ENGINEERS' BOOKSTORE
Balance Sheet
For Year Ending May 23, 1925

Resources—	
Cap and Gown Replacement Fund	$ 450.00
Cash Account	678.05
Bank Account	2,491.66
Certificate of Deposit	5,800.00
Accounts Receivable	506.12
Office Equipment	30.00
Store Equipment	324.00
Office Furniture	40.00
Store Furniture	33.00
Cap & Gown Rental Outfits	894.65
Merchandise Inventory	7,158.20
	$18,397.68
Liabilities—	
1921 Dividend	$ 76.33
1922 Dividend	109.68
1923 Dividend	177.18
1924 Dividend	276.18
1925 Dividend	5,225.55
Vouchers Payable	845.95
Cap & Gown Deposits	259.50
Membership Deposits	6,345.00
Surplus	5,082.21
	$18,397.68

CONDENSED INCOME STATEMENT
May 31, 1924, to May 23, 1925

Net Sales	$47,875.72
Cost of Sales	35,588.88
Profit from Sales	12,266.84
Bank Interest	164.41
	$12,431.25
Expense and Fixed Charges	5,708.82
Profit for Distribution	6,742.43
To 1925 Dividend	5,317.24
To Surplus	1,425.19

The dividends are paid each year at the first day of school and prove very handy for members to secure books for the ensuing year. The original five dollar deposit is refunded to each member upon his graduation or leaving school permanently. Dividend shares increased rapidly each year, as indicated by accompanying data. The amount paid this year was slightly less than the year previous, due to the fact that the volume of business was a trifle less. Under the heading of liabilities, the small amount accredited to dividends shows that an engineer's memory is excellent in regard to calling for the dividends each year.

This year marks several changes in the bookstore. Howard Jacobson, one of the leaders among its founders and manager of the bookstore since its beginning, has resigned his position in order to devote all his time to the Jacobson Machine Works. His efficient administration and good judgment no doubt had a good deal to do with the success of the store. Harold D. Smith, his successor, appointed by the Board of Directors, promises, however, to keep the store up to the former standard, and we are sure he will. He has been working in the store for a number of years, and understands the workings. The cleaner appearance of the store this fall has been largely due to his efforts.

Upon the Board of Directors fall the responsibilities of the store, and they deserve more credit than is commonly given to them. They determine the policies, appoint the manager, declare the dividend, and are responsible for the upkeep of the store.

The 1926 faculty members of the Board of Directors, who are appointed by the dean, are: Professors C. A. Mann, W. H. Kirchner, and O. S. Zelner. The student members, who are elected at large from the student body, are: Ed Young, chairman; Glenn Meader, secretary; Robert Kranzfelder, Harold Rollin, and J. H. Kugler.

If we are able to judge correctly from certain reports, this board is well qualified for the work before them. Ed Young, civil department representative and chairman, according to reports, has already demonstrated his executive ability as a traffic cop with a police whistle. No doubt with this little aid, meetings will have a law-abiding character.

Glen Meader, the electrical secretary (?), has shown his business ability by renting out his long-used Dodge car to some classmates who were going to the R. O. T. C. at Camp Custer, taking a Pullman himself. We have a suspicion that his classmates bought a few spare parts for the Dodge.

Harold Rollin, a mechanical, sold Engineers' Day buttons, and from the results he attained it is evident that he needs no introduction to the selling game.

Robert Kranzfelder and J. H. Kugler are architects and chemists respectively, both without spot or blemish on their reputations.

The Engineers' Bookstore is one of the most active of campus organizations, and so it is expected that the board will have plenty to do during this, the sixth year of its successful existence.

ALUMNI AND FACULTY PERSONAL NEWS

FACULTY

ARCHITECTURE

Prof. L. E. Arnal was in France this summer but will resume his duties at the University this fall.

Mr. D. C. Heath taught during the first session.

Mr. E. E. Young is on a leave of absence to study in New York.

Prof. S. Chatwood Burton was married this summer.

Prof. R. Robertson traveled during the summer months and recently sailed for Europe.

Prof. J. H. Forsythe, in company with his wife, toured through Florida, New York, and other states.

CIVIL ENGINEERING

Prof. F. H. Bass has been designing a sewage disposal plant for Rochester, Minnesota.

Prof. J. I. Parcel taught the first quarter of the summer session.

Prof. O. S. Zelner was at the summer camp at Cass Lake.

Prof. G. A. Maney spent the summer in contracting for the building of homes.

Prof. L. F. Boon was at the summer camp at Cass Lake.

Prof. M. B. Lagaard assisted Mr. Bass in designing a sewage disposal plant for Rochester. He also worked for the concrete department of the State Highway Commission.

Prof. A. S. Cutler was at the engineers' summer camp at Cass Lake.

F. C. Lang, professor of highways, has been with the State Highway Commission this summer. He was in charge of the design and construction of the experimental piece of roadway through the engineering campus on Church Street.

Hibbert Hill, instructor in the civil engineering department, has been doing special testing for the Northern States Power Company at their various plants in the Twin Cities.

DRAW. AND DES. GEOM.

Professor William C. Kirchner, head of the department, has returned from a year's sabbatical leave which time he spent touring in Europe. He will take up his work in the department again this fall.

R. F. Schuck, H. C. T. Eggers, H. D. Myers, O. W. Potter, and W. S. Williams taught at sessions of summer school.

Mr. W. C. Lawson worked part of the summer for the geology department. He now has a leave of absence for a year.

Mr. L. J. Quaid was at his home in Illinois.

Mr. E. O. Schultz remained in Minneapolis during the summer.

Mr. L. Archibald taught the first session, and spent the remainder of the summer touring.

Prof. R. W. French was at Cass Lake the first part of the summer and taught during the second quarter of the summer session.

Mr. E. H. Tollefson has a leave of absence for a year.

ELECTRICAL ENGINEERING

Professor G. D. Shepardson, head of the department of electrical engineering, left recently for the first part of his journey around the world. He is visiting in the East before sailing the latter part of November for Europe.

F. W. Springer, who assumes the leadership of the department in Prof. Shepardson's absence, has spent the summer in study and travel.

W. T. Ryan, assistant professor of Power Engineering has been engaged in work for the Minnesota tax commission. He is president of the Minnesota Federated Engineering and Architectural Societies and delivered an address at the Winnipeg meeting held this summer.

Assistant Professor C. M. Jansky has been employed as consulting engineer with the Washburn-Crosby radio station WCCO during the summer months.

M. E. Todd has been with the Northern States Power Company in their instrument department this summer. He was very active in arrangement of the meterman's short course which was held here this fall.

G. W. Swenson, assistant professor in charge of the telephone and telegraph department, has been conducting a survey of all telephone lines in the state under the direction of the Northwestern Bell Company.

Louis J. Schnell has been investigating for the Northern States Power Company, concerning the practicability of wired wireless for use in communication along high tension transmission lines.

Assistant Professor J. H. Kuhlman has spent the summer engaged in study and in the preparation of a new text-book which he hopes to publish soon.

Rene A. Braden, former teaching fellow in the electrical engineering department, is now working with the Zenith Radio Corporation at Chicago in their engineering department.

Otto Heidelberger, also formerly a teaching fellow, is now with the Electric Machinery Company of Minneapolis in their designing division.

Clifford Sampson is an engineer with the Northwestern Bell Telephone Company at Minneapolis. He was a former teaching fellow.

MATHEMATICS and MECHANICS

Among those in the department of mathematics and mechanics who taught during summer school were H. B. Wilcox, H. E. Hartig, W. E. Holman, G. C. Priester, and F. E. Miller.

Prof. W. E. Brooke taught during the first session of summer school, and spent the rest of the time in vacation at Cass Lake.

Mr. H. L. Smith taught mathematics at the University of Chicago summer school.

Mr. H. A. Doeringsfeld, instructor, worked with the State Highway Department.

Mr. W. R. Warne, instructor, enjoyed a vacation spent in travel.

Prof. G. C. Priester spent the first part of the summer at Cass Lake.

Prof. C. A. Herrick taught at both sessions of summer school.

Prof. W. E. McClintock was working with his railroad signal business in St. Paul.

Prof. R. R. Hermann was employed by the Northern States Power Company in their sales department.

Prof. H. H. Dalaker taught the first session of summer school. He spent the remainder of the summer at Cass Lake.

Prof. J. O. Jones taught during the first session of summer school and spent the rest of the summer in research work in the hydraulics laboratory.

Mr. O. C. Lee was with the Electric Machinery Company of Minneapolis.

Miss Veblen, librarian in the main engineering library, enjoyed her summer vacation at Onamia, Minnesota, with Miss Helen Ranson, of the Main Library. They spent most of their time hiking.

MECHANICAL ENGINEERING

Prof. J. J. Flather spent the summer traveling in the East. He attended the fortieth reunion of the class of 1885 at Yale.

Prof. J. V. Martenis was in the city most of the summer.

Mr. D. A. Rogers, instructor, taught machine shop during both quarters of summer session.

Prof. S. C. Shipley toured through Yellowstone Park and other points throughout the West.

Mr. J. Flodin has been working at the Bethlehem Ship Yards in Boston.

Mr. T. P. Hughes of the forge department taught during the first term.

Mr. W. H. Richards spent the summer working on pattern and art work. He taught during the summer session.

Mr. J. H. Moffett, instructor in the foundry department, spent the summer at his home in Cincinnati.

SCHOOL OF CHEMISTRY

Prof. C. A. Mann, head of the department of chemical engineering, after instructing a class in chemical manufacture methods at the first session of summer school, toured the west and attended the convention of the American Chemical Society in San Francisco.

In the School of Chemistry, the following were instructors during summer school: W. H. Hunter, W. H. Lauer, R. E. Montonna, Mrs. A. M. Lohmann, Caryl Sly, R. B. Ellestad, L. H. Reyerson, G. B. Heisig, and D. E. Edgar.

Prof. F. H. MacDougall, physical chemistry, was in California during the summer.

Mr. R. C. Ernst, instructor, drove to North Carolina, his home state.

Mr. E. L. McMillen, chemical engineering, enjoyed a vacation this summer.

Mr. F. J. Dobrovolny attained a Doctor's Degree the second quarter. He has left to accept a position with the Roessler and Hasslacher Chemical Company.

Prof. E. P. Harding taught during the first summer session and spent the remainder of the summer at Woman Lake.

Mr. R. E. Brewer, instructor, taught at the first summer session. He later drove to his home in Iowa.

Mr. L. E. Swearingen, assistant, spent the summer in research work at the University.

Mr. P. J. Riley, technological department, worked in the main storeroom during the summer.

Mr. L. W. Hartkemeier worked in the laboratory of the State Highway Commission. He is now employed as assistant chemist for the Milwaukee Railroad.

Mr. F. A. Gray, assistant, while working in the woods with the Boundary Survey, sprained his ankle and was forced to return home. He later visited his home on the coast.

Miss H. M. Crawford assisted in first session of summer school and spent the rest of the summer at home in Iowa.

Mr. W. S. Dyer assisted in first session of summer school. He was granted a Master's Degree at the end of the second session and has left the University of Minnesota to teach in a college in Kentucky.

Mr. L. B. Beckwith, inorganic, was employed in a bank in Montana during the summer months.

Mr. A. L. Chaney was married in Washington, D. C. He has left the University of Minnesota to teach in Michigan.

Prof. G. H. Montillon, chemical engineering, is studying for a Doctor's Degree at Ann Arbor.

Mr. L. A. Sarver, instructor, has been with the State Lighthouse Commission of New York.

Prof. M. C. Sneed, chief of inorganic department, spent the summer in Tennessee.

Prof. I. W. Geiger taught during the first session and spent the remainder of the summer at Woman Lake in northern Minnesota.

Mr. A. C. Beckel, organic department, has left the University of Minnesota to work with a chemical company in Rochester, New York.

Prof. G. B. Frankforter left recently for California where he was granted a professorship at Leland Stanford University.

Prof. P. H. Brinton, analytical chemistry, has returned from a trip to England.

Mr. R. E. Jackman was home in Montana during the summer.

Mr. P. E. Millington is an assistant in organic chemistry at the University of Wisconsin.

Mr. H. N. Stephens, instructor, was in Canada after the first session of summer school.

Mr. J. L. Lewis taught during the second session of summer school. He also attended the Officers Reserve Chemical Warfare training camp in Colorado this summer.

Mr. H. H. Barber, curator instructor, spent the summer on a trip to Alabama with his family.

Prof. L. I. Smith taught during the first session of summer school. He spent the rest of the summer at his home in Ohio.

Prof. N. C. Pervier, inorganic department, spent the summer with his family at Woman Lake in the north woods.

Prof. R. E. Kirk, inorganic chemistry, taught during the first session of summer school and has been working with the State Highway Commission.

Miss Lillian Cohen was in California where she attended the meeting of the American Chemical Society.

Mrs. K. E. Crowley, librarian, spent the summer in northern Minnesota and with her mother in South Dakota.

SCHOOL OF MINES

Dean William R. Appleby says he has been too busy this summer to take a vacation. His time has been taken up by departmental work both at the main building and with the Tax commission and also at the experimental station.

Prof. L. B. Pease vacationed during the summer.

Prof. C. R. Stauffer taught during part of the summer.

Prof. O. E. Harder spent his vacation at his home in Oklahoma. On his way back he attended the meeting of the American Steel Treaters at Cleveland.

Prof. P. Christianson was engaged in testing at the experimental station during the summer months.

Prof. E. M. Lambert was with the State Tax Commission.

Prof. A. J. Carlson has a leave of absence for one year. He is working for a doctor's degree at the University of California.

Prof. J. C. Sanderson spent the summer camping at Beaver Bay, Minn.

Prof. F. F. Grout, geology and mineralogy department, spent the summer working in the northern part of the State.

Mr. I. S. Allison, instructor, worked on water supply problems for the state.

Mr. R. W. Allard, instructor, spent the summer in engineering work.

Prof. E. H. Comstock has been in Canada.

Prof. W. H. Emmons, geology and mineralogy, did research work on ore deposits.

Prof. J. W. Gruner worked on the mineralization of porphyries of Minnesota.

Mr. E. H. Kersten, instructor, attended the summer sessions at the University.

Prof. G. M. Schwartz worked on diabasis and slates of northern Minnesota.

Prof. W. H. Parker visited mines in western and northern United States during the summer.

Mr. R. L. Dowdell, an instructor in metallurgy, worked in the laboratory during the summer.

Edward W. Davis, superintendent of the experimental station, recently returned from a trip to Spain where he has been investigating deposits of low grade iron ore, which are similar to some deposits found in this state.

Miss Henderson, librarian in the School of Mines, remained at home in Minneapolis during the summer.

ALUMNI

ARCHITECTS

'77—Funeral services were held on May 26 for Walter Stone Pardee. Mr. Pardee was one of the oldest graduates of the Minnesota College of Engineering, being graduated in 1877 from the school of architecture. Mr. Pardee was the first building inspector for the city of Minneapolis and was the architect of many of the city's schools. At the time of his death, Mr. Pardee was a member of the firm Miller & Pardee, Inc., of Chicago. Among the pallbearers were E. B. Pierce and Dr. L. J. Cooke, of the University of Minnesota.

'21—Reinhold Melander, of Duluth, was married to Miss Florence Knox of Minneapolis on May 23rd. Miss Knox is a graduate from the University of Minnesota as an interior decorator. Mr. and Mrs. Melander are now at home at 3031 E. Branch St., Duluth.

'23—Eddie Holien has gone to Boston to work and will attend the M. I. T. in the fall.

Arch. E. '24—The engagement of Larry Tvedt to Mary Slocumb has been announced. Miss Slocum received her degree in interior decoration last June.

'24—Anton Johnson was married to Miss Helen Bystrom of Minneapolis on June 10th. They will make their home in Milwaukee.

'24—Emil F. C. Backstrom has accepted a position in New York City with Bertram Grosvenor Goodhue's Associates.

'25—Peter P. Bross is now located at 19 Eighth St. N. E., Rochester, Minnesota.

'25—George Freeberg has accepted a position as draftsman for the Northwestern Lumberman's Association. In October George will leave for a tour of the East, as a result of his winning the Moorman Prize.

'25—Walter Kendall flivvered to Milwaukee with Al Jansma to accept drafting positions.

'25—Alwin Rigg left June 20th for a tour of the East.

'25—Everett Peterson spent several weeks this summer at his home in Cobden, Minn., on a vacation.

'25—Edwin Molander has accepted a position with an architectural firm at Rochester, Minn., but was seen in the Cities as late as June 20th. The reason is Miss Mayme Boynton, a recent cigar fest having announced their engagement.

CIVILS

'00—Edwin M. Grime, formerly of Fargo, North Dakota, has moved to St. Paul, Minnesota. Address him at 889 Goodrich Avenue. He was formerly supervisor of bridges and roads in North Dakota.

'02—Correct address of W. S. Weston is Chatek, Wisconsin, instead of Chester. He is in the nursery and landscape business.

'02—George S. Houston is now manager of the bond department of the Transportation Brotherhoods National Bank with offices in the Metropolitan National Bank building, Minneapolis.

Ex '03—H. C. Frahm of Minot, North Dakota, was appointed chief engineer of the state highway department for the state of North Dakota by Governor Sorlie on Septemberr 14. Mr. Frahm has been connected with highway work in that district for seven years. He was raised in Rochester, Minnesota, and attended the University of Minnesota studying civil engineering from 1901 to 1903. Upon leaving school he was engaged in other work for four years and upon completing his course, went with the Great Northern in their engineering department. He later had a private practice in Minot before entering highway work. He succeeds W. G. Black who recently resigned. The appointment which was unsolicited, came as a surprise to Mr. Frahm.

'25—William C. Brose is with the Marion Steam Shovel Company in Marion, Ohio.

G '08—Dr. L. W. McKeehan, research physicist, Bell Telephone Laboratories, Inc., New York., B. S. '08, M. S. '09, Ph. D. '11, has prepared with Professor A. F. Kovarik, Yale University, a bulletin on radioactivity for the National Research Council. In some two hundred pages there is summarized our present qualitative knowledge as to radioactive transformations, the geographical relations of radioactivity, and the effect of radioactive substances on matter, including the bombardment of atoms by alpha particles from radioactive substances, and such effects as fluorescence and phosphorescence. Professor Kovarik and Dr. McKeehan's report has been issued as Bulletin 51 of the National Research Council and is a partial report for the Committee on X-rays and radioactivity.

'09—J. T. Ellison will succeed John H. Mullin to the rank of assistant commissioner and chief engineer of the Minnesota Highway department. Mr. Mullin is leaving to do highway and railroad construction work as a member of the firm of Nelson, Mullin and Nelson of Minneapolis. Mr. Ellison became identified with the highway department in 1911 and was appointed to the office of chief highway bridge engineer in 1917. He has since served in that position in addition to holding the second assistant commissionship.

'17—Walter D. Luplow graduated from the Engineer's School of the United States Army at Fort Humphrey's, Virginia, on the fifteenth of last June.

ELECTRICALS

'08—F. A. Anderson visited the campus this summer while on his vacation trip. He was greatly impressed by the new electrical building. Anderson is manager of the National Appliance Company of Portland, Oregon. His home address is 1522 Wisteria Avenue.

'09—Joel A. Fitts of the Electric Storage Battery Company of Chicago passed through Minneapolis this summer on a vacation trip. He was accompanied by his nine year old son.

'13, EE. '14—Vincent H. Irvin is now with the United States government at the Panama canal as designing engineer of a large power plant. He was formerly with the Electric Power Company of Guild, Tennessee. Irvin was in the twin cities recently and was an interested visitor at the new electrical building.

'13—R. C. Mathes is the co-author of a paper describing echo suppressors for long telephone circuits appearing in the July issue of "Electrical Communication." Mr. Mathes is with the Bell Telephone Laboratories of New York City. He is engaged in apparatus development work and cooperated in perfecting a recent device for suppressing echoes on telephone circuits.

'14—John H. Putz, whose name appears under information requested, is located. Address him at Spooner, Wisconsin, care of R. F. D.

'16—J. L. Thompson, formerly of Bakersfield, California, has moved and can now be addressed at the Kerchoff Power house, Auberry, California. He is an inspector of substations for the San Joaquin Light and Power Company.

'19—Richard H. Olson of St. Louis was in the city on vacation this summer. He is district manager for the Electric Machinery Company at St. Louis with offices in the Railway Exchange building.

'20, '21—Ezra B. Curry and Ruth Severance Field were married on June 6th at Wadena, Minnesota. The attendants were Monica Langtry, SLA '19, and Raymond A. Lockwood, E '20. Curry is shop foreman for the C. M. and St. Paul R. R. Co. at Green Bay, Wisconsin.

'21—C. Phillip Carlson is an electrical engineer with the Chile Exploration company. Basil Maine, also of this class, is with him. V. H. Carlson, '20, is also in South America.

'22—Howard C. Kelsey is working for the Jos. T. Ryerson & Son, Inc., at Buffalo, N. Y.

'22—Henry Drost is employed by the Commonwealth Edison Company of Chicago, Ilinois.

'22—A. C. Willard, formerly with the sub-station department of the Duquesne Light Company, is now in the engineering department, construction division, of the same company at 601 Philadelphia building, Pittsburgh, Pa.

'23—R. W. Hargreaves says: "Very glad to get the alumni issue of the Techno-Log. Great to see what the old boys are doing now." He is an engineer for the Minnesota Power and Light Company at Duluth. Home address is 1820 Woodlawn Avenue.

'23—William F. Helvig of Chicago paid the Techno-Log a visit this summer and incidentally handed in his subscription. He is an investigation engineer with the Western Electric people with headquarters at 2431 50th Avenue, Cicero, Ill.

'24—Irving Marshman is a patent attorney for the General Electric Co. Address him at Edison Club, Schenectady.

'24—E. G. Anderson is now in Washington, D. C., doing standardization work on photometry at the Bureau of Standards His correct address is 1431 Clifton Street. His home is at Clarkfield, Minn.

'24—In a letter recently received from Larry Warren, he states that he will spend another year at Schenectady and that he is at present in camp with several other graduates, among them being Fayette Anderson, also EE. '24, at a lake about fifteen miles out from the city. They make the trip to work every day in a flivver. His address is the Edison Club at Schenectady.

'24—Ingwald Monseth of Wilkinsburgh, Pa., spent his vacation in Minnesota and incidentally inspected the new electrical building. He is in the switchboard department of Westinghouse, being located at East Pittsburgh.

'24—Charles T. Skarolid was an interested visitor at the electrical building this summer. He is now located at Brainerd, Minn., at 415 Kindred Street N. E.

'25—Clarence H. Nelson is studying at the Chicago Central Station Institute in Chicago.

'25—Emil Steinert is with the Westinghouse Electrical Company in Schenectady, N. Y.

'25—Richard G. Taylor is now loctated at 5715 Drexel Ave., Chicago, Ill.

'25—Sidney A. Parsons has accepted a position with the General Electric Company in Schenectady, N. Y.

'25—R. D. Schuck is working for the Northern States Power Company in Minneapolis.

'25—Raymond Walter Keller is taking a student's course at the Curtiss Lighting, Inc., located at 1119 W. Jackson Blvd., Chicago, Ill.

'25—Winfield R. Koch is with the Westinghouse Electric and Manufacturing pany of East Pittsburgh, Pa.

'25—Carl E. Ellis is in Fort Wayne, Indiana, working for the General Electric Company.

'25—Norman W. Hussey holds a position with the Westinghouse Electric Company of East Pittsburgh, Pa.

'25—Grant C. Nierling is studying at the Chicago Central Station Institute in Chicago.

'25—Glenn A. Westingard is with the Northern States Power Company in Minneapolis.

'25—Henry A. Wurzbach is in East Pittsburgh holding a position with the Westinghouse Electric Company.

'25—Berkeley R. Lewis, Jr., is in Minneapolis working for the Northern States Power Company.

'25—James P. McCully is with the General Electric Company of Schenectady, N. Y.

'25—Robertson B. Johnson is working for the Northern States Power Company in Minneapolis.

'25—Lawrence D. Solomonson is with the Northwestern Bell Telephone Company in Minneapolis.

'25—Jeffery L. Lund is now in the employ of the General Electric Company of Schenectady, N. Y.

'25—Alexander D. McEwen has accepted a position with the Westinghouse Electric Company in East Pittsburgh, Pa.

'25—Arthur C. Jacobsen is with the Century Electric Company of Minneapolis.

'25—Arthur L. Christiansen is located in Minneapolis with the Northern States Power Company.

'25—Lester L. Boe is in the employ of the General Electric Company of Schenectady, N. Y.

'25—Hugo H. Hanft has accepted a position with the Westinghouse Electric Company in East Pittsburgh, Pa.

'25—Henry R. Reed has received a fellowship in the University of Minnesota.

'25—Arthur P. Anderson is now studying at the Chicago Central Station Institution in Chicago.

'25—Harold D. Smith is now manager of the Engineers Bookstore in the Main Engineering building.

'25—Philip E. Richardson is located with the General Electric Company of Schenectady, N. Y.

'25—August L. Untinen holds a position with the Northwestern Bell Telephone Company in Minneapolis.

'25—H. F. Brossard is working for the Northern States Power Company in Minneapolis.

'25—Andrew Thompson has accepted a position with the Miller Products Company of Minneapolis.

MECHANICALS

'15, M. E. '16—Abner Holmberg of Bessemer, Michigan, recently visited Minnesota, making a tour of the Iron Range. He is with the McKinley Steel Co., at Bessemer.

'22—Clarence J. Eddy, who was with the Minneapolis Tribune as pressman, is now employed at the Hawthorne Station of the Western Electric Company at Chicago, Illinois, as an engineer.

"22—Frank Fahland, Jr., is now working in the mechanical engineering department of the Northern Pacific Railway Company at St. Paul. He was formerly a salesman in Duluth for the F. E. Christofferson Co., Inc.

'22—Howard C. Kelsey, who was in Chicago, is now with the Machinery Sales, Jos. T. Ryerson & Son, Inc., of Buffalo, N. Y.

'22—Armin R. Kleinschmidt, formerly with the C. F. Meyer & Sons Co., of Wisconsin, is now a general constructor at Mankato, Minnesota.

'22—Walter C. Peters is employed by the St. Paul Gas Light Company. He was formerly of Janesville, Minn.

'22—Arthur W. Kumm, who has been recently connected with the teaching staff of Minnesota, plans on going East this fall. He was also an instructor at Rice Institute at Houston, Texas.

'22—Chester Bros was maried on August 25. He is with the William Bros Boiler and Manufacturing Company at Minneapolis.

'23—Delton T. Waby is with the Public Service Company of Northern Illinois, at Chicago, Illinois. He was taking a graduate course at the Chicago Central Station Institute.

'23—Raymond C. Ascher is with J. T. Ryerson & Son, Inc., at Detroit, Michigan. He was with the Bethlehem Steel Company of New York.

'23—Arthur W. Sear, formerly a draftsman for the Nordberg Manufacturing Company of Milwaukee, is now employed by the Link Bolt Company of Chicago.

'25—Thomas B. Caswell is in the employ of the General Electric Company of Schenectady, N. Y.

'25—William O. French has accepted a position with the Wisconsin Railway Light & Power Company of Winona, Minnesota.

'25—Alfred J. Jacobi is in Washington, D. C., working in the United States Patent Office.

'25—Elliott L. Ludvigsen is in Cleveland, Ohio, with the White Motor Company.

MINES

'23—Hartley H. Hawlick, who was with the Mill Mutual Insurance Company at Crete, Nebraska, is now employed by the Equitable Life Insurance Co. at Chicago, Illinois.

NEWS FROM THE TECHNICAL CAMPUS

Various Engineering Buildings Undergo Repairs This Summer

The pattern wood shop in the Mechanical Engineering Building is now capable of accommodating twelve more students than it did heretofore. An adjoining drawing room has been removed, and the wall between the rooms has been taken down. This furnished a space large enough for six new work benches.

The Main Engineering building can no longer claim the quarters of the General Extension Division. This department having been moved to the new Administration Building leaves two vacant rooms on the ground floor. These rooms have been remodeled and are to be used as classrooms.

Several changes and repairs have been made to the experimental building this summer. The concrete floor on the first floor has been repaired and a rearrangement of hydraulic equipment as well as the installation of new channels and apparatus has been completed in the basement.

Senior Electrical Engineers Guests at Nela Park Recently

Minnesota was represented at the third annual Junior school of lighting at Nela Park by Professor E. W. Johnson, of the Department of Electrical Engineering, and Kenneth R. Ferguson, Richard W. Jones and Albert Lee, Senior Electricals.

Nela Park, properly called the "University of Light," is the home office of the National Lamp Works of the General Electric Co. in Cleveland, Ohio, and contains the general sales and executive offices, together with the many laboratories that serve the factories and sales divisions scattered over the country.

The Nela School of Lighting is conducted for the purpose of creating a better appreciation of good lighting and the lighting industry, and the courses consist of talks by the department heads, interspersed with actual problems and trips to study modern installations. As an example of the work conducted at Nela Park, might be mentioned the "Half Mile Laboratory," over 2000 feet of street fitted out with some forty different lighting systems.

Northwest Engineers Attend International Meet at Winnipeg

Over 140 members from Minnesota were in attendance at the first international meeting of architects and engineers of the Northwest held at Winnipeg the 20th and 21st of August. The gathering was under the auspices of the province of Manitoba, the city of Winnipeg and the Architectural and Engineering Societies of Manitoba. The Engineers of North Dakota and Iowa were also invited.

The program of the convention consisted of sight-seeing tours, technical talks and several social gatherings. At the meeting on the first day, papers were presented by W. T. Ryan, Minn. '05, on the Organization, Purpose and Activities of the Minnesota Federation of Architectural and Engineering Societies, The American Engineering Council was the subject of W. H. Hoyt, Minn. '09, of Duluth and president of the Duluth, Missabe and Northern Railway Company. J. T. Ellison, chief engineer of the Minnesota highway department, gave an address on Minnesota's Highways. G. H. Herrold of the planning board of St. Paul spoke on City Planning and E. V. Willard of the state drainage and waters commission of the state of Minnesota discussed Boundary Waters. A talk by C. M. Jansky, Jr., assistant professor of electrical engineering of the University of Minnesota on Radio Broadcasting in the Northwest closed the program of the American section. In the Canadian section of the meeting, F. H. Martin of Manitoba was the principal speaker.

A dinner dance was held that evening in the Marlborough Hotel.

On Friday, the twenty-first, the convention was guests of the city of Winnipeg Hydro at a picnic held at Pointe Du Bois. This event took all day and immediately after lunch at noon, the party was entertained with music by Princess Pat's band. An inspection of the immense hydro-electric plant which supplies power for the entire province of Manitoba took place in the afternoon.

The guests were very much impressed on the huge scale by which electric power is being used in Canada. Nearly every home uses electricity for the sole means of cooking.

Among those attending from the University of Minnesota were: Professor and Mrs. Bass and daughter; Professor and Mrs. Rowley; assistant professor and Mrs. W. T. Ryan; assistant professor and Mrs. C. M. Jansky; assistant professor and Mrs. Kuhlman and Harold D. Smith of the Engineer's bookstore.

National Scientists Attend Chemical Symposium Here

The third National Colloid Symposium was held at the University this summer on June 17-18-19. Noted authorities on Colloids as well as scientists from the entire United States and Canada were in attendance. Over twenty papers were presented covering the various fields of colloidal chemistry. Representatives from various large American chemical, electrical, photographic, and optical concerns were present, notable among whom was Dr. Irving Langmuir of the General Electric Company. Dr. Herbert Freundlich of Berlin was a guest of honor. He also remained as an instructor in the first session of summer school.

Members of Techno-Log Board to be Elected Soon This Fall

The first election of members for the new Techno-Log board will be held early in the fall quarter. At a special election held last spring, the proposed constitution was voted upon favorably. This constitution provides for the Techno-Log Association composed of every student registered in the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Membership in this association is automatic with the student's registration. From this association, six student members are elected who, with the three faculty representatives, compose the Techno-Log board. The duties of this board are to approve budgets and act with the managing editor in determining editorial policies.

The entire constitution appeared in the May, 1925, issue, copies of which can be obtained at the Techno-Log office. However, we herewith reprint Article V concerning elections:

ARTIVLE V.

1. Six members of this association and three faculty representatives shall constitute a body to be called The Minnesota Techno-Log Board.

2. The membership of this board shall be as follows:

(a) three students to be elected from the College of Engineering and Architecture, no two to be from the same department;

(b) one student to be elected from the School of Chemistry;

(c) one student to be elected from the School of Mines;

(d) one student to be elected at large from the College of Engineering and Architecture, the School of Chemistry and the School of Mines;

(e) the Dean of the College of Engineering and Architecture or his personal representative;

(f) the Dean of the School of Chemistry or his personal representative;

(g) the Dean of the School of Mines or his personal representative;

3. Student members shall be elected at the annual All-University election in the spring of each year.

4. To be eligible for election, students must have been members of this association longer than a year and eligible under the regulations of the University and their respective colleges.

5. Each board shall go into office at the end of the spring quarter directly after its election, and shall serve one year or until the succeeding board shall qualify.

6. After the election of a new Board its members shall meet with the old Board but shall not exercise the privilege of voting.

7. Each vacancy in the board shall be filled at a special election to be called and supervised by the member of the All-University council representing the college from which the vacancy occurs, said election to be as soon as possible and in no event later than a month after the occurrence of the vacancy.

8. As soon as possible and before a month has elapsed after its election, the board shall meet and select from its own membership a president, a vice-president, a secretary and a treasurer.

Extension Division Announces New Course in Electric Vehicles

A course in Electric Vehicles, intended for truck owners, drivers and garage men, will be conducted during the first semester of 1925-26 by the General Extension Division of the University of Minnesota, the teacher being Harry S. Greiner, an electrical engineering graduate of the University, who has had many years of experience in the use of vehicle batteries and in the manufacture of trucks. Classes will be held one evening each in the Electrical Engineering Building, from September 28, 1925, to January 30, 1926. It is expected that this course will be quite similar to courses conducted in New York City and Chicago under the auspices of the Electric Light Association.

The
MINNESOTA TECHNO-LOG
University of Minnesota

A GRADUAL uncovering process has been at work this summer. With the clearing away of the old Campus Club and other buildings, the campus near the technical colleges assumes a more definite shape as planned by Cass Gilbert in his Greater University plans. From the steps of the Main Engineering building, the white pillars of the million dollar library loom up alongside those of the School of Chemistry. On our right hand side is the magnificent Administration building, finished this summer and housing the executive offices for the first time. Further to the right of this are the new playing fields adjoining the memorial stadium, already dotted with the maroon and gold of football players.

Announcement has been recently made of a new Physics building to be located directly across from the electrical building and to cost in the neighborhood of a million dollars. Work will soon start on the $70,000 highways materials testing laboratory to be built along Washington avenue next to the experimental engineering building.

The greater Minnesota Technology is today being constructed in mortar and brick and will tomorrow send forth men into the world recognized as leaders in their fields of endeavor.

ONLY three unknowing souls voted contrary to the TECHNO-LOG constitution at the special election held May 29th of last spring quarter. The establishment of this association and board marks the biggest step that the magazine has taken since its founding several years ago. There has been a distinct need shown at various times for a stable governing body to which the publication could go for counsel and who would directly oversee the policies and the several problems of management that arise from time to time.

Accordingly members of the staff last year drafted plans for this association, composed of every student in the College of Engineering and Architecture, the School of Chemistry and the School of Mines. From this body, six students will be elected, who serve with three faculty members as a board of governors. This system has been patterned after the main student board of publications and the system in use on the agricultural campus.

It is advisable for every student in the technical colleges to secure a May TECHNO-LOG and read the constitution through carefully. Copies are also posted on the bulletin boards. This is a matter concerning every student, as his registration automatically makes him a member of the association. Each individual has an indirect vote in the affairs of the magazine, as the various representatives on the board are subject to his vote.

The many classes and departments are already talking over their prospective nominees. The race for board members will be hotly contested, as is every position in the live-wire engineering colleges. May the best man win!

AGAIN the Minnesota TECHNO-LOG enjoys the distinction of being the first college publication to appear on the campus this fall. This is the second year that an October issue has been printed. Certain details of make-up have been instituted as well as a different cover stock and arrangement. It is our plan to have a change of color on the cover each month. This will be an innovation from previous procedure and will give the magazine a distinctive appearance.

It is especially fitting that the University of Minnesota establish a course covering agricultural engineering, in its curriculum. There is an enormous field to cover, Minnesota ranking as she does, foremost among the agricultural states of the Union. Harry B. Roe, the author of this article, is one of the pioneers in this branch and is a graduate of the general engineering class of 1908.

The Engineers' Bookstore, which incidentally was founded the same year that the TECHNO-LOG succeeded the *Minnesota Engineer*, is an outstanding example of student enterprise. It is demonstrated by its yearly account sheets that it furnishes books and supplies to technical students at a great saving.

There is no reason why this policy should not be extended to other colleges on the campus. The fact that actual dollars and cents are saved to a student, is sufficient reason.

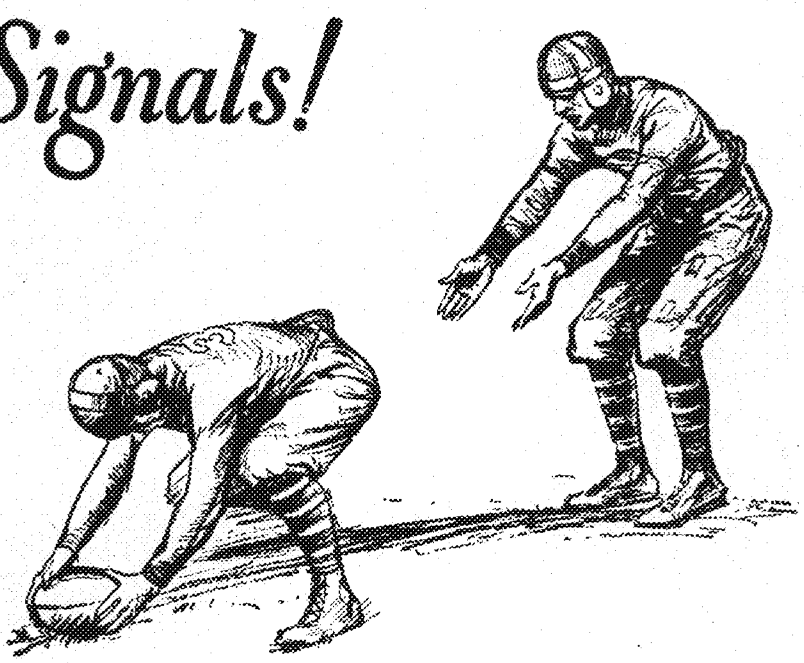
The largest industrial addition to the Twin Cities in recent years is the Ford plant. We are grateful to Stone and Webster of Boston for the co-operation which was shown to our staff in obtaining the story and also for the photographs. George A. Nelson, the author, graduated from the civil department this spring and is a Tau Bete and a Chi Epsilon. He is now in Alaska with the United States Coast and Geodetic survey.

Football is the all-important topic this fall. The TECHNO-LOG is pleased to present to its readers this exclusive story written by Lee A. Amidon of the University of West Virginia, Doc Spears' former home. Amidon is a graduate of the mechanical department in 1923 and is now an assistant professor of steam engineering at Morgantown.

The article on radio moving pictures is especially appropriate this month inasmuch as the first demonstration of its workings will be given in the Twin Cities soon. This invention, when practical, will completely revolutionize newspaper photo service, as it will be only a few seconds between the time an uprising in South America takes place and the time that the photographs appear in all American papers.

The new strip of pavement which runs along Church street through the engineering campus is in reality, a laboratory project on an extended scale. This roadway is composed of 19 different contypes of pavement construction, each having various mixes and aggregates. The road was designed and built by the highway department and will be tested from time to time to determine effects of travel and weather on the deterioration. Professor F. C. Lang of the civil engineering department is in charge of the experiment.

Signals!



—vital in electrical communication, too

"41-7-27-3," sings out the quarterback; and the football goes on towards a touchdown.

"Madison Square 32198," says a voice in San Francisco; and a message starts on its way across the continent.

But the similarity between football and the communication art doesn't stop there. In each case signals have unleashed a great force. Coordination has scored the goal.

And this was made possible only through years of preparation. In one instance, on the gridiron. In the other, in the college classroom and the laboratories of industry.

That, in short, is why men who've learned their fundamentals and how to apply them at the snap of a signal are qualifying for positions of leadership in the greatest field of signals known to man — the field of communication.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Published for the Communication Industry by

Western Electric Company

Makers of the Nation's Telephones

Number 51 of a series

Agricultural Engineering

(*Continued from page 6*)

to call themselves agricultural engineers are but a handful to those who will shortly be needed.

A Recognized Profession. The Division of Agricultural Engineering is frequently asked to recommend and secure men to fill various positions in this field. We have not been able to provide men from our own institution for these positions. The agricultural colleges in seven of our agricultural states are already giving courses which lead to professional degrees in agricultural engineering and other states are preparing for such work, but the demand for agricultural engineers is steadily increasing and it is the opinion of the farm equipment companies and public utility companies that in the next few years there will be a great demand for agricultural engineers for these lines of service, and that the agricultural colleges are not preparing such men in sufficient quantity.

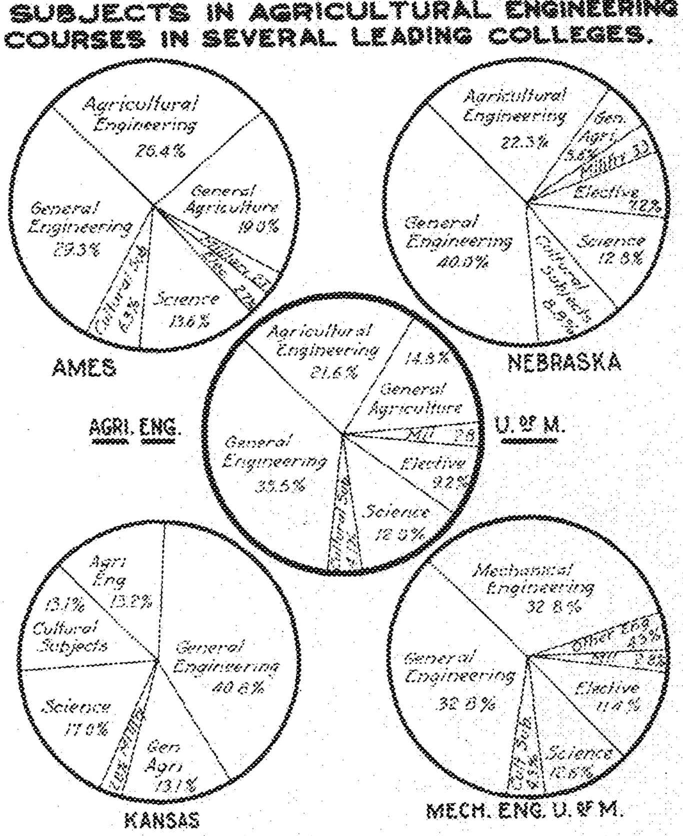
The work in agricultural engineering is well recognized by the United States Department of Agriculture which has a thoroughly organized and very active Division of Agricultural Engineering. This division is fostering the development of technical agricultural engineers in the different states.

The American Society of Agricultural Engineers. The American Society of Agricultural Engineers is one of the Federated Engineering Societies of America. It was organized about 20 years ago, under the enthusiastic leadership of Prof. J. B. Davidson of Iowa State College, familiarly spoken of as The Dean of Agricultural Engineers. It is now an active international organization and its membership is represented in all educational and commercial activities throughout nearly the whole world. Our own able Chief of Agricultural Engineering at University Farm, Professor William Boss, is a charter member and nearly half his present staff of 25 men are also members. The total membership of the Society is now upwards of four hundred. It supports an able secretary on full time and publishes a monthly technical journal of high character and standing, entitled Agricultural Engineering. The Society has three regional sections now active in various parts of the United States with still a fourth in prospect. There are also several student branches at various colleges where agricultural engineering is well established and we look forward confidently to the day when a student branch shall be established at the University of Minnesota.

The following paragraphs quoted from the title page of Agricultural Engineering gives the official origin, character and aims of the Society:

> The American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc.
>
> The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.
>
> The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:
>
> (a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.
>
> (b) Farm Structures—buildings and other structures and related equipment.
>
> (c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.
>
> (d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.
>
> (e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.

COMPARISON OF THE DISTRIBUTION OF SUBJECTS IN AGRICULTURAL ENGINEERING COURSES IN SEVERAL LEADING COLLEGES.



The New Course—Its History and Character. Eight years ago the writer stood practically alone on the faculty of the University of Minnesota as the pioneer of this new professional field; but the following year Professor William Boss, who as a former member of the faculty from 1905 to 1909, almost from the beginning of it, was familiar with the development of this type of work, became a logical convert to the argument for a technical course in this field. Dean Freeman of the College of Agriculture, Dean and Director Coffey of the Department of Agriculture, and others of that faculty gradually followed and when, a little over two years ago, Dean Leland of the College of Engineering and Architecture was approached on the subject, he gave it very courteous hearing, and after a careful study of the matter, so characteristic of him, he became a very earnest advocate of the proposed new course, which in its final form shows clearly the stamp of his handiwork.

The plan of the new course had very simple beginnings. The first outline was prepared about five years ago by the writer. In it he was guided to a considerable extent by the

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Agricultural Engineering

(*Continued from page 20*)

existing course at Ames, Iowa, using modifications suggested in his own consciousness by a decade of experience on the staff of our Department of Agriculture. Starting in this manner the course ran the gauntlet of six faculty committees and two deans until one could scarcely recognize the original child; but looking closely we find that the essentials are all there still, and the course much improved and strengthened by contact with several minds expert in curriculum building as well as by comparison with other leading curricula in agricultural engineering.

It is the consensus of opinion among all those active in building up this course that a good foundation of pure science, mathematics and some cultural subjects are more important to an engineer, and especially an agricultural engineer, than some highly specialized subjects in his own line of engineering. This view seems fairly well borne out by the quite close similarity of the ideas of engineering educators generally as shown by the accompanying comparative charts of engineering courses here and in other agricultural institutions offering courses in agricultural engineering. The agricultural engineer must fundamentally be an engineer, but in addition he must have a broad scientific training and a knowledge of the fundamental principles of agriculture. The curriculum that has been outlined for the course in Agricultural Engineering at the University of Minnesota will provide men with such training.

Field of the Agricultural Engineer. You, who read this discussion, will probably ask, especially if you are a student of engineering either present or prospective: After all what is agricultural engineering, how it is different from other established lines of engineering, and what new or promising fields of opportunity does it hold out to the student who chooses to follow this line of special training? To these queries we will reply as follows:

Agricultural Engineering may be defined as the art and science of engineering *as applied to agriculture*, embracing both the technical and economic phases of the application of engineering to agriculture. It may be comprehended under the following general headings:

(a) Farm structures, embracing farm buildings and other structures, building materials, concrete construction, arrangement of buildings, ventilation, etc.

(b) Farm Mechanics, including gas, animal and electric power, farm implements, water supply, sewage disposal, lighting and heating, and farm home conveniences.

(c) Land Reclamation, such as drainage, prevention of soil erosion, irrigation, land clearing, and roads.

The new course is clearly mapped out as a general course but the three distinct lines of specialization above listed are also made possible.

Agricultural engineers must be able not only to serve as specialists in their line of work but they must also be able to work directly with the farmers and with the individual farm problems and arrive at a solution for such problems. However, the greatest field of service of the Agricultural Engineer is in the design and construction of equipment that the farmer may use. The design and construction of one type of efficient farm equipment may result in carrying help to hundreds of thousands of farmers, while an engineer could not possibly reach all these same farmers by individual consultations and personal service throughout his whole lifetime.

Some of the important positions which Agricultural Engineers are called upon to fill are shown in the following list:

1. With the manufacture of farm machinery, farm equipment and farm building materials, as follows:
   a. Executives.
   b. Research and development engineers.
   c. Publicity managers.
   d. Sales managers and expert salesmen.
   e. Technical field experts.
2. Superintendents or managers of large farms where machinery and farm equipment have been highly developed.
3. Drainage and irrigation engineers in reclamation service.
4. Teachers, investigators, and extension specialists in agricultural engineering in colleges, experiment stations and in the United States Department of Agriculture. (Possibilities in desirable and needed research in this field seem almost unlimited.)
5. Editors and agricultural engineering experts for farm papers and technical magazines.
6. Designers and contracting engineers for farm buildings.
7. General practicing engineers for farm machinery and equipment installations.
8. Agricultural advisers with electric and other public utility companies who have a worth-while service to sell the *farmer for* his increased profit and comfort of living.

Details of curriculum, program, description of courses, etc., will be found in full in the new bulletin of the College of Engineering for the year 1925-26 just published. Members of the staff of the Agricultural Engineering Division will be glad to answer questions not made clear by official publications. The writer is authorized to extend the cordial personal invitation of Professor William Boss to any and all students registering in this course to meet him at his office at University Farm at a convenient season and confer with him on points of interest in the work.

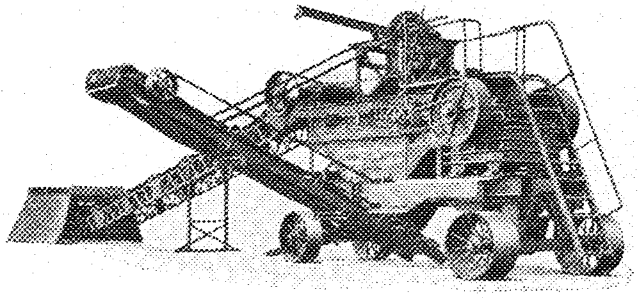
The Division of Agricultural Engineering. The Division of Agricultural Engineering is situated on the Agricultural Campus in a comfortable, large and well equipped building provided by the foresight and liberality of the Legislature of 1909 and 1910. It is here, under the direction of members of the divisional staff that all special courses in agricultural engineering and such fundamental or general engineering courses as are taught from an agricultural standpoint,—of which surveying and agricultural hydraulics are a type,—will be taught to those registering in agricultural engineering. The division is well organized and has for sixteen years been doing a large amount of work in fundamental teaching, some in agricultural extension, and a limited but rapidly increasing amount in official research. The whole division is composed of five sections representing the major divisions of the work, namely, buildings, mechanics, land clearing, physics, and drainage. Each section is headed by a man of extended practical experience in his line who has had a life long contact with the agricultural field.

The chief of the division, Professor Boss, is a native of southeastern Minnesota, a farm product with a broad experience both in teaching of the fundamentals of engineering as an instructor and administrative officer, for many years, in the School and the College of Agriculture, and in practical commercial life where from 1910 to 1918, during which time the University lost his services, he built up and still aids in directing a flourishing manufacturing business in the Midway District of the Twin Cities. His varied experience coupled with his genial and ready sympathy especially fits him as an advisor and guide to students in Agricultural Engineering.

The Section of Farm Buildings is headed by Professor H. B. White, a practical farmer, farm architect, builder and successful teacher of many years' experience.

The Section of Farm Mechanics is

(*Continued on page 28*)



Moving Pictures by Radio

(*Continued from page 11*)

through this lamp. By adjusting the speed of the motor to the temperature change of this filament soft gradations of light and shade are obtained which probably can never be equaled by any other device, a photograph of true photographic value, entirely free of lines.

Of course, the sending machine and the receiving machines must run in exact synchronism. This synchronous control of the sending and receiving motors is maintained by the vibration of a rather heavy fork at each station and adjusted to beat together with such slight automatic correction by radio as may be required to keep all receiving forks in step with the fork of the station which at the moment is sending. It is a very simple and dependable mechanism, by which any number of motors, of any size, separated by any distance, can be made to run in synchronism. Of course, it would be fatal if it were necessary to wait until the picture was developed before it could be discovered that the receiving camera was getting out of control. So a special "neon" lamp is located to shine on a revolving marker on the motor shaft of the receiving instrument and flashed by the incoming radio signals which latter bear a definite relation to the rotation of the sending station motor.

Radio Photographs and Radio Vision, when both are done by the flat-plate method, are identical in principle, the difference being only in the speed of the apparatus, with such modification in the apparatus as will permit of the required speed. Just as in the Radio Photograph the picture surface of the Radio Vision is covered with a small spot of light moving over the picture surface in successive parallel lines, with the light value of the lines changed by the incoming radio signals to conform to a given order, the order being controlled by the distant scene at the sending station. As the whole picture surface is covered in one-twelfth to one-sixteenth of a second, persistence of vision of the human eye is sufficient to get the picture from the white receiving screen—a photographic plate is not necessary.

When the machine of Radio Vision is turned over slowly, the little spot of light on the screen which makes up the picture looks for all the world like a tiny, twinkling star as it travels across the white surface of the screen in adjacent parallel lines, changing in light value to correspond in position and intensity to the light values of the scene before the lens at the broadcasting station. But when the machine is speeded up until the succession of lines recur with a frequency which deceives the eye into the belief that it sees all these lines

VISUAL RADIO HOME ENTERTAINMENT

"The time is not very far off now when inaugural ceremonies, ball games, pageants, and other notable events may be sent reproduced in action on a small screen in the home, carried there by radio."

all the time, then a picture suddenly flashes out on the white screen in all the glory of its pantomime mystery.

To accomplish this, the apparatus must be speeded up until a whole picture can be assembled on the screen, say, in one-sixteenth of a second, to be seen by the eye directly. It was necessary to modify the Radio Photo apparatus to permit this increase in speed. So a lens disc is substituted for the fast pair of prismatic plates. Each lens draws a line while the relatively slow rotation of the prismatic plates distributes the lines over the whole picture surface, just exactly as the plates do in the Radio Photo Camera. The Radio Vision receiving set and the Radio Movies set are identical, and one may, therefore, see in one's home what is happening in a distant place, an inaugural parade, football, baseball, or polo game (and we call it Radio Vision) or one may see the motion picture taken from the screen of a distant theatre (and we call it Radio Movies).

The Radio Vision receiving set, as now designed, is very simple; namely, a mahogany box, containing, beside the radio receiving set and a loudspeaker, only a small motor rotating a pair of glass discs, and a miniature high frequency lamp for outlining the pantomime picture on a small motion picture screen.

NEWS NOTES

Edwin R. Martin, who for several years has been assistant professor of Electric Power Engineering at the University of Minnesota, has resigned in order to take a position in the Industrial Power division of the Westinghouse Electric and Manufacturing Company at Pittsburgh.

G. W. Swenson, B. S., E. E., has been promoted to Assistant Professor of Telegraph and Telephone Engineering at the University of Minnesota. After graduating from the University, Mr. Swenson was connected with the Northwestern Bell Telephone Exchange Company and with the Western Electric Company, later serving as an instructor in vocational training of drafted men during the war. He then became an instructor in electrical engineering at the University of Minnesota, specializing in electrical communication.

Elmer W. Johnson, B. S., E. E., has been transferred and promoted from Instructor in Mathematics and Mechanics to Assistant Professor of Electric Power Engineering at the University of Minnesota. After graduation from the University of Minnesota, Mr. Johnson spent two years with the Westinghouse Electric and Manufacturing Company at Pittsburgh, one year of which was in the Railway Application Section. This was followed by a year of experience in the substations and shops of the Chicago, Milwaukee and Puget Sound Railway electrification. He spent over a year during the war in charge of electrical construction and maintenance at the docks at Brest, France, including the adjacent railway yards and supply depot. For two years he was assistant electrical engineer with the Northern States Power Company, continuing with special problems for them while engaged as an instructor at the University of Minnesota.

DAYLIGHT ILLUMINATION.

The angle of refraction being equal to the angle of incident, it is a simple matter to determine the correct angles to use in manufacturing glass which will give good illumination. But for proper industrial plant illumination, there is more to be considered than mere deflection of light. The direct beam of light must be eliminated in order to prevent sun glare, which is objectionable on account of its causing heavy shadows and strong contrasts which decrease the efficiency of employees and necessitate the use of shades which in turn reduce the light to such an extent that daylight illumination any distance from the light source is not sufficient. Therefore, in order to produce a glass which when used in the windows of industrial plants will produce as near to ideal illumination as possible, we must first eliminate the direct rays of the sun by deflecting the light to the ceiling and side walls which re-deflect it back to a distance 25 to 50 feet from the window throughout the entire working area. To accomplish this we have scientifically designed a type of glass which is named "Factrolite."

Factrolite consists of 30 ribs to the inch, running at right angles, forming 900 pyramidical prisms or 3,600 light deflectin~ surfaces which completely disintegrate the direct beam of light from the sun. Furthermore, the depressions in the surface of Factrolite are so slight that the accumulation of dirt and dust is minimized and can be perfectly cleaned with an ordinary dry scrubbing brush. Incidentally, the cleaning of windows is most important for keeping up production and increasing the efficiency of any industrial plant and should be given more consideration in plant management.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.

Our New Coach, Clarence W. Spears

(Continued from page 12)

until he recites the correct procedure. But it is hard on that player if he repeats that mistake because Spears rules with an iron hand and nothing but the best is good enough. Any player in a game realizes that he is in there only so long as he can work with his ten comrades better than some other man on the bench can. The thoroughness of this fundamental training can readily be appreciated even by the untrained observer when he sees holes opened by the line big enough to drive a wagon through, and sees the elusiveness of the wingmen who refused to be boxed, or the clean tackles made on the opposing backs.

In general, Spears prefers to use open field running, off tackle slashes, end runs, and line plays instead of a passing game, although he has developed an aerial attack of a perplexing and bewildering nature, used with high success in many games. In the Rutgers game in particular, the 27 to 7 score was largely due to the very effective passing game which West Virginia displayed. Passes are provided with a good defense, so that in case the pass is intercepted, the opposing team cannot make much headway. As yet no opposing team has ever scored a touchdown on an intercepted pass from a Spears coached eleven.

The main stay of Spears' running attack is the great shift play, which he largely developed. As a student at Dartmouth he played as guard in a shift which used the guards and backs. When he became coach at this school, he enlarged the shift by calling the ends also into action. He has perfected the shift still more, so that the guards, ends, backs, and tackles, in fact everybody but the center moved. This shift has proved so deceptive that even "Doc" said that if he were called upon to perfect a defense for the shift when it was working properly, he would not know how to do it. Dr. Spears had this shift so well developed here that offside penalties were seldom called, and no criticism was directed against the play.

He believes a good defense has much to do with the winning of a game, and he emphasizes this very strongly. That his defense has always been good is proven by the following scores and accounts of yardage. The figures are also a proof of Spears' knowledge of the game and of his ability to impart that knowledge to the players.

In 1921, West Virginia won 5 games, lost 4, and tied 1, scoring 160 points to our opponents 82. In 1922, we won 9, lost 0, and tied 1, scoring 267 points to the opponents' 34. In 1923 the count was 7 won, 1 lost, and 1 tied, scoring 297 points to our opponents' 41. In 1924, his last year here, we won 8, lost 1, scoring 282 points, the opponents 48. In his entire career, only two teams have defeated one of his coached elevens by as much as two touchdowns, and both defeats occurred during his first year at West Virginia, when Rutgers won 17 to 7, and Washington and Jefferson, 13 to 0.

In 1923 West Virginia held opponents to only 651 yards in their running attack, and totaled 3,420 yards themselves, while in passing they made 473 yards to their enemies 276. In 1924 the team gained 752 yards by forward passes to their opponents' 472, and in the running attack showed 2,390 yards against the 628 of opposing elevens.

Dr. Spears is a man of average height, full-faced, clean shaven, and of immense girth. This most noticeable feature being accounted for by a beam tilting avordupois of 238 pounds. Last year Spears in conjunction with Ira Rogers, the present West Virginia coach, and another near Santa Claus decided to reduce. They would don rubber vests, work a couple hours a day in the gym, wrestle an hour or so, work out with the sub-basketball team to such a result that Spears would lose sometimes as much as 8½ pounds per day. However, the report has it that on Sunday, his day of rest, he would regain all he had lost during the week and finally gave up reducing as a bad job.

Dr. Spears is usually very quiet and good natured. He sits expressionless on the bench during the football game and gives no sign regardless of whether the play is going in his favor or not. However, he is only human, and the interest is there whether he shows it or not, as evidenced by an occurrence during the Rutgers-West Virginia game in Spears' first year here.

The game was close and so the story goes, a pretty tense situation was the result. In the third quarters West Virginia managed to work the ball over the line and the score was 7-0 in our favor. Not long after this a Rutgers man broke loose and made a long run for a touchdown, thus making a tie game. At the instant this play started, one of the cops on duty at the game had managed to get in front of Spears and shut off his view of the play. Spears threw off his cap, letting out a whoop, he jumped up and grabbed that cop by the neck of his coat and the seat of his pants and threw him clear over the fence back of the bench. He then resumed his seat, and again viewed the playing as though nothing had happened.

Dr. Spears was All-American guard at Dartmouth. He is interested to a great extent in sports other than football and basketball, baseball, track, and wrestling are all on his list of activities. Rarely has a big track meet gone by but that Dr. Spears attended, and often he has assisted in the coaching of the squad.

Doc is also somewhat of an engineer and inventor, and has designed several appliances for football equipment on which he has obtained patents and receives royalties from the manufacturers.

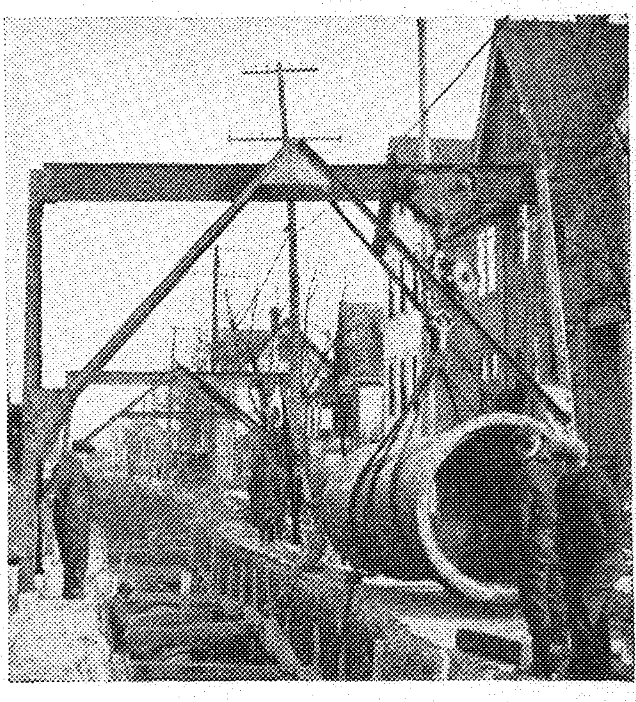
You at Minnesota are fortunate in getting such a man. Perhaps he will not develop a championship team the first year, maybe not the second, but one thing can be assured and that is that he will organize a real fighting team; one that plays when it is on the field. It will have spirit, co-operation, which in the words of the fan is team work, pep, and it will be using its brain all the time. One cannot always ask for a winning eleven, but what one wants to see is some spirit and fight, a thing for which Minnesota teams have always been noted. However, I believe that Dr. Spears has the ability to give Minnesota a winning football team, but it is necessary to get all the available material out for practice and the remaining loyal sons to get out at the games and make Minnesota second to none in the Big Ten.

So here's to Clarence W. Spears, Coach, doctor, and inventor, may you all learn to love him.

G. S. Liebeck, B. S., E. E., a graduate of Worcester Polytechnic Institute, who has been connected with the electrical engineering department of University of Missouri, has accepted an appointment as an instructor in electrical engineering at the University of Minnesota.

Appointments to Teaching Fellowships in the Department of Electrical Engineering at the University of Minnesota for the year 1925-1926 are as follows: Louis J. Schnell, B. S., E. E., graduate of University of Colorado; George F. Corcoran, B. S., graduate of South Dakota State College; I. C. Benson, B. S., E. E., graduate of University of Minnesota; Henry R. Reed, B. S., E. E., graduate of University of Minnesota.

J. H. Kuhlman, B. A., E. E., has been promoted to the rank of Assistant Professor of Electrical Design at the University of Minnesota. Mr. Kuhlman is a graduate of the State University of Iowa. Following several years experience in practical design with one of the electrical manufacturing companies, he served as an instructor in electrical design at the University of Minnesota, and now receives a well deserved promotion.



Agricultural Engineering

(*Continued from page 22*)

headed by Professor J. B. Torrance, also a practical farmer and a gas engine expert and teacher of years of experience.

The Section of Land Clearing is headed by Professor M. J. Thompson, who as Superintendent of the Duluth Sub-station has developed with great success the System of delayed land clearing.

The Section of Agricultural Physics is headed by Professor E. A. Stewart, a farm product, one of the few thoroughly equipped agricultural physicists in the country and a teacher of experience and rare ability.

The Section of Drainage is headed by the writer, a farm product, an engineer of twenty-seven years' experience, eighteen of which have been in agricultural phases principally drainage, and a teacher of years of experience.

Agricultural Engineering Research. It will doubtless be of interest to the reader to learn that under the Agricultural Experiment Station the Division of Agricultural Engineering has, at the present time approved and active, thirteen official projects in investigation and research. These are distributed as follows:

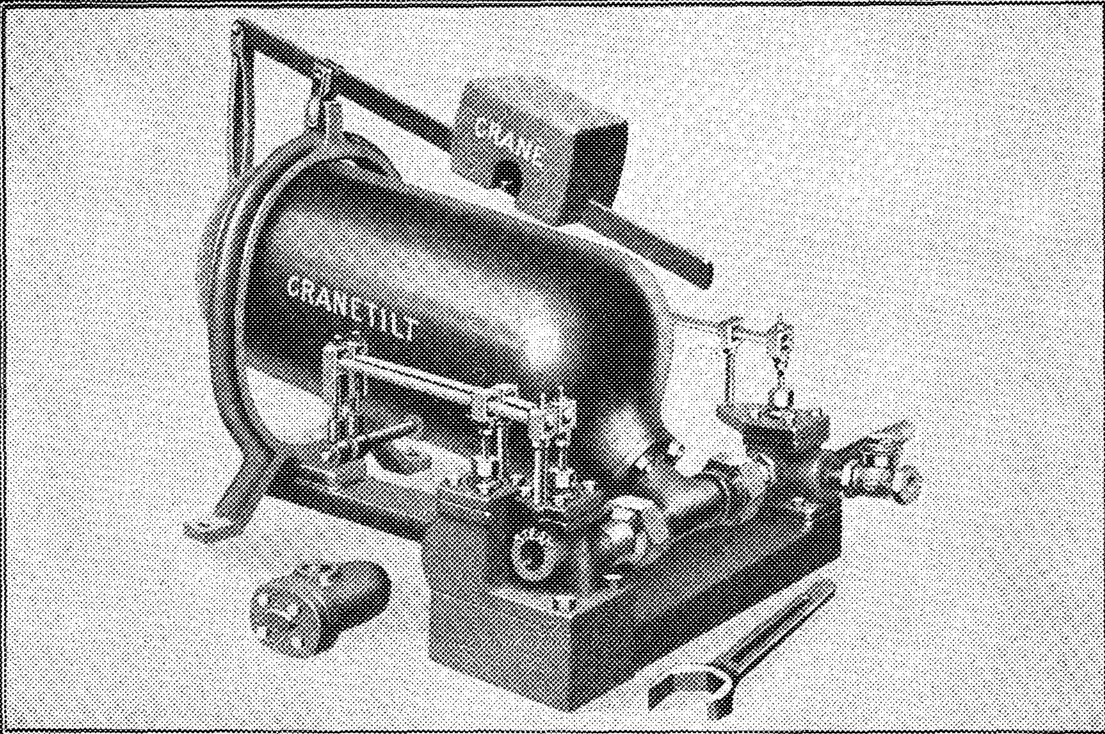
One in farm buildings.
One in farm mechanics.
Two in land clearing.
Five in agricultural physics.
Four in drainage.

One of this last group, namely the one aiming to secure types of material and methods of manufacture that will insure permanence of drain tile, is conducted co-operatively with the State Department of Drainage and Waters and the United States Department of Agriculture, Bureau of Public Roads. The active leader of this project is Mr. D. G. Miller, a government drainage engineer, who has his permanent headquarters with the Agricultural Engineering Division. Mr. Miller, who has been with the Federal Department for the past eighteen years, is a civil engineer of exceptional ability and a scientific investigator of a very high order. He is without doubt the best authority in the country today on natural agencies deleterious to concrete and their control. His present work embraces field work in four states and keeps busy at full capacity a large laboratory at University Farm, where he will be glad to meet the students and explain the work of his interesting laboratory.

The methods of attack and results of the research projects above listed so far as available will be at the service of students in agricultural engineering but the whole field is so new and so vast that, in the research line, it has scarcely as yet been scratched. However, the need for research in various phases of agricultural engineering is so great that an unusual opportunity is offered in this field for graduate study.

Counsel to Students. While we would not for a moment discourage the student from the large city who, after due consideration, has decided that he earnestly wishes to train for this work, still we do feel that the prospective student best fitted to develop to the best advantage as an agricultural engineer is the young man from the rural district,—best of all from the farm itself with a background of years of farm experience at home—with a natural liking and bent for engineering work; always provided, of course, that he has the proper grounding in his college preparatory work.

To the young men of the state and of the country we would say: if you are interested in engineering work in any line and if you also are interested in agriculture, the field of agricultural engineering affords great opportunity. However, the active field is new and in its pioneer stage. Pioneering always means hard work and sacrifice but it also means achievement. If you are not willing to face the sacrifice and do the hard work for the sake of the achievement, if you have not the capacity or the inclination for hard work, the spirit and the power to rise above discouragement and to keep your eye fixed on the goal of final achievement, keep away from this field; there is no real place for you in it. As this phase of education develops, we do not want in the pioneer classes the many who go through college just to get a job, but we do want the few, the stalwarts who always arrive because they never turn their faces backward. If you have the vision; if you love mechanical or engineering work and sympathize with the importance of the great agricultural community; if you love the work for the work's sake; if through grinding toil not yielding to discouragement, you can keep your eye on the goal of achievement for the community and the state, then come into this field and you will find there a worth-while job with unlimited opportunities for real service to an earnest and appreciative clientele.



CRANETILT THREE-VALVE, LIFTING-TYPE STEAM TRAP

WHAT IS A STEAM TRAP?

A successful steam trap should be a passageway for water and a barrier to steam. It prevents the loss of any steam while it disposes of the accumulated condensation from pipe-lines and headers. Or drains receivers, drip pockets or steam using appliances. It is automatic, performing its important function without attention.

Steam traps of the right type, properly arranged, will return hot condensation directly to the boilers as pure feed water. Conserving the "heat of the liquid" of this condensate, they effect large fuel economies. They are the most economical devices on the market for boiler feeding. Steam traps can also be used to draw condensation from low pressures or vacuums, discharging directly into a higher pressure, and metering the discharge if desired.

Cranetilt traps perform these and similar functions in many important power plants, in chemical plants, paper mills and oil refineries. Their operation is fully described in a Crane publication entitled "Condensation." We will be glad to send a copy to any engineering student who writes for it.

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ALUMNI NOTES

CIVILS

'18—George W. Putnam is chief engineer of the Missouri Sanitary Commission with offices at Jefferson City, Mo. He recently completed a detailed report on water purification as regards disease and epidemics. This represents several years survey and incorporated the findings of several who have been engaged on this project for a long time. Putnam was recently in Minneapolis on his vacation and visited friends on the campus. Incidentally, he was one of the first founders of the Engineer's Bookstore and was active in instituting St. Pat's day at Minnesota.

G '22—Harry E. Brown, formerly of LeRoy, Minnesota, is now sales engineer for Fairbanks Morse & Co. of St. Paul.

G '22—Rudolph Ernest Melli, Jr., is now working in the Mechanical Engineering office of the Great Northern Railway Company at St. Paul. He was formerly at the Cedar Lake Shops of the M. & St. L. R. R. Co. at Minneapolis.

'22—Edward J. Soslnik is with the Virginia Bridge and Iron Co. of Birmingham, Alabama.

'22—Nels S. Anderson is a draftsman for the Minneapolis Board of Education.

'22—Clifford LeRoy Swanson, formerly with the Corrugated Bar Co., Inc., is now employed by the Concrete Engineering Company of Cicero, Illinois, as designer and estimator.

'22—George R. Bailey passed through the city this summer on his vacation. He is now working for the Illinois Bell Telephone Company with offices at 1401 Bell Telephone building, Chicago, Ill. He has charge of suburban construction work for the company around Chicago. Football fans will remember Bailey as a star on the gridiron in the past.

'22—Roland E. Ost is now at Mason City, Iowa, working as engineer with the Northwestern States Portland Cement Co. He was formerly with the Northwest Paper Co. at Cloquet, Minn., working on paper mill construction.

'22—S. R. Cray, Jr., who has been with the Northern States Power Co. working on hydro development work on the St. Croix, Mississippi and Chippewa Rivers, is now the City Engineer of Chippewa Falls, Wisconsin, member of Board of Public Works and State Inspector of Buildings.

'23—H. W. Abramson is located at Springfield, Ill., where he is working for the Illinois State Highway Department as assistant engineer of materials.

'23—Maurice "Micky" Judd visited old friends about the campus lately. He is now a sales engineer for the Northern Iowa Brick and Tile Company with offices at Mason City, Iowa.

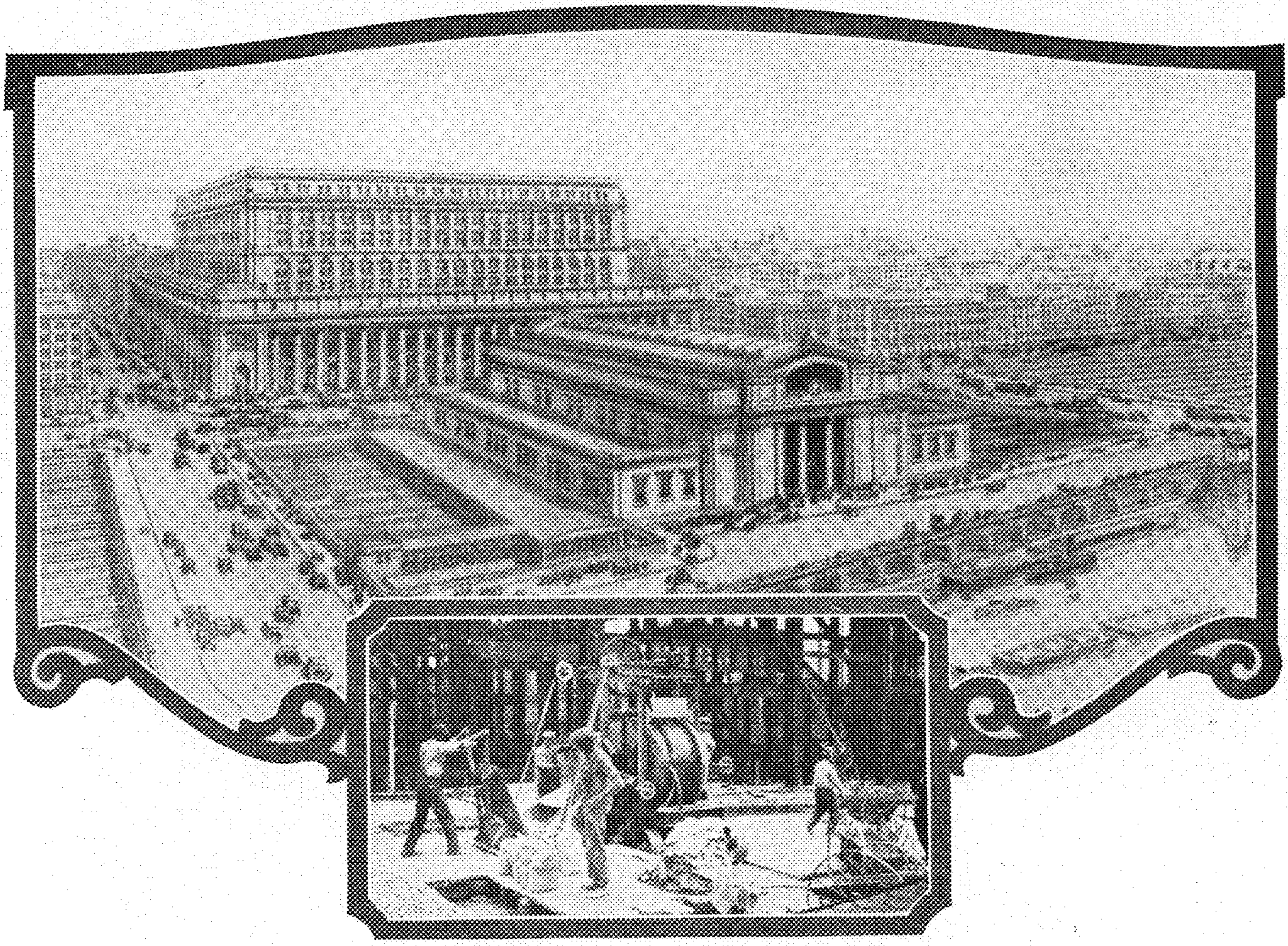
'24—Frank T. W. Roos is working for the Minneapolis Street Railway Co. as draftsman in their schedule department.

'24—Clifford M. Stoner is with the Joliet & Eastern Railway Co. and is located at Joliet, Ill.

'24—George H. Sprehn is with the Minnesota Highway Commission.

'24—Hugh A. Stoddart is with the United States Bureau of Public Roads and is living at Portland, Oregon.

'24—Laurence E. Holder is working as transitman for the St. Paul Department of Public Works. The past season he has been working underground, surveying for the construction of a new sewer tunnel.



New Union Station, Chicago, and Koehring

THE new terminal of the Chicago, Milwaukee and St. Paul, Chicago, Burlington and Quincy, Chicago and Alton and Pennsylvania railroads now being completed, will be the finest railway station in the world. Covering two entire blocks, the value of the buildings alone is $15,000,000.

Caisson work, retaining walls, substructures; concrete arches, superstructure—the concrete work throughout on this Union Station is another product of Koehring Concrete Mixers.

Over 22,000 cubic yards of concrete were used in the 163 caissons, retaining walls and substructures; and approximately 25,000 cubic yards additional were required for the arches and superstructural work.

Koehring Mixers and Pavers are identified with the noteworthy building and road construction projects in all parts of the country.

"Concrete—Its Manufacture and Use", now in its fourth edition, is a 207 page treatise on the uses of concrete, including 26 pages of tables of quantities of materials required in concrete paving work. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY
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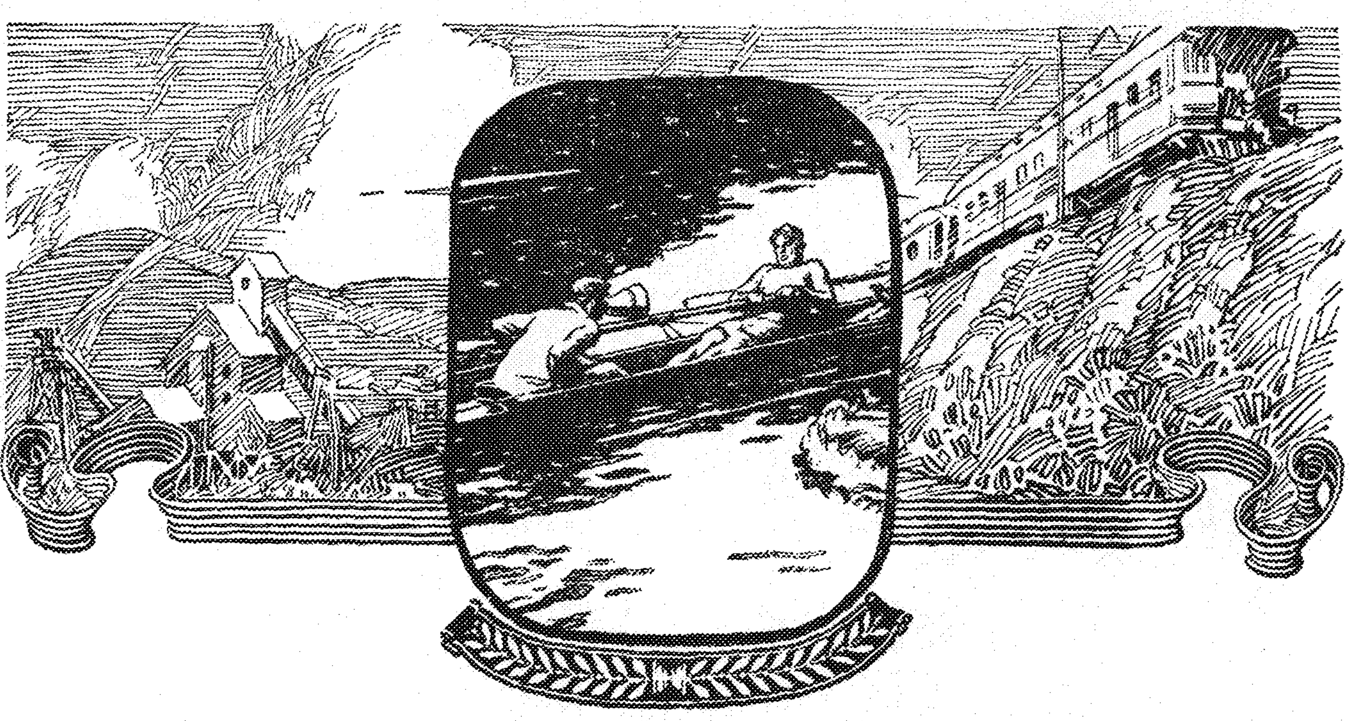
Manufacturers of Pavers, Mixers—Gasoline Cranes, Draglines, Shovels



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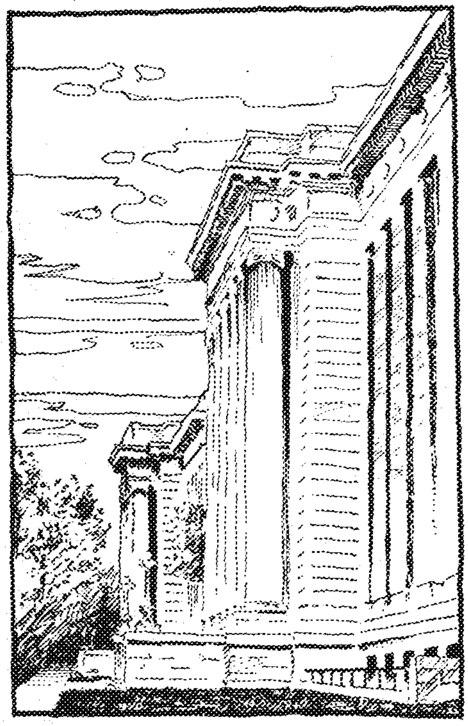
THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges
of the University of Minnesota



NOVEMBER
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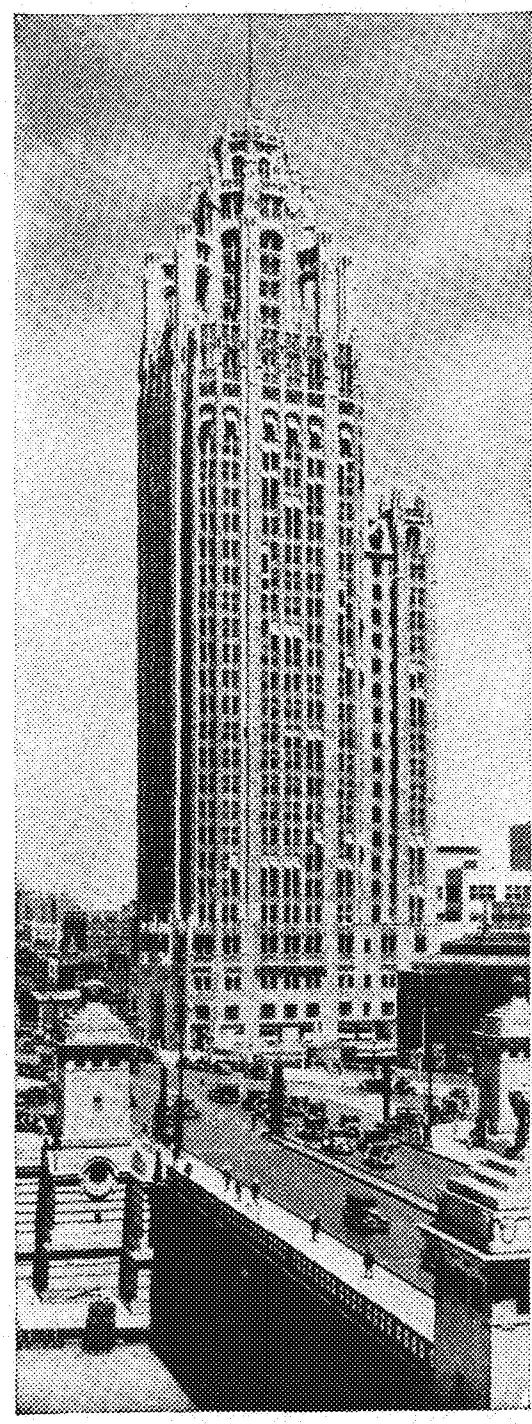
VOL. VI. MINNEAPOLIS, MINN. NO. 2.

Member Engineering College Magazines Associated

A Lesson in Psychology

AN OLD CHIEF of the Pueblo Indians, on his first visit to Chicago, was taken to the top of the new Tribune Tower Building. On leaving the elevator, he turned to his guide and asked, "When are we going up?" When he was told that he was already on the top floor, the old man declared flatly that he did not believe it, because he had climbed no ladders;—nor could he be persuaded until he looked over the city spread out beneath him.

It's all a matter of association. The Chief had always associated the idea of "going up" with the ladders of a Pueblo. In a similar fashion, to people in modern cities the world over, the idea of ascent is inextricably bound up with the name of Otis.



THE CHICAGO TRIBUNE BUILDING *is equipped with nine (9) Otis Elevators, traveling at a speed of 800 F. P. M., and operating with signal control, which is entirely automatic in operation and independent of the operator. This is the newest and most improved operation for intensive elevator service in high buildings.*

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The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

VOLUME VI. | MINNEAPOLIS, MINN., NOVEMBER, 1925 | NUMBER 2

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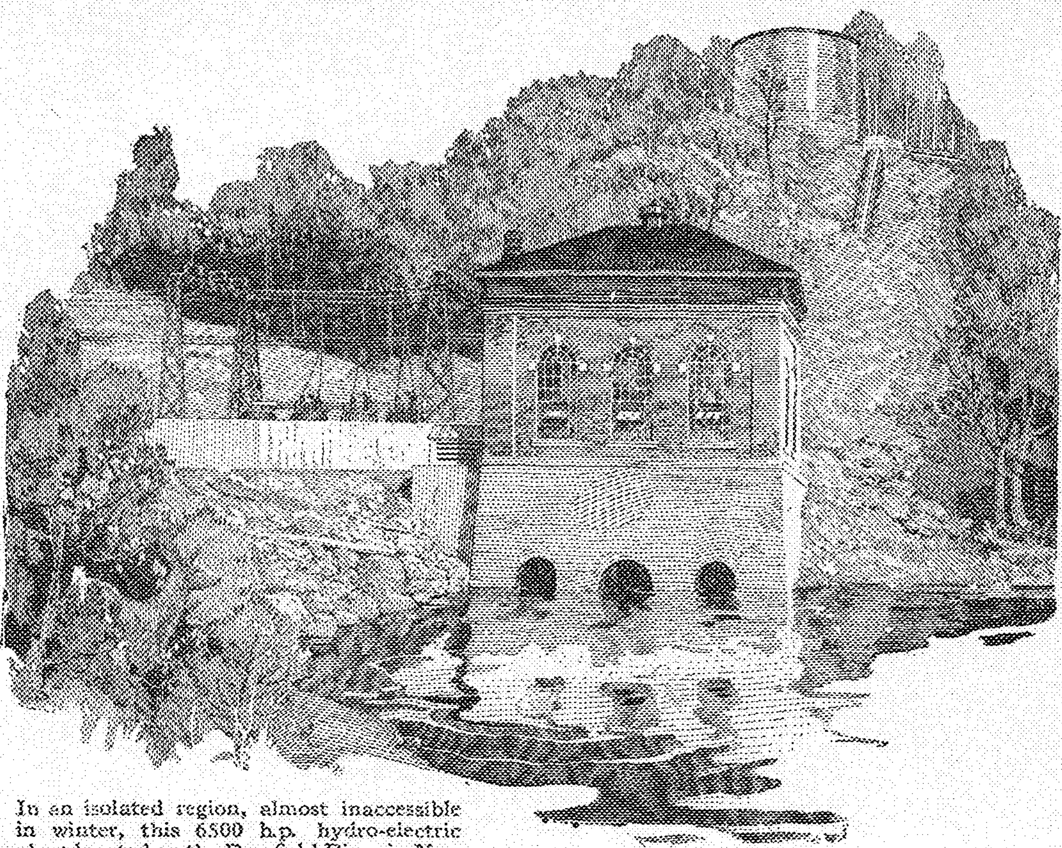

In an isolated region, almost inaccessible in winter, this 6500 h.p. hydro-electric plant located on the Deerfield River in New England, starts, protects, and stops itself.

A Self-Starting Power Plant

Dawn—the slumbering city awakens and calls for electric current. Many miles away the call is answered. A penstock opens automatically, releasing impounded waters; a water turbine goes to work, driving a generator; and electric current is soon flowing through wires over the many miles to the city. This plant starts and runs itself.

Power plants with automatic control are now installed on isolated mountain streams. Starting and stopping, generating to a set capacity, shutting down for hot bearings and windings, gauging available water supply, they run themselves with uncanny precision.

Thus another milestone has been reached in the generation of electric power. And with present-day achievements in power transmission, electricity generated anywhere may be applied everywhere.

The non-technical graduate need not know *where* electricity comes from—nor even *how* it works. But he should know *what* electricity can do for him no matter what vocation he selects.

The General Electric Company has developed generating and transmitting equipment step by step with the demand for electric power. Already electricity at 220,000 volts is transmitted over a distance of 270 miles. And G-E engineers, ever looking forward, are now experimenting with voltages exceeding a million.

A new series of G-E advertisements showing what electricity is doing in many fields will be sent on request. Ask for booklet GEK-1.

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The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI NOVEMBER 1925 Number 2

Patents and the Engineer

Complexity of present day inventions require patent attorneys with knowledge of the sciences and a thorough technical training

EDITOR'S NOTE—This is the first of a series of articles dealing with the opportunities for a graduate in various fields of engineering endeavor. Though the profession described in the following article is somewhat new, it nevertheless presents a distinct opening to every undergraduate. This series is an innovation and we hope that it will be of extreme interest to our readers.

By ALEXANDER T. LAGAARD, E. E. '14

Patent Attorney and Electrical Engineer, Minneapolis, Minn.

WHILE the United States Patent Office was still in its infancy, one of the patent examiners who had served but a comparatively short time, handed in his resignation, giving the following as his reason. He stated that he believed that practically all conceivable inventions had been invented and that sooner or later the activities in the Patent Office would drop off to such an extent that he would in all probability find himself without a position, and to guard against being without means of livelihood in his old age, he thought it advisable to resign while he was still a young man and to enter other fields. Little did he know of the vast multitude of inventions which were to be patented, and the new arts which were to be developed, the electric light, the aeroplane, the automobile, radio, and many others. Little did he realize the growth which would take place in the Patent Office and the development of the profession of the Patent Attorney who was to prosecute these inventions before the Patent Office.

The character of inventions on which patentable protection has been sought, during the life of the Patent Office, has changed greatly. The early patents granted were for simple devices of more or less use to the public in general, devices including household articles, farm implements, tools, toys, etc., and a class of articles termed novelties, embracing tricks, pocket articles and amusement devices not so important at the present time.

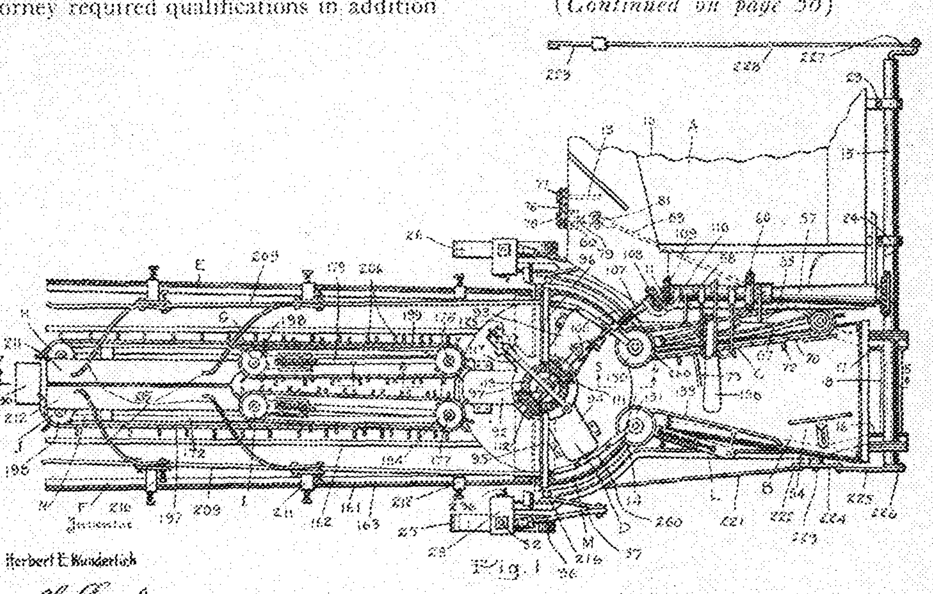
As the country became more developed and the requirements of civilization increased, the kinds and classes of inventions became more numerous and the inventions became more complicated. This development continued until the present time finds the Patent Office with a multitude of inventions ranging from safety pins to threshing machines, and covering new arts and inventions which would have astounded our despondent examiner.

The earlier inventions required but one or two sheets of drawings to illustrate and were fully covered by a few simple claims. Today there may be found in the patent office patents with dozens of sheets of drawings and hundreds of claims. The cut illustrates the complexity of our present day inventions, being a plan view of a grain shocker conceived by an ingenious and creative inventor.

It is needless to state that the degree of skill required to prepare and prosecute an application for patent has correspondingly increased, so that the present patent attorney must be a man of experience and ability to produce the best results. From the start, the attorney-at-law was deemed to be the choice for the handling of patent matters, but it was gradually found that the patent attorney required qualifications in addition to those possessed by the attorney-at-law, namely a knowledge of the sciences and an insight into mechanisms, machinery and engineering. The profession soon realized this fact, and a new field for the engineer was created. It is now probably true that some of our best patent attorneys are engineers as well as lawyers, and that the offices of most of them have associated with them one or more engineers, graduates of our many engineering institutions.

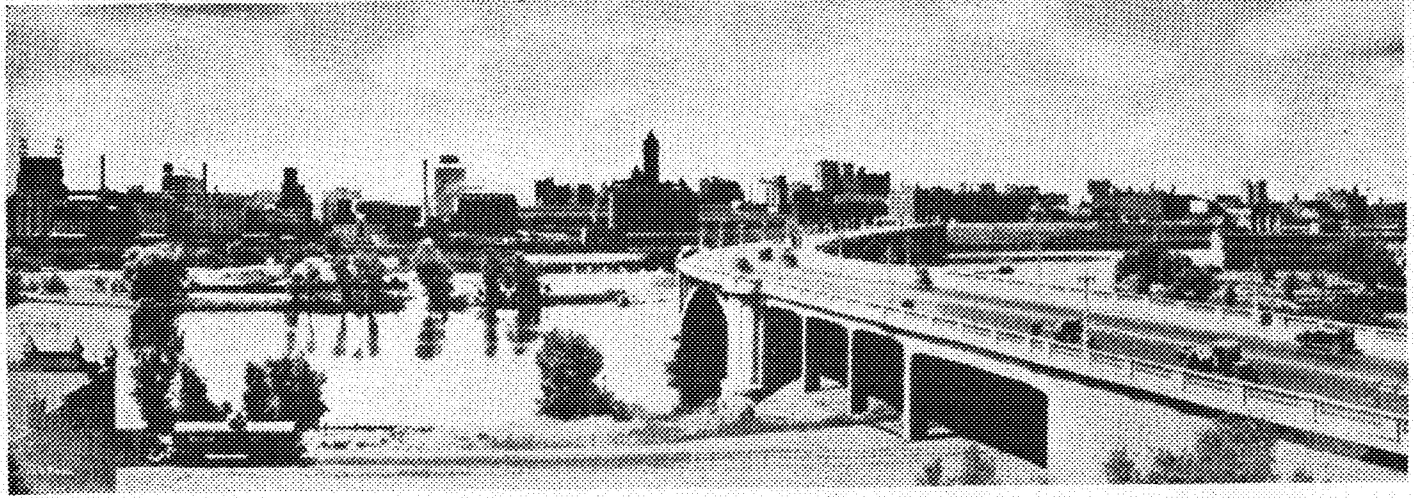
But why should it require the brains of two of our most dignified professions to secure patents. A brief review of the procedure in prosecuting an application for patent should make this clear. Supposing the superintendent of a telephone exchange brings in to his attorney's office an invention for a new exchange system which he wishes to patent. The first step is to prepare detailed drawings, showing the wiring diagrams for the installation of the invention, and then additional drawings showing in detail the construction of all features of the invention not in common usage and not

(Continued on page 56)



PLAIN VIEW OF A GRAIN SHOCKER

One of the many drawings which must be prepared by the patent attorney for prosecution of the application. Note the combinations of mechanisms present in this device.



MINNEAPOLIS RIVER FRONT—FROM THE THIRD AVENUE BRIDGE

The Proposed Harbor of Minneapolis

Elevated canal and locks to make the pool of St. Anthony Falls the inland seaport of the Empire of the Mississippi Valley

By FRANCIS M. HENRY

Princeton University, '88

Associate Member of the American Society of Civil Engineers.

EARLY this year, Mr. A. L. Crocker, commissioner of navigation for the city of Minneapolis, and who receives his commission by appointment from the Mayor, invited several engineers to make suggestions without recompense, for a river terminal to be located on the present site owned by the city at the Washington avenue bridge where the river is some 90 ft. below the street level.

Being among those engineers selected to do this, I made and submitted sketches for a Water Terminal and Warehouse for Miscellaneous Freight which seemed to be adapted to the conditions. As river navigation is increasing very fast all over the United States, this problem is one of very great importance. Because of the restricted area and the general conditions of the Washington avenue site, it did not seem that this should be the only river terminal for the city. For the handling of coal, iron ore, and grain in large quantities, it is out of the question and sites for future factories would be extremely limited.

Accordingly, unbeknown to anyone, the accompanying plans were worked out by myself. This system provides for making the pool of St. Anthony Falls, the harbor of Minneapolis, with the elevated canal and locks as the means of access to and from the harbor. When every phase of the problem had been taken into consideration, sketches were made and shown to various people with the result that considerable interest was manifested. Mayor Leach soon appointed the River Terminal Commission to investigate this proposition further.

Because of the proximity of the proposed harbor to the campus, this plan is of special significance to the University of Minnesota. The success of this harbor would be reflected in the growth of the University at large and who can tell but that the river will serve as a means of more friendly relationship with the various schools along its route to the Gulf.

> *That Minneapolis will some day be connected with the Great Lakes on the north by a canal, and with the Gulf of Mexico on the south by a six foot navigable channel down the Mississippi river is as sure as the rising sun—and the Great Lakes-St. Lawrence waterway is a certainty. Minneapolis must begin to prepare to be in a position to take every geographical and industrial advantage that these new conditions will offer. We must begin to think about a harbor. That future generations will not find us remiss and derelict in our duty, we must start to execute something definite, so that our opportunity to develop and grow will not be lost.*
>
> —GEORGE E. LEACH,
> *Mayor of Minneapolis*

This commission in addition to Mr. Crocker and myself was composed of Mr. George F. Dickson, Manufacturers Club, Mr. E. J. Gasink, Merchants and Manufacturers Bank, Mr. Otto A. Zimmerman, member Chamber of Commerce, Mr. John F. Beyers, attorney, Mr. W. M. Hodge, Civic and Commerce Association, Mr. F. S. Keating, Builders' Exchange, Mr. H. G. Benton, Minneapolis Real Estate Board, and Mr. N. W. Elsberg, city engineer of Minneapolis.

The complete report of this commission follows:

The first matter to which we have given attention is a terminal above the Falls of St. Anthony, now known as the St. Anthony pool, and which for convenience we shall call the Harbor of Minneapolis.

This pool is about twelve miles long, extending from the Third avenue bridge in Minneapolis, to the Coon Creek dam. For nine miles of this distance it is now available for any boat that can use the proposed six ft. channel in the Mississippi river. The depth of the harbor channel varies from six to nineteen ft. This harbor offers alvantages superior to any other river harbor in America. Including Islands, is has more than twenty miles of shore line. Its banks are low, making loading and unloading of boats cheap and easy and allowing the easy construction of slips to render available sites back from the river. There is no swift current and no high water to contend with. The engineers tell us that the highest flood rise in the harbor is not more than four ft., and this height is maintained for only a few hours at any one time. Loading and unloading devices may be constructed simply and inexpensively. It is crossed by many bridges and railroads. Every coal dock, every ore dock, every grain elevator, every warehouse and every factory upon the harbor can have the river at its front door and the railroad at its back. It is in the business center of the city and has on both sides a large population of real home-owning laboring men.

Map. No. 1 is a reduced tracing from the U. S. Government Geodetic Survey and clearly shows the relation of the harbor to the city.

The harbor has, in part, been sounded by the government and our figures in relation to the water are taken from the government harbor maps.

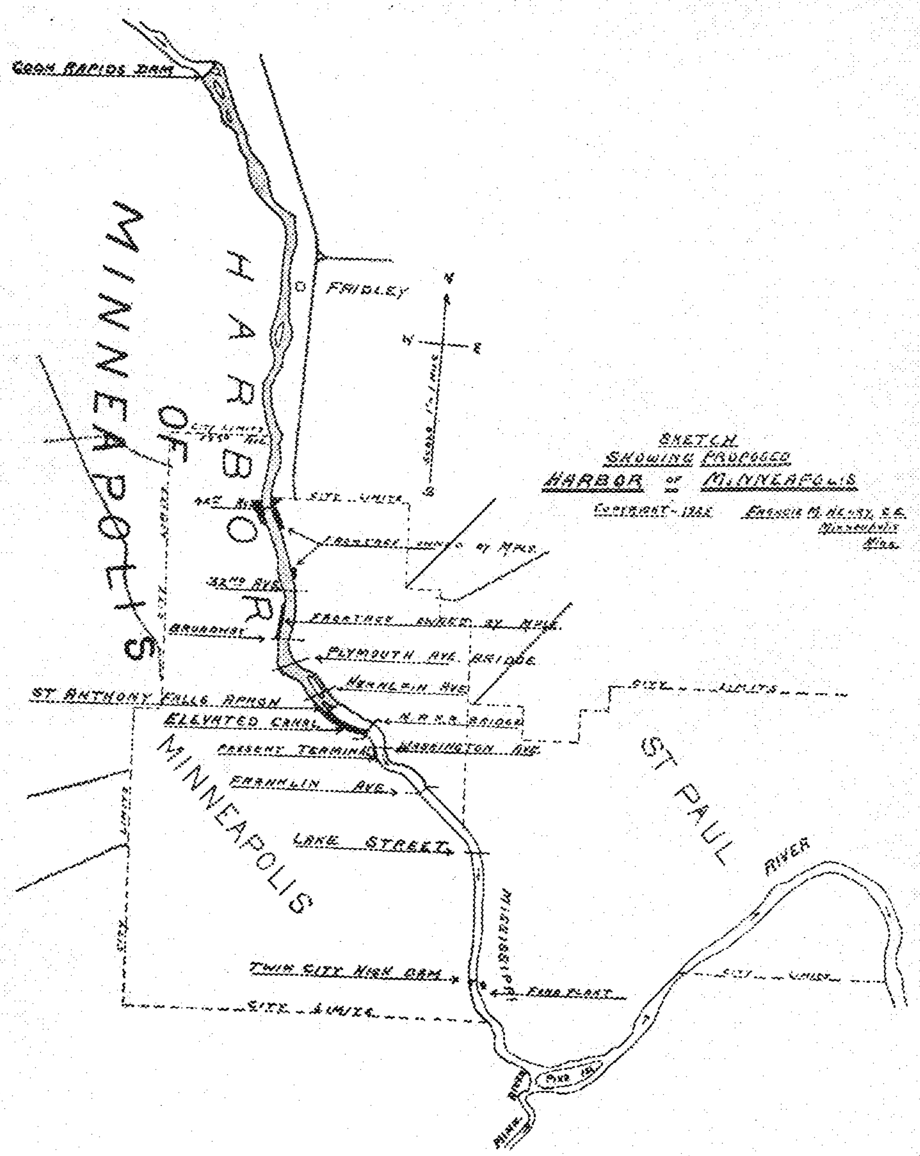
To state the exact truth about this harbor is likely to expose us to the charge of exaggeration, but when we say that it offers the best river terminal in America we feel sure that we are not guilty of any vain boasting but are uttering forth the words of truth and soberness.

There is a great traffic awaiting its opening. It is the greatest asset that Minneapolis possesses, a fact of which most of our people are profoundly unaware. It is time for Minneapolis to wake up. If we wish to keep our mills and factories we must create conditions more favorable than now exist.

From the High Dam to Reed's Landing there is not yet a dependable six-ft. channel, but there is dependable and now usable, a four and one-half foot channel; and the government plans to build a dam or dams that will insure the six-ft. channel from St. Louis to the Washington avenue bridge, Minneapolis.

The St. Anthony pool, in spite of its astonishing potentialities, is of no use unless boats can get into and out of it. The river at the Washington avenue bridge is about seventy-five ft. below the level of the pool. To overcome this, a plan has been devised by Mr. Francis M. Henry, civil engineer, which is clearly shown by map No. 2. This, in brief, is a canal about four thousand ft. long built of reinforced concrete along and against the west bank of the river from the new Northern Pacific railroad bridge to the harbor above. This canal will be ninety ft. in width between its walls and will have a channel of at least seven ft. in depth. It will be provided with two locks about of the same pattern and size as those at the present high dam. The city now owns three water powers from which it derives no revenue. These powers will furnish enough water to permit at least five lockages per day. The construction has in it nothing new or untried. Everything from the lock gates to the electric mule employed to haul the boats from one end of the canal to the other has been tested many times. Much of the rock for the concrete may be taken from the side of the canal. If it becomes necessary to condemn any part of the right of way the costs will be nominal because, in every case the benefits will be much greater than the damage to the property taken. The entire canal lies landward of the government harbor line so that the city, if it wishes, can build without serious interference on the part of the government.

In fact, the whole plan is so simple and so practical and the resulting benefits so great, that the surprising thing is that some one should not have thought it out long ago instead of leaving it to Mr. Henry.



MAP NO. 1—THE HARBOR AND THE CITY

The largest interests of Minneapolis and the Northwest from a transportation point of view are in wheat, flour, iron ore and fuel. All are necessities.

Coal costs too much in the northwest. Minneapolis uses approximately 2,000,000 tons of soft coal each year. Most of this comes from mines in Pennsylvania, West Virginia, Ohio and Kentucky by lake and rail via Duluth, and from Illinois by rail. The freight charges on this coal, taking Sandusky, Ohio, as an average point of shipment from the mines to Minneapolis, is $4.36 made up as follows: from the mines to Sandusky, something over 200 miles, $2.14; from Sandusky to Duluth, something more than 700 miles, 40 cents; from Duluth to Minneapolis, 150 miles, $1.82. The committee has been assured by operators of barge lines that this same coal can be brought from the same mines by barges coming down the Ohio and up the Mississippi for less than $2.00 per ton and at a saving of considerable loss at every point of transshipment. If comparative distances were to govern, the rate of barge line freight would be about $1.00 per ton. At all events, your committee feels safe in assuming that the saving in the cost of coal would be at least $2.00 per ton. This would mean a yearly saving of $10.00 or more to every householder in the northwest who has trade relations with Minneapolis. As near as we can learn, there would be a saving of about a cent per gallon on each gallon of distillate used in heating furnaces and upon each gallon of gasoline.

While the saving in household use is very important and widespread, it is, perhaps, of greater importance to the industries and their wealth of employment which we hope to keep and the others which we hope to attract by creating better business conditions here.

The saving above set out would be greater if the barges bringing in coal were assured of a return cargo. It hap-

(Continued on page 54)

An Experimental Pavement

New types of construction are employed in test pavement recently constructed through campus by State Highway Commission

By Fred C. Lang, C '08
Associate Professor of Highway Engineering, University of Minnesota.

MINNESOTA'S system of highways, made possible by the Babcock good roads plan, in recent years has become known all over the world. Acting in conjunction with the State Highway Commission, the Highways Testing Laboratories carries on intensive research, and conducts investigations into all material entering into the state's roads. These laboratories are a part of the College of Engineering and Architecture of the University of Minnesota and will soon be housed in a $70,000 testing laboratories building, plans for which are now completed.

With the completion of the Memorial Stadium, Church street became the first through street between Washington and University avenues west of Oak street. This made it necessary that it be paved. The first plans called for a creosote block construction. Its nearness to the College of Engineering and Architecture of the University of Minnesota and the laboratories of the State Highway Department, however, made it an ideal place for an experimental pavement. Thus, plans were made with this end in view, and its completion early this fall marks it as the first similar piece of pavement of its kind in the entire mid-west.

The Highway Department cooperated in furnishing engineering services for original plans, testing all material and specimens made during the progress of the construction, and supervising construction of the asphalt portion. The Portland Cement association donated the services of one of their engineers to supervise the construction of the cement concrete pavements. The department of buildings and grounds of the University made all surveys during construction and prepared final estimates. The writer had general supervision.

While the pavement may be considered as an experimental one, only first-class construction was permitted. It was not considered desirable to lay very many types of surface as this would make a patchwork which would not have a pleasing appearance. The original plan called for 36.5 ft. of lumnite cement concrete, 26.6 ft. of sheet asphalt on an asphaltic concrete base, and the remainder of Portland cement concrete. The asphalt was to be laid over the old railroad cut as it is a more flexible type and would be easier to maintain if any settlement in the fill should occur. When bids were taken, however, the cost of the lumnite cement concrete was $4.38 per sq. yd., almost twice as much as for Portland cement concrete, and it was found that $938.00 could be saved by substituting cement concrete for the asphalt even though double reinforcing was placed at edges of fill. The lumnite cement concrete was therefore reduced to 10 lineal ft. and the asphalt omitted. Later, however, after the Portland cement concrete had been constructed over the fill, Thornton Bros. Company of St. Paul offered to donate the asphalt pavement. Their offer was accepted by the University and 727.1 sq. yds. were laid in front of the armory. At the price bid for asphalt, the donation amounted to $2,530. This donation made it possible to pave Pleasant street over the railroad fill. Some of the sections which were originally planned for Church street were then laid there.

There was some discussion as to the desirable width, 30 ft. between curbs being finally decided upon. This should be sufficient provided parking of cars is not permitted. On concrete paving, the curb was constructed at the same time, there being no joint between pavement and curb. This is called integral curb construction. On the asphalt portion, the curbs were constructed separately. All of the paving is seven in. thick. During the construction a special effort was made to produce a smooth riding surface.

The Portland cement, except for four half sections, was proportioned one part cement, two parts sand, and three and one-half parts coarse aggregate. The four half-sections were proportioned 1:2:3. The concrete was mixed as dry as possible and yet obtain requisite workability. One brand of cement was used throughout. On the east half of section 1 a rather fine sand was used; otherwise the sand was practically uniform throughout—all obtained from one source. Four types of reinforcing were used, types A, B, C, and D. Four kinds of coarse aggregate were employed: Minneapolis limestone, Dresser Junction, Wisconsin, trap, Kettle River sandstone, and Minneapolis gravel pebbles. Three different kinds of admixtures were also used, these being hydrated lime, Celite (donated by Celite Company), and calcium chloride. The composition of the different sections is shown on plan.

The Portland cement tested as follows:

TABLE NO. 1

Fineness—Per cent retained on No. 200 sieve—from 18.22 to 19.08.
Time of Setting—
Initial—from 4 hrs. 00 min. to 7 hrs. 5 min.
Final—from 6 hrs. 20 min. to 8 hrs. 20 min.
Soundness .... O. K
Seven day tensile strength from 267 to 278.
Twenty-eight day tensile strength from 313 to 360.

The fine sand used on east half of section 1 tested as follows:

TABLE NO. 2.

Passing .25 in. screen	100.0%
Passing No. 10 sieve	95.2%
Passing No. 20 sieve	72.6%
Passing No. 50 sieve	9.4%
Passing No. 100 sieve	1.3%
Organic Test—Color Plate No. 1	
Loss by Elutriation	0.61%
Per cent Shale	0.26
Seven day tensile ratio	1.01
Twenty-eight day tensile ratio	1.09

SPREADING THE ASPHALT SURFACE
After the base consisting of asphalt and a coarse aggregate has been rolled, the asphalt surface is applied while hot. In this photo, it is being raked into place before final rolling.

The sand used on all other sections tested as follows:

TABLE NO. 3.

Passing .25 in. screen	100.0%
Passing No. 10 sieve	72.9 to 75.0%
Passing No. 20 sieve	47.5 to 50.7%
Passing No. 50 sieve	8.5 to 9.1%
Passing No. 100 sieve	1.6 to 2.0%
Organic test—Color Plate No. 1.	
Loss by Elutriation	0.54 to 0.86%
Per cent Shale	0.46 to 1.15
Seven day tensile ratio	1.35 to 1.52
Twenty-eight day tensile ratio	1.32 to 1.38

The test on the coarse aggregate are shown below in table 4.

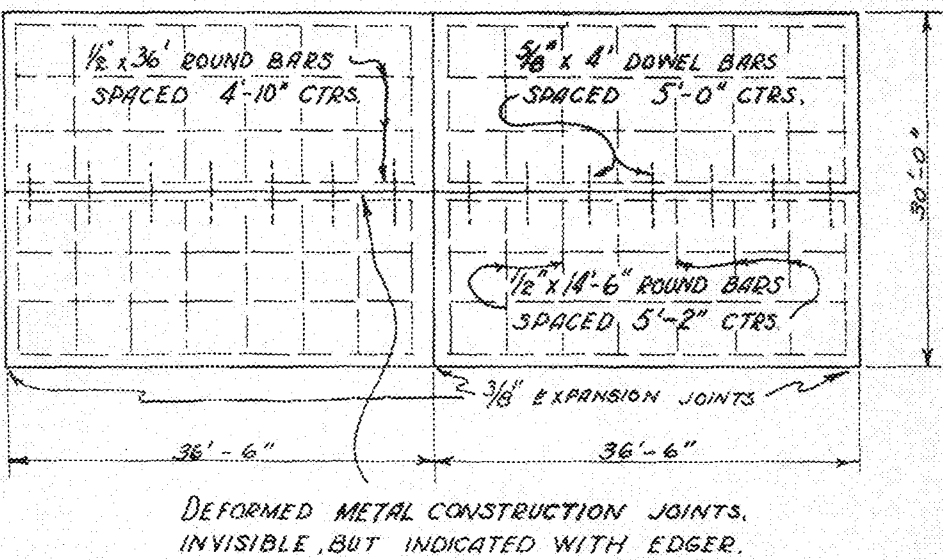
The fabric reinforcing used was of the welded rectangular flat sheet type. The reinforcing rods used were deformed round of structural and intermediate grade, having a tensile strength from 60,000 to 80,000 lbs. per sq. in.

The amount of water per sack of cement was 5.5 gal. on gravel pebbles, limestone, and trap, and from 6.5 to 7 on sandstone. The admixtures used in gravel as coarse aggregate required 5 gal. per sack of cement, although 5.5 gal. were used on Celite and two per cent calcium chloride.

The present standards for constructing this type of pavement were followed, such as correct proportioning (allowing for bulking of sand) full one minute mix, wetting subgrade, careful placing and finishing. The pavement was cured by covering with canvas as soon as hard enough, keeping this canvas wet until the next day. The pavement was then covered with two in. of earth and kept wet for ten days. Traffic was not allowed on pavement for 3 weeks.

During the time the pavement was being constructed, 6 in. x 12 in. cylinders were made from the concrete taken from the street. A number of these are still unbroken as it is the intention to keep them for about a year before testing, or until cores are taken from pavement.

The results of tests made to date are shown in table No. 5, below.



TYPE B REINFORCING

There is always a question in concrete paving work as to the most desirable coarse aggregate. The amount and type of reinforcing is also a subject for dispute. The introduction of admixtures to either hasten hardening or increase workability so that less water can be used, is being urged especially by manufacturers of these materials. We hope that in course of time this pavement will help solve these questions. This highway also makes an ideal place for certain measurements by students, such as contraction and expansion from heat and moisture changes, slab deflection under loads and distribution of pressure in subgrade.

In the lumnite section, Atlas lumnite cement was employed in place of Portland cement. Type A reinforcing and gravel pebbles were used. In all other respects except curing, the materials and construction were the same as with Portland cement concrete. The curing is quite different from the Portland cement practice. The pavement was laid between 3 and 4:30 p. m. No covering or moisture was applied until 10 p. m. when it was then covered with water. This water remained on the pavement until 10 a. m. when it was drained off. A representative of the Atlas Lumnite Cement Company came from Chicago to supervise this construction.

The result of tests made to date are:

TABLE NO. 6

Compressive strength in pounds per square inch of 6 in. x 12 in. cylinders taken from Lumnite cement concrete on Church street during its construction.

Age	*Breaking Load lbs. sq. in.*	*Average of three*
24 hrs.	5050	
	4800	
	4900	4917
48 hrs.	4110	
	5590	
	4160	4620
72 hrs.	5650	
	5050	
	4630	5110
7 Days	6040	
	5210	
	5380	5543
1 Month	4975	
	5330	
	5830	5378

This shows the high early strengths obtained with this cement. The comparison of this table with Table No. 5 for Portland cement is interesting. As yet practically nothing has been published on the expansion and contraction of this kind of concrete. Some investigators claim such a pavement surface will dust and scale when lumnite cement is used, especially if not properly cured. This section was very carefully cured and the condition of the surface will be watched.

The asphalt section is a comparatively new type in Minnesota and is constructed on what is known as a black base. So far as the writer knows, there

(*Continued on page 63*)

TABLE NO. 4

	Limestone	*Trap*	*Sandstone*	*Gravel Pebbles*
Passing 2.5 in. screen	100.0%	100.0%	100.0%	100.0%
Passing 2 in. screen	100.0%	100.0%	99.5%	100.0%
Passing 1.5 in. screen	85.0%	93.2%	75.7%	82.5%
Passing 1 in. screen	63.5%	55.0%	42.1%	62.8%
Passing .75 in. screen	40.0%	36.2%	29.9%	39.7%
Passing .25 in. screen	1.6%	2.5%	10.0%	2.0%
Passing .125 in. screen	0.8%	0.4%	7.8%	0.7%
Per cent Shale	—	—	—	0.2%
Loss by abrasion	2.86-5.16%	1.6%	10.9%	—
Loss by abrasion special gravel pebble test	—	—	—	6.62%
Toughness	5-14%	—	5.25%	—

TABLE NO. 5

Compressive strength in pounds per square inch of 6 in. x 12 in. cylinders taken from Portland cement concrete pavement on Church street during its construction.

Age	*Trap Rock*	*Sandstone*	*Limestone*	*Gravel*	*Gravel 2% Calcium Chloride*	*Gravel 4% Calcium Chloride*	*Gravel 5% Celite*	*Gravel 2% Hydrated Lime*	*Gravel 4% Hydrated Lime*	*Gravel 6% Hydrated Lime*
7 Days				2440	2510	2220				
				2240	2780	2290				
				1970	3100	1980				
Average				2217	2797	2163				
28 Days	2960	2960	3350	3075	3235	2665	2950	2710	3140	3495
	2680	3800	3520	3355	3430	3435	2650	1920	3580	3740
	1800	4550	3300	3380	3840	3065		2280	4480	3255
	1980	3880	2775	1740						
				2810						
Average	2355	3797	2986	2878	3501	3055	2815	2303	3733	3497

Chemical Manufacture

Summer laboratory course on semi-plant scale prepares students for work in various branches of chemical engineering

By MARVIN C. ROGERS, Ch. E. '26

UNTIL a few years ago the importance of the chemical engineer in industry was not realized by most people. Industries went on from day to day without a definite idea as to the operation of their plants. Thousands of dollars were wasted in equipment that was not efficient nor properly designed, and not only in equipment was this money wasted, but in the actual control of the processes. The rule of thumb and the cut and try methods were used almost extensively.

Conditions have changed greatly in the past few years and now, many industries, making all kinds of materials, own and operate their own semi-plant laboratory which contains small size manufacturing equipment with all the conveniences and advantages of plant size machines. A laboratory such as this permits the chemical engineer to develop processes of manufacture and to determine operating conditions on a small scale before any great investment in equipment is made. This is the job of the chemical engineer in industry. It is in the semi-plant laboratory that designs in equipment are first tried out. They can be tried here because the cost of failure is not nearly as great as it is with plant size machinery.

It is for these reasons that a semi-plant laboratory is maintained at Minnesota. It serves to give practical experience in the operation of plants, and it also gives the students an opportunity to use their own initiative in the selection of apparatus for the manufacturing of certain materials. The laboratory is located in the basement of the chemistry building and contains all of the equipment necessary for the working out of the more common problems and many of those of less consequence which confront the graduate engineer.

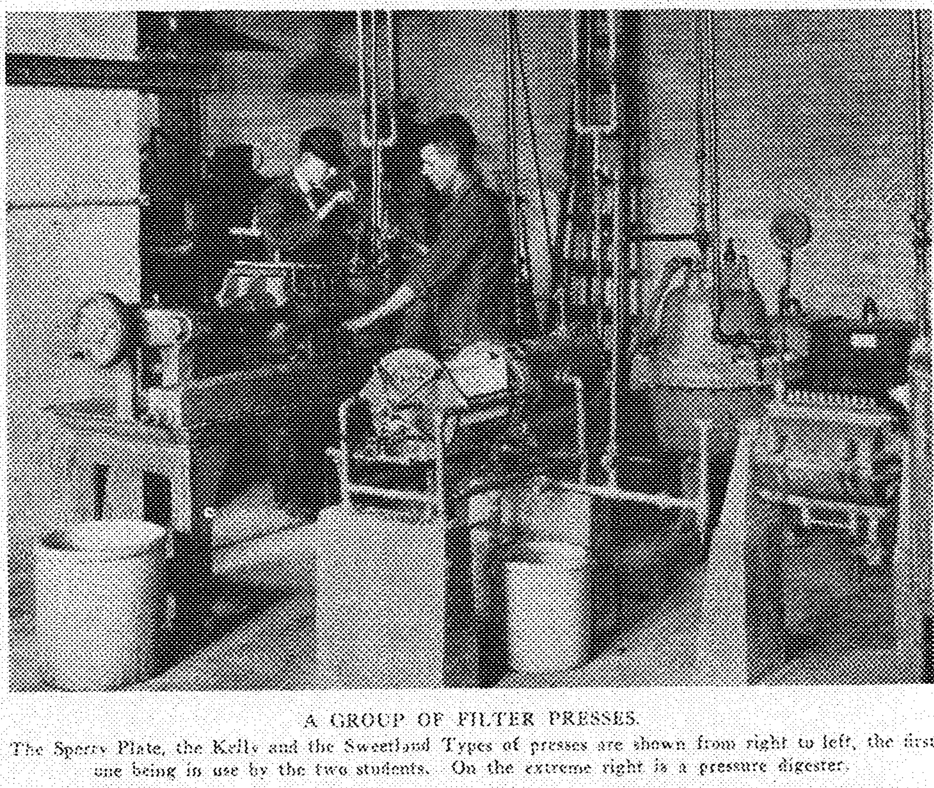
There are very few people, unless they are connected with the chemical engineering department, who realize what the laboratory really consists of and what goes toward making it a successful department. A part of the requirements for the chemical engineering course is the course in chemical manufacture which is taken during the summer following the junior year. This year, 15 students remained for the summer session to learn about the operation of a manufacturing plant. In order that the course be as practical as possible, no suggestions or instructions are given out with the problems. Everything which concerns the manufacture or control of a process must be investigated by the student, and he may use any of the equipment he chooses as the best suited for the particular case.

The American Institute of Chemical Engineers recently placed the department of chemical engineering at Minnesota among the 14 highest ranking similar departments of schools in the United States.

The laboratory contains equipment which is of semi-plant size just as is found in the industries. Probably the most important, and also the most noticeable piece of equipment which is in the laboratory, is the double-effect evaporator shown in the accompanying illustration. This evaporator combines two types of apparatus into one double-effect outfit. This makes it a very interesting piece of machinery. The vacuum is obtained by a steam engine directly connected to a vacuum pump. Vacuum as high as 27 in. of mercury were obtained during the summer. The first effect of the inclined tube part of the machine is supplied by the steam which is exhausted from the steam engine. This steam passes through the steam chest and out into the sewer. The vapor from the first effect passes over into the second effect steam chest through a system of pipes, and evaporates the solution in the second effect. The second effect, which cannot be seen in the photograph, is of the upright type. The piping is so arranged that the effects can be used singly or together. Theoretically, 2 lbs. of water should be evaporated for every pound of steam which is fed from the engine, but due to radiation losses, the water which can be evaporated, is only about 1.5 lbs., which is very good practice. This evaporator was used during the summer for concentrating solutions of the soluble cyanide salts obtained from extracting the gas plant iron residues. It was also used for the concentration of whey, from skim milk, after the casein had been removed. Whey contains about 4 per cent sugar, and it can be readily seen that some rapid means of evaporation without decomposition is necessary. One of the principal advantages of the vacuum evaporator is the fact that it makes possible the distillation of compounds which are unstable at their boiling temperatures when under atmospheric pressure.

A smaller evaporator, single-effect, is also used in the laboratory, its main advantage over the large one being that it is possible to collect the distillate from it without breaking the vacuum in the main pan. The heat for the distillation is obtained from the low pressure steam line in the building. This evaporator was used most extensively during the summer for the first evaporation of the alcohol residues which were obtained from the Anatomy Department.

Two other pieces of apparatus which are of considerable importance to the



A GROUP OF FILTER PRESSES.

The Sperry Plate, the Kelly and the Sweetland Types of presses are shown from right to left, the first one being in use by the two students. On the extreme right is a pressure digester.

chemical industry are the atmospheric dryer and the vacuum dryer. As is indicated by the names, one of these operates at atmospheric pressure and the other operates under vacuum. The vacuum dryer is ribbed and reinforced to protect it against atmospheric pressure. The vacuum is obtained by using an electrically driven vacuum pump. Pressures as low as 1.25 in. of mercury were obtained with this pump when the dryer was used for evaporations during the summer. The main advantage of the vacuum dryer is similar to the advantages of the vacuum evaporator as it permits the driving off of the moisture at a temperature which is not harmful to the material being dried. The atmospheric dryer is arranged so that air supply from a motor driven fan passes through steam heating coils and then over the surface of the material to be dried. It is a very effective dryer and can be used in such drying processes as the drying of fruits and vegetables. In such drying processes, however, much care must be exercised in controlling of the heat, to prevent the material from forming a crust around itself and preventing any further escape of water.

Although evaporators and dryers are necessary in the plant, no chemical laboratory would be complete without its filter presses. The presses in the laboratory are shown in the illustration. Four different types of filter presses are in the laboratory. Only three of these are shown in the picture. The largest of these are the plate and frame type. Two of these are used, one a steel frame piece of apparatus, and the other of wooden frame construction. These presses give large capacity, but are not desirable for all purposes. The two smaller types of presses are the Kelly and the Sweetland. Each of these can be seen in the figure. The essential difference in these presses from the others is in the method of fastening the filter clothes. The sludge, which is the name given to the material to be filtered, is supplied from the montejus, or supply tank, by means of compressed air. The compressed air forces the sludge out of the montejus and into the press where the filter cloths remove the solid material and pass the liquid on through the outlet cocks. The montejus can be seen in the picture just behind the presses.

When it is desired to filter smaller and thicker batches of sludge, the vacuum nutch filter can be used. These filters resemble the Buechner filters which are used in the experimental laboratory, and the vacuum is obtained by a rotary vacuum pump capable of obtaining pressures as low as .02 in. of mercury. This pressure cannot be reached because of the losses due to leakages.

The compressed air system in the laboratory which supplies the air for the presses is automatic and maintains a nearly constant pressure all the time. A supply line leads to all parts of the building. Supply lines for hot and cold water, high and low pressure steam, vacuum and gas are placed so as to make any of these available at any point in the room. The pipes are colored to distinguish the contents of each from the other.

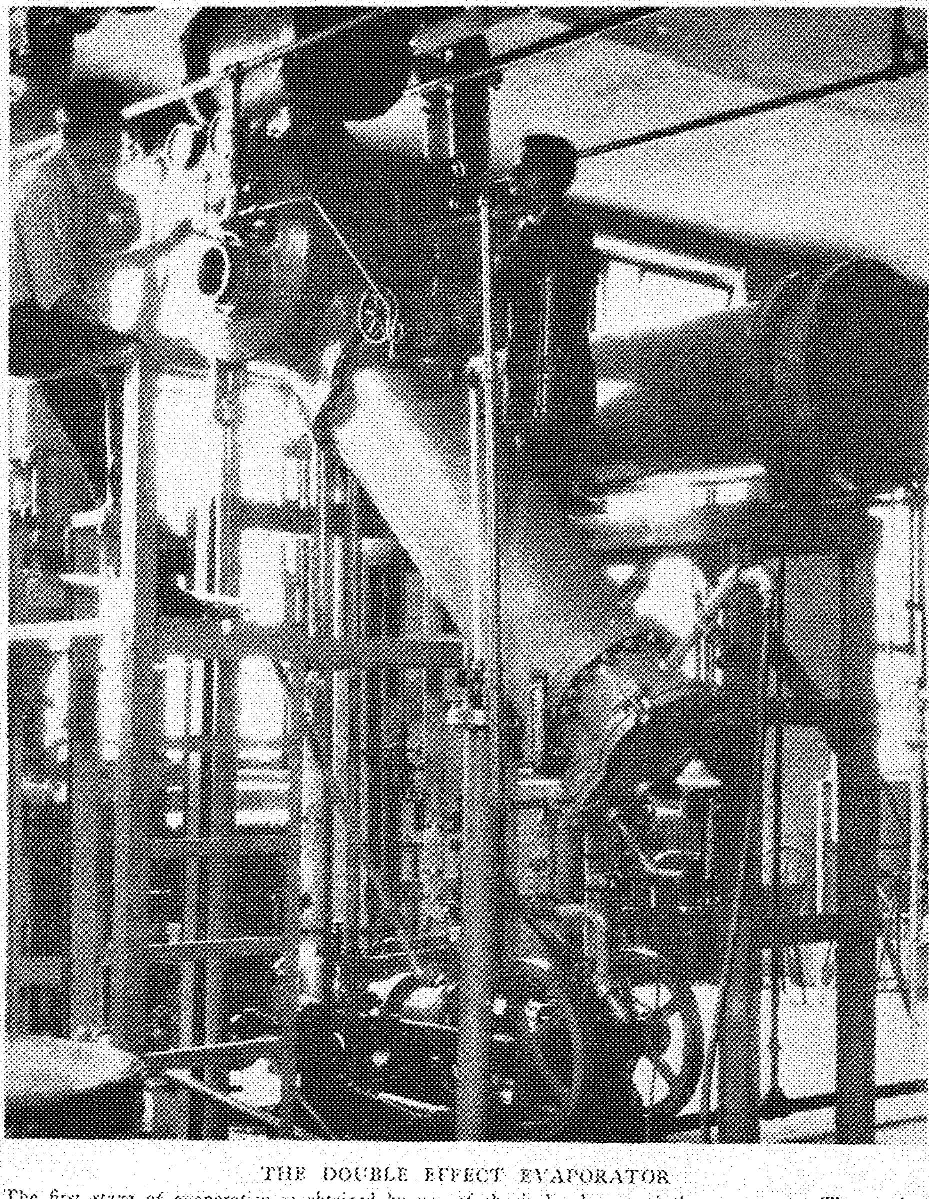
Inasmuch as most of the common inorganic substances are crystalline in character, it is necessary to have some means of removing the water from the crystals without spoiling them. The centrifuge is used for this purpose. The wet crystals are placed in the basket and the water whizzed out. Very good dry crystals are obtained in this way.

The laboratory is also equipped with apparatus which is designed primarily for organic use. Among this equipment are a Nitrator, Sufonator, Reducer, Autoclave and a Beta-Napthol still. These pieces are all constructed so as to be safe for use and are all provided with safety devices. A gas furnace is also in the organic end of the laboratory. It is supplied with gas from the mains and the air is supplied by a rotary pump driven by an electric motor.

Crushing and grinding of raw materials is done in the mill's room where laboratory size crushers and grinders are installed.

Some of the results of the assigned problems were far from what they should have been; the soap manufacturing was not very efficient, and Roger's hypo turned out to be 100 per cent sodium sulfate, but that did not dampen the ardor of the class. Sverdrup and Lewenstein gathered stray apparatus and constructed a sulfur burner, at least they called it one. No one was able to find out actually how much of the sulfur actually burned.

On July 30th came the final clean-up followed by the closing of the laboratory. Those days will go down in memory, never to be forgotten and never to return.



THE DOUBLE EFFECT EVAPORATOR

The first stage of evaporation is obtained by use of the inclined part of the apparatus. The vertical section is used for further results. These effects can be used singly or in combination.

"Six Weeks" at Cass Lake

By

"Doc" Halbkat, C '26

J. R. Johnson

L. W. Neuhauer

1—2—3—4—5—6—
7—8—9—10—11—

Gesundheit!—Schnaps!!

Everyone Had a Good Time and we Don't Mean Maybe

CASS LAKE, once a thriving, busy lumber town in the heart of a forest area, has of late years lost its activity with the passing of its saw mills and has settled down to the ordinary routine of business that one finds in any small village. Unlike many towns of equal size there are paved streets in the business district, but in front of the garages and filling stations the same Main Street characters settle world politics and whittle on a piece of a packing box. A Texas or California license no longer stirs their interest, for tourists have long since became a part of their life in this region of lakes and forests. Once a year, however, these curb-stone politicians, and incidently their daughters, have a new subject of talk when the Senior Civil Class comes to spend six weeks in summer surveying camp at Norway Beach.

Camp, this year, was not due to start officially until noon of August 14, but the advance guard began arriving a day or two before. About one-third of the men were in camp the night of the 13. Enough tents had been set up that day to provide sleeping quarters, so after a general exchange of greetings, the men in groups of two or three began a search for their luggage among the various piles of duffle stacked around. Some of the fellows arrived before their baggage, some of it came before its owners. Luckily things were about even, so everyone had a cot and bedding for the night.

By morning a cold fog from the lake, so thick one could almost swim in it, had enveloped camp and the mercury in the official thermometer had crawled down under the floor of the office tent. Promptly at 5:45 a. m. a terrible *Clang! Clang! Clang! Bang!* came tumbling out of the mist around the cook tent. With a yell of "Indians," Charlie Bunnell scrambled out and crawled under his cot. Hoffman started to follow Charlie but found the air too cold and crawled back under the quilts, Schultz sleeping peacefully through it all. Finally someone remembered Cook Erickson's saw gong: with the origin of the noise settled, Schultz was wakened, Bunnell coaxed out from under the cot, and all dressed for breakfast. Meanwhile Mr. Boon had enticed the mercury out from under the floor, read the barometer, raingage and watergage. This was the coldest morning during the six weeks of camp.

After breakfast, each group got busy building a home for itself. One floor platform for tent 11 had to be moved onto a line with the rest of the tents on the company street. Eight or ten of the camp huskies grabbed a root or corner and heaved. Up came the floor, but it was not in air very long. Slowly an old skunk lead her family from under the platform where their home had been. Consternation reigned, all the huskies let go simultaneously and hot footed it into the brush. No casualties resulted among man or beast, although the skunks barely missed extermination under the falling floor and stampede of feet. When the field cleared, the floor was cautiously moved.

By noon, camp was well established, and on the official bulletin board nailed to a tree near the office tent, the work for the afternoon was assigned. Instruments needed adjusting, the dock had to be built, the barge floated and brought up from the hotel beach, and everything put in the best of order to start work without delay. Along side these assignments was posted the daily schedule of work. We found the first call came at 5:45, with roll call and breakfast at 6:10. Field and office work started at 7:00 and followed through until 4:30 and 5:15, respectively, with a half hour off for lunch at noon. Later it developed that the length of this half hour varied with the disposition of the chief of party when in the field.

The work in camp falls into three main divisions, railroad work under Mr. Cutler, and topographic and hydrographic work under Mr. Zelner. The railroad work, aside from Mr. Cutler's famous cross-over problem, consists chiefly in mapping the Great Northern yards, and running in location lines in the wilds west of town. Cass Lake is at one end of an engine division on the G. N. which has a large and intricate system of tracks in town that makes the mapping anything but an easy job. Every foot of track is chained, all frogs located and their numbers determined; every siding spur track, switch, sign post, and building is carefully located by tape measurements. All this is then plotted on a detail sheet in the office. The men who worked on this job doubt very much that the railroad's own engineers have as detailed a map of the yards as they made. Every day or so a party was sent out to run in a proposed cross-over between the Soo and G. N. tracks near Pike Bay where the tracks converge at an angle of about 8 deg. About every so often a party chief pulled into camp early in the afternoon with a party plumb disgusted with the railroading game in general.

The computations were all absolutely correct, of course, but their layout on the ground would not check in angle or distance. The result usually was that this same party ran cross-over the next day and incidently took profile and set slope stakes. One party with not less than two Tau Betes in its makeup took three full days to get a check. Wanamaker, one of the party, says he can set slope stakes in his sleep now.

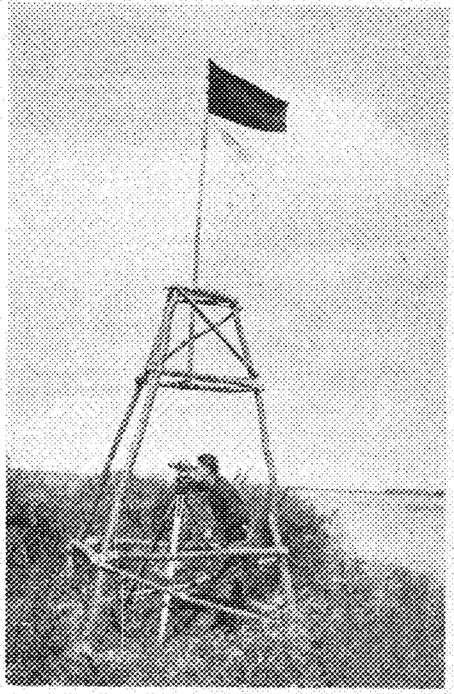
Topographic work was started with transit parties who were sent out to map the shore line in various assigned regions and obtain as much other detail as the growth of brush and trees would permit. These traverses usually ran along the beach until a convenient trail lead off into the woods. Then the line of hubs followed down through the woods and eventually closed back on a station near the starting point. I say closed, that is they should have, but most of them were anywhere from 20 min. to 20 deg. off in azimuth when they closed, and so had to be re-run. Much of the success of these parties depends on the rodman. Fred Imsande and Sam Balkin proved to be as good rodmen as ever held a rod up-side down. Imsande showed more ability than Sam in that he never held the rod at the same angle with the vertical. This required the transit man to exercise his brain in doing a rapid mental calculation correcting the observed distance to the vertical. Sam, however, was occupied otherwise, we found. One day he killed 25 mosquitoes, Some of um was big enough to stuff, by golly, me ketchum, Sam said.

This transit topography was plotted to a scale of one in. equals 400 ft., on 24 in. x 30 in. sheets in much the same form as the maps of the Mississippi River Commission. When every one in camp had had his turn on this job, the rest of the mapping was done with plane table. Parties for this work consisted of four men and as in all work lasting over a day, the job of each man was changed daily. Positions most desired were those of sketch or rear-rod, for in either case most of the day could be spent sleeping. It is remarkable the amount of sleep that can be made on such a job. The only disturbing elements were poison ivy and the head-rodman who was often sent back to give a back-sight.

A triangulation control system for our work had been established and monumented by previous camps, but signals had to be erected, angles read, base-line measured, and computations made to find the location of the various stations relative to the zero-zero of coordinates of the system before work started off them could be tied together to make a consummate whole. Measurement of the base-lines for this control system proved a jinx to some parties. Even with the use of various refinements in chaining, constant pull, support of tape and temperature corrections, the results varied widely yet consistantly. Something was obviously wrong but no one knew what or where.

Hydrography was a new job for most if not all of the men. Mr. Zelner had spent the winter quarter last year lecturing on stream measurement and sounding methods, but on one in camp had ever rated a meter and measured a discharge or heaved a lead and measured depths. Each party on stream measurements made a still water rating of a meter, there being two in camp, a Haskell propeller meter and a Price electrical meter, and then went with Mr. Zelner to measure the flow in one of the several streams flowing into or out of the lake. Sounding was done from a big flat bottom scow called "Cataram," the Leviathan of Norway Beach. The barge was propelled across the lake in lines approximately 300 ft. apart. Depths along the line from 3 to 15 ft. were measured with a sounding pole and taken every 30 seconds as the boat proceeded across the lake. When the depths reached 15 ft., the lead line was substituted for the pole and soundings made every minute. The lead had to be thrown five seconds before the time of reading to allow the line to become vertical for reading on the minute. Sextant location angles between triangulation stations were read every two minutes and locations plotted as soon as made with a three-arm-protractor on the sounding chart. Sextant men received a 30 second warning from the time-keeper to enable them to have the angle set and ready to clamp on the minute. Sounding crews consisted of ten men besides the skipper and first mate who were merely supernumeraries and who did no work whatsoever. Some sounding was done on Pike Bay with a sounding pole and rowboat, locating by intersection of transit lines. The transit men followed the boat with their instruments and read the angles on signal by flag from the time-keeper in the boat. These crews were not bothered with supernumeraries, however.

As the City Council of Cass Lake desired a plat of the town, they approached Prof. Cutler about having the job done by the camp. Mr. Cutler accepted and for several weeks a party worked in town, running chain traverses around the blocks and measuring the plusses to house corners. Distances from the traverse lines to house corners and house dimensions were paced. Every man who went on this job was overly enthusiastic about it, for it enabled him to get rather intimate with the good looking girls in the vicinity. Plane table parties on job



STRAWBERRY POINT SIGNAL TOWER
These towers were built to allow one party to read from station without interfering with others sighting this point.

in the town survey invariably set a hub in the front or back yard if they knew a *jeune fille* lived there. A survey of the territory around the outlet of the lake finished the work for the town. The outlet dam and topography near it as well as a large number of cross-sections of the stream bed, were taken. In appreciation of the work done for them, the Commercial Club invited the entire camp to a chicken dinner at Norway Beach Hotel. After the speeches, a general mixer, smoker and song-fest concluded the affair. The new Minnesota Fight Song was introduced by its author, Mr. Rickard, who was vacationing on Star Island at the time. It was surely an evening that will be remembered.

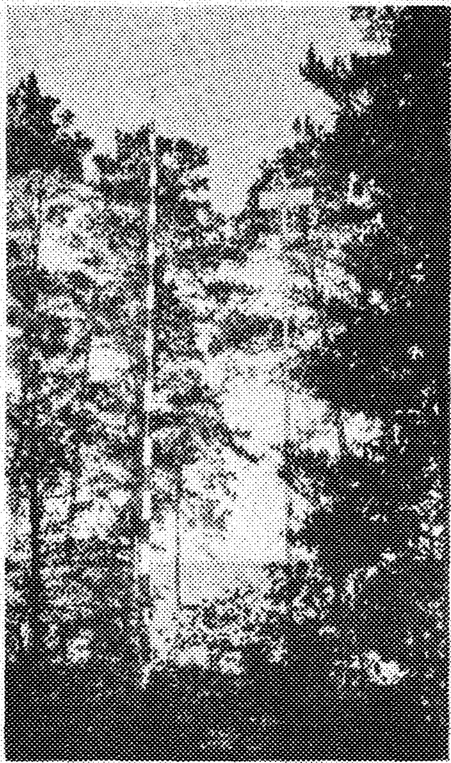
CATARAM, LEVIATHAN OF NORWAY BEACH
After drifting nearly two miles off the sounding line course, towing in was necessary as bucking the waves had swamped the motor. This boat was used chiefly to make soundings of the lake.

Transportation facilities of the camp amounted to about fourteen cars, including Fords, and two outboard motors for the camp boats. Jobs located at a distance from camp were usually assigned to men with cars at their disposal. These vehicles were indisposed a great deal of the time, distemper, perhaps, at least they had to be coaxed and petted quite a bit before they ran at all. Two of them had to be pushed to get them started. Foster's fliv did not even have a crank on it. The outboard motors worked fine when they worked, but often they did not, and once the boat had to be rowed three or four miles across the lake. Balkin came in one night after having trouble with a motor and suggested to Mr. Zelner that as motors they made good anchors, but Mr. Zelner thought they were too light for that use so they were kept in the capacity of motors.

Whenever Mr. Boon anticipated that

Polaris would shine, he posted instrument and station assignments for observations on the star. From these observations and a set of computations not at all comparable with the job, the azimuth of a line between two triangular stations was determined, and from it, the azimuth of each line in the system was found. A few times no observations could be made when scheduled because of clouds, once the men were rained in, but that did not help any for it all had to be done sometime.

Ken Foster by common assent, became athletic manager for the camp, and acting in that capacity scheduled a game with the Ames Forestry School Camp on Pike Bay. Equipment was gathered in from everywhere until there was enough on hand to supply all men in action. Each man in camp bought a ten-cent share of stock in a ball, Mr. Zelner being sold two shares. (Blue-Sky men notice.) Work in the field that Saturday was halted at noon, if not before, and after dinner in camp, all headed for the town ball park which the business men opened for our use. Phil Manson marshalled the team out to warm up and the rest of us took seats in the bleachers. But Phil was worried, Foster was not there and the game was waiting. Then it developed that he had not been in to dinner. He must still be out on the lake with Gould, for their job that day took them to North Star Point on the Island. Minutes of anxious suspense followed, Phil becoming more anxious and finally the Ames boys told us that they thought we were



THE 1926 TOTEM POLE

Each man in the camp has his initials carved on this totem. The class numerals are also engraved here and topping its ninety foot length is a large gopher. The previous camp vowed that no pole would pass theirs, but this one towers far above the former one. Each of the painted sections are three feet in length.

stalling. Cooper came with the news that he had been out on the lake but did not sight the other boat. At that a search was started to find a new pitcher. Stew Kreger started warming up while Manson and an Ames man agreed on umpires. Les Croswell umpired on bases and the Ames camp cook took his position behind the mound. Suddenly, in true movie style, Sam Balkin dashed into the field out of a cloud of dust with Ken hanging on the side of the Chevrolet. The hero being present, the game proceeded. In camp that night Sam said he started to slow down back by the box factory and even then had to coast the last eight blocks.

At the start both pitchers were a little wild. Manson at backstop got everything that came his way and when his turn at bat came managed to clout out a three bagger. As the game progressed it developed that the Ames cook's name was Postum—There's a Reason—at least he had one for every decision he made except strikes. One outstanding feature during the entire game was the team work. Whenever a long fly needed catching or a fumble required attention the whole team was on the scene of action at once in a body. Foster threw a wide ball which the batter ducked. In the fifth inning, Ken must have been trying strategy for the ball hit the bat. This immediately started an argument. Ken said the man was out, but umps said No! Although it took a while for Ken to believe it, the umps finally gained his point. Bunnell in the field missed a long fly but it did not get far. He took a running dive and fell on it the way Cooper falls on the pigskin. The fall was disastrous for Charlie, as he tore a big hole in the west side of

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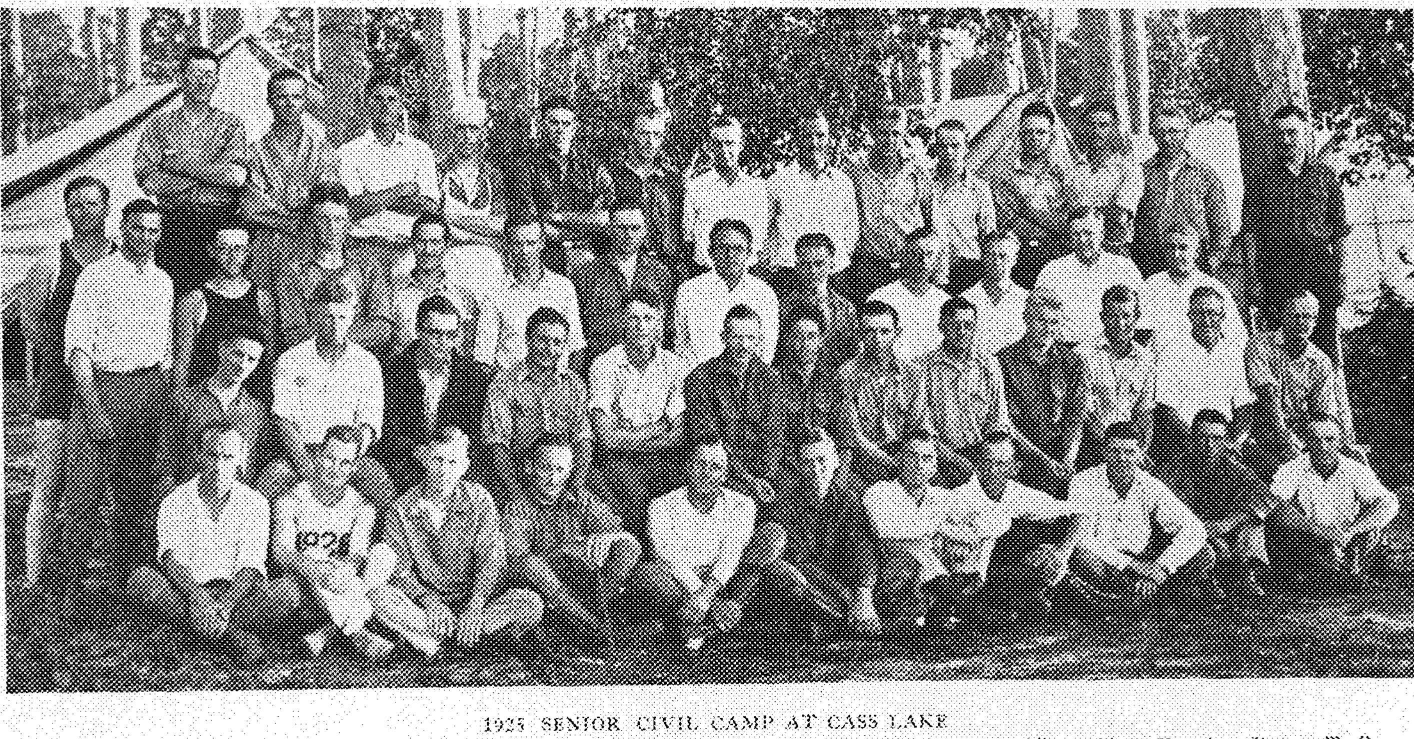


1925 SENIOR CIVIL CAMP AT CASS LAKE

Platzer, Flasten, Anderson, Erickson (Cook), Croswell, Drdla, Imsande, Cooper, Johnson, J. R., Bunnell, Gibeau, Liese, Kaercher, Young, T. P.
Juell, Breeden, Lipchick, Nelson, Neubauer, Lusbene, Johnson, C. S., Gould, Ohman, Jaskula, Nasvik, Zelner, Cutler.
Lewin, Johnson, R. A., Comfort, Balkin, Williams, Lindsteit, Deegan, Meyerdick, Boon, Manson, Krieger, Wanamaker, Erickson.
Sullivan, Kelley, Sandvig, Bolstad, Young, E. F., Foster, Ruth, Sandberg, Fenton, Cosgrove, Lund.
(Hoffman, Robinson, Schulz and Halbkat are not in photo.)

Nela Park

Study of good lighting in all its phases, research problems, are major courses at National Lamp's 'University of Light' at Cleveland

By Albert A. Lee, E'26

NELA PARK, just what is it? What are its functions? What place of importance does it occupy in the industrial world and who owns and directs its activities? These are questions which are often brought up when the subject of lighting is discussed. To do justice to the work and the place Nela Park occupies in furthering the cause of good lighting would take volumes, but I shall endeavor to give, as briefly as possible, an outline of the function of this institution.

The National Lamp Works and the Edison Lamp Works are subsidiaries of the General Electric company which owns the patent rights for the use of tungsten in incandescent lamps. Nela Park is owned and operated by the National Lamp Works. Its primary purpose is to further the cause of good lighting and to serve the fourteen factories, the eighteen sales divisions, and the 35,000 agents of the National Lamp Works in the manufacture and marketing of the National Mazda Lamps, amounting to one hundred thirty-five million annually. It is a feature of Mazda Service which has made the Mazda Lamp the highly desirable product it is today.

Nela Park is justly termed a University of Light, for it is not merely a lamp laboratory, it is an institution where the study of light in all its phases is carried on. The visitor to Nela Park is struck by the resemblance its grounds bear to that of a college campus. Broad lawns, pleasant winding walks beneath great trees, and clear, gleaming pools, form a beautiful setting for the buildings which are built in the architecture of the Georgian period. Here one does not see the closely huddled groups of buildings, or find the grime and noise and dust, typical of the average factory or industrial plant. Instead, one finds spacious grounds where each building fits perfectly into the general scheme of the landscape. As one stands on the brow of the terrace near the Engineering building, he can look out over Lake Erie to the north. To the west and below him, for Nela Park is on a hill, lies the city of Cleveland, while on the east and south is a deep, wooded ravine which effectively shuts off the neighboring residence district, thus giving the place a seclusion not enjoyed by many colleges. The grounds thus bounded, occupy 90 acres of ground, providing plenty of room for the 19 buildings, and leaving plenty of room for lawns, shrubs, trees, and athletic grounds.

All of this sounds tremendously expensive and you wonder why a large corporation will permit such an extravagance; yet it is not an extravagance. An office building in the heart of a city, to contain all of the departments of Nela Park, would have to be 100 ft. square and 45 stories tall. This building would command a higher rent than the expenses of Nela Park, yet it would not have all of its advantages.

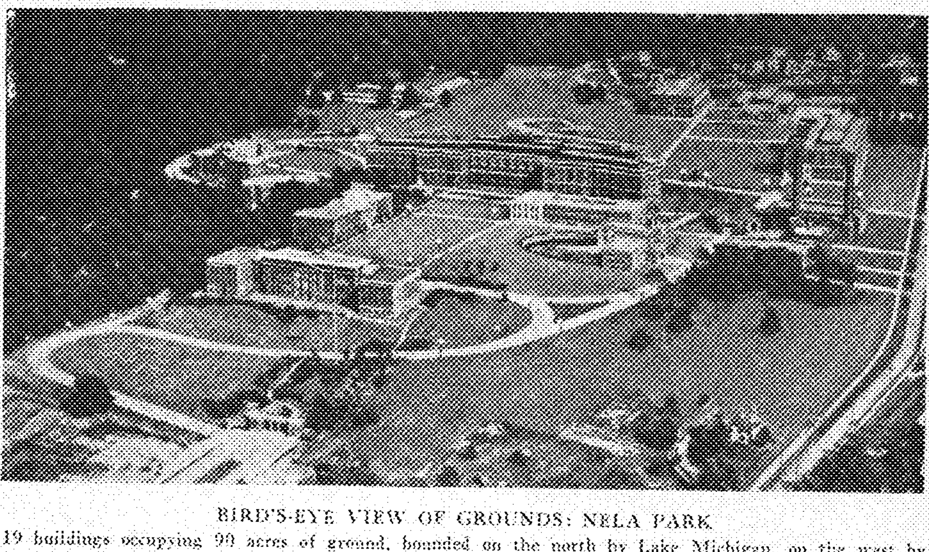
Nela Park is a university for study and research. No lamps are manufactured there, although it does have a miniature factory for experimenting on new designs for lamps and the machinery for producing them. Research work is carried on extensively, for the directors of the company believe that no institution which does not make an attempt at progress, which does not try to find means of making its product better, can survive in the dynamic business world of today. At Nela, then, we find one whole building devoted to pure research, not only in the making of lamps, but in the production of light from any source whatever. Near it is another building devoted to the application of the results of research to lighting problems. Then we come to the lamp laboratory where new ideas, inventions, and discoveries are tried out to see if they are commercially practicable. In the laboratory they are continually going over old processes to straighten them out and make them better, or trying out new methods of manufacture to use in the factories of the company. In this building also is located the lamp testing department where thousands of lamps, enough to light a city of 35,000 population, are on test every day, to determine the life, the quality of light, the efficiency, and many other tests of the lamp. Thousands of lamps in huge racks are kept burning night and day to determine their life. At night, ships far out on Lake Erie can see the glow in the sky caused by the burning of these lamps.

Now let us turn to the Engineering Department. The men in this department must know all the ins and outs of the manufacture and production of lamps. In addition they must aid in the marketing by finding new uses for lighting, by co-operating with reflector manufacturers to see that the reflectors conform to the standards of good lighting determined at Nela Park, and they must aid the customer in using his light to the best advantage. They are experts in all the phases of lighting which apply to their particular field, for the department is subdivided into various divisions such as Street Lighting, Automobile Lighting, Sign Lighting, Home, Office and Factory Lighting, and many other divisions. The knowledge of these experts is not obtained from desk and laboratory alone, but from actual contact with the problems and realities of the actual application of light.

An important branch of the Engineering department is the Technical Publicity Department. The results of research, the findings of the engineers in lighting, the progress in the manufacture of lamps, are all brought together by this department and published in the form of pamphlets which are available for the use of those interested in lighting.

The head office of the National Lamp Works is located at Nela Park with its accompanying quota of departments. Here is located the head office of the sales and publicity divisions who have done much creditable work in educating the public to the desirabilities and need of good lighting in offices, homes, stores,

(*Continued on page 58*)



BIRD'S-EYE VIEW OF GROUNDS: NELA PARK

19 buildings occupying 90 acres of ground, bounded on the north by Lake Michigan, on the west by Cleveland, compose this renowned University of Light.

NEWS FROM THE TECHNICAL CAMPUS

Student Elections Held Recently

Jay R. Pike was elected secretary of the student branch of the American Society of Mechanical Engineers at a special election held last Saturday.

Harold Rollin was elected to represent the Minnesota chapter of Tau Beta Pi at the national convention held at Purdue University on October 15 and 16. Officers of the local chapter were installed at a luncheon in the Minnesota Union, October 2.

Pi Delta Nu is a new chemical sorority recently installed at University of Minnesota. It was made a national last July. This society was formerly known as Alpha Kappa Epsilon.

Class elections in the engineering colleges resulted as follows: Freshmen: Evans Healy, president; Leon Mears, vice-president; Merle Carlsom, secretary-treasurer. The freshmen commission representatives are Willis Edgel and Paul Magoon.

Sophomores: George Thwing, president; Helbert Hathoway, vice-president; Glendon Brown, secretary-treasurer. Melvin Eck and Frank Blackmore are the commission representatives.

Juniors: Neal Nelson, president; Albert A. Cooper, vice-president; J. C. Marcroft, secretary; John E. Hovig, secretary.

Seniors: George Mork, president; Kenneth Foster, vice-president; J. R. Johnson, secretary-treasurer; athletic maager, Phillip W. Manson.

All classes in the School of Mines have held their elections of officers for the school year. The vote in all classes represented practically one hundred per cent of the students.

The Seniors picked for their president Ralph Johnson, who is to be aided in running the class by Everett Van Duzee, vice-president, and Conrad Haase, secretary and treasurer.

Paul Deringer was again elected president of the class of 1927. Lee Armstrong was chosen vice-president, Marshall Coolidge, secretary, and Ted Erck, treasurer.

In the Sophomore class Herbert Boeger got the big job. John Folliet is the new vice-president, and Maurice Finberg is the secretary-treasurer.

The Freshmen, a small but select bunch of beginners, found Tracy Waller good material for the presidency. Other officers of the first year men are Roderic Stavely, vice-president, and Henry Nelson, secretary-treasurer.

There were no elections in the School of Mines Society this fall as they were held in the spring according to the Society's new constitution.

Many Technical Students Are on Football Squad

Considering the heavy schedule that the engineers are required to carry, the technical colleges can be proud of its men on the varsity football squad. In the line we have: Sheldon F. Johnson, E '28, center candidate; Roger Wheeler, Ch. '27, end; Chas. D. Kopplin from Regina, Sask., C '28, end; Lewis G. Tiffany, Ch. '28; William Hess, C '28, transferred from the Case School of Applied Science; R. Conrad Cooper, C '26, center. In the backfield are John Stark, E '28, and Everett Van Duzee, Mines '26, fullback.

Former Chemistry Dean Goes to Leland Stanford

DR. G. B. FRANKFORTER

One of the oldest and most noted members of the faculty of the School of Chemistry was lost to the University when Dr. George Frankforter accepted the position of professor of chemistry at Leland Stanford University. He is to have charge of freshman instruction in chemistry, giving special courses in explosives, dye stuffs and terpens.

Dr. Frankforter has been with the University of Minnesota since 1893 when he was appointed dean of the School of Chemistry and director of chemistry laboratory. Since his coming into charge the School of Chemistry has grown rapidly and it has been largely through his efforts that it has achieved the distinction of being a leading school throughout the country, in size as well as in the amount of research work done.

Dr. Frankforter is a graduate of the University of Nebraska. He was made an assistant in his sophomore year there and immediately upon his graduation in 1886, was appointed instructor in chemistry, during which time he studied for his M. A. degree.

He spent four years abroad studying chiefly in the German Universities and in 1893 took his Ph. D. degree in the Royal University of Berlin. He specialized in chemistry, choosing the plant alkaloids and more particularly the opium compounds. He worked out the constitutional formula for the opium alkaloid narceine and succeeded in making it synthetically.

Upon his return from abroad he was made a lecturer in the University of Nebraska and later became professor of analytical chemistry. In that same year he resigned and accepted the position at the University of Minnesota as head of the chemistry department, which station he held till the outbreak of the war in 1917. He served as major in the Ordinance Department of the U. S. Army. He was financial adviser of the war claims board and was on the ordinance claims board.

He also served as a member of the United States Mint Commission which was appointed in 1900 by President McKinley. During the war, he was in charge of the officers training school conducted at the Dupont powder works.

Dr. Frankforter has published numerous papers in almost every line of chemical science, and also is author of a number of bulletins on explosives. He is a member of chemical societies at home and abroad.

Extension Division Enrolls 600 in Engineering Courses

The engineering courses offered by the University Extension Division has been very popular. The present enrollment is estimated at about six hundred. During the school year of 1924-25, there were 876 students registered for the first semester, and 550 registered for the second semester, making a total registration of 1,336 students for the school year.

Certificates are offered in architecture, and in mechanical, electrical, and civil engineering, upon the completion of forty-five credits of work in any of these four branches.

In 1923-24, three certificates in engineering were granted by the Extension Division—one civil and two in electrical engineering. Up to the present time, there are 27 engineering extension certificate holders.

These evening courses have been laid out with special attention to the needs of men who are working, or plan to work, in shops and in industrial and engineering establishments. They are so planned that such men may add to their practical training a technical and theoretical knowledge which will enable them to render more efficient service and advance more rapidly in their work.

They also offer an opportunity to college graduates who may wish to specialize in some subject which was not covered in their regular college course. The courses embrace elementary as well as graduate work.

The duration of these subjects is 16 weeks, consisting of two hours each week. This constitutes a total of thirty-two hours spent in classrooms for the term. After the first semester, a second course of sixteen weeks of advanced subjects is offered. The four groups of studies begin with elementary mathematics, physics, and mechanical drawing, and continue through the more advanced engineering subjects.

The prerequisites for admission are rather simple. They require that the student be of sufficiently mature age to carry the necessary subjects, and that he be able to read and write. The ages of the entrants vary from sixteen to sixty, averaging about twenty-five years of age.

The Extension Division is also conducting engineering courses in Duluth and the Iron Range. In Duluth there are one hundred students taking various subjects. There are three instructors, Professor Phillips of the Duluth Central High school, who teaches physics, and Professors Bleifuss and Defries, who teach mathematics, drawing, surveying, and architecture.

At Hibbing, Professor L. M. Becker, formerly of the University of Minnesota faculty, has charge. Here mathematics and applied mathematics are offered.

Professor C. M. Sneed Writes New Chemistry Text

C. M. Sneed, professor of chemistry and chief of the department of inorganic chemistry at Minnesota University has completed a new text entitled, General Inorganic Chemistry, to be published early in the spring. The manuscript is now in the hands of publishers, and illustrations are being prepared.

The text had been written especially for beginners in chemistry in colleges and universities. It will contain 700 pages and 155 illustrations when complete.

Chemistry Institute Grades Instruction Given Here

On July 25, at a meeting of the American Institute of Chemical Engineers in Providence, R. I., chemical engineering courses at the University of Minnesota were given a high grading. The report of the committee on chemical engineering education, recommended that Minnesota along with 12 other schools be rated as giving satisfactory courses in that field. The other schools are as follows: Armour Institute, Carnegie Institute, Case School of Applied Sciences, Columbia University, Iowa State College, Ohio State University, Brooklyn Polytechnic Institute, Yale, Rennsellaer Institute, the University of Cincinnati, Michigan University, and the University of Wisconsin.

Mines Station Develops Ore Reduction Process

The Mines experiment station at the University of Minnesota has recently accomplished a laboratory process whereby concentration of a low grade iron ore into a high grade ore is possible. The process does not refine the ore but makes it suitable for uses in steel furnaces.

If this laboratory method can be developed into a commercial process, the iron ore deposits in Minnesota will be made practically inexhaustible.

Spain, also, because of its large amount of low grade iron ore, is especially interested in the experiments being made here at the University. This summer both Edward W. Davis and Henry H. Wade of the experimental station were in Spain to look over the system tried there. Now Spain has sent Prof C. A. Miranda of the Metallurgy Department of the University of Madrid to the United States, and especially to Minnesota, to study conditions and processes used here.

Rooter Club Has Origin Among Technical Students

Lusty cheering and an abundance of pep at football games this fall is the slogan of the Rooters Club which was recently organized. The plans of this aggregation which completely fill one entire section, are to aid in organized cheering as well as to put across feature stunts from time to time, such as the introduction of new fight songs and yells.

The club in reality had its origin in the engineering colleges, a mass meeting being held last spring at which preliminary plans were discussed. The idea was started by members of Scabbard and Blade, military fraternity, who, seeing the need of an organized system for cheering, put the first plans on foot. With the coming of fall, the club became a reality with the result that the section now numbers over 700 members.

Barton Juell, a senior civil engineer is the president of the club. A distinctive uniform will, perhaps, be decided upon soon for the Club but as yet, the men rely upon their leather lungs to let the rest of the stands know that they are there.

George Huck Has Narrow Escape in Utah Mine

Immediate rescue by an assistant mine superintendent saved George Huck, a senior mining student at the University of Minnesota, from poisonous fumes. He was with a party of 12 students, senior miners, who visited several mines in Western states during the summer. Huck was fighting a fire in a Utah mine when he became overcome with gases. He fell down a mine shaft but escaped with minor injuries.

The group left Minneapolis on May 15, with Professor P. C. Christianson, E. H. Comstock, and W. H. Parker of the mine school. They went to the Golden Cycle mine, Colorado Springs, Denver, and through Wyoming and Utah. They studied the smelting of mines at Salt Lake City and spent a night in Bingham, where the largest open pit copper mine of the state is situated.

Former Architectural Student Awarded Grand Prix de Rome

High honor has again come to a University of Minnesota engineering graduate. George Fraser, a former student in architecture, has recently been awarded the Grand Prix de Rome fellowship in architecture. He is now a professor in design at Cornell University.

Mr. Fraser was born in St. Paul, where he graduated from the Mechanic Arts High School in 1914. He received his under-graduate work and a B. S. degree at the University of Minnesota. In 1920-21 he took his graduate work at Cornell University and is the holder of a Master of Architecture degree from that school. After leaving Cornell, he was a member of the Ohio State Faculty, returning to Cornell in 1923, where he has been a professor of design for two years. He is a member of Phi Kappa Phi, Tau Sigma Delta, Savage Club, Gargoyle, L'Ogive, and Delta Chi.

Mr. Fraser is the first man from the University of Minnesota to receive a fellowship at the American Academy in Rome, and is the second man from Cornell University.

The award is valued at $10,000. It includes a three-year appointment to the American Academy in Rome, tuition, sustenance, a studio, and an allowance of $1,200 a year. This prize was awarded to Mr. Fraser for the design of a stadium, which was selected by a jury of five prominent architects as the best of eight designs submitted. He feels that he is greatly indebted for his success to Professor F. H. Bosworth, Jr., of Cornell, and Professor Roy Childs Jones of Minnesota.

Mr. Fraser is 29 years old. He served with the engineering department in the World War. He will sail shortly to take up his studies in Rome where he will remain for three years.

Professor Tate Nominated as Editor of Physical Review

John T. Tate, professor of physics at the University of Minnesota, has received the nomination of editor-in-chief of the Physical Review, national physics magazine. It is a monthly journal of experimental and theoretical physics conducted by the American Physical society.

Professor Tate, who is already a member of the editorial board, will go to Kansas City at Christmas vacation to attend the meeting of the American Physical Society. Only one man is nominated by members of the society but anyone may be put up for election by the signatures of a certain number of persons. So far Mr. Tate is the only man who has received the offer.

Changes Made in Engineering Faculty

Dr. N. W. Taylor from the University of California will be assistant professor of physical chemistry. He is a graduate of the University of Saskatchewan, Canada, having received his B. S. degree there. He worked for his Ph. D. degree at the University of California at which place he was teaching until the present time.

Everett H. Tollefson, an instructor for two years in the school of mines, left the University of Minnesota to go into the oil business. He is at present employed as geologist of the Roxana Petroleum Corporation of Camden, Arkansas.

Carl E. Larson from Iron Mountain, Michigan, and a graduate of the University of Michigan, will be new instructor in the department of drawing and descriptive geometry. Before coming here he was connected with the Ford Motor Co.

Prof. A. J. Carlson, instructor in the mine plant and mechanical department of the school of mines has been given a Sabbatical leave of six months. He has gone to the University of California to take work for his doctor's degree. He is expected to return to Minnesota in February.

New Athletic Board Is Formed This Fall

Interclass athletics in the technical colleges will be under the supervision of the Technical College Athletic Board this year. The board will be composed of an athletic manager elected by each of the classes in the College of Engineering and the School of Chemistry, and a technical college athletic director and his assistant.

These ten men will direct all interclass athletic events in the two colleges. They will also have charge of the athletic fund dances to be held during the winter quarter.

Heretofore contests were arranged by the individual athletic managers representing the various classes. The plan of having a controlling board was presented last spring by Kenneth Foster, who has been athletic manager of his class for two years. It has recently received the approval of Dean Leland, Dean Nicholson, and the technical commission.

Financial Statement of Technical Association

The financial statement of the Technical Association is as follows:

Bal. brought forward from 1923-24		$ 5.06
Dues received from member societies		72.00
Collected for homecoming decorations		51.81
Total Receipts		$128.87
Stationery and postage	$ 8.15	
Homecoming decorations	32.00	
Meeting expenses	27.50	
Election expenses	7.75	
Seals for St. Pat's Day	4.72	
Gopher page	24.50	
Total	$104.62	
Balance 10-1-'25		$34.25

The Technical Association is an organization of the recognized departmental societies in the College of Engineering and Architecture and School of Chemistry. The purpose of the association is to assure students in these various organizations a representative voice in matters of general interest to these colleges and to the University.

The
MINNESOTA TECHNO-LOG
University *of* Minnesota

ENGINEERS again triumphed at their annual class scrap this fall, inasmuch as this event, formerly a free for all tussle resulting with serious injury and general dissatisfaction, was run off in an orderly manner, with plenty of good fun for all concerned.

Formerly, the health service did a rushing business immediately following the scrap, but this year there were no cases of injury more than a bruised nose or a ripped pair of trousers. We do not think that class scrap day is on the decline and will eventually end with a duel with cream puffs at ten paces. The zest that always characterizes engineering student life is well established. This change is only an improvement.

Shouting their Gesundheit yell, technical students on this scrap day paraded through campus buildings as much as to say, We are the engineers, look us over. Our weaker brothers looked on with awe, and many a diminutive co-ed breathed a certain sigh as a particularly stalwart disciple of the slide rule marched past.

Engineering enthusiasm does not end on the campus. The theatre party is an annual classic and is a red letter day for everyone. The varied population of downtown Minneapolis gets a view of Minnesota Engineers in action when 1,000 strong they paraded up Hennepin avenue that night.

This may have seemed to some as bordering on rowdyism. It is only the outburst of the extra pep of a college of students who have the ambition to take a real course and who, many a night, spent until the small hours of the morning working on the morrow's lessons.

One of our academic brothers remarked to us, "You fellows certainly have the pep." We hesitate to say just what would be the result if every individual college displayed similar activity.

While we are speaking about this time-worn subject of spirit, a word about the School of Mines would be fitting. Though their enrollment hovers about the fifty mark, they are the best organized aggregation on the campus. Their Mines Society has 100 per cent membership. Mines has many men leaders of campus affairs in the past and present. Its successful alumni are found in every corner of the world.

The Miner and Engineer will always be distinctive at Minnesota, each doing its share to a greater and better University.

NATIONAL engineering societies play an important part in the engineering world. They are the clearing house of engineering thought, where the opinions of the foremost engineers are collected, organized, and distributed for the advancement of the profession.

The engineers of tomorrow must come from the various technical schools of the country, and the national societies have realized the desirability of giving students an early acquaintanceship with their ideals and functions. To this end, they established the student branches of their societies which are open to all undergraduates.

These student branches hold occasional meetings where an outside speaker gives talks on some engineering project. Too often, this speaker goes into a highly technical discussion or describes some of the detailed work of the company in which he is involved. To the average student, this is to a large extent uninteresting and should be relegated to the classroom.

The purposes of these student branches should be in line with the following: First of all, they should present to the student the details and qualifications of the line which he intends to enter. This can be done in several ways by non-technical talks and by honest heart-to-heart conversations with the men in the fields themselves. They should serve in a social sense among the student members themselves. It is indeed unfortunate when a student will go through school and not make the acquaintanceship of the majority of his classmates. This side of student life can never be stressed too much in an engineering school.

The student society should sponsor various events for the welfare of their department, conduct trips to large industrial plants, and should in some way acquaint the student with the main large organization of which their branch is a small part. We fail to see the advisability of a student subscribing to the publication of the society. In most cases it is too technical for him to masticate and text-books should constitute the major part of his fundamental training.

The various student branches at Minnesota have a distinct job cut out for them this year. We are glad to note that so many of the departments have student branches established, and we understand that one will soon be organized in the School of Chemistry. In the past, the success of most of these has been rather doubtful. We hope that this year will be a big one for all concerned. Society chairmen—get busy.

A FEW SIDE-LIGHTS— — —

The fall issues of the TECHNO-LOG would not be complete without the annual tale of the civils and their everlasting camp. This has become a tradition. A summer camp of this sort affords an opportunity for a closer acquaintanship among classmates, and from all reports, work is combined with pleasure. It is regrettable that other departments cannot have such a camp as this.

Engineering can be applied to many seemingly distant fields of endeavor. It has invaded the domains of Blackstone and now we see the T-square and a volume of Corpus Juris on the same table. "Patents and the Engineer" by Alex Lagaard, E. E. '13, tells in an interesting fashion of the work of a patent attorney.

Practice and theory are combined in the experimental highway about which Professor Lang writes. It seems quite fitting that a Minnesota graduate should head this department in our state, made famous the world over for its excellent roads.

The proposed Minneapolis Harbor has aroused much interest the last few months. We are fortunate in being able to present the first hand information about this from the pen of its originator, Francis M. Henry. The entire Northwest is watching with interest the development of this plan.

AROUND THE WORLD WITH OUR ALUMNI

Chemists

'25—Harold Bunger had his eyes severely burned by sulfuric acid in an explosion at the laboratories of the Hercules Powder Company. He will lose one eye as a result of the burn. Doctors at Rochester, Minnesota, where he is undergoing treatment, expect to save the other eye.

Civils

'08—George W. Walker has left the Buhl State Bank at Buhl, Minn., and is now living in Florida.

'11—M. J. Hoffman is located at St. Paul where he is working as bridge engineer for the State Highway Commission.

'19—Edward H. Coe, a second lieutenant on the Corps of Engineers, has left the Engineers School at Fort Humphreys, Va., to join the 2nd Engineers at Fort Sam Houston, Texas.

'20—Arnold M. Pless has left the highway work and is now the city engineer of Abert Lea, Minn.

'20—Donald O. Nelson has left Portland, Oregon, where he was in charge of the engineering department of the Truscon Steel Co. and is now at the University as a research fellow in the experimental department. Mrs. Nelson is also taking graduate work at the University. Mr. Nelson made the trip East in a Ford and he reports that the roads all through the west show the effects of a greater engineering development, so that now a person may travel through the west on as good roads as we have in Hennepin County.

'21—C. E. Olson and Lyle Dills are in the bridge department of the State Highway Commission.

'21—E. H. Grochau is with the Gauger-Korsmo Construction Company at Tampa, Florida. His address is 109 East Lafayette street.

'21—William S. Mackintosh is working on the Robert street bridge in St. Paul.

'21—Everett J. McCubrey is still working for the State Highway Commission but he has left Cologne to become resident engineer at New Ulm, Minnesota.

'21—George M. Christilaw is working for the State Highway Commission as resident engineer at Red Wing, Minn.

'21—Cyril D. Jensen has resigned from the Northern States Power Co. in Wisconsin and has accepted a position on the faculty of Lehigh University.

'22—Charles H. Palda is working for Hanlon & Okes at Owatonna as superintendent of construction.

'22—Arden D. White has opened up an office in Los Angeles, California, and is doing topographic surveying and general engineering.

'22—C. O. Markson is resident engineer at Hugo, Minn., where he is in charge of state paving construction.

'22—C. A. Thompson is working for the State Highway Commission as resident engineer at Sandstone, Minn., and has charge of all the paving in that vicinity.

'22—V. R. Wood is resident engineer at Farmington and has charge of the state paving in that vicinity.

'23—Julian (Spike) Garzon, former alumni editor on the Techno-Log staff, has resigned from the Northern States Power Co. on the Chippewa River, Wisconsin, and is now working for the Minnesota Highway Commission.

'24—Clarence Velz is with a real estate company in Florida.

'24—Walter Wilson has been with the city engineering department of the City of Duluth since his graduation. He expects to go to work in Florida in the near future.

'24—Cards have recently been received announcing the marriage of Archie McCrady. Archie will be remembered for his spicy writings as well as his officiating as St. Patrick. He is a patent attorney at the United States patent office.

'24—Herbert W. Gillard is field agent for the Minesota League of Municipalities and travels extensively over the northwest. His home address is 4400 46th Avenue South, Minneapolis.

'25—Irvin S. Macgowan is working in the Engineering Department of the Northern Pacific Railroad Co. He is stationed in Minneapolis and is living at 4112 Colfax avenue.

'25—Arthur J. Kroll is located at Thompsonville, Ill., where he is working as engineer for the Illinois Central.

'25—Clarence Burley is working as inspector for the State Highway Commission. He is located at Owatonna, Minn.

'25—John A. Banovetz is employed as chief of party by the engineering department of the Northern Pacific Railroad Co. He is living at 406 11th Ave. S. E., Minneapolis.

'25—Edward F. Brownell and Harold E. Bird are working in the Minneapolis laboratory of the Minnesota Highway Commission.

'25—Charles E. Prichard is the inspector on the paving job of the Concrete Products Co. at Elk River, Minn.

'25—C. E. Hendrickson and H. N. McAndrews are working for the State Highway Commission on the construction of paving at Winona, Minn.

'25—Horace W. Nutting is working for the state on paving construction at Pine City, Minn.

'25—Herbert F. Dungay is working for the Minnesota Highway Commission at Red Wing, doing highway construction work. He paid a visit to the U this fall and friends say that he looks prosperous and healthy.

'25—Frank E. Nichols was working for the Minnesota Highway Commission this summer and is now back at the University as a research fellow in the experimental department.

'25—Ursula Quinn is working for the Berger Manufacturing Co. of Minneapolis.

'25—Clarence R. Peterson is with the State Highway Commission at Red Wing where he is working on paving construction.

'25—William Auxer and Reeve Hawkins, '24, recently formed a partnership and are doing general engineering work.

'26 C—Lawrence T. Robinson slipped out of the civils summer camp on the shores of Cass Lake, came down to Minneapolis, and was married to Miss Anne West on September 5. Mrs. Robinson is a member of the senior medical class and is serving her internship this year at the University Hospital.

'26 C—The reason that most of the senior civils were seen smoking cigars on October 12th is that Homer Wanamaker, a member of the senior civil class, had a brand new 8-pound baby boy. Homer says that his new son Jimmie will be an engineer when he grows up, just like his father.

Electricals

'23—Louis T. Bumgardner was married to Miss Mary Elizabeth Bullock on September 22, 1925. Mr. and Mrs. Bumgardner will make their home at 1381 Goodrich Ave., St. Paul. Mr. Bumgardner is employed as electrical engineer for J. H. A. Brahtz of St. Paul.

'23—E. C. Manderfeld is with the Bell Telephone Laboratories of New York engaged in personnel work. In addition to his regular duties, Mr. Manderfeld is instructor in telephone practice in the out-of-hour educational courses which this company provides for its employees during the winter months. Mr. Manderfeld has been with the Laboratories, formerly the Engineering Department of the Western Electric Company, since graduation.

'25—Oscar Borchert is in Chicago working for the Commonwealth Edison Co.

'25—Robert V. Ludlum is in St. Louis, Mo., working in the sales department of the Century Electric Co.

'25—Frank O. Knoll is working for the Northern Staters Power Co. in Minneapolis.

'25—Lawrence D. Solemenson has been appointed second lieutenant in the Coast Artillery Corps of the regular army in recognition of his excellent record in the Reserve Officers Training Corps and in his college.

Prior to his transfer to Hawaii for duty, he has been ordered to report immediately to Sandy Hook Coast Defense of Fort Hancock, N. Y., where he will be temporarily stationed. He is to be on duty in Hawaii with Captain W. R. Hall who was instructor of the Coast Artillery Corps at the University of Minnesota from 1921 to 1924.

Mechanicals

'24—Frank Morris, last year a fellowship student in experimental engineering has been made an instructor in mechanical engineering, and assistant director of the experimental laboratories.

'25—Russell E. Backstrom has been given the fellowship in experimental engineering this year.

'25—Everett B. Stevens is taking graduate work at the University of Minnesota this year.

Miners

'00—Rensselaer H. Toll, mining engineer at Long Beach, California, writes us that he appreciates the Alumni issue very much.

'10—G. Gordon Stewart is at 663 5th St., San Bernardina, California.

'21, Met.—Loren Dawson was married to Miss Helen Jeanette Dempster of Lake City, Minnesota, on August 18, 1925. Mr. Dawson is in maintenance and construction work with the Northern Pacific railroad and is located at Darling, Minnesota.

'24—Word has been received that Stanley G. Olson died October 8th as a result of injuries received when he fell from an ore bucket in the Kennicott Corporation mine at Kennicott, Alaska. Mr. Olson was resident engineer for the Kennicott Corporation.

'25—Bernard J. Larpenteur is working for the State of Minnesota as assistant metallurgist at the School of Mines Experiment Station.

'25, Met.—Ed H. Hennen is in Philipsburg, New Jersey, working for the Ingersoll-Rand Co.

The Proposed Harbor of Minneapolis

(Continued from page 39)

pens that the mines furnishing the coal are contiguous to the blast furnaces now using the Cuyuna iron ores. The barges bringing up coal would be loaded with ore at a point north of the city limits and returned to their starting point with a full cargo both ways. The railroads are practically certain to deliver the ore at this point rather than at any point below Minneapolis because the cost of hauling through the Twin Cities will equal or perhaps exceed that of hauling from the mines to Minneapolis. The Minnesota Bureau of Mines estimates the annual output of the Cuyuna range as 2,500,000 tons per annum which can be increased to 10,000,000 tons if freight conditions warrant. When the Minneapolis harbor shall be completed, we feel certain that at least one-half of all the Cuyuna ore produced will be shipped to furnaces on the Ohio and Mississippi rivers by way of Minneapolis rather than by lake and rail from Duluth.

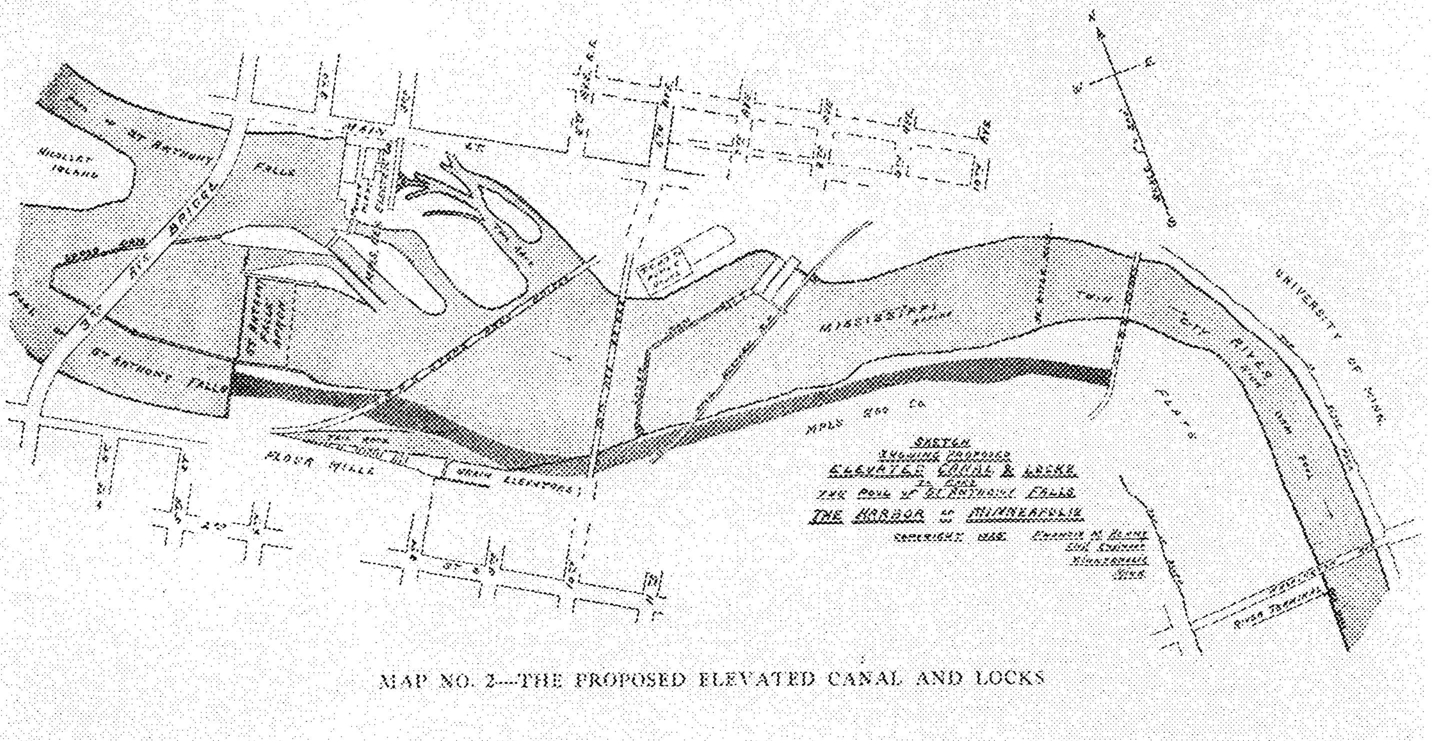
Minneapolis was formerly a lumber town; then it became a wheat and flour city. The lumber is gone and the flour mills are going unless conditions are changed. Some mills have been built at Buffalo by Minneapolis millers, not in the least because the millers wanted to do this, but they felt compelled to do so by reason of freight rates which operate very much against Minneapolis and in favor of Buffalo. The rate from Minneapolis to seaport towns for export on wheat is 16 cents per bushel by way of Duluth, and on flour export is 70 cents per barrel. From a large number of estimates by experienced river men and from the experience of the Mississippi and Warrior river barge lines, we believe it is safe to say that there would be a saving upon wheat shipped from Minneapolis to New Orleans of from two or three cents over shipments from Duluth to Atlantic coast points and eight or ten cents on shipments from Minneapolis by way of Duluth, and the saving on flour would be from fifteen to twenty cents per barrel on shipments from Minneapolis to New Orleans over shipments by lake and rail to seaboard points. It may be remarked that ocean rates from New Orleans to European ports are the same as the rates from Atlantic coast cities. There will be a further saving because the mill feed will be produced close to the cattle of the butter state of the Union. If we can show the millers an approximation to our estimated savings will they grind the flour here instead of at Buffalo? They will. If the farmers of the Northwest can be shown a saving on the cost of exporting their grain will they ship their grain here? They will.

Your commission does not think the Washington avenue terminal adapted to handling the heavy freight we have discussed because of the lack of sufficient space. To illustrate: one coal dock company at Duluth handling one million tons of coal per year has a storage and track space of about 70 acres. Another handling about four hundred thousand tons per year has 2,400 ft. in length of docks 250 ft. wide and contemplates the building of additional dockage, and we all know the amount of space required by a grain elevator.

But this terminal is of very great importance. It is just what will keep the river alive until we can unlock the harbor, and it will always be the terminal for package freight for a large part of the city and is the only passenger terminal we have. It should have strong support. The proposed river barge line company should also be pushed along. This line will be of immense advantage to the city and we think will be very profitable.

The Panama canal has had such an effect on shipping rates that much of our trade territory both to the East and West has been cut off and our trade diverted to other channels. There is no profit in blinking this fact. If we expect to expand it must be to the North and South. The river is the opening way. If the river were open to us it is apparent that we have some advantages over every other city on the river. In Mexico and South America, we have some advantages over Atlantic Coast ports that will put us on equal terms with any of them. We shall be at no disadvantage in relation to trade with China, Japan or the Philippines. We have helped to pay for the Panama canal and it is hurting us. We have the means of making it useful to us, and we think it is up to us to do it. We want manufacturers of all kinds in the city. If we create conditions that will make industries want to come here they will come.

One prime condition is easy access to the markets of the world. The Harbor of Minneapolis removes every impediment to or limitation upon that access. Another and perhaps more important is the vast market opened to us in the whole Empire of the Mississippi Valley.



MAP NO. 2—THE PROPOSED ELEVATED CANAL AND LOCKS

THE DISADVANTAGE OF POOR LIGHTING.

As thousands of our industrial plants are operating to-day with poor lighting and in some cases with extremely bad facilities, it would seem that the importance of the subject of lighting has not been given the serious consideration by those responsible for such conditions.

Poor lighting is one of the most serious handicaps under which a manufacturing establishment can operate. First of all, poor lighting is the cause of a large number of accidents in industrial plants; and it is singular that accident reports do not yet properly classify the hazards of poor lighting, which in many cases is the primary cause of an accident attributed to what is really a secondary cause. Safety engineers and other officials who make accident reports should always consider the condition of the lighting when working up a report of accident causes, for it plays an important part in a great many casualties and is apt to be overlooked. All accidents due to poor lighting are accidents of neglect, and are preventable. The poor lighting accident hazard is clearly chargeable to management and not men. It is a difficult matter to make such progress with Safety First in a plant which has neglected to provide one of the fundamental requirements of accident prevention—good lighting.

Probably no one single factor connected with the equipment of a plant so directly affects the efficiency and inefficiency as the quality and quantity of the lighting. The curtailment of production of all working under the disadvantage of poor lighting represents a big loss each day; the poorer the lighting the less able is the working force to function efficiently. Quality and quantity both suffer, representing a preventable loss wholly removable by improving the lighting.

Under poor lighting condition, we cannot expect and rarely do we find an orderly, clean factory. Darkened places encourage careless habits and workers are often led to deposit discarded articles or material which should be deposited elsewhere. The eyesight of those who attempt to use their eyes continually in insufficient light, below nature's demands, is often affected. Too much light, such as is furnished by bright, unprotected lights, is as harmful as too little illumination; both are fundamentally wrong. Nature's own illuminant, daylight, is unequalled for our requirements of lighting.

The eye is best suited to daylight in the proper quantity. Sun glare should be avoided, and in the darkened hours proper artificial illumination provided. Daylight should be utilized to the fullest extent. It is supplied free in abundant quantity for our use. Modern invention has supplied a means whereby the interior of buildings can be lighted by daylight, and all the advantages secured which is furnished by good lighting at the smallest cost.

Industrial buildings should have as much wall space as possible devoted to windows fitted with Factrolite Glass, which insures the maximum amount of daylight and which prevents the direct rays of the sun from passing through as it properly diffuses the light.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.

220 Fifth Avenue,

St. Louis. New York. Chicago.

No. 2.

Patents and the Engineer

(*Continued from page 37*)

sufficiently disclosed in the wiring diagrams. The inventor may have a modification which he may be entitled to have covered in the same patent, which must also be drawn up. The second step is to prepare a written document which states the objects of the invention, gives a detailed description of the various parts of the invention, the manner of installing them in the circuits, and explains the operation and use of the invention. This document concludes with a number of claims which are merely condensed statements reciting the combinations of elements comprising the applicant's invention. The application is then sent in to the Patent Office in Washington, together with a petition oath and the filing fee of $20.00, where it waits in turn for action by the examiner.

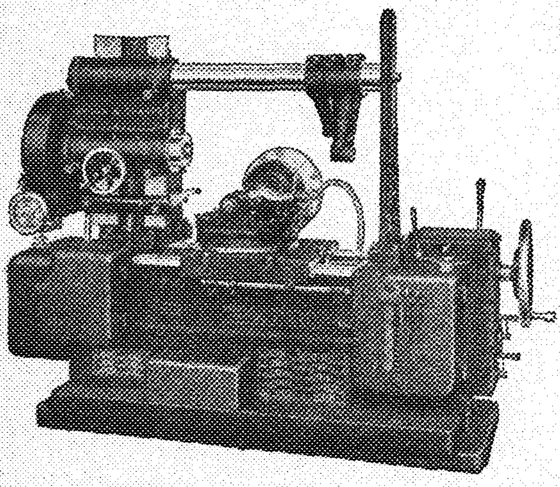
In order that a patent be granted, the invention must be novel, useful and not contrary to public policy, and certain rules must be complied with. When the examiner reaches the application, he makes a careful examination of the Patent Office records and cites such patent as in his opinion anticipate the invention, rejecting all of the claims which read upon them. This information together with any other requirements of the examiner are embodied in an action which is sent to the attorney, who has one year in which to reply to it and to amend the application. Upon receipt of the amendment the examiner again acts upon the case and the attorney has another year in which to amend. This procedure continues until the attorney and the examiner have come to an agreement on the available protection, at which time the application is allowed and the applicant given six months in which to pay a final fee of $20.00 to the government, preparatory to the issue of the letters patent.

Since the claims of the application constitute the protection which the patentee receives and, since the scope of the protection is determined by the breadth of the claims, it is highly important that they be properly drawn. The claims to be allowable must not read upon any existing patent or other disclosure, but must read upon the applicants invention only, and must specifically point out the same. At the same time the claims should cover the invention so that competitors cannot copy the invention in a similar form without infringing the patent. Where the patents cited show inventions which are quite similar to the applicant's device, he is entitled to only such claims as cover his improvements.

It can hence be seen that in the preparation of the application the attorney must not only comprehend the invention, but must understand it thoroughly in order that he can explain and describe it in the application so clearly that even our new technical judges, who may later be called upon to determine the validity of the patent and the infringement of it, can fully comprehend the nature of the invention and the scope of the claims without difficulty.

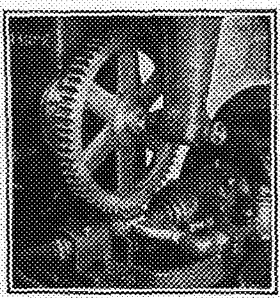
Truly no one without an engineering training can accomplish these results, and certainly not in some of the more specialized arts in which the engineer is so well trained. It would be hardly conceivable in the case of our telephone exchange system of a non-technical attorney, to whom the terms and language of the invention were foreign and who was unfamiliar with the theory and operation of electrical devices, being able to compete with and secure the results obtainable by an electrical engineer with the same ability and experience in patent law.

Engineering was probably the first of the professions in existence and from its inception it has been developing and expanding. New fields of activity are constantly entered, and through various channels engineering finds its way into other professions, till now we find it woven into a profession aiding man in securing the exclusive right to the creations of his mind, his invention. As engineers, we are proud of this achievement and feel grateful that we are given the opportunity to so serve mankind.



The Differential Eliminates Unnecessary Calculation

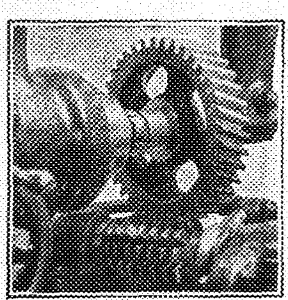
A WINNING feature of the Brown & Sharpe No. 44 Spur and Spiral Gear Hobbing Machine is the differential. With the introduction of this device the selection of change gears, previously a difficult mathematical problem, was greatly simplified. And, the differential is but one of the modern construction features of the No. 44 Machine.



Hobbing a Spur Gear

The Brown & Sharpe No. 34 Spur and No. 44 Spur and Spiral Gear Hobbing Machines are representative of the highest development in machines made for the rapid production of accurate gears.

If you are further interested in the design, operation or production possibilities of these machines, send for "Brown & Sharpe Gear Hobbing Machines," a well illustrated booklet covering both.



Hobbing a Spiral Gear

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

Du Pont chemical engineers insure uniformity of quality by chemical control through every step of manufacture from raw material to finished product.

Why Risk Successful Blasting?

DU PONT blasting accessories are absolutely dependable. They have been developed by explosives experts having had extensive and practical experience in the detonation of explosives. Every stage of their production receives the most rigid inspection thereby insuring dependability and efficiency of performance.

A partial detonation of an explosive charge caused by the use of deficient blasting accessories causes an increase in the final cost of the blasting operation. Complete detonation can be insured by the correct use of du Pont explosives and detonated with the following approved du Pont blasting accessories:

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- Delay Electric Blasting Caps
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- Cap Crimpers
- Tamping Bags

Write for Blasting Accessories Catalog containing descriptions and illustrations of du Pont accessories and practical information about their use.

E. I. DU PONT DE NEMOURS & CO.
Incorporated
Explosives Department
WILMINGTON, DELAWARE

DU PONT

POWDER MAKERS SINCE 1802

Nela Park

(*Continued from page 47*)

and factories. While they have done much in this cause, a great deal remains to be done, for the surface has only been scratched in this education. Experts are agreed that levels of illumination approximating daylight, or at least 1500 foot candles are desirable; yet only in very special cases is the illumination today more than 20 foot candles.

In connection with this educational program which is being carried out, it is interesting to note that the Northern Lamp Division of the National Lamp Works has, at an expense of several thousand dollars, installed a remarkably complete display room at 523 Marquette avenue, Minneapolis. In this display room one can see the principles of good lighting, as worked out at Nela Park, demonstrated at first hand. No matter what your lighting problem is, whether for your home or your office, your factory or your store, a visit to this display room and a talk with those in charge will undoubtedly help you.

It is interesting to know that the illumination classroom at the University of Minnesota contains many of the types shown in this display. Incidentally, a complete description of this classroom was contained in a recent article in "*Light*," a publication of the National Lamp Works. This classroom is the only one of its kind in the United States and has caused favorable comment from various illuminating engineers who have inspected it.

Though a person may not have the opportunity to see the real Nela Park, he can obtain an idea of the applications of the problems worked out in theory to the every-day usage of light in all of its various branches.

The Standardizing Department has done excellent work in cutting costs by the standardization of lamps. There used to be 176 types of bases and now there are 6 which are considered standard, at least in this country. The types of lamps have dwindled from over 1000 to 45 and they hope to cut these 45 down to 5 standard types. The result of this is lower costs of manufacture, hence lower cost to the consumer.

Now we come to the Nela School of lighting directed by L. C. Kent, familiarly known as L. C. by his friends. This school is carrying on intensive lighting courses to educate their salesmen, their jobbers, their agents, and the students of technical schools from whom they plan to procure the men they need to carry on the work of the company, especially of the engineering departments. The courses given to these engineering students is an intensive two weeks study of lighting in its many phases. As the manager puts it, The only requirement is your interest and the only tuition is your time, for all expenses incurred are paid by the company. An enjoyable two weeks is spent by the students, for the management puts forth a great deal of effort to make their stay as pleasant as possible.

One could go on and on telling of the work and accomplishments of Nela Park. The work done here is one of the prime reasons why you can get twenty-one times as much light for your money now as the electric light of 1880 gave. One could tell of the work of the Vacuum Tube Division which manufactures radiotrons for the Radio Corporation of America at Nela Park. One could tell of the law, accounting, treasury, and statistical departments and numerous other divisions of work. But to really appreciate this institution one must visit it. He will receive a cordial welcome there, and every effort will be made to make his stay a pleasant one at Nela Park—University of Light.

Six Weeks at Cass Lake

(Continued from page 46)

his pants, the side the sun sets on. Ruth was substituted for Bunnell and filled the place to perfection. The final score of 12-7 in their favor was far from satisfactory to us. Tommy Comfort and George Platzer wanted to challenge Ames to a bridge tournament to see if they couldn't square things, but the game never materialized, although they did put in a lot of time running signals and getting into condition.

The camp location is well within the boundary of a U. S. forestry reserve tract which is also a game reserve. This reserve feature, however, did not deter in the least the administration of quick justice on a number of extremely curious skunks in the vicinity that insisted on prowling about the mess tent at night. Cook Erickson supervised the building of a trap for them that worked to perfection: A barrel was arranged with a tilting cover, baited with a generous piece of bacon, sunk in the ground to half its depth near the cook's tent, and filled about two-thirds full of water. The skunks walked up an incline to the top and on tackling the bacon were dumped immediately into the water which very effectively drowned both skunk and odor. The first night, three skunks walked the plank, as it were, and we were not bothered for a while. Later, one or two more grew bold enough to prowl in the day time around a garbage pit off in the brush. Fred Ruth immediately got his 45, took deliberate, deadly aim and fired, but for some unknown reason the bullet went crooked and Fred only hit the box where the animal had been. On another occasion Robinson, bent on annihilation, got within ten feet of a skunk, aimed his shotgun and blazed away. He came close, so close in fact, that the skunk was tumbled over by the force of the explosion. A second shot fired from a greater distance finished the job.

One Friday night, somebody worked up interest in a pajama parade. The bunch pulling on pajamas over their clothes, went to town. There they saw a movie free, sang songs, did a Gesundheit snake dance through the hotel and were royally entertained by the town people. Cal, the candy man, passed out nickel plated cigars while the town people on the streets enjoyed a hearty laugh at the camp cut-ups.

At the beginning, six weeks looked like an awful long while, but when the time was up, things seemed different. Somehow we wanted to stay; we were comfortable, happy and satisfied; camp was our home and we hated to leave it. Luckily the last few days were dry weather so we did not have to wait for canvas to dry before we could pack. The grounds were policed, rubbish burned, tents rolled and personal goods packed. With each truck load of goods that went to town a group of men left.

One by one the cars pulled out, until just enough men were left to load the last truck which reached town about noon. To those riding atop the load on this last truck, the road seemed a great ribbon pulling itself from under the wheels and receding rapidly into the distance, a long, long trail and winding. The forest on each side appeared to close behind, a great curtain drawn swiftly on that which had been real but a short while before, but which was now only a memory.

Back at the beach, the giant Norways stood like the pillars of a cathedral nave. Awing silence was everywhere. In town the business-man and loiterer paused a moment to watch the truck pull through to the depot and then went on their way.

Another Civil Camp had passed into history.

An Experimental Pavement

(Continued from page 41)

TABLE NO. 7

Grading of aggregate used in base

Size	*Per Cent*		*Requirements*
Pass 2 in. Ret. 1½ in.	3.5		5—25%
Pass 1.25 in Ret. 1 in.	6.3	25.1	25—40%
Pass 1 in. Ret. ¾ in.	18.8		
Pass .75 in. Ret. ½ in.	15.6	28.5	10—20%
Pass .50 in. Ret. ¼ in.	12.9		
Pass .25 in. Ret. No. 10	11.3		5—10%
Pass No. 10 Ret. No. 20	1.8	8.1	15—30%
Pass No. 20 Ret. No. 40	3.0		
Pass No. 40 Ret. No. 50	3.3		
Pass No. 50 Ret No. 80	6.1	23.5	5—10%
Pass No. 80 Ret. No. 100	4.5		
Pass No. 100 Ret. No. 200	6.4		
Pass No. 200	6.5		
Total	100.0		
Per cent Bitumen	4.7		
Penetration of Asphalt	50		

is only one other black base in the state. The asphaltic concrete base is 5.5 in. thick on which is constructed a sheet asphalt surface 1.5 in. thick. The contractor ran short of rock, however, so that between stations 13+58.7 and 13+88.7 the base is 5 in. thick and the surface 2 in. Table No. 7 shows composition of base course.

Trap rock, local sand, limestone dust, and oil asphalt were used in the mixture. Seventy pounds of the limestone dust were used in a batch totaling 1,495 lbs. The asphalt used in both base and surface mixture tested as follows:

TABLE NO. 8

Specific Gravity at 25°C	1.0264—1.0393
Penetration at 25°C 100 g. 5 sec.	50
Solubility in Carbon Disulphide (CS_2)	99.69—99.80
Bitumen Soluble in Carbon Tetrachloride ($C Cl_4$)	99.50—99.62
Ductility at 25°C	100
Flash Point	300—308°C
Loss at 163°C, 5 hrs.	0.20—.58%
Penetration of residue at 25°C 100 g. 5 sec.	48

The asphaltic concrete mixture was mixed in St. Paul and hauled by trucks, the temperature of the mix was 290° F. when dumped on the street. The usual practice in laying asphalt pavement mixtures was observed, the entire load being shoveled and raked into place. The base was laid to full thickness in one course. It was given an initial compaction with a 10-ton tandem roller and final compaction with a 15-ton three wheel roller. The sheet asphalt surface course was laid the day after the completion of the base course.

Table No. 9 shows composition of surface course.

TABLE NO. 9

Grading of aggregate used in sheet asphalt.

Size.	*Mix No. 1*	*Mix No. 2*	*Mix No. 3*
Pass. No. 10 Ret. No. 20	4.9	4.3	5.0
Pass. No 20 Ret. No. 40	9.9	10.2	9.3
Pass. No. 40 Ret. No. 50	10.8	11.9	11.8
Pass. No. 50 Ret. No. 80	19.7	20.4	27.8
Pass. No. 80 Ret. No. 100	14.4	15.0	15.7
Pass. No. 100 Ret. No. 200	20.5	20.9	14.0
Pass. No. 200	19.8	17.3	16.4
Total	100.0	100.0	100.0
Per cent Bitumen	11.0	10.5	10.45
Penetration of asphalt			53

Mix No. 1 used between Sta. 14+20.9 and Sta. 14+46.7.

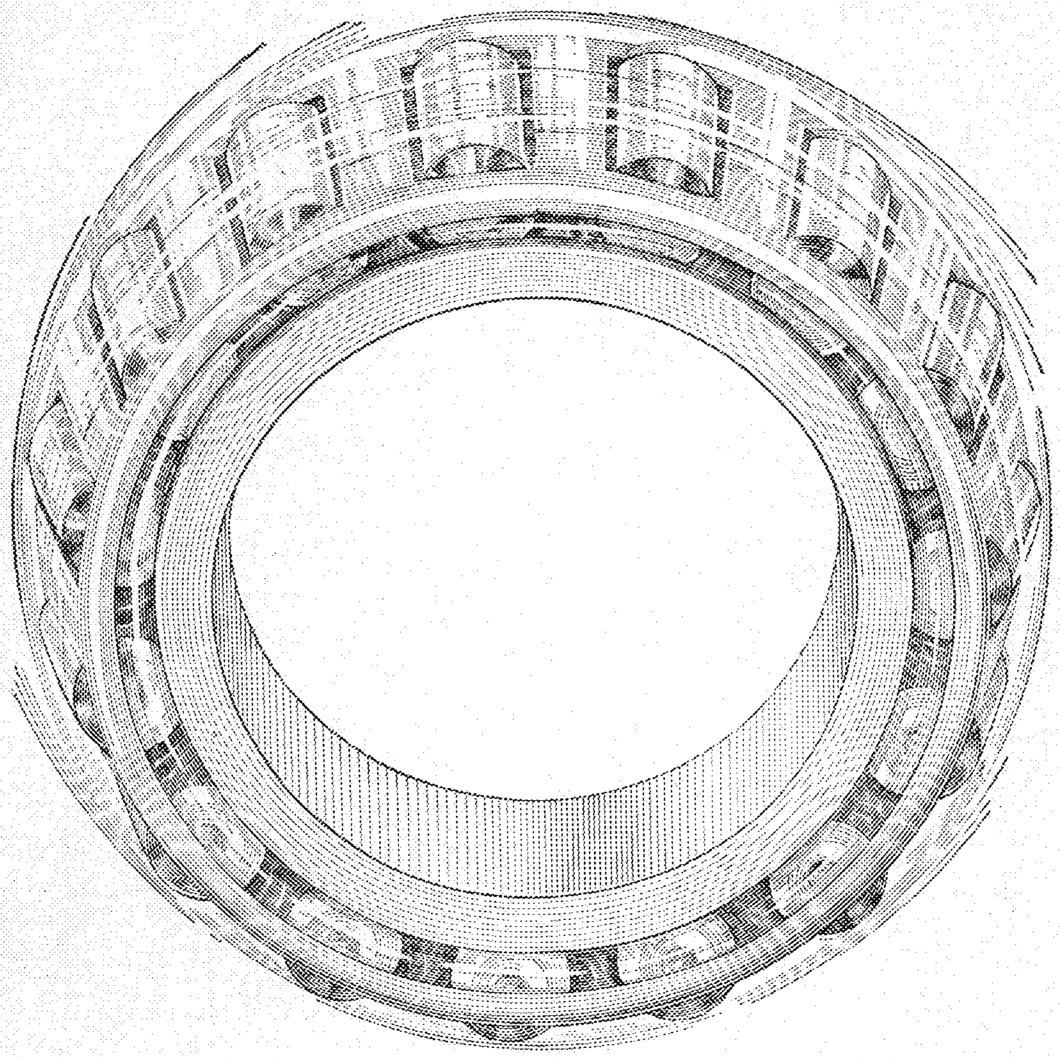
Mix No. 2 used between Sta. 14+46.7 and Sta. 15+31.7.

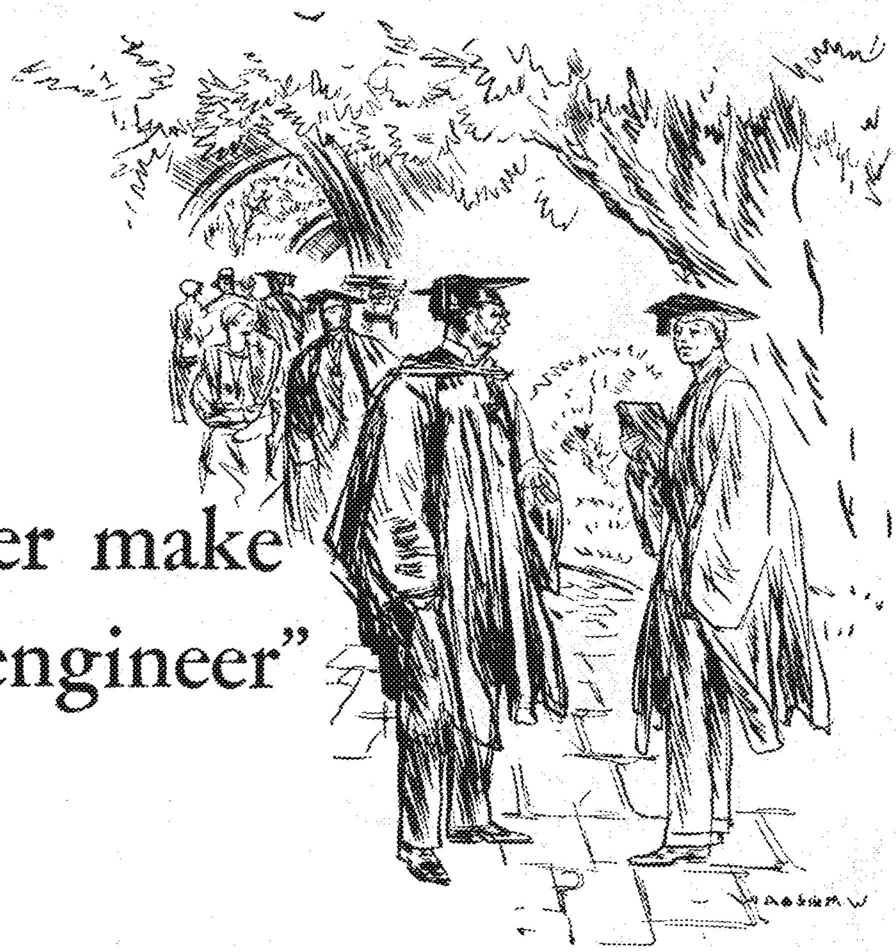
Mix No. 3 used between St. 15+31.7 and Sta. 15+.97.1.

13+58.7 and Sta. 14+20.9.

The sheet asphalt surface was laid at a temperature of 300° F.

The pavement has been laid for such a short time that no definite conclusions are as yet possible.





"You'll never make an electrical engineer"

The question is asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents? Or are they forced into narrow grooves?

This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came to Westinghouse within the last ten years, immediately after graduation.

Carl Taylor

SO a blond young man named Taylor, just graduating in electrical engineering at the University of North Carolina, was advised by a conscientious professor. The professor's conviction was based on quiz papers and was amply justified. But the young man was not discouraged; he had other hopes, he said. Today—ten years later—he occupies a peculiarly important position with the Westinghouse Company.

Before Carl Taylor had completed his apprenticeship with Westinghouse he began to sell apparatus to utility-customers. He had previously sold clothing in college. He had selected an electrical engineering course because he believed the industry promising for men of selling interests.

His first actual order—the electrification of a scrap yard—was awarded to him at a higher price than that asked by any other bidder because he had "lived with" the job and given all the service this implies.

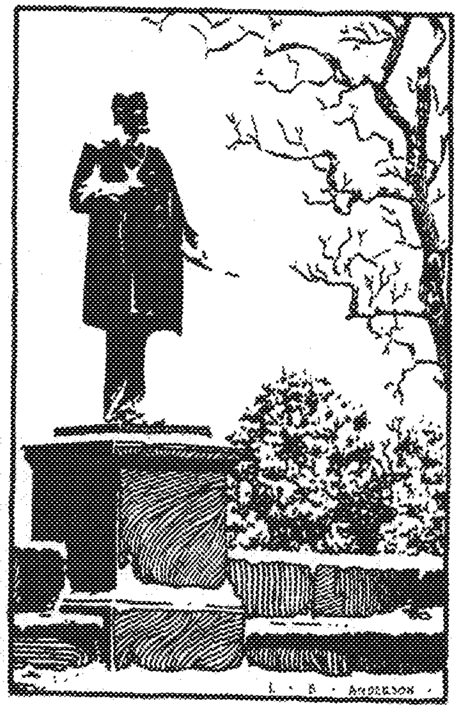
Some months later the Company was surprised at a request from him for an indefinite leave of absence. He wanted to take a job with a manufacturer of steel mill machinery, in order better to understand the problems of such users of electrical equipment. His leave lasted two years. He returned from the superintendency of a well-known plant—returned at a lower salary than the superintendency had paid him. But within three years he was manager of the industrial division of the Pittsburgh Sales Office—the largest division of the Westinghouse Company in the entire country. Today he has a sales organization of sixty-five men.

To get the customer's point of view—to go the limit to anticipate his wants and keep him satisfied—this is the Westinghouse sales policy. It is the policy of all enlightened industrial organizations. Men who can exemplify it in their personal careers need have no question about their futures.

Westinghouse

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges
of the University of Minnesota



DECEMBER
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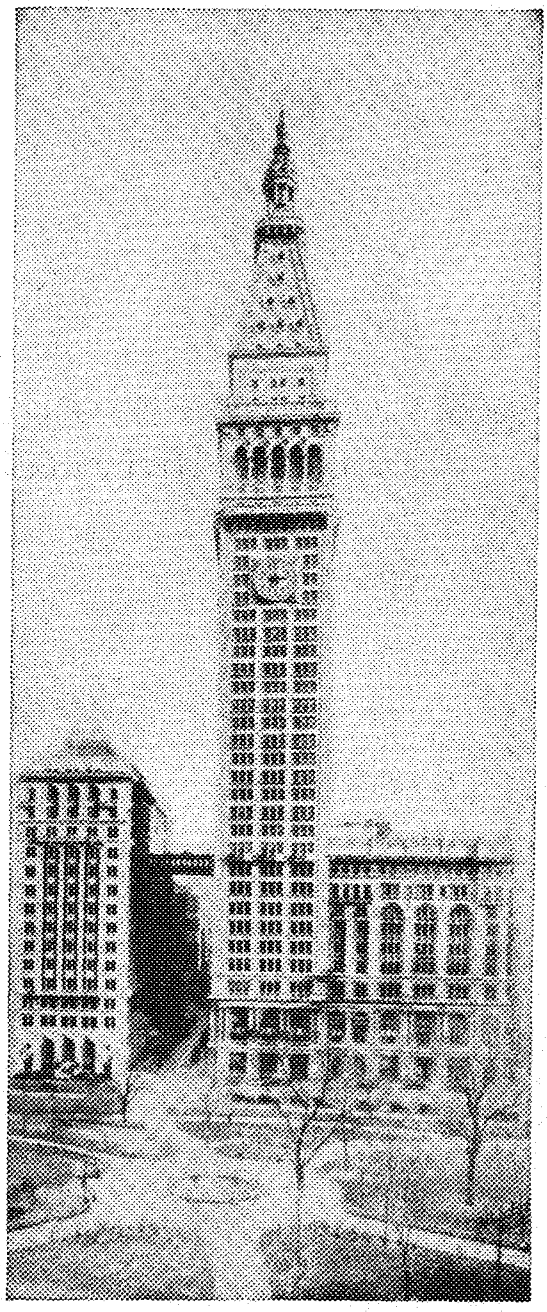
VOL. VI. MINNEAPOLIS, MINN. NO. 3.

Member Engineering College Magazines Associated

He Preferred The Ride



BERNARD was every inch a Swiss, from his knowledge of cuckoo clocks to his skill as a yodeler. So on his first visit to New York, his cousins watched with some amusement his amazed delight as the Otis Elevator whisked them to the top of one of the highest buildings. They looked forward to witnessing his thrill as he stepped out on the balcony which overlooked the vast panorama of lower New York.

To their disappointment he seemed to lose interest as soon as they left the elevator.

"Look down", they said to him, "You've never seen anything like this in Switzerland!"

Bernard shrugged his shoulders.

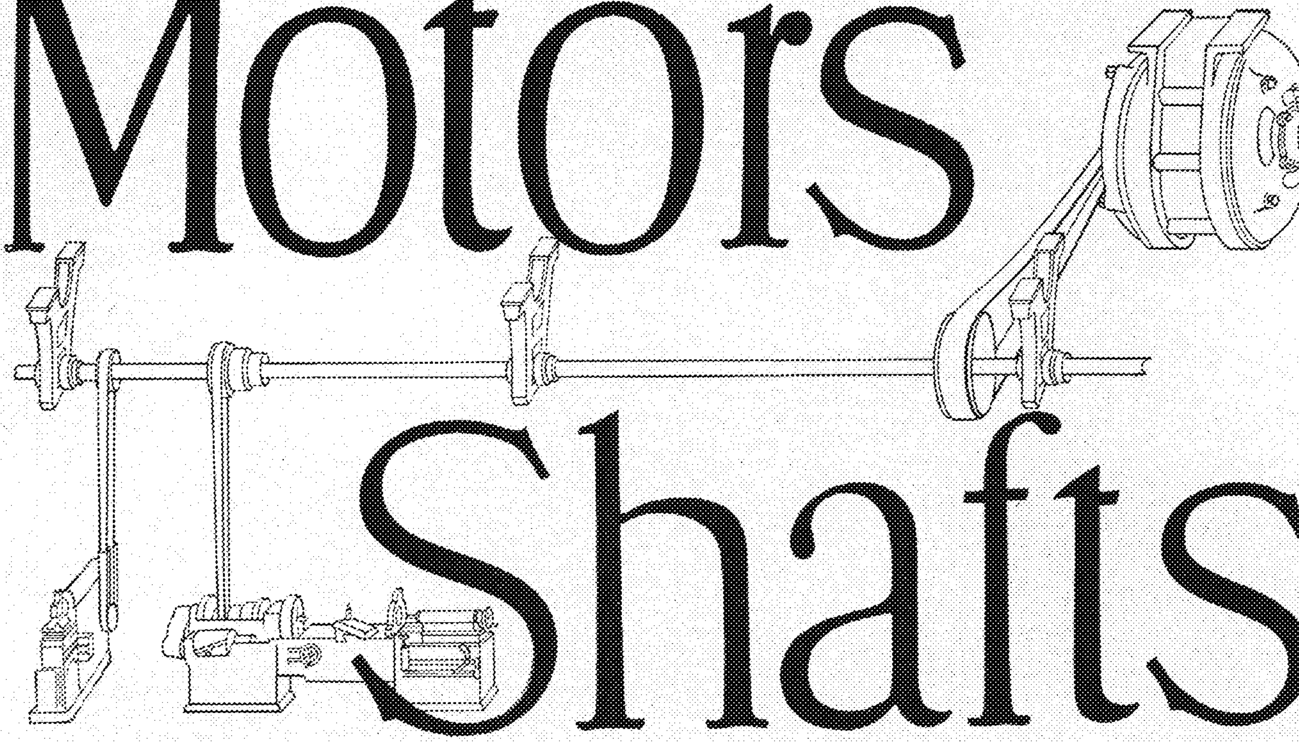
"This is all very well, but my own mountains are much higher. If you don't mind, I'll spend my afternoon going up and down in those elevators. It is not the height of these buildings which I find impressive; it is the fact that we don't have to climb to the top of them!"

THE METROPOLITAN BUILDING, New York, is one of the earlier tall buildings, but its dignity and pleasing lines make it a favorite, and it is hard to realize that the top of the tower is some six hundred feet above the sidewalk. In the tower portion of the building there are six (6) Otis Gearless Traction Machines, running at 600 Feet per Minute. In the main part of the building, the old high pressure hydraulic elevators are being replaced by twenty-nine (29) Otis Gearless Traction Micro Drive Elevators of the latest type.

OTIS ELEVATOR COMPANY

Offices in all Principal Cities of the World

Motors



Shafts

Machines

Power is applied with Timken Tapered Roller Bearings in electric motors. Power is carried on Timken Bearings in shaft hangers and pillow blocks. Power is at work in Timken-equipped machinery of every sort.

Along the whole path of production Industry is economizing with Timken Bearings. They remove the drain of excess friction. Starting and running load is less. Lubrication becomes a petty item. Output is increased and improved.

Basic charges also shrink. Lighter power units and lighter belts are possible. Depreciation is halted by the faultlessly preserved position of Timken-mounted shafts, gears, and pulleys. Replacement is postponed by the extreme endurance of special Timken Bearing steel.

Throughout industry Timkens are used more and more extensively—for economical prime power, for economical power transmission, for employing power economically in every type of mechanical equipment.

Entering so largely into modern engineering, Timken Bearings are of interest to you. The very worth-while Timken story, in an attractive stiff-bound book, is yours for the asking.

THE TIMKEN ROLLER BEARING CO., *CANTON, OHIO*

TIMKEN *Tapered Roller* **BEARINGS**

The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

VOLUME VI. MINNEAPOLIS, MINN., DECEMBER, 1925 NUMBER 3

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Volume VI DECEMBER 1925 Number 3

Regulation of Radio Broadcasting

Allocation of wave-lengths, restriction of licenses, copyright questions, highlights of Fourth Annual Radio Telephone Conference held at Washington, D. C.

An Interview with
PROFESSOR C. M. JANSKY
Assistant Professor of Radio Engineering,
University of Minnesota.

ONE of the most important engineering and commercial developments of the past six years has been radio broadcasting. The problem of regulation of this industry has caused the United States Department of Commerce to call a radio telephone conference each year since 1922. The University of Minnesota has been represented at each one of these meetings by Prof. C. M. Jansky, assistant professor of radio engineering, and the Northwest has been fortunate in having thus been represented.

Prof. Jansky came to the University in January, 1920, and has had charge of the radio work of the Electrical Engineering Department since that time. Incidentally, the first broadcasting station in the Northwest was operated by the Department of Electrical Engineering of the University of Minnesota.

It was quite natural that in search for information concerning what went on at Washington, D. C., at the Fourth Annual Radio Telephone Conference that the editor should interview Prof. Jansky for the interest of the readers of this magazine.

"This year's conference was the fourth one that I have attended," Mr. Jansky said. "The total attendance at the first one was only fifteen and we got along very nicely in a small office room adjacent to Secretary Hoover's office. But at the fourth conference, there were over 450 persons and it was necessary to use most of the auditoriums and rooms of the new National Chamber of Commerce building in order to accommodate the committees. This may be cited as one of the side-lights of the growth of radio's popularity."

Men were there from all parts of the country, representing every important broadcasting station in the United States and every other branch of the industry. Manufacturers such as Powell Crosley, A. Atwater Kent, A. H. Grebe, David Sarnoff and others were present. Publishers were represented by such men as Henry M. Nealy of "Radio in the Home," Laurence Cockaday and Arthur Lynch of the "Radio Broadcast" and K. B. Warner of "QST." Newspapers publishing radio sections, such as the Chicago Tribune, the Baltimore Sun, and the Detroit News had their men there. Amateurs were represented by Hiram Percy Maxim, president of the American Radio Relay League and by K. B. Warner, its secretary. J. H. Dellinger, chief of the radio laboratory of the Bureau of Standards, was the chairman of the committee on the allocation of wave-lengths. Other delegates from the immediate Northwest were Mr. Henry A. Bellows, director of the Gold Medal station WCCO of this city, and Foster Hannaford, representing the Northwest Radio Trades Association.

"In general, the conference considered two distinct types of problems. The first of these were those attendant to the regulation of radio by national government, the other, those problems which must be settled by the industry itself and concerning which, the government has no primary interest. The broadcasting of copyright music, a question of greatest importance, and the use of stations for advertising purposes, are illustrations of problems which must be solved by the industry itself."

"Nine representative committees had previously been appointed and most of the detail work was done by these committees. The question of power limitation was the salient point of discussion at the meeting last year. This year it was not considered as it is now a generally accepted fact that stations with power in put up to five kilowatts do not hinder service nor increase interference.

"The biggest problem which confronted us this year was how to meet the excessive demand for broadcasting licenses. Only a certain range of wave-lengths is available for broadcasting, 200 to 545 meters, and the number of stations in operation at the present time far exceed the number of wave band available. Of course, since the number of bands cannot be increased, some means must be found to limit the number of stations. At the present time, the Department of Commerce does not have the legal authority to refuse an applicant's license. The council was of the opinion that not only should licenses be refused all applicants for the present, but also that the present number of stations be reduced.

"In spite of the fact that Secretary Hoover felt that the responsibility of deciding who should broadcast and who should not was too great to be placed on the shoulders of any one man, the conference recommendations asked that this authority and responsibility be vested in the Secretary of Commerce."

"Who were the subcommittees?" I asked.

"There were nine in all," Prof. Jansky replied. "Each one had its chairman and secretary and held its sessions separately. The details of the main issues were subdivided for each one of the committees and the final action was contingent upon their decisions. The first one was on the allocation of wave-lengths and was headed by Dr. J. H. Dellinger. This committee decided that the broadcasting band should not be changed. I might add, that should even a comparatively slight change be made in the limits of this band, millions of receiving sets in the country would be rendered obsolete. Several changes and revisions were made relative to the higher wave bands but these are not of importance to the average listener. Certain wave-bands below 150 meters have previously been alloted to the amateur for experimental purposes and also for beam transmission. This allocation was not changed."

Committee two wrestled with the problems of advertising. It had as its chief, Commissioner D. B. Carson, head of the Bureau of Navigation of the Department of Commerce. Some of the reports which Prof. Jansky showed me next, stated that the resolutions of this committee showed that the best interest

(*Continued on page 86*)

Our Lake and Stream Levels

Subnormal rainfall, drainage, and geologic processes factors causing lowering of Minnesota's 10,000 lakes; new legislation fixing levels needed

By E. V. Willard, Ex. '05

State Commissioner, Drainage and Waters, State of Minnesota.

WATER is the basic element required to sustain all forms of animal and plant life and is the one element, more than any other, the presence or absence of which measures human progress. The hunter, trapper and prospector, traveling through unexplored regions, concerns himself first of all with how and where he may keep in touch with water. The pioneer made his camp and later built his home on the banks of some stream or lake because he knew that he and his stock could not subsist a single week without water. Agriculture prospers or suffers almost directly with sufficient or deficient rainfall. Water is the life blood of industry. Large cities are limited in their power to expand and prosper by their ability to furnish a dependable supply of sanitary water for human consumption as well as for the treatment and disposal of sewage and other wastes. Its presence and abundance in our state and the ease with which we are supplied with it, makes a subject of its intelligent conservation and use one seldom thought of by the average citizen. It is only when its supply is threatened or curtailed in some manner that its value is impressed on us. "We never miss the water 'til the well runs dry."

Public attention has probably never before been so keenly focused on the subject of the waters of the state and their value as a real and vital natural resource as right now. Several years of abnormal low rain and snow fall have brought about record low stages in our lakes and streams. With the flow of water in our streams continually growing less, coupled with increased demands from urban centers for water supply, industrial requirements and sewage disposal, discussions of the subject are no longer confined to the laboratories of the city chemist and sanitary engineer, but has become a daily topic in the public press and upon the streets.

It is with reference to the lakes of Minnesota that this article is to deal. The North Star state has become famous as the "State of Ten Thousand Lakes." Not so many years ago a reference to our lakes as a thing of value and beauty which had in it the possibilities of being "sold" to the pleasure and recreation seeking public as a real and commercial product, was looked upon by a great many of our practical minded people as just another one of the many sentimental fads with which we are afflicted. The fame of Minnesota as a public playground, however, has spread so rapidly in recent years that no longer does the value of her lakes, forests and streams need a defense even from purely commercial considerations. The state is already known nationally and internationally as a mecca for the pleasure and recreation seeking tourist in search of rest and a contact with the out-of-doors, and the business which has been built up around tourist trade has become a factor of real economic significance. It is, therefore, only natural that grave concern should be felt over the present low stages of our lakes.

What causes the present low stage? Will normal stages again return or is this the beginning of the end of our treasured lakes? What, if anything, can be done to conserve them for the future? These are questions which are being asked on every hand. I shall discuss briefly these questions in the order given:

What causes the present low water stages in our lakes and streams?

The agencies which act to destroy lakes and lower the stages of water in streams may be classified under the following heads:

1. Geologic processes which have gone on through the ages, and which continue at present, and which are not influenced perceptibly by the operations of man.

2. Abnormally low precipitation.

3. Cultivation of the drainage areas from which run-off waters are supplied, thus making available larger volumes of soil to be carried into and deposited as sediment in lakes and streams.

4. Substitution of cultural crops for nature's vegetal covering, which crops use a greater volume of water for their growth and development and to this extent reduce the volume of natural run-off.

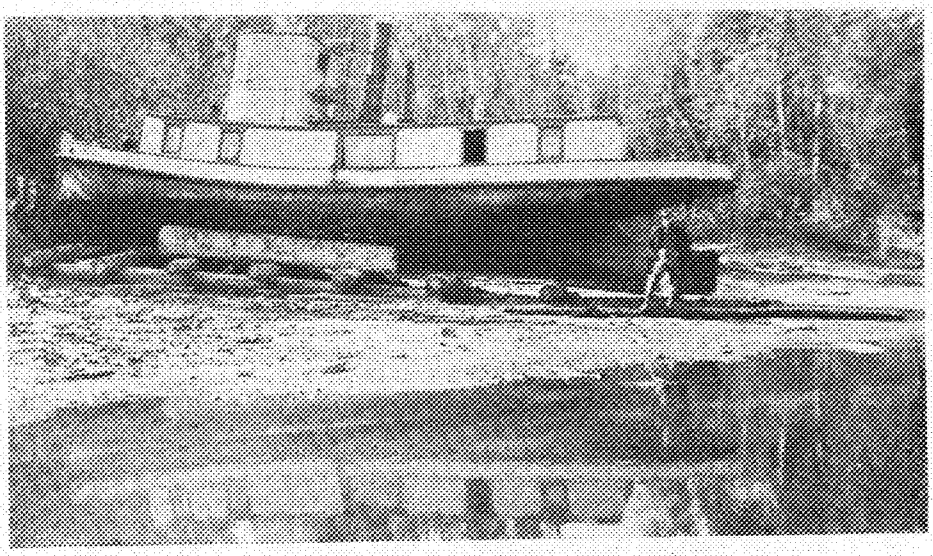
5. Draining or lowering of lakes, directly or indirectly, by the construction of artificial drainage systems.

6. Diversion by man-made structures such as drainage and road ditches, storm-sewers, wells of all descriptions and the like, of a substantial portion of the run-off waters from their natural courses.

7. Growth of aquatic vegetation in lake beds during abnormally low stages and the lowering of the outlets by erosion.

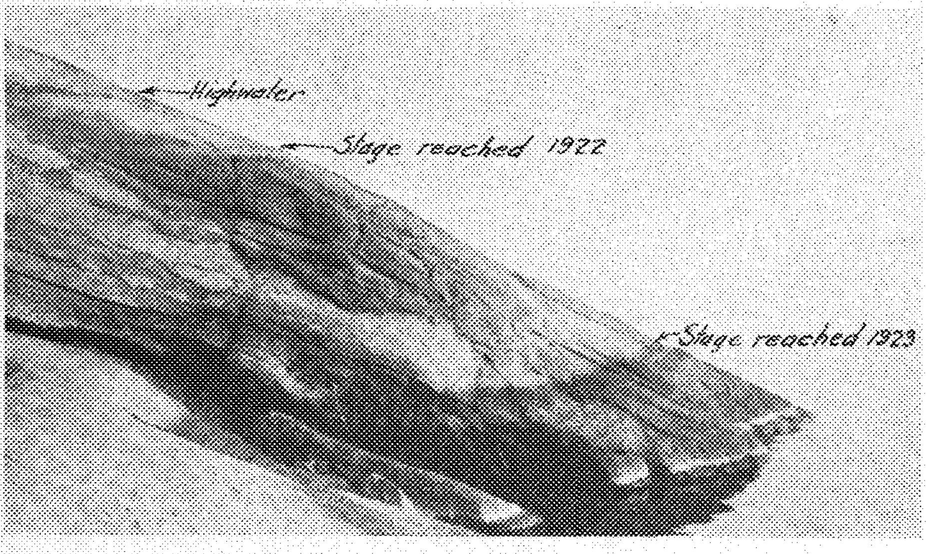
Geologic Processes. From the very time of its formation a lake is destined to disappear. Recorded history is not old enough to enable scientists to have observed the formation and subsequent developments and disappearance, from so-called natural causes, of any single lake of considerable size. But by studying the various past stages of development as they are disclosed by geologic formations, a fairly good idea of the course they have run may be obtained and on which conjectures as to future developments may be promised.

A study of the state's geology indicates conclusively that our present lakes are but small remnants of large areas of water which was held by and left behind the huge glaciers which covered a large part of the state in pre-historic times. Lake Agassiz, so geologists tell us, covered all of Red Lake, Pennington, Marshall, Kittson and Roseau counties and portions of 12 other counties



STRANDED HIGH AND DRY

This boat, drawing six ft. of water, was placed in position under its own power on September 20, 1922. Since then the waters receded leaving it as shown. Photo was taken on November 5, 1923.



EXTREME FLUCTUATION OF LAKE LEVEL
Graphic portrayal of the rapidly decreasing stage of a typical Minnesota lake. The total difference in this case amounts to approximately 13 ft.

adjoining this area, and is estimated to have had a depth, at Fargo, of about 200 ft. and at the present mouth of the Red Lake into Lake Winnipeg of about 650 ft.* The Red Lakes, Lake of the Woods and other scattering lakes found at present throughout this area are all that remain of this huge inland sea. Ancient Glacial Lake Aitkin, once 50 miles in length north and south and 10 to 25 miles wide and covering the greater part of Aitkin county north of the Northern Pacific Railway Company's tracks, has all but disappeared. Only what remains of the ancient beaches and a few small lakes mark what was in the far distant past, Lake Upham, which occupied the St. Louis River basin. Lake Duluth, we are told, once occupied the entire drainage basin of Lake Superior and its surface was 500 ft. above the present level of the lake. Some of the agencies which acted to reduce and destroy these large pre-historic inland seas before man entered on the scene to observe and record events, we know, are not now operating to destroy our present lakes. Others, such as the natural erosion of the outlets and the filling in of the lakes by sediment and by growing weeds still continue to lower them and decrease their capacities.

Effects of Abnormally Low Precipitation. So far as it is possible to draw conclusions from available precipitation records, the effects on lake and stream stages from the vagaries of rain and snow fall appear to have been only temporary in character. High and low stages have alternated with one another as periods of heavy and light precipitation have prevailed, over the entire period of which climalotogical records are available. We have no information which points conclusively to a measureable cumulative increase or decrease in precipitation within this state. So that while present conditions are disconcerting to the average layman, the student of past records receives the consolation that similar periods of drought have prevailed before and normal conditions have again returned. This subject will be referred to again later on in this article.

Effects of Human Activities. The lowering and diminishing effects which result from the cultivation of the soil, substitution of cultural crops for nature's plants and forests, drainage and diversion of run-off waters from their natural courses, enumerated in the preceding classification, are the direct results of human activity and progress. The operations which cause these effects are deliberately planned and executed and are classed as developments to increase the material prosperity and add to the comforts of the people. As man's skill and resourcefulness have developed, more demands have been made upon nature to give of the things of immediate material value. Just when man's ingenuity to convert nature's forces and resources to meet the increasing and complicated demands of civilization ceases to be wisdom, or at what point further development of such resources ceases to add to the sum total of human needs and comforts, will always remain a source of controversy with ever changing viewpoints. The cultivation of the soil for the raising of crops; the use of forests for its lumber and other finished products; the construction of roads and drainage systems and the development of industries and cities and their needs are all an essential part of our boasted civilization and to the extent that natural stages of lakes and streams must suffer as the result of a scientific and intelligent pursuit of such developments, such conditions, regrettable as they are, will have to be accepted as a matter of course. The day is passed, however, when the value of a stream is measured in terms of its capacity to dilute and carry sewage and other wastes or of a lake by the value of its bed for the raising of crops or for city lots. The value of both as a source of recreation has taken on a new meaning which must be reckoned with and properly evaluated by those who plan the development of rural and urban communities and their needs and every effort within economic reach should be exerted to preserve our waters undiminished and unpolluted, as nearly as may be, for our own and future enjoyment. In other words, while all of these development problems must of necessity be met and solved, and while immediate needs may appear to justify their rapid promotion, their treatment and solution should be tempered by a proper appreciation of their effects on

(*Continued on page 92*)

A SPILLWAY IN PROCESS OF CONSTRUCTION
This miniature dam is being built to save water where there is none. In the event of a rainy season, it will serve to maintain the stage of the lake. View is taken from bed of lake towards outlet.

*"Story of the North Star State" by D. E. Willard.

With an Engineer in the Army

Activities of the Corps of Engineers in civil and military duties throughout the country offer varied and desirable opportunities

By Walter D. Luplow, C '17
Captain, Corps of Engineers Headquarters, The Engineer School, Fort Humphreys, Virginia

EDITOR'S NOTE:—This is the second of a series concerning the opportunities for a technical graduate in the various lines of endeavor. The next will appear in an early issue of the Techno-Log.

OPPORTUNITIES in any line of human endeavor may be of so many kinds that the writer proposes at the beginning of this article to eliminate some from consideration. By so doing, the time of some readers may not be lost in that they need not seek further for what is not here.

In the first place, to those who would accumulate much of this world's goods I would say, "Read no further." Secondly, those who are not full of a certain spirit of adventure or, perhaps, of wanderlust, but who would prefer to round out their existence in one chosen spot will have no interest in my dissertation. Finally, this is above all else not written for the attention of the few who can not take pride in the service of their country. I do not mean here those who are labeled pacifists—seekers of peace. The writer knows of no class of people who abhor war more or hope for continued peaceful relations with other countries more zealously than those in the armed forces of the country. I mean those among our citizens who are lukewarm if not openly hostile to the welfare of this nation, to the continuance of its institutions and authority.

To all others who are casting about in search of a life work this should be of interest.

There are positions in the Army which require the service of technically trained men. Yes, many of them. They exist in practically all branches of the service. When I make that statement I do not refer to those positions ordinarily filled by technically trained civilian employees of the War Department. The Signal Corps offers a wide field for electrical engineers who are interested in communications. I believe I am correct in saying that Mr. David Grimes, whose magnificent success in the radio industry is known to all those who claim the same Alma Mater, owes something to his war time experience in the Signal Corps.

The Ordnance Department of the Army has the tremendous responsibility of seeing that our troops are equipped in peace and war with weapons and instruments of destruction equal in effectiveness to any possessed by nations which are potential enemies. New developments must be constantly sought for, otherwise we will be seriously handicapped in any future conflict. Pioneer work along this line or the production end of this game offers a field of usefulness to mechanical or electrical engineers.

The Chemical Warfare Service, a development of the World War, offers opportunities for service to chemical engineers and chemists. Much of the work of this branch at present is in the interest of promotion of the chemical industry in this country and in fostering the use of chemicals for the good of mankind. The discovery of lethal gases, a thousand times more powerful than any known heretofore, is incidental. It does not constitute the main mission of this group.

There are also positions in other branches such as the Coast Artillery Corps which call for high technical knowledge. But I shall dismiss these all with the brief mention made above and proceed to a part of the subject upon which I can write at greater length and with more authority by virtue of closer acquaintance. I refer to service in the Corps of Engineers.

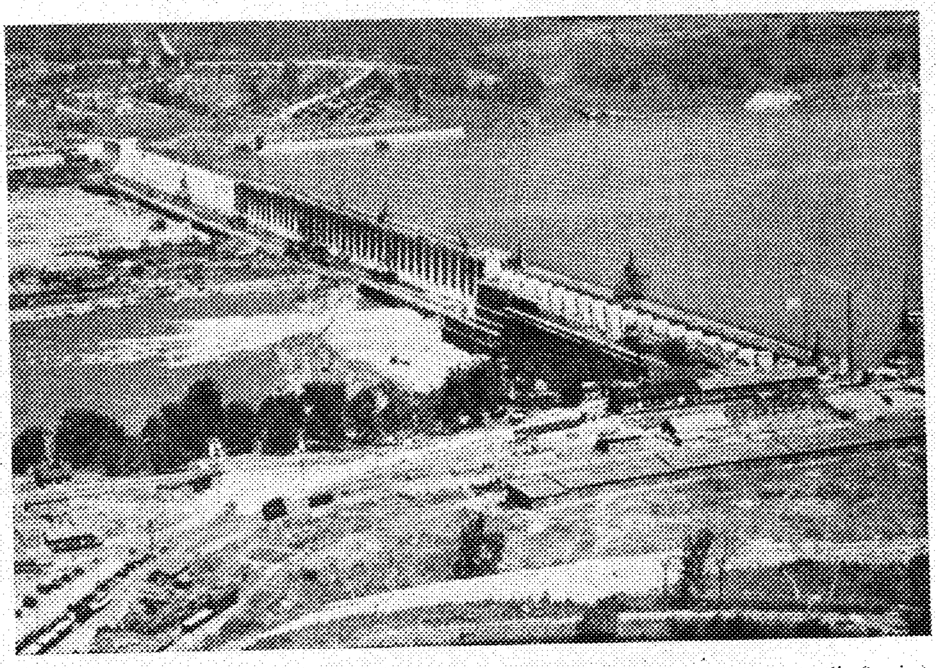
The Corps of Engineers was founded during the period of the Revolutionary War. An Act of Congress in 1802 established the organization as it now exists. Since that date, the Corps has been continuously in service. Engineer troops in the Army were employed soon after the Corps was founded but the oldest organization now in our service, Company A, First Engineers, dates from 1846.

During its more than a century of existence the Corps has carried on its military and civil duties in a manner to earn the high regard of those familiar with its history. Perhaps its greatest achievement was the construction of the Panama Canal. I might dwell at great length on the various important projects successfully completed under the supervision of officers of the Corps in the past, but a lengthy history has no place in this article written for those who are looking to the future. A brief but complete history of the Corps, written by Lt. Col. H. C. Jewett, C. E., may be found in the last two numbers of "The Military Engineer" for 1922.

The present duties of the Corps may be divided into two general classes, military and civil. Frequently an officer is so situated that he will be detailed on both classes of duty at the same time but there is a rather sharp line of demarcation dividing these two classes.

It may be well to interpose here a description of the organization of the Corps of Engineers. It consists now of about 500 officers on the active list and troops numbering between 4,000 and 5,000. The Chief of Engineers, a major general, with offices in Washington, D. C., commands the Corps and directs the activities of the Engineer Department. This latter organization takes care of the civil functions of the Corps. The

(Continued on page 88)



(Courtesy United States Army Air Service)

WILSON DAM AT MUSCLE SHOALS, ON THE TENNESSEE RIVER

The greatest engineering and power project of the age, designed and built entirely by the Corps of Engineers and its officers. View is taken from above south bank of river.

Ceramic Engineering

As one of the oldest arts, the technology of the silicate or non-metallic industries is an important factor in nation's development

PROF. A. F. GREAVES-WALKER
Professor and head of department of Ceramic Engineering, North Carolina State College, Raleigh, N. C.

ALTHOUGH the first department of ceramic engineering was established at Ohio State University 30 years ago, the term "Ceramic Engineering" and what it refers to, is still little understood, even in the engineering colleges. The word "Ceramic" or "Keramic" is generally accepted as referring to pottery, usually art pottery, and in Europe this is the case. In the United States and Canada, however, the word has been given a much broader meaning, and refers to the products of the silicate or non-metallic industries. Ceramic engineering deals, therefore, with the technology of these industries.

The Ceramic industries may be divided into 12 main divisions, each one of which may again be divided into a number of subdivisions, representing industries devoted to the manufacture of ceramic products. These divisions and their subdivisions follow:

CERAMIC RAW MATERIALS

Ball clays, china clays, kaolins, sagger and wad clays, fledspar, cornwall stone, limestone, flint, fire clay, glass sand, and talc.

WHITE WARES

Domestic china, hotel china, porcelain, floor tile, wall tile, electrical insulators, art pottery, refrigerator linings, porcelain sanitary ware, spark plugs, chemical ware, and artificial teeth.

STRUCTURAL CLAY PRODUCTS

Common brick, face brick, enameled brick, hollow tile, drain tile, sewer pipe, electrical conduit, paving brick, terra cotta (decorative), wall coping, and flue lining.

VITRIFIED WARE (*not white bodied*)

Sanitary ware, stoneware crocks and jugs, chemical stone ware and art pottery.

YELLOW WARE

Kitchen utensils and art pottery.

REFRACTORIES

Fire brick, silica brick, diaspore brick, chrome brick, magnesite brick, bauxite brick, carborundum brick, alundum brick, sillimanite brick, tank blocks, muffles, crucibles, saggers, glass pots, zinc retorts, insulating brick, and refractory cements.

GRAPHITE PRODUCTS

Pencil leads, crucibles, and graphite brick.

GLASS PRODUCTS

Plate glass, window glass, wire glass, art glass, oven glass, abrasive paper, bottles, light bulbs, lighting fixtures, street lamps, optical glass, tumblers, fused quartz glass, mirrors, railroad signals, chemical glass ware, art ware and artificial eyes.

ABRASIVES

Grinding wheels, stones, machine tools and abrasive paper.

ENAMELED PRODUCTS

Sanitary ware, kitchen sinks, cooking utensils, refrigerators, heating and cooking stoves, kitchen cabinets, table tops, restaurant fixtures, hospital ware, scale plates, and signs.

CEMENTS

Portland, pozzelain, natural and magnesium cements, gypsum plasters, dental cements, lime and lime plasters, mortars, keene cements and alumina cements (fondu).

INSULATING MATERIALS

Kieselguhr brick, asbestos products, magnesia insulating products and insulating cements.

A glance at this list will readily convince one that from the standpoint of utility, amount of capital invested and value of product this group of industries, taken as a whole, is one of the most important, not only in the United States, but in the world. One cannot turn in any direction in the home without the eye resting upon a ceramic product. The glass in the windows, the plaster on the walls, the dishes on the table, the kitchen utensils, the bathroom fixtures, as well as the materials in the walls and roofs are ceramic products.

Outside on the streets, the sidewalks, road surfaces, sanitary sewers, street signs, and telephone and power insulators are also products of these industries, in fact, our present state of civilization could not have been reached had it not been that advancement in the silicate industries paralleled it. In this advance, utility and art were never divorced. With the discovery that clay could be fashioned and its form made permanent by firing, clay vessels were home utensils and home utensils became home decorations. Glass and cement were first formed by chance but it was not by chance that glass making and the use of cement parallels the history of civilization. Ceramic wares have in all past ages been essential to man's spiritual and material welfare and are more so today than ever before in the world's history.

In the thirty years since the first department of ceramic engineering was established at Ohio State University, departments have been organized at Alfred University, Alfred, New York, known as the New York School of Clayworking and Ceramics, Rutgers, University of Illinois, Iowa State College, University of Washington, North Carolina State College, Georgia School of Technology, Pennsylvania State College, University of North Dakota, Tulane University, University of Saskatchewan, and the University of Toronto. Plans are being made to establish departments at Alabama Polytechnic Institute, Louisiana State University and University of Southern California. Three of the older departments have this year over 100 students above the rank of freshman.

One of the very notable effects of the establishment of these departments in the various states has been the marked advance made by the ceramic industries in these states, almost from the date of organization. In North Carolina, over one and a half million dollars was invested in new ceramic industries and improvements to old ones within a year after the department was organized, with the amount of the investments increasing at an even greater rate this year.

The hundreds of graduates these departments have turned out are filling positions in every branch of ceramics and, although more trained men are available each year, the demand for them far exceeds the supply. Last year it was estimated there were five positions offered for each man available.

It was the trained ceramic technologist who developed the present sillimanite-magnesia spark plug porcelain that has largely made the accomplishments of the aeroplane possible, who has given us the thin mechanical pencil lead, the pyrex and quartz glass, the world famous American hotel china, the enameled kitchen and office furniture, the high tension electric porcelain which has made possible the transmission of high voltages, and many other ceramic products which have revolutionized modern industry.

A tremendous field still awaits the ceramic engineer. Research is necessary to determine how to control the plasticity of clays, how to eliminate lamination in clay products, how to make cast iron ware that will enamel well, how to prevent the disintegration of refractories under certain conditions.

In twenty years, at the present rate of consumption, lumber will be so scarce as to be available only for inside trim. Every state has large resources of clay and cement materials and these must be developed for structural products. The realization of this has resulted in the establishment of the large number of departments of ceramic engineering at state universities and colleges which have come into being in the past few years.

Heat Treating Grey Cast Iron and Semi-Steel*

Annealing process rectifies defects of casting, producing a uniform hardness, eliminating cementite and preventing dimensional change of metal

By Orrin W. Potter, E. M. '14
Instructor, Drawing and Descriptive Geometry, University of Minnesota.

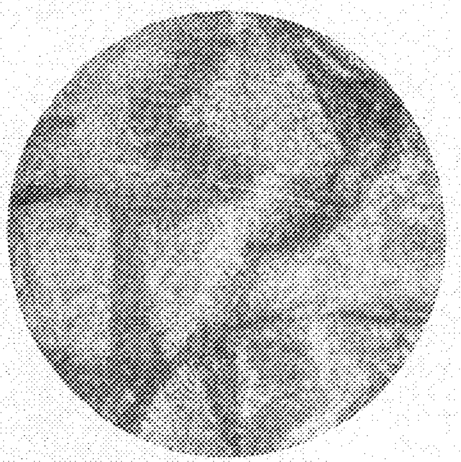
HEAT treatment, the annealing, tempering and the like, of metals and their alloys is one of the oldest arts. It was practiced by all ancient civilizations and by some to a very high degree of perfection as is evidenced by the armour, swords, spears, and other implements found in the ruins of these civilizations. From the earliest days of our history, the blacksmith has been one of the important cogs in its progress. His treatment of tools, and handling of metals and working them to desired forms is really the basis of our modern treatment of metals and their alloys, e. g., the rolling, forging, drawing, and heat treatment.

In recent years, systematic research has been made to determine the causes of the effects of heat treatment and of hot and cold working, so that the properties of metals could be more closely controlled. This brought into use the microscope and more recently, the X-ray apparatus in conjunction with chemical and physical analysis to correlate all these properties.

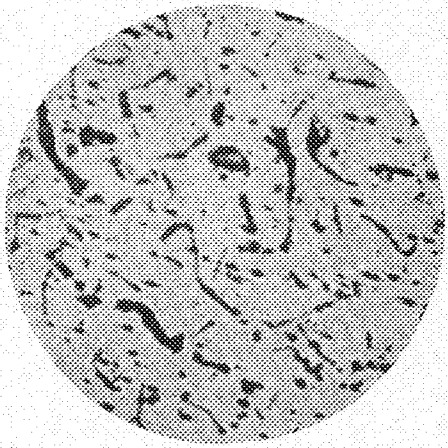
The iron-carbon series of alloys is one of the most complicated, yet much research has been done to determine the properties and the effect of heat treatment and impurities. By far, the greater amount of investigation has been done on the steel side of the series. The complexity of the composition of cast irons, including semi-steel, and the difficulty of controlling compositions during melting have no doubt been factors in hindering extensive investigations. It has been generally thought that cast iron being a weak, brittle material, comparatively cheap in cost of production, could not have its properties improved. The late eminent authority on steels and cast irons, Doctor Howe, stated many years ago that he believed the possibilities of improving the properties of grey cast iron by heat treatment were even greater than they were for steel. We find today that through stress of production demanding ease of machinability and uniform properties, heat treatment has been resorted to with considerable success.

Grey cast iron has two properties, the control of which has always been one of the foundrymen's big problems. They are the hardness and dimensional changes under repeated heating and cooling. To produce uniform hardness and eliminate massive cementite from grey iron, is the constant endeavor of every foundryman who manufactures castings which must be machined. Cementite is extremely hard and soon ruins the best cutting tools. The ideal condition is to have grey cast iron wholly in a pearlitic condition which eliminates all massive cementite. This is difficult to obtain under ordinary casting conditions because of such influencing factors as casting temperature, rate of cooling, chemical composition, carbon content, amount of impurities present, design of casting, etc. It has been found by some manufacturers that the only real satisfactory method of getting uniform hardness and the elimination of massive cementite is to heat treat (anneal) the castings.

For many years, the peculiar growth property of grey cast iron has been known. Outerbridge[1] did some extensive work in the 90's on this property and it has been observed since by many others. In 1924, Bradley Stoughton[2] reported the results of the Schaap process of heat treatment. One of the important findings reported was the elimination of growth under proper heat treatment. If this is correct, then many problems of the manufacture of castings which must be machined and subjected to high temperatures either continuously or intermittently, will be lessened. Also the warpage due to casting strains is considerable in cast irons. The ageing of castings has been practiced for many years by some manufacturers to overcome this difficulty, but recent practice is to heat treat with a low temperature anneal.



32% SEMI-STEEL
Etched with picric acid and magnified 500 times.



25% CAST IRON (T-1)
Etched with picric acid and magnified 500 times. Specimen was heated to 870 deg. and cooled rapidly.

25% CAST IRON
Relief polished and magnified 100 times.

Additional data on the effects of heat treatment has been reported by Harper, Piowarsky, Knowlton, Forsyth, and others, and it is the object of this article to add further data to this important field. One of the difficulties noted in looking over the available literature of this branch is the lack of definite data from which intelligent conclusions can be drawn. If heat treatment of grey cast irons and semi-steels is to become a commercial success, data on research must be so reported and correlated as to make it possible to determine the proper heat treatment necessary for the production and control of the desirable properties. This involves proper chemical analysis, temperature of treatment, rate of heating and cooling, media during treatment, etc.

**In this article are the high-lights of a paper which the author delivered before the recent annual convention of the American Foundrymen's Association. It was presented on behalf of the Twin City Foundrymen's Association and will appear in a bulletin soon to be issued by the national organization.*

[1] Journal Iron and Steel Inst., Vol. 83, No. 1, p. 643.

[2] Iron Age, January 3, 1924.

THE EFFECT OF HEAT TREATMENT ON THE PROPERTIES OF GREY CAST IRON AND SEMI-STEEL

Teat Treatment: T-1 (Heated to 870 deg. C. [1600 deg. F.] and cooled rapidly.)

Spec. No.	15 C. I.		17 C. I.		20 C. I.		25 C. I.		33 S. S.		40	
Chem. Anal.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.
T. C.			3.41	3.36	3.49	3.24			3.22			
G. C.			2.90	3.03	2.53	2.95			2.37	3.02		
C. C.			.51	.33	.96	.29			.46			
Hardness—												
Br.	196	114	183	114	179	115	196	107	202	114	192	118
Sc.	35	33	39	34	40	34	40	31	39	32.5	36	34
Transverse (lbs.)	535	447	502	419	520	348	660	430	543	342	484	370
Deflection (in.)	.07	.08	.07	.05	.085	.08	.02	.09	.065	.085	.08	.09
Charpy Impact	23.8	25.6	17.2	20.4	16.3	29.1	14.7	16.4	26.4	25	23.8	15.9

TABLE NO. 1.

Specimens and Their Preparation. The material used in this investigation was regular run cast grey iron and semi-steel used in a commercial plant. The charges consisted of 50 per cent Northern pig iron and 50 per cent machinery scrap iron melted with a good grade of foundry coke. The semi-steel bars were made from the same materials with 15 to 25 per cent steel added to the charge.

The ordinary arbitration test bar 1¼ in. in diameter and 15 in. long cast according to the recommendations of the American Foundrymen's Association was used.

The tabulated results are shown in Table 1.

Summary. From the results of the tests on heat treated specimens in this research, the effect on the properties seem to be about the same on either grey cast iron or semi-steel.

Heat Treatment T-1: (Heated to 870 deg. C. (1600 deg. F.), held for three hours, and then cooled to black in 15 minutes in furnace, and then air cooled).

1. Total carbon is unaffected.
2. Combined carbon is reduced to around 30 per cent (reduction of 50-75 per cent).
3. Hardness is greatly reduced (from 200 to 155, Brinell, and from 40 to 35 Scleroscope).
4. Transverse strength is reduced (about 15 per cent).
5. Deflection under transverse loading is increased.
6. Impact property is greatly improved.
7. Practically all massive cementite is removed.

Heat Treatment T-2: (Heated to 790 deg. C. (1450 deg. F.) and quenched in water.)

1. Hardness is greatly increased.
2. Transverse strength is increased (5 to 20 per cent).
3. Deflection in ,transverse is decreased.
4. Impact strength is increased (25 to 40 per cent).

Heat Treatment T-3: (Heated to 735 deg. C (1370 deg. F.) and quenched in water). (Below critical.)

1. Total carbon is reduced, probably due to surface decarburization.
2. Graphitic and combined carbon are reduced.
3. Hardness is substantially reduced.
4. Transverse strength reduced (5 to 15 per cent).
5. Deflection is increased.
6. Impact tends to increase (not marked).

Teat Treatment T-4: (Heated to 870 deg. C. (1600 deg. F.) and cooled slowly in furnace.)

1. No change in total carbon is shown.
2. Practically all combined carbon is graphitized.
3. Hardness is greatly reduced (nearly to that of ferrite).
4. Transverse strength is greatly reduced (20 to 30 per cent).
5. Deflection is increased.
6. Impact is reduced.

Heat Treatment T-5: (Heated to 735 deg. C. (1370 deg. F.) and quenched in oil). (Below critical.)

1. A slight oxidation of carbon is evident from reduction of total carbon.
2. Combined carbon is greatly reduced.
3. Hardness is reduced considerably.
4. Transverse strength is reduced (10 to 20 per cent).
5. Deflection is reduced slightly.
6. Results on impact are very erratic.

Heat Treatment T-6: (Heated to 790 deg. C. (1450 deg. F.) and quenched in oil.)

1. Hardness is increased.
2. Slight reduction in transverse strength.
3. Tendency to increase impact properties.

Heat Treatments T-7 and T-8: (Heated to 870 deg. C. (1600 deg. F.) and cooled slowly in furnace, reheated to 910 deg. C. (1670 deg. F.) and quenched in water and oil, respectively.)

1. Hardness greatly increased.
2. Graphite is spheroidized.

Heat Treatments T-9 and T-10: (Heated to 790 deg. C. (1450 deg. F.) and quenched in water and oil, respectively and drawn at 700 deg. C. (1292 deg. F.)

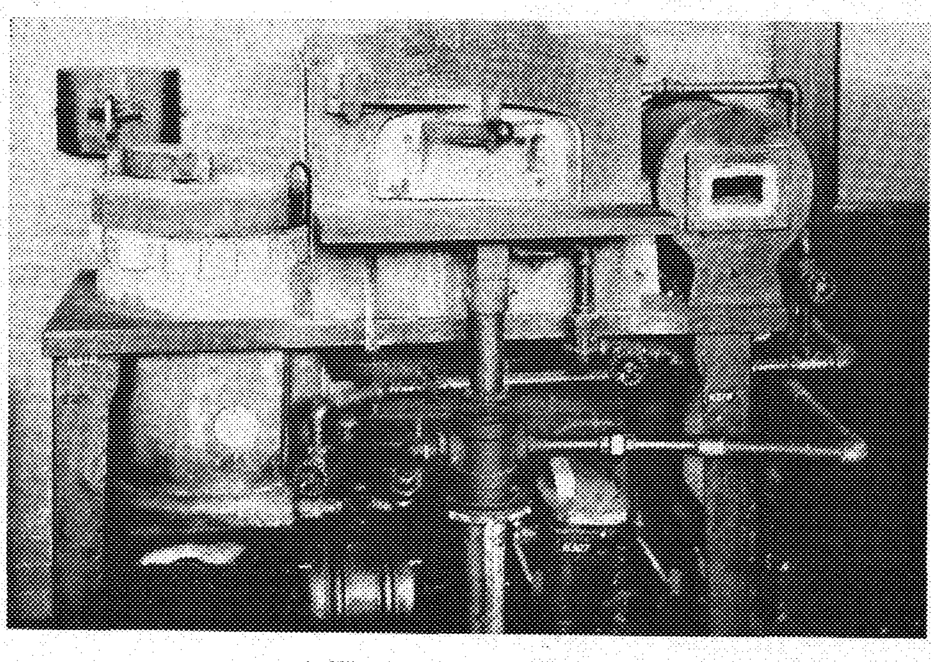
1. Hardness reduced to that of original specimen.
2. Graphite spheroidized and granular pearlite (or sorbite) formed.

From the foregoing summary of effects of heat treatment, it is seen that it is possible to greatly vary the physical properties through heat treatment. The temperature of heating, the time held at temperature, the rate and method of cooling are all very important factors to be considered. This study has shown that certain properties of both grey cast iron and semi-steel can be improved by heat treatment and they can also be almost ruined.

After studying over the results obtained a number of interesting relations or tendencies were noted.

1. The silicon content seemed to be directly proportional to critical tempera-

(*Continued on page 94*)



A HEAT TREATING FURNACE

On the left is the cyanide pot for case hardening. The muffle furnace shown in the center is used in treating ordinary steel. The heating chamber for hardening high speed steel is on the right.

Modern Sewage Disposal

Austin and Rochester, Minnesota systems effectively solve problem of city waste and prevent contamination of rivers

By Frederic Bass, B. S.
Member American Society of Civil Engineers.
Professor of Municipal and Sanitary Engineering.
University of Minnesota.

THE city of Austin, Minnesota, is situated in the heart of one of the richest agricultural regions of the northwest. It lies fifteen miles from the Iowa boundary on the headwaters of the Cedar river, a small stream winding its sluggish current southward to flow through three-quarters of the length of eastern Iowa to the Mississippi. By the year 1924, Austin had reached a population of about 12,000 persons of whom nearly 2,000 were employed by a single industry, the Hormel Packing Company.

The wastes from the city and from the packing plant had combined to foul the river beyond the endurance of the communities on the river below in Iowa. Numerous complaints and threats of legal action had brought the need of remedial action before the city government for a number of years. The city was growing and the packing company was doubling in size every five years, and finally impending legal action forced the city to a decision to install a sewage disposal plant. A plan was proposed by a company controlling a proprietary process to install a plant which would treat both the wastes of the city and the packing plant. Doubt of the economy of this process led to investigations which resulted in its rejection in 1923. In 1924 a new city council determined to build the sewage disposal plant described here. The council found the waste from the packing plant much more difficult to treat than the city sewage; in fact the credit of the city was unequal to the burden that would be imposed upon it by treating this waste.

The plant waste and the city sewage both, in the process of disposal, need oxygen which must be supplied either from the atmosphere or from that dissolved in the water of the river into which the wastes must finally flow. It was found that although the wastes were substantially equal in volume, the plant waste required many times the amount of oxygen necessary for the city sewage.

Therefore, the city council ordered a disposal plant for the city sewage only. A collecting or intercepting sewer 42 in. in diameter had previously been built along the river bank to a point near the city limits where a tract of land of about 30 acres had been purchased. This sewer discharged below the water level of the river, so the design of the disposal plant included a pumping station through which the sewage was lifted about 35 ft. to the plant itself, situated on ground high enough to be above the flood level of the river, which was probably about 12 ft. above the ordinary river level.

The pumping station is a concrete structure 37 ft. by 27 ft. in plan and 29 ft. deep, below the ground. In it are three 8 in. centrifugal pumps directly connected to electric motors, automatically operated by float mechanism. There is also an 18 in. pump to take care of the ordinary storm water flow which enters the sewer system in a part of the city area. The pump pit is surmounted by a masonry house which contains an office and laboratory.

The sewage is pumped through a 12 in. C. I. pipe about 300 ft. to the disposal plant.

The disposal plant consist of the following units:

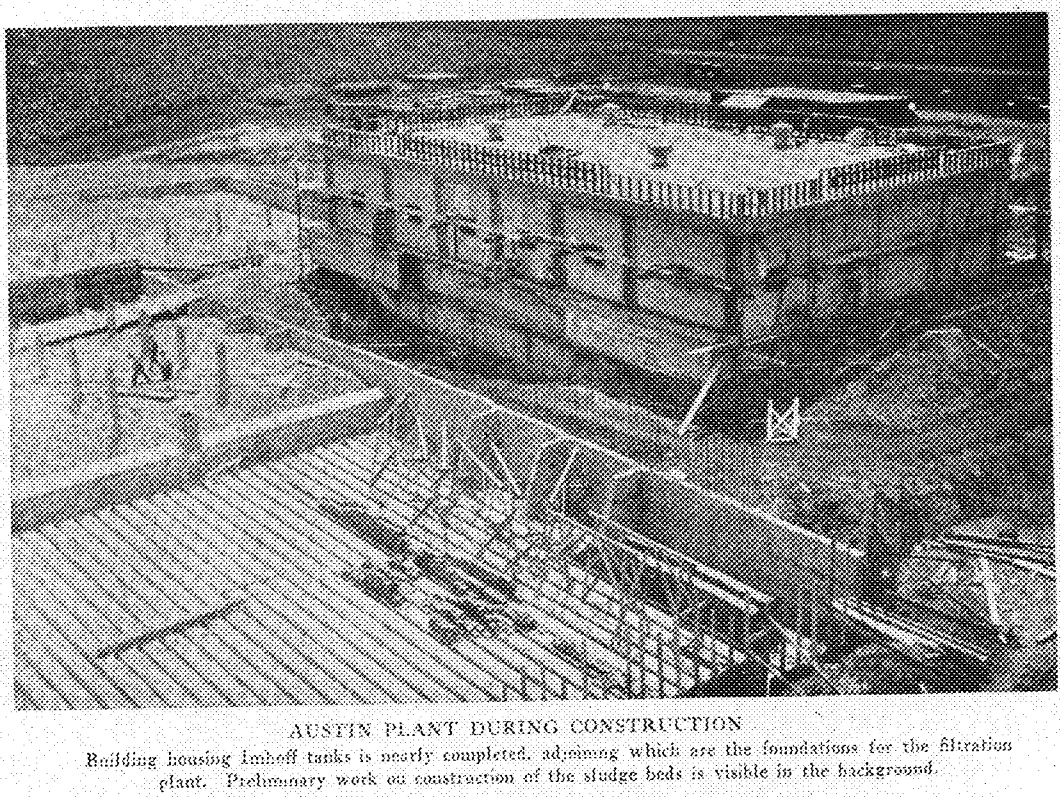
1. Imhoff tanks
2. Dosing tank
3. Percolating filter
4. Dorr clarifier
5. Sludge bed

The sewage flows successively through the first four units in the order named. The sediment or sludge in the Imhoff tanks is removed from time to time, flowing by gravity to the sludge beds.

There are two reversible flow Imhoff tanks, each 87 ft. long by 26 ft. 3 in. wide by 27 ft. 6 in. deep below the water level. In the upper or settling compartment there is an average detention period of one and one-half hours. All solids which will settle out in this time pass through slots in the bottom of this compartment to the sludge compartment below which has a capacity of approximately 30,000 cubic ft. in each tank. The sewage passes from the Imhoff tanks to a dosing tank, so called because it holds the effluent from the Imhoff tanks for an average period of 20 minutes and then suddenly releases it upon the filter, after which another 20 minute flow is held and again released and so on.

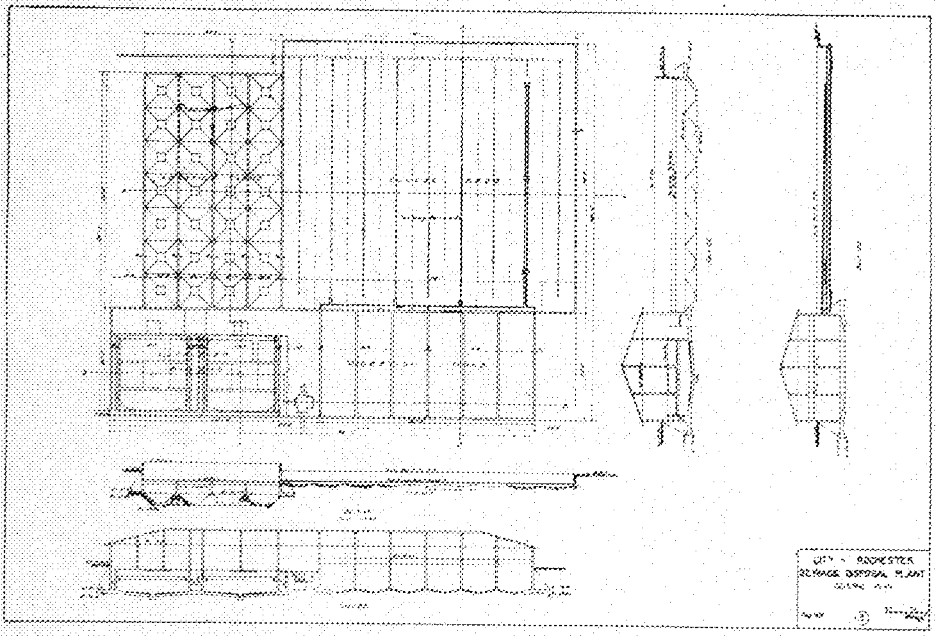
The dosing tank is 41 ft., 8 in. by 20 ft. in plan and from 4 ft. to 6 ft. in depth. A 24 in. automatic siphon carries the sewage to the filter.

The filter is 229 ft. 2 in. by 178 ft. 1 in. in plan and the filtering material, which is screened broken stone from 1.5 in. to 3 in. in diameter is from 7 ft. 9 in. to 8 ft. 9 in. in depth. The sewage is carried from the dosing tank through the siphon to a 24 in. vitrified pipe running the length of the filter. From this central pipe, 29 8-in. vitrified pipe laterals extend to the sides of the filter. On each lateral there are six risers, on top of which, 6 in. above the surface of the



AUSTIN PLANT DURING CONSTRUCTION

Building housing Imhoff tanks is nearly completed, adjoining which are the foundations for the filtration plant. Preliminary work on construction of the sludge beds is visible in the background.



PLAN VIEW OF ROCHESTER PLANT

Though location and natural conditions are similar to those at Austin, Minn., specifications for this system are entirely different as shown by these general plans.

stone there are set sprinklers. In plan, the sprinklers are at the apices of equilateral triangles 16 ft. on a side. After being sprayed over the surface of the stone, the sewage gradually percolates to the bottom where specially constructed underdrains of What-Cheer vitrified tile are placed in a concrete bottom at intervals of 27 in. These underdrains conduct the now oxidized sewage to side channels which in turn conduct it to a square settling tank 32 ft. in diameter and having an extreme depth at the center of 7 ft. 8 in. In this tank there is set a mechanism which consists of four revolving radial arms attached to a central vertical shaft. The revolving arms are in contact with the bottom of the tank and make one revolution in about 30 minutes. By means of inclined shoes attached to these arms the sediment or sludge in the filter effluent is scraped to the center where there is a sump from which the sludge is pumped back through a 3-in. cast iron pipe to the Imhoff tanks.

The effluent from these tanks flows over weirs to a collecting channel and flows directly to the river through a 24-in. vitrified pipe.

The Imhoff tanks, the filter and the final settling tank are all surmounted by superstructures to protect against cold weather and freezing. If not covered, the surfaces of all of these units would be covered with ice for months in the winter and not only then, but for other months when the temperature drops below 50 deg. F. their efficiency would be impaired to a great extent. This superstructure or housing is of wood frame construction with an exterior finish of portland cement stucco on metal lath. The interior is lined with ceiling to add warmth and to prevent condensation on the interior side of the stucco which otherwise would be exposed. Previous experience with structural steel framing led the designer to substitute the wood. Corrosion of steel is extremely rapid in the atmosphere of such buildings.

The sludge from the lower compartment of the Imhoff tanks flows by gravity to a sludge drying bed 160 ft. by 100 ft. in plan and about 2 ft. deep. There are six cast iron pipes leading from the bottom of the tanks to a concrete channel running along the side of the tank and extending to and along the center of the sludge bed. The water from the dried sludge after filtering through the beds goes to the river. The dried sludge will be stored on the surface of the ground. It is entirely inoffensive and can be used for filling or for fertilizer. Experience has shown that farmers are eager to haul it away as it has considerable value.

The construction of the plant was performed by contract, the contractor being Gjellefald and Chapman of Forest City, Iowa. The contract price was approximately $220,000.

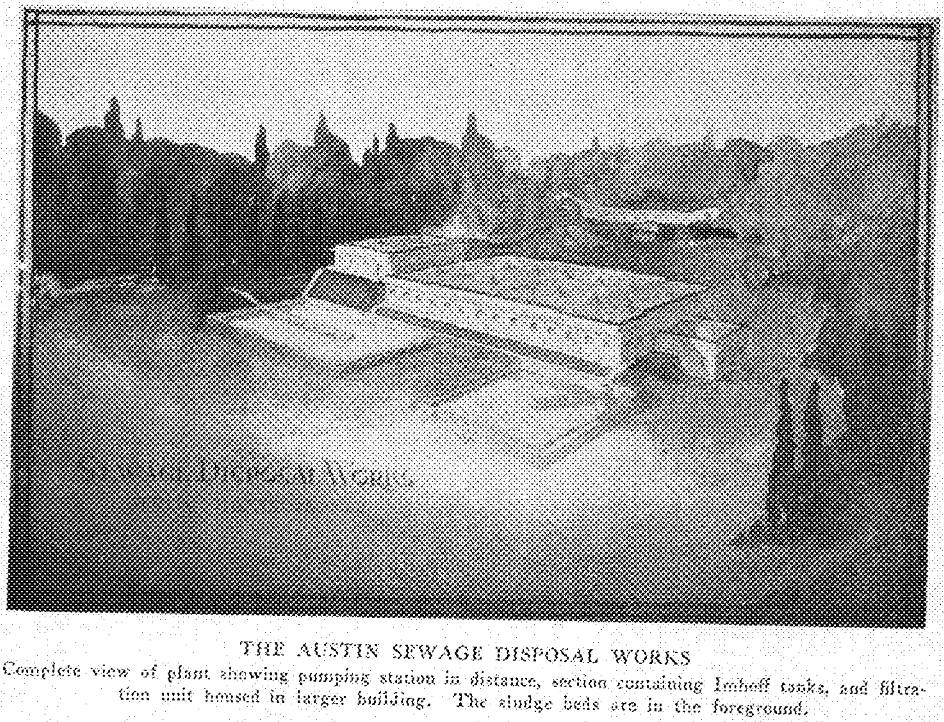
When this plant is put in operation which will have been done when this article is published, the city of Austin will have removed the offense from the river due to the municipal sewage, leaving the offense due to the packing plant waste to be dealt with by the packing company which has already started action concerning this matter.

THE city of Rochester lies on the south branch of the Zumbro River which flows northward and then eastward to the Mississippi River. The Zumbro at Rochester has a smaller drainage area than the Cedar River at Austin, but has a larger minimum flow. As at Austin the city had for some years been considering the desirability of a sewage disposal plant, but not until 1924 when the complaints of riparian owners below on the Zumbro became more insistent did the city take action. In that year the council recognizing the situation, ordered a vote of the people on a bond issue of $350,000 for a sewage disposal plant. The vote was in favor of the issue by an 8 to 1 vote.

Rochester in 1925 has a permanent population of about 14,250. As is well known, it is the home of the Mayo Clinic which brings to the city a transient population of perhaps 3,500 persons. In addition there is a population of 1,500 at the State Hospital, making a total of approximately 20,000 persons.

After a preliminary study of the situa-

(*Continued on page 86*)



THE AUSTIN SEWAGE DISPOSAL WORKS

Complete view of plant showing pumping station in distance, section containing Imhoff tanks, and filtration unit housed in larger building. The sludge beds are in the foreground.

Former St. Patrick Discusses:

What Price, Diplomas?

A Dissertation On Things of No Consequence

By none other than

Archie McCrady C'24

I RECEIVED a letter from Dean Leland a while back, asking me whether I was satisfied with my position, if any, and what was my favorite flower and so forth, and finally, what did I think of the course in engineering at Minnesota, and how would I change it if I were running it? Now, I am always glad to hear from the dean and feel flattered to think that he finds time in the rush of affairs to sit down and write me a long letter on his mimeograph, so I have given the matter of his letter considerable thought.

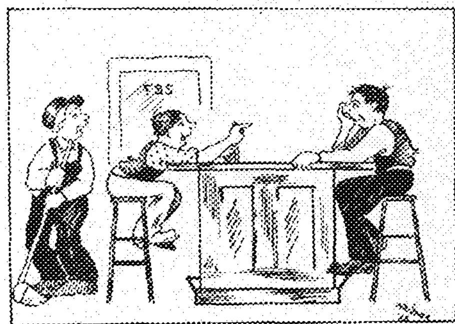
I have also learned that several others of the boys have received similar letters from him, so it appears that the dean is really wondering what is wrong with the engineering course and is going to fix it up. And, of course, it is natural that he should consult some of us prominent old grads before doing anything drastic.

Now, of course, there isn't anything really wrong with Minnesota. To say there is would be not merely disloyal but untrue. And yet, in all colleges, there are certain tendencies developing which cause a certain uneasiness among educators, a certain apprehension as to whither are we drifting, an apprehension no less marked among those who are the best friends of the school and of education.

There is, for one thing, the unparalleled growth of the campus population. Minnesota is a rich school and builds every year the equivalent of the entire equipment of some colleges, and yet classrooms are crowded and laboratory space is at a premium. The dear old public, one might say, manifests a disposition to come to college "en masse," and it strains the resources of a rich and generous state to provide accommodations. And while it is very gratifying to note this eagerness for learning, the movement brings with it certain economic problems not easily disposed of.

There is the old supply and demand business, which in this connection appears to mean that the more engineers we graduate the less demand there will be for engineers, with consequent lower salaries, until we finally have a "marginal" engineer, toward whom employers would be indifferent as to whether or not they secured his services at any price. Indeed, I believe this marginal engineer has already appeared in the market, being in fact a classmate of mine, toward whom all employers have thus far manifested an almost complete indifference.

The teachings of economics, therefore, would seem to indicate a limitation of output as the only solution. It seems harsh to place an arbitrary limit upon the number who may graduate each year, particularly as neither faculty nor students have any marked confidence in the grading system whereby we determine who may graduate and who may not, but that is essentially what all good schools have been doing in the past. The policy at least has the support of precedent, and appears to be the only practicable way in which the supply may be limited to avoid glutting the market.



"—the only member of the faculty present being the janitor—"

As I look back upon my college days, I remember there were several particulars in which it seemed to me the school could be improved. Others felt the same about it, and one group especially, I remember, would often get together in Room 227 and discuss the shortcomings of the course and plans for its betterment. Some very good suggestions were made, too, and the meetings would undoubtedly have been fruitful; but for the fact that our deliberations were unofficial, the only member of the faculty present being the janitor, who, while he undoubtedly listened sympathetically, was without sufficient authority to make any sweeping (not a pun) changes in the procedure of the institution, but confined his comments to "Ya, I guess you fallers got it pretty hard, too," a statement which, you will note upon analysis, is rather non-committal. So our conclusions were inarticulate and never reached the ears of those in authority, being, you might say, merely the dicta of a bull session.

But now the movement for a change at Minnesota has pragmatic sanction. The Dean himself has been studying over these matters almost as much as I have myself, and has decided that it is time for us boys to get together and revamp the course.

Any scheme of progress for the college must take into account the student, his aspirations and his limitations. Even in an idealized college, he would probably be present, even though to leave him out would enormously simplify matters and make the conduct of the institution far less troublesome.

The motives which actuate a young man to register as a freshman in the engineering college are very lofty motives of self-improvement and social service, but they are motives of very little importance to this discussion since they seldom outlast the first quarter of his first year. On the other hand, the motives which cause him to continue the course to graduation are less lofty but far more important, since they are the key to his actions during the remainder of his college career.

When the first-year man comes to college, he is imbued with an eagerness to

(*Continued on page 90*)

"—used to read his diploma to his horses before starting work—"

AROUND THE WORLD WITH OUR ALUMNI

Architects

'21—Rheuben P. Damberg has left Virginia, Minn., and is now in Boston in the employ of an architectural firm. He reports that he enjoys his work and the east very much.

'23—Last July, Miner J. Markuson accepted an assistant professorship at the Massachusetts Agricultural College, Amhurst, and is now busy teaching rural architecture and drawing there. He was formerly with the Virginia Polytechnic Institute, Blacksburgh, Va.

For a vacation jaunt, he drove a car from Blacksburgh to Minneapolis and then went east again, taking advantage of the many splendid tourists' camps along the way for places to camp at night. He rolled up a total mileage of 2,800 miles. While he was here he visited the campus and said he thought the changes looked very good.

Chemistry

'24—Leonard Harkemeier, M. A., is assistant chemist with the Northern Pacific railroad in St. Paul.

'24—Cecil J. Mayo with Mrs. Mayo (Ruth Stier, Ch. '25) has gone to Kansas City, Mo., to take up his work with the National Lead Battery company.

'24—Ernest Jewett and Rudolph Krantz are with the firm of Proctor and Gamble at Ivorydale, Ohio.

'24—Karl Paul visited here a few ago. He is still in the oil game and has just completed a series of tests on the evaporation of gasoline from different colored tanks. He is now in Buffalo, N. Y.

'24—Alvin Fuhrman is in El Dorado, Kansas, and is with the Western Distributing company.

'25—William Vievering is employed as chemist for the Minnesota Mining and Manufacturing company in St. Paul.

'25—Homer Hamm is employed at the St. Paul plant of the Minnesota Oil and Paint company.

Civil

'00—Edwin N. Grime, for a number of years supervisor of bridges and buildings for the Northern Pacific railroad at Fargo, North Dakota, was recently promoted. He is now in charge of supervision and investigation of all water supplies for that company and has his headquarters in St. Paul.

'03—Harry A. Grow, for many years with the Minneapolis Steel and Machinery company, resigned last summer and is now on the engineering staff of the Byllesbye Engineering and Management corporation. His headquarters are in Chicago.

'10—Edward N. Leach, a mining engineer with offices at Hibbing, Minn., was down and attended the alumni banquet and the Iowa during Homecoming.

'14—Dow I. Sears has moved to 231 Harding avenue, Ironwood, Mich. Mr. Sears is the superintendent of the water department there.

'15—Dan S. Helmick made a trip to Alaska last summer for the purpose of investigating a proposed water power development. Mr. Helmick is associated with Ralph Thomas, consulting hydraulic engineers of Minneapolis.

'16—R. M. McCullough recently resigned as pastor of the First Presbyterian church at Litchfield to accept his present pastorate of Calvary Presbyterian church in Minneapolis. Mr. McCullough was with the Minnesota Highway Department for a while after his graduation but resigned to take four years of work at the McCarwick Theological Seminary after which he went into the ministry.

'17—A. C. Knauss until recently has been with the United States Forest Products research laboratories at Madison, Wisconsin, studying strength of timbers and kiln drying. He resigned a short time ago and is now with the Oregon-American Lumber company, located at Vernonia, Oregon. He will install and have charge of the operation of very large dry kilns.

'18—Nick Konstan is now living at 6248 Wayne Ave., Chicago, Ill.

'20—L. T. Wyly has resigned from the bridge department of the Northern Pacific railroad and is now working with the American Bridge company at Gary, Indiana.

'20—Henry M. Lende is now with the Dayton Co., Minneapolis. He was formerly with the Minneapolis Park Board.

'22—H. B. Palmer is working for the Wisconsin Civil Service and is now living at Appleton, Wisconsin. At present he has charge of the construction of a concrete dam on the Fox river near Depere. He is superintendent of construction of the whole Fox river district and has charge of a series of dams and locks and all improvements on that river. He and his family were in Minneapolis this fall and attended the Wisconsin game.

'22—Wm. P. Tarbell, assistant city engineer of Fargo, North Dakota, was in Minneapolis and attended the alumni banquet and the Iowa game during Homecoming.

'22—Loring Slade is working for the Minnesota Highway Commission as instrument man and is located at Owatonna, Minn.

'23—Julian (Spike) Garzon has left the Minnesota Highway Commission and is now in Florida. He left about November 10.

'23—Mike Mitchell returned from Florida to visit his family in Minneapolis and to attend the Homecoming. In his senior years, he was full-back on the varsity football team. Mr. Mitchell has been in Florida for some time and his trip north was partly to recover from malaria.

'23—Hibert M. Hill, an instructor in civil engineering, has been working for the Byllesbye Corporation making tests of water wheels at the St. Anthony Falls plants.

'23—James Darrell until recently was with the Northern States Power Company on power developement surveys. Now he is with the Minnesota Highway Commission and is working in the St. Paul office.

'23—Arthur C. Zimmerman resigned last summer from the United States Army Engineers at Duluth and is now in Florida on construction work.

'23—George O. Guesner, for the past two years on power development surveys on the St. Croix, Mississippi and Chippewa rivers, has been transferred by the Byllesbye Corporation to similar work in Maryland.

'23—Leo Buhr is the engineer in charge of operations for the Northern States Power Company on power development surveys on the Chippewa river in Wisconsin.

'24—Walter E. Wilson and Gus Bodin left for Tampa, Florida, on November 16th to work for a contractor on construction work.

'24—Martin E. Nelson is with the Southern California Edison company. He has been working as chief of party on surveying and has designed and been in charge of inspecting a multiple arch concrete dam. At present he is in charge of the central testing laboratory in Los Angeles.

'24—Neal Bartholomew is working in the engineering department of the Illinois Central and is living at 1325 Broadway, Paducah, Ky. He is working on the construction of a large group of shops at Paducah.

'24—Clarence Velz is located at Kissimmee, Florida, and is working as chief engineer for C. A. Blair & Co developing Lago Vista, the "Venetian home in the heart of Florida." The problem involves 20 square miles of development including 6 miles of lake front, 14 miles of canals to dredge into a chain of artificial lakes, the design and construction of a water supply system and a sewage disposal plant, design of a parkway lighting system and an electric central station, surveys for boundary lines, sub-division, drives and winding streets, and miles of curbs and sidewalks. Mr. Velz says that the problem of securing materials in Florida is very great and that all of the materials being used are shipped from the north. He also says that land is selling so fast that they are about a year behind the sales force on their construction.

'25—George A. Nelson is in Alaska working for the United States Coast and Geodetic Survey. He writes, "Alaska is a great place—for rain. I certainly do miss that Minnesota sunshine." He gives his address as 202 Burke Building, Seattle, Washington.

Ex. '25—Edward S. Brownell is working for the Northern States Power Company on a power development survey on the Chippewa river in Wisconsin. His address is care of that company at Bruce, Wisconsin.

'25—Vernon H. Olson is working in the Maintenance-of-Way Department of the Northern Pacific with his headquarters in Duluth.

'25—Fred Imsande recently accepted a position with the Northern Pacific. He is working in the Maintenance-of-Way Department and has his headquarters in Jamestown, North Dakota.

'25—George Cornell has accepted a position in the Structural Department of the Soo Line railroad and is working at the general offices in Minneapolis.

'25—Mark Haima is working in the Maintenance-of-Way Department of the Northern Pacific railroad. At present he is working on yard improvements in the Mississippi street yard in St. Paul.

'25—Joe Lushene is in Washington, D. C., employed by the United States Coast and Geodetic Survey.

'25—Kenneth M. Olson and Anton E. LaBonte are with the Chicago, Milwaukee & St. Paul railway company and have their headquarters in Milwaukee, Wis.

'25—E. I. Quinn is with the State Highway Commission at Owatonna, Minn., where he is working on paving construction.

'25—Hamilton S. Craig is with the construction division of the Illinois Steel company. He has been working in Chicago but was recently transferred to Boston.

'25—Clarence Blue is in Genesco, Illinois, in the employ of W. D. Lovell, a Minneapolis contractor. Up until about October 1, Mr. Blue was working for the city of Austin as the engineer on Austin's sewage disposal plant.

NEWS FROM THE TECHNICAL CAMPUS

Minnesota Initiates Meterman's Short Course

The University of Minnesota claims the distinction of being the first college in the Northwest to offer a course for electric metermen who are employed by public service corporations. The General Extension Division of the University, in co-operation with the Electrical Engineering Department and the North Central Electric Light Association, offered this course which was held during the week of September 21-25 in the electrical engineering building.

The course proved to be a great success, there being thirty-five registrations. A fee of ten dollars was charged for the course which consisted of a combination of lectures, discussions, and actual meter laboratory practice. The facilities of the electrical engineering laboratories and the engineering library were at the disposal of the students. Each meterman brought with him a standard watt-hour meter from the company he represented, for laboratory work.

A number of meter manufacturers had representatives present to exhibit and demonstrate their equipment. Their displays, which included many different types of instruments, proved to be very instructive. The manufacturers who were represented were the General Electric, Westinghouse, Duncan & Sangamo, and the Northern States Power Company. The Northern States Power Company were very generous in sending eight men as laboratory instructors, and also some special types of demand meters for demonstration and use in the laboratories.

Monday morning, September 21, was devoted to registration. In the afternoon, an assembly was held, at which Dean O. M. Leland, of the College of Engineering, welcomed the students. The rest of the afternoon was given over to lectures and laboratory work. In the evening there was a dinner and acquaintance meeting at the Minnesota Union. Mr. R. R. Price, Director of the University Extension Division, was toastmaster, and R. F. Pack, Vice-President and General Manager of the Northern States Power Company, was the principal speaker.

On Tuesday, lectures and demonstrations were given, and laboratory work was practiced. In the evening, motion pictures on meter construction were shown.

Wednesday was given over to discussions and laboratory practice. Thursday, lectures, discussions, and laboratory work were offered, with a two hour visit to a manufacturer's display. On Friday, the last day of the course, the morning was devoted to motion pictures on technical and electrical subjects, and talks by Mr. G. O. House, president of the North Central Electric Association, and Mr. J. W. Lapham, executive secretary of the N. C. E. A., were given. In the afternoon, the metermen visited several Twin City power plants.

During the week, lectures were given on fundamentals of alternating current measurement, mechanical construction of single phase induction meters, care of instruments, safety, meter-registers and application of constants, instrument transformers, polyphase metering, demand meters, and application of correction factors.

The students showed a wide range of demand. Their meter experience ranged from a few months to twenty-five years.

Scarab Fraternity Organized In Architectural Department

Members of the Dodeca Club, a professional architectural organization, recently received word from the national convention of the Scarab fraternity that their application for a charter of Scarab at Minnesota had been accepted. The local club was organized last year among upperclassmen in the School of Architecture. It is purely a professional group. "Scarab" is the oldest architectural fraternity in the country and has eight chapters located at the strongest Schools of Architecture at the present time.

Technical Honor Fraternities Choose Fall Quota of Members

The various technical honorary scholastic societies have chosen the following men for members as their fall quota:

Chi Epsilon, honorary civil engineering fraternity: juniors: Frederick Teske, Loren Pohl, Tauno Pajari, Carl Luethi, Hugh L. Turritin, seniors, Barton Juell, Edward Gould, William R. Edgington, and Arthur S. Krefting. These men were pledged on Nov. 7.

Eta Kappa Nu, honorary electrical engineering fraternity: juniors, Stewart Bailey, J. H. Wald, John Brightfelt and Carl Everett Swanson; seniors, Fred Joesting and Lester B. LeVesconte. The formal initiation was held at the Leamington Hotel on December 10. Hilder Bergman was toastmaster and Stewart Bailey responded for the new members.

Pi Tau Sigma, honorary mechanical engineering fraternity: juniors, J. Edwin Coates, Albert A. Cooper and Frank A. Trexler; seniors, Theodore R. Corbett. The initiation banquet was held on November 19 at the Andrews Hotel. Leonard Kleinfeld acted as toastmaster and talks were given by Prof. J. V. Martenis and L. F. Campbell.

Tau Beta Pi, honorary technical scholastic fraternity: juniors, R. F. Edgar; seniors, Lester B. LeVesconte, Marcus Fiene, Hilder W. Bergman, W. J. Carman and Charles J. Berghs, electricals; William R. Edgington, James R. Johnson, Arthur S. Krefting and Franklin J. Holbkat, civils; Clifford E. Comfort, mechanical; Joseph S. Kugler, chemistry; Thomas F. Andrews, miner. The informal initiation was held on Wednesday evening at the Kappa Eta Kappa house and the final rites were put on at the Andrews hotel on Wednesday evening, Dec 2. Prof. E. W. Johnson was toastmaster and W. R. Edgington responded for the new members.

'25 Alumnus Addresses School of Mines Society

Alva J. Haley, Mines '25, gave a talk to the School of Mines Society on methods of sampling in Butte, Mont. Mr. Haley, who has been sampling for the Anaconda Copper Co., demonstrated by means of sketches, figures, and explanations, just how the samples are cut across the "breast" of a working, how the assay of the sample is figured with the width of the seam to get the proper value of the ore, and why such careful check is kept on the mining.

Chemists Hold Smoker; 1925 Class Engaged In Research

The first chemist mixer of the year was held in the Chemistry building on Friday evening, Nov 6. This was sponsored by the Chemist Club, and was given as a Freshman welcome. Over 100 students and members of the faculty attended.

Dr. Mann spoke on the advisability of the establishment of a new student organization, and the remainder of the evening was used in becoming acquainted with the students in chemistry and in playing cards and dancing. The refreshments consisted of doughnuts, apples, cider and some more cider. The arrangements for this affair were made by Joe Kugler and Bruce Weetman.

Nearly all of the Class of 1925 have returned to school this year to follow up their undergraduate work with research of some kind or other. Loren Shirk is working on problems with the dephlagmating column; Al Reiter, electro-deposition of lead from lead sulfate; William Zeidlick, studies of chemical effects of high frequencies in electric currents; Lester L. Johnson who holds the Engineering Experiment Station Fellowship in chemical engineering is busy doing experiments on waste sulfite liquors. John McKee who is assisting in the Inorganic Department, is working with Furfural as an ionizing medium. Murray Sprung is assisting in the Organic Department and is doing his research in that department also.

Dr. Montonna has returned to his duties in the Chemical Engineering Department after recovering from an attack of typhoid fever. We are glad to see him back with us again, and we hope that he will not be obliged to take another vacation such as the one he has just returned from.

Dr. F. G. Cottrell Speaks Here On Nitrogen Fixation

Dr. F. G. Cottrell, director of the nitrogen fixation laboratory of the United States government, and widely known as a scientist and as inventor of the precipitator of flue dust which bears his name, spoke Tuesday, November 24, at the auditorium at the School of Chemistry on "The Fixation of Nitrogen." This is the first of a series of similar lectures planned to be given this year under the auspices of the School of Chemistry. His address was illustrated with lantern slides and was exceedingly interesting to the large audience that greeted his appearance.

Hughes Completes Textbook On Forge Practice Principles

Thomas P. Hughes, instructor in forging has written a textbook entitled "Principles of Forge Practice." The book includes a complete discussion of the simpler tools and forging operations, and describes some of the more intricate machine forgings. One section is devoted to the methods of heat treating and hardening steel. The first issue is in mimeographed form and is illustrated with blueprints.

Errata

The organization which sponsored the founding of the Rooter's Club is Mortar and Ball, instead of Scabbard and Blade as given in the November issue.

New Chemistry Professor Designs Huge Electro-Magnet

The designing of a gigantic electro-magnet weighing over two tons and being over 50 ft. in height, is one of the achievements of Dr. N. W. Taylor, a new professor in the School of Chemistry. This magnet which is the most powerful one ever designed for experimental work, is located in a laboratory at the University of California at which place Dr. Taylor was formerly on the faculty.

It is used in the separation of magnetic substances from ferrous ores for many other problems encountered in research. Dr. Taylor who took the position vacated by Dr. L. M. Henderson last spring, is conducting extensive investigation on the properties of alloys and is the author of much literature on the subject.

Techno-Log Staff Heads Attend Meet At Cornell

Paul B. Nelson, managing editor, and Stanley Bull, business manager of the Techno-Log, were delegates to the annual convention of the Engineering College Magazines Associated held October 23 and 24 at Cornell University, Ithaca, New York. Events on the two day program were various discussions of student technical magazine problems as well as an address by Frank Wight, editor of the Engineering News-Record, and by Bristow Adams, head of the Journalism department of Cornell. At the business meeting held on Saturday, the association decided upon Minnesota as their meeting place for next year.

Wire Rope Manufacture Movies Shown Students

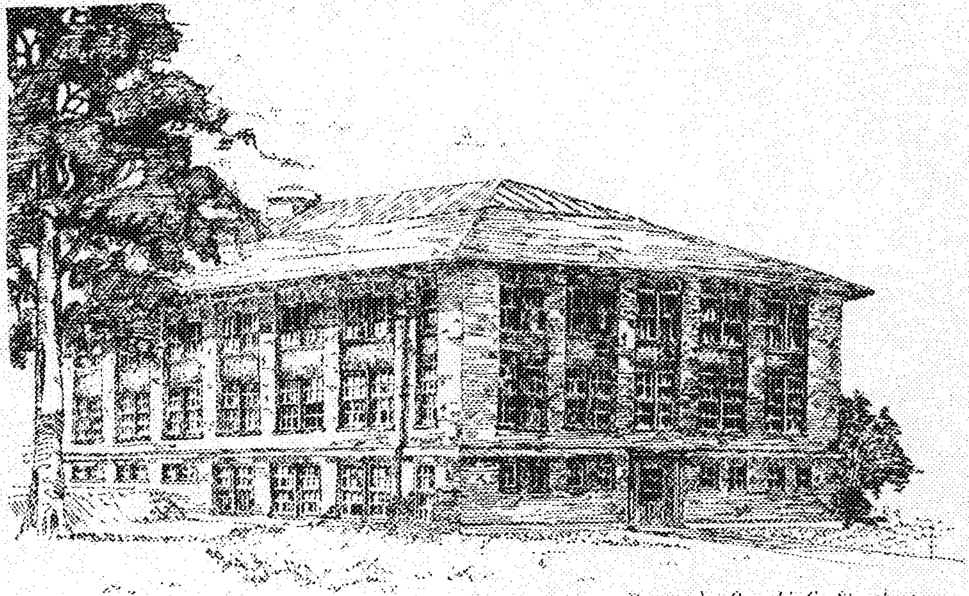
Undergraduates recently had the opportunity to see how wire rope such as hoisting cable is made. A representative of the James A. Roebling's Sons presented a six reel cinema showing all processes in the making of the rope, from charging the open hearth furnace to shipping the finished product.

After showing views of the mills and other buildings of the Roebling plant, the making of "Heat Number X," a special low phosphorus pig, into rope, was followed through. The charging of an open hearth furnace with pig iron was presented both by actual photographs and by animated diagrammatic cross-sections of the furnace. This was followed by the pouring of the steel into the ladle, tapping the ladle into ingot molds, stripping the ingots, and rolling the ingots into billets. In the last process a 15,000 h. p. steam engine is connected directly to the rollers. Rolling reduces the 18 in. ingots to 4 in. bars which are cut into 3 ft. lengths to be sent to the rod mill. Here, in the space of two minutes, a billet is rolled out to a long hot rod of a diameter near a quarter of an inch. At the end of the rod rolling process, the rod is going through the mill at the rate of a mile a minute and some very dexterous handling on the part of the mill men is necessary to swing the rod to the next set of rolls.

The rod, now coiled in bundles, is heat treated, bathed in acid, and baked to remove occluded hydrogen from the acid bath before being drawn into wire. Drawing consists only of the simple process of dragging the rod through a hole in a very hard plate. The wire is drawn through as many dies as are required to reduce it to the proper size. Between each set of dies the wire has to be reheated, bathed, and baked.

The wire is then sent to the rope factory where it is first twisted into strands, these later being twisted into the finished wire rope. There are 5 grades, 37 sizes, and 40 constructions of rope manufactured by this concern. The twisted rope may be had in sizes ranging from 1-32 in. to 4¼ in. Machines doing the twisting are simple in principle and have not changed much in design in the last 60 years. Spools of wire, or strands, if rope is being made, are supported on a frame revolving about the center strand; the wire is fed through a head which lays the wire around the center as it is pulled from the machine, and wound into coils.

Throughout the entire milling and manufacturing operation, tests are made to check on the quality of steel, strength of wire and finished rope.



Drawn by Oswald C. Stageberg.

THE NEW HIGHWAY MATERIALS TESTING LABORATORY

Highway Laboratory to be Added to Experimental Building

Visions of a completely equipped highway laboratory at the University of Minnesota have been realized to the extent of the completion of the plans and the letting of the contract for its construction. This new unit is to be built as an addition to the experimental engineering building. The bids were received by the department of administration and finance, and were closed Monday, November 16.

The addition is to be a three story structure. A generous portion of the floor space is to be used for laboratories. Half of the addition is to be used by the State Highway Department for testing work. The offices of the department will be located so as to have entrance from Washington avenue. The cost of the structure is estimated to be about $70,000. The plans of the addition reveal that the architecture will conform with that of the present experimental building, thus making the addition an improvement in appearance as well as being practical.

The presence of the State Highway laboratories in combination with the student laboratories will be a big factor in making the University a headquarters for experimental work for the entire state. The students will also be benefited by the opportunity to practice actual highway problems. The equipment will be as complete as the appropriations permit.

New Equipment Added To Mechanical Shops

Several new machines have been added to the equipment of the mechanical engineering shops this year. The forge shop has received a 200 pound steam hammer and an electric furnace. A punch press has been installed in the machine shop, and will greatly facilitate the making of some of the parts of the rowboat motors. In the foundry, a sand blast for cleaning castings has replaced the former tumbling barrel. A twenty-five horse power Brownell steam engine and a double expansion, vertical navy engine have been installed in the experimental shops.

Senior Civils Make Canes at Summer Camp

Tent No. 11—Continue Transit Topography, Twin Elm to Willow, and beyond. Transit No. 11.

So read the assignment sheet on the bulletin board of Civil Camp on August 21st of this year. The day was just an ordinary camp workday, which implies no rain or other excuse for pulling into camp early. About an hour before noon Mr. Zelner came splashing along the shore, for there was no beach, to see how things were progressing. Everything was going fine so the instrument man "pulled up" and the party started for the next station. Tommy Comfort, at rear-rod, remained behind to give a back-sight for orientation. Here is where and when the search for canes commenced.

Mr. Zelner found a diamond willow branch and showed Tom how to make a cane. From that time on for the rest of the day, as a rear-rodman, Comfort made a good cane hunter. As soon as he was "waved down" he let go the rod and dived into the brush or around a point in search of a willow branch to make into a cane.

After that day, a diamond willow cane became the official emblem of the Senior Civils. Hardly a party returned to camp without an assortment of canes in the rough. The number of sticks carried home varied directly as the square of the number of men in the party. Mr. Boon caught the fever and made several long hikes afield, even going as far as Star Island to get specimens to work on when he had no triangulation quadrilateral to rigidly adjust. He spent hours in front of the "council wigwam," whittling, scraping, and sanding, but the results were worth the effort. Bob Drdla and Ray Deegan, the long and short of Tent 10, compiled a motley collection of sticks, most of which had to be thrown away when camp was packed, but even then they carried home a half dozen each.

When camp closed every Senior Civil took back with him a cane that would in the future serve a dual purpose in recalling memories of the two crowning events of his college life,—Summer Camp and the Senior Year.

Radium Lost in Sewer Mains Is Found By Use of Electroscope

To find a tiny capsule of radium which slipped down the drain at St. Joseph's hospital, St. Paul, was the difficult task given to Professor H. E. Erikson of the Physics Department several weeks ago. The radium, valued at $8,600, might have been anywhere in the sewer system of St. Paul or might even have been carried down the Mississippi river. The recovery of the valuable bit of metal by any ordinary means of search was impossible, and Professor Erikson was called on to bring into play the instruments of science.

The apparatus used has been likened to a divining rod or a mechanical bloodhound, but in fact is nothing more than an electroscope which is highly sensitive to the rays emitted by radium. Since the sewer mains are 40 ft. underground, an electroscope carried above ground might pass the radium without giving any indication. An instrument had to be specially constructed that it might be carried in the sewer tunnels.

After four weeks spent in constructing this special instrument, and in exploring the mains of St. Paul, the first indication of the radium's location was given Sunday morning, Nov. 22. By noting the intensity of the rays at various points, the exact location of the radium was finally determined.

Construction of New Physics Building to Start Next Spring

Construction of the first unit of the new Physics building will be started next spring. This unit will be the first half of the contemplated structure and will cost $450,000. It will be located on State street, directly east of the new Library.

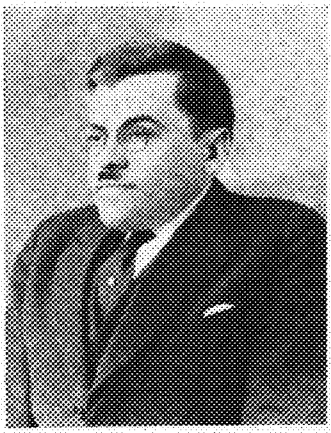
Plans for the new building were started by Prof. James H. Forsythe before his death and are now being completed by Prof. F. M. Mann, head of the department of architecture, and by members of the department of physics.

The building when completed will be the same size as the Chemistry building or new library. It will be in the form of a hollow square with the lecture rooms on the inside facing the court. The upper floor of the structure will house the department of astronomy. The auditorium and observatory will be on this floor and will be lighted by six sky-lights.

It is barely probable that the unit to be built next spring will include the astronomy department but the building of the second unit will bring together the departments of physics and astronomy which have been separated since the building of the present physical laboratory.

According to Professor Zeleny the new building will have complete equipment in every detail, and will contain the latest laboratory facilities necessary for the study of many of the newer developments in science.

Prof. James H. Forsyth Dies After Short Illness



THE LATE PROF. JAMES H. FORSYTH

On Sunday, the first of November, James H. Forsyth, professor of architecture in the College of Engineering and Architecture died at his home, 2256 Hendon avenue, St. Paul. Mr. Forsyth was born in Newcastle, Pennsylvania, and was forty years old. He graduated from the University of Pennsylvania in 1908, received his M. A. at Harvard in 1912, winning a traveling scholarship. During the year 1913-14, he studied at the American Academy in Rome, returning to America in 1915.

He has been a member of the faculty at the University of Minnesota for the past 11 years and during that time has acted as consulting architect to the Board of Regents, chairman of the Student's Work Committee, and a member of the University Functions Committee.

Professor Forsyth was one of the designers of the Memorial Stadium, and his solution to the exit problem has gained national recognition among architects. He was also consulting architect for the library, administration, and several other campus structures.

He will be more intimately remembered by the student body in the engineering college because of his close contact and sympathy with student problems.

Theses Are Required of School of Mines Seniors

One of the things about the school of Mines which is not so generally known, is the requirement of undergraduate theses. A theses on the special phase of mining which interests him most must be turned in by each senior before he can get his degree. This year, there are eight theses being written on the development of an immaginary mine in a district of the student's choice. The mine must be described from the preliminary geologic report to the detailed methods of mining and the erection of a plant.

Nearly every senior metallurgist is writing a thesis on some problem in metallography, a most interesting study of metals and their alloys based on examination with the high powered microscope. There is one metallurgical theses being written on the best method of treating a certain ore preliminary to its smelting. The only paper to be written under the Geology Department will be on the theory of oil flotation.

Election is Held for Student Members of Techno-Log Board

Elections for the student members of the Techno-Log Board were held Wednesday, November 18, with the following results: Three representatives from the College of Engineering and Architecture, Arne A. Jakkula, Lester V. Cameron and George Bohannon. Representative from the three technical colleges at large, Winston C. Close. School of Chemistry representative, Marvin C. Rogers, and the School of Mines representative, Evald Nelson. Other candidates for these positions were Clarence Pilger and Jack Carman, electricals, and Howard Kyser, a miner. The two electricals split up the vote in their section with the result that neither received a sufficient ballot to be one of the three highest in the engineering college ticket. Kyser opposed Nelson and all other positions were uncontested. Though there was this lack of contestancy, a record vote was cast. The Board met for organization on Friday evening, November 27, at the Minnesota Union and elected the following officers: president, Marvin Rogers; vice-president, Winston Close; treasurer, George Bohannon; secretary, Arne Jakkula.

Civil Department Faculty Appointed On Committees

Professor Frederick Bass, chairman, L. F. Boon, F. C. Lang and O. S. Zelner were appointed as a committee to recommend engineers for a survey of certain roads in Hennepin county to determine how much gravel was put on during a recent surfacing project. The action was the result of a claim that the county paid for more gravel than was actually laid.

The committee recommended a list of five engineers of which one was to be chosen by the grand jury to make the survey. Mr. W. L. Darling, former chief engineer of the N. P. railway was selected. Mr. Darling found that less gravel than the county paid for was used on the roads in question, and so reported.

At a meeting of the Professional Men's Club, Mr. H. T. Parks, attorney, Dr. A. E. Benjamin and Professor Frederick Bass were appointed a committee to recommend legislation directed toward the improvement in court practice in taking expert testimony.

Chemist-Miner Football Game Results In 0-0 Tie

One of the strongest teams of several seasons from the School of Chemistry was held to a scoreless tie by a pick-up team from the School of Mines at the traditional game on Wednesday, November 11, played on a medium dry field on the river flats.

The contest was characterized by a brand of good, hard, clean football. There was no spectacular starring by individuals but indications of good team work were shown on both sides. This fact was rather surprising as it was the first time the Miners had played together.

The outstanding feature of the game occurred in the third quarter when the Miners from under the shadow of their own goal posts, started a brilliant march up the field, but were held on the 10 yard line by a clever bit of defensive play on the part of the Chemists.

The referee was furnished by the intramural branch of the Athletic Department and the head linesman by the School of Chemistry.

Technical College Enrollment Increases Over Previous Year

Following is the classified registration of the various technical colleges for both this and last year. Engineering and Chemistry show an increase in numbers while the enrollment in the School of Mines is about the same.

College of Engineering and Architecture

Fall Quarter, 1924-25

	Pre-Bus.	Int. Dec.	Arch.	Arch. E.
Freshmen	4		55	4
Sophomores	9		26	16
Juniors		2	11	11
Seniors		4	16	8
Unclassed			2	
Total	13	6	110	39

	C. E.	E. E.	M. E.	Uncertain	Total
Freshmen	81	154	39	34	371
Sophomores	74	92	49		266
Juniors	50	88	32		194
Seniors	65	68	28		189
Unclassed					2
Total	270	402	148	34	1022

Fall Quarter, 1925-26

	Agr. E.	Pre-Bus.	Int. Dec.	Arch.	Arch. E.
Freshmen	1	5		84	2
Sophomores		11		32	12
Juniors			1	13	13
Seniors			5	9	6
Unclassed				8	
Total	1	16	6	146	33

	C. E.	E. E.	M. E.	Uncertain	Total
Freshmen	64	151	62	59	428
Sophomores	65	110	48		278
Juniors	53	84	41		205
Seniors	56	78	29		183
Unclassed					8
Total	238	423	180	59	1102

School of Chemistry

Fall Quarter, 1924-25

	Chem.	Che. Eng.	Total
Freshmen	17	46	63
Sophomores	6	37	43
Juniors	9	23	32
Seniors	11	19	30
Total	43	125	168

Fall Quarter, 1925-26

	Chem.	Che. Eng.	Total
Freshmen	21	53	74
Sophomores	13	48	61
Juniors	4	19	23
Seniors	4	16	20
Unclassed	1	1	2
Total	43	137	180

There are three graduate students doing research in the general inorganic division of the School of Chemistry, seven in the Analytical Division, 16 in the Organic Division, three in the Physical Division, one in the Technological Division, and 12 in the Chemical Engineering Division, making a total of 42 graduate students.

School of Mines

Fall Quarter

	1924-25	1925-26
Freshmen	21	19
Sophomores	24	20
Juniors	16	19
Seniors	14	14
Graduate		1
Total	75	73

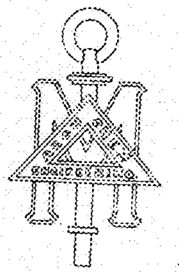
Engineers Star In Intramural Athletics; Bookstore Gives Keys

The old contention concerning the Engineers' Spirit was well proven last spring by the showing made in athletics. We had both quantity and quality. Three days a week found 250 Engineers and Chemists playing baseball, diamond ball, tennis or golf in organized technical college competition. Teams were organized in the various classes. There was a diamond ball league, having two divisions, which made possible as high as 15 games a week. Eighteen men turned out for the college baseball team and practiced or played three times a week. A golf tournament with 30 aspiring Walter Hagens dubbing around the courses provided good exercise. Seventy Engineering Bill Tildens were matched in a tennis tourney which lasted even after the close of the quarter. Hundreds of other students and faculty members found enjoyment in watching the play of the others. On many days the crowd in our "back yard" gave it the appearance of circus day. That much for quantity. All-University championships speak for our quality.

Prof. Zelner, of the Civil Engineering Department, did much toward getting things started. His enthusiasm seemed never to lag. Under his direction, a complete athletic census was taken in the college. At that time, the chemists were not allied with the engineers so that no idea of their desires was obtained.

After getting an idea on what the men wanted to do, we started after equipment. Coach Thorpe immediately made accommodations for the swimmers. Mr. W. R. Smith, head of the intermural athletics at Minnesota, did his best, procuring baseball equipment, diamond balls and bats, and having additional diamond ball courts laid out. He also aided in many other ways and deserves much credit. However, our diamond ball league needed more bats and balls in order to "carry on." The Engineers' Bookstore extended a very welcome helping hand, and bought what was needed, thereby solving that difficulty.

It was the Engineers' Bookstore committee that suggested the alliance of the chemists' and engineers' athletics. This was done and is a very good thing for many reasons. It made the two independent of the rest of the campus. There is enough competition between chemists and engineers to provide all of the athletics that either cares for. The opportunity for meetings between chemist and engineer is greatly aided, which is very desirable.



Intra-Mural Key

To be a little more specific concerning those intra-mural championships that the engineers won, the first was taken by the freshmen engineers' diamondball team. They first won the title in the Engineers'-Chemists' league defeating the junior and senior chemist team in the deciding game. Either team could have won the all-University championship, playing as they did that day. After downing the chemists, our frosh played the ag faculty team, which had been declared victors in the ag campus league, and were again the winners. A letter was sent from a member of the ag team to Dean Leland, commending the brand of sportsmanship that the engineers had shown. To win the intra-mural title, the frosh met against some rather trying circumstances, but behind the superb pitching of Lloyd Hoover, won the game. For the All-U title, the team received intramural letters. For the Engineers'-Chemists' championship they received college letters with sweaters.

The other Intra-mural championship was won by our hard working baseball team and is the most coveted of all intramural titles. Enough men for three teams were on hand to play the first game, but the number soon thinned down to 15. Practices were held two, and sometimes three times a week in preparation for the opening of the college league. In the first league game, Max Joern held our opponents well in hand and won easily. In the second game, our short-stop tried his hand at pitching, owing to the absence of Joern, and we received our first and last defeat of the season. In the championship contest the Engineers came through with a brilliant nine to seven victory. Max Joern allowed the previously undefeated Sigma Chi team but a few scattered hits, Carl Lidberg being the only man who really did any batting. Aside from Joern it is difficult to pick any outstanding stars among the Engineers. Practically the entire team will be back next spring which will again assure us of a good baseball team. The players were awarded intramural keys.

The men are: P. W. Manson, catcher; Max Joern, pitcher; K. W. Foster, shortstop; E. F. Young, first base; Frank Sweeney, second base; E. Pierson, third base; R. C. Deegan, left field; H. McAndrews, center field; C. E. Meyerdick, right field; Ed Hendrickson, utility.

Another engineer that distinguished himself as an intra-mural athlete of prowess, was Art Christianson. Art defeated the best of the engineer golfers in the engineers' tournament. After winning this tourney, he was in good form for the winning of the All-University title which he did defeating the cream of the golfers of the campus. Christianson was awarded two gold medals and a college letter for his efforts.

The engineers' spring tennis tournament was also successful. Homer Tatham and Arne Jakkula were the finalists. Jakkula forced Tatham to the very limit before losing by a close score. Tatham received a gold medal and a college letter and Jakkula was given a silver medal. The medals for the golf and tennis were given by the Intra-Mural Department.

All of these events took place during last spring quarter. This year should be a bigger and better one. The newly organized Technical College Athletic Board should help to put athletics in its rightful place in college activity. Athletics is the one open thing, free to every red-blooded engineer, chemist and architect. It provides that desired opportunity for the different classmen to meet. It sweeps the cobwebs from the fagged minds of all and makes us better students. Get in the game; it will do you good.

Freshman Miners Are Welcomed at Smoker

Each year the freshmen of the School of Mines are guests of the upper-classmen at a smoker and general get-together. This year's traditional reception was held on Tuesday night, October 20. A program of games particularly adapted to freshmen was followed with keen interest, while a boxing bout between Spain and Pixler furnished plenty of thrills for four snappy rounds.

The
MINNESOTA TECHNO-LOG
University of Minnesota

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"YOU'LL never make an engineer!" was the keynote of an advertisement which a large industrial concern ran in a number of college publications recently. This add portrayed a young man in academic dress, standing at the doors of his college and in conversation with a professor who had just made this contradictory statement. The caption goes on to tell of how this same young man entered a sideline of engineering, one in which he could apply some natural ability, and in the course of a few years had achieved a remarkable degree of success. Though this is all very well and was a good stunt of advertising for this particular firm, it nevertheless brings before our mind a very important question.

First of all, who of us will be engineers and who not? The term "Engineer" in the past has had the connotation of dealing with the purely technical side of the profession and all other branches were classed otherwise. If this, then, is true, a scant ten per cent of students engaged in technical training in the colleges of America today will ever become engineers. The writer was recently in conversation with an employment head of the largest electrical concern in existence and who in the course of a year visits over sixty of the largest colleges and universities in the United States. He declared that less than one-tenth of the men that came to his company followed purely technical fields, i. e., research, design and the like. Others went into sales work, construction, publicity and allied lines.

It is our belief that each of us are born into this world with certain talents. One of the purposes of our college course is to bring our aptitudes out into the light so that we can determine the nature of work that we will later engage in. By previous observation of oneself, it should be found out the advisability of ever starting an engineering education. The first year in most cases points out to the student whether or not he is on the right trail and the system is more or less automatic when the part of the student's work committee is taken into consideration.

College can be called a great awakening. Various opportunities in a multitude of activities, scholastic and extra-curricular, are on every hand.

Our University career should so present the world to us that our minds will be made up in a general way as to the way to turn upon graduation.

Perhaps some of us will never make "Engineers." This term, originally, a noun, has come into common use as a verb, with the meaning of management and to a large extent, successful achievement. Engineering, like religion, is practical and its principles are applicable to any branch of endeavor which is concerned with the solution of a problem. This is all-embracing, for what is life itself but a stupendous problem?

Some, perhaps, will fail in engineering but they would do so in any field. What line of human endeavor does not require ability, initiative and downright hard work?

IT is with deep regret that we chronicle the death of Prof. James H. Forsyth. Previous to his demise he had been in excellent health and spirits and the notice of his death was learned of with great surprise. His work in connection with the student's work committee is an example of fair mindedness and has set a precedent that will be hard to follow. Many an erring freshman received kind words of encouragement or stern words of admonition as the case might have been, and many a now successful alumni can look back upon his school days and say, "He was a real fellow."

By your deeds, ye shall be known. His have won him an niche in the invisible Hall of Fame of the University of Minnesota.

MINNEHAHA FALLS, made famous by Longfellow in his "Hiawatha," and Minnesota's fame as the Land of 10,000 Lakes are in the immediate danger of disappearing as set forth by E. V. Willard in his article on "Our Lake and Stream Levels." That the water level has decreased, is an alarming fact for every reader, as all are vitally affected by this situation.

The problem is discussed in true engineering style by Mr. Willard, a former student of Minnesota and who is now the State Commissioner of Drainage and Waters. This proposition resolves itself into one of engineering and we can rest assured that it will be coped with successfully with such a man as he being state commissioner.

"Ceramic Engineering" is one branch that is as yet practically unknown in colleges of the Northwest, though we believe that such a course is given at Iowa. Agricultural engineering was only recently added to the curriculum here at Minnesota and the time may come when ceramics will be also included. At any rate, this account by A. F. Greaves-Walker, head of that department of North Carolina State College, will serve as the first step in that direction.

The University of Minnesota is fortunate in having a man on its staff who recently stepped forth into national recognition for his research on the effects of heat treatment of various common metals. Mr. Orrin W. Potter is practically a pioneer in his efforts and his paper presented at a national convention of foundrymen was very favorably received.

We think that all of our readers will be interested in the account of the radio conference held the first part of November in Washington, D. C. Questions came up here that all are concerned with, for who does not have a radio set in their home?

Regulation of Radio Broadcasting

(*Continued from page 69*)

of the listening public, of the radio industry and of the broadcasting are all served by that form of broadcasting which provides a meritorious program of entertainment and education,—deprecated the use of broadcasting for direct sales effort, and stated that the problems of radio publicity should be solved by the industry and not by the government.

The third committee was in charge of Deputy Commissioner A. J. Tyrer, work consisting of detail work on license and classification.

Operating regulations under Gen. Charles McK. Slatzman were discussed by the fourth committee and matters dealing with the Navy were taken up by committee five, Captain Ridley McClean acting as chairman.

"I suppose that you are most interested in the recommendations relative to the activities of the amateurs," Mr. Jansky said. "Inasmuch as the amateur has caused no serious disturbance, no one attempted to limit his activities. A recommendation prohibiting the use of spark sets by amateurs was passed at the suggestions of the amateurs themselves.

"Interference was the knotty problem of committee seven under Gen. O. Squier. Some of the salient points discussed by this committee were the radiation from receiving sets, maintenance of assigned frequencies, harmonics, non-radio electrical interference, spark transmitting sets, arc transmitting sets, use of unnecessarily high power, careless testing, high power broadcasting stations, etc. The work of this committee was voluminous and is worthy of careful study.

"Judge S. B. Davis was the chairman of committee eight which dealt with legislation. I have spoken previously about the need for this. Additional recommendations were that in case of war, the president should have the right to control the activities of all stations; that monopoly in broadcasting should not be permitted; and that rebroadcasting of programs should not be allowed except when permision is granted by those operating the original transmitter.

"The last committee considered the problems of copyrights and was headed by the Hon. Wallace H. White. This is one of the biggest questions and it aroused much interest. It is one of those problems again which the government cannot solve and will have to be worked out by the industry itself. Representatives from some of the largest music publishers in America were there as well as program directors from the four corners of the country."

"How about broadcasting conditions in the Northwest?" I asked.

"In my opinion and in that of many others, the broadcasting situation is more nearly ideal here than it is anywhere else in the United States. This is because this community is primarily interested in the operation of one large station supported by the business interests of the locality."

Modern Sewage Disposal

(*Continued from page 77*)

tion which included a gauging of the flow in the sewer system, and hearing the suggestions of many engineers and others, the city council ordered plans prepared for an activated sludge plant with a capacity to treat 2,500,000 gallons per day, the estimated cost being approximately $280,000.

The reason for the adoption of the activated sludge plant at Rochester was partly because it eliminated the necessity of pumping the sewage. The main sewer arrives at the disposal plant at an elevation about 6 ft. above the ordinary level of the river; since the vertical drop through the Imhoff tank-percolating filter type of plant is about 16 ft. and the drop through the activated sludge plant is only about 2 ft. 6 in., and the effectiveness of each type is about the same, the saving of the first cost of a pumping station which would amount to about $35,000 and the saving of the annual cost of pumping which would amount to nearly $3,000 annually became an important consideration. Even without the item of pumping, the activated sludge plant was slightly less expensive.

In the activated sludge plant, the sewage first goes through a revolving drum screen with openings two in. long by three-eights in. wide. After going through a Venturi meter, it goes to the aerating tanks. Here it flows through two parallel channels 20 ft. wide, 12 ft. deep and 280 ft. long; in each of these channels are placed 14 aerators which by means of surface agitation introduce oxygen from the air into the sewage. From these tanks it flows into two settling tanks set in parallel and equipped with Dorr sludge thickeners, from these tanks the sewage flows over weirs, aerated and clarified, to the river.

The sludge settling to the bottom of the settling tanks is drawn through an opening in center of the bottom and returned to the aerating tanks in the proportion of about one part sludge to four parts of screened sewage. This sludge is termed activated because it appears to be necessary for the bacterial activity that utilizes the oxygen drawn in by the aerators.

The excess sludge and the screenings are mechanically removed to a sludge digestion tank 130 ft. by 63 ft. in plan and about 20 ft. deep. In this tank the sludge remains for several months, slowly returning by anaerobic bacterial activity to a condition in which it becomes entirely inoffensive when it is drawn out of the bottom of the tank to dry on the surface of the sludge bed.

The sludge bed is 160 ft. by 170 ft. in area and about 2 ft. in depth. It consists of a layer of gravel overlaid with a layer of sand 6 in. in thickness.

In this plant is it expected that the aeration tanks will be used only during the periods of low water in the river and that at other times the sewage will go directly from the meter to the settling tanks and thence to the river.

The settling tanks and the sludge digestion tanks are housed in by a building having concrete walls 12 ft. high and a creosoted timber roof construction. The roofing will be of red asbestos shingles. A heating plant is provided for these buildings to keep the temperature up to 55 deg. F., as below this temperature there is but little bacterial activity.

In the building there is provided an office and laboratory for the superintendent.

The contract for this plant was let September 4th to G. Schwartz & Co. of Rochester for the sum of $277,600. Both plants were designed by the writer with the assistance of Messrs. Lagaard, Boon, Wise of the College of Engineering and Architecture and a number of others, nearly all graduates of the College.

Perhaps the interesting feature of the situation at these two cities is that although of similar size and located similarly on small rivers of nearly the same type, entirely different types of disposal plants were adopted.

With an Engineer in the Army

(Continued from page 72)

Chief is assisted by an Aide with the grade of brigadier general and a staff of 15 to 20 officers in the Washington office.

Troop units of the Corps which are stationed in various parts of the continental United States and in our foreign possessions are officered exclusively by engineer officers. The basis organization of these units does not differ from that of other military units. Of course, the nature of the work carried on by a company of an engineer combat regiment is different from that with which an infantry or artillery unit concerns itself, but the administration and supervision is practically the same in both cases.

The Engineer Department is organized on decentralization principles. The continental United States, the Philippines, Hawaiian Territory, Panama, Porto Rico, and Alaska are divided into about 53 engineer districts. The size of the districts depends on the extent of the engineering activities contained therein for which the Corps of Engineers is responsible. It is contemplated that the district engineer, an officer of the Corps, with a suitable staff of civilian employees, shall be able to closely supervise and carry on the work of the district. Sometime in districts where activities are extensive, one or more officers may be detailed as assistants to the district engineer.

The engineer districts in the United States are organized into eight divisions, each containing from three to six or more districts. A senior officer of the Corps, a man of long experience, is detailed as division engineer. He supervises the work of the district engineers of his division and acts as a consulting engineer in his relations with them. The Chief of Engineers, through the division engineers, holds the district engineers absolutely responsible for the engineering activities within their respective districts. The district engineers, through the division engineers, correspond directly with the Chief's office on matters pertaining to their districts. There is no other chain of command as in military units.

The civil duties of district engineers consist almost exclusively of river and harbor improvement and the construction of sea coast fortifications. The projects under the first of these general duties, that of the improvement of rivers and harbors, vary widely in the different districts. They range from the construction of levees and bank revetment on the Mississippi River, to the dredging of Ambrose Channel with a depth of 40 ft. in New York harbor, and to the construction of locks in the St. Mary's River, Michigan, large enough to accommodate two of the largest lake freighters at one time.

A military duty which district engineers or their assistants are now often detailed to perform is in connection with units of the Organized Reserves. This is a post-war development and is attaining great prominence and importance.

A considerable number of engineer officers are detailed on miscellaneous civil duties. Some of these duties are of a continuing nature while others are temporary in connection with some specific project.

At the risk of boring the readers of this article, I am going to list under the two major headings the duties which an engineer officer may be called upon to perform at one time or another.

MILITARY DUTIES:

With engineer troop units of the Regular Army.

With engineer units of the Organized Reserve.

Instructor with National Guard engineer units.

R. O. T. C.

Instructor or student at a special service school (The Engineer School, The Infantry School, The Field Artillery School, etc.).

Instructor or student, The General Service Schools, Fort Leavenworth.

Instructor or student at the Army or Naval War College.

In the office of the Chief of Engineers.

In the engineer supply service (in charge of engineer supply depots).

In connection with war time procurement of supplies.

War Department General Staff.

General Staff with troops.

On the staff of corps area commanders as corps area engineer.

Military attaches to foreign countries.

Student in foreign service schools.

Military aide to the President.

Student in civilian technical institutions.

Detailed in other branches of the service temporarily.

Instructor, U. S. Military Academy, West Point, N. Y.

CIVIL DUTIES:

Division engineer.

District engineer.

Member, Board of Engineers for Rivers and Harbors.

Engineer commissioner or assistant, District of Columbia.

Superintendent (or assistant) of Public Buildings and Grounds, in District of Columbia.

In the office of the Chief of Engineers.

Governor of the Panama Canal Zone.

Engineer of maintenance, the Panama Canal.

Member, Mississippi River Commission.

Member, Board of Road Commissioners for Alaska.

In charge of Lake Survey.

Member, Federal Power Commission.

Member, American Battle Monuments Commission.

Member, California Debris Commission.

Engineer, St. Lawrence River Waterways Commission.

I believe that most of the above listed duties are self explanatory. It would require too much space to describe in detail the various assignments. The list indicates, if nothing else, the variety of work which may fall to the lot of an engineer officer.

Having provided a background of information, it is possible now to point out opportunities as I see them.

Let us consider for a moment the matter of pecuniary compensation. Here I reiterate that to anyone wishing to accumulate wealth, service in the Army offers no inducement. The income of the Army officer from his pay is moderate indeed, and often does not compensate him for the great responsibilities he bears. But it is assured and regular. There are no periods of depression, and his declining years are made easy by the pay he gets even after he is retired. In general, this amounts to three-quarters of the pay he was receiving at the date of retirement. If he has served for a period of 20 to 30 years, the retired pay represents the income from a principal amounting to, perhaps, $75,000. The base pay of a recently commissioned second lieutenant amounts to $1,500 per year. This is increased somewhat by certain allowances. The pay increases from that point by reason of promotions to higher grade and length of service.

The variety of one's work in the Corps is a most attractive feature. It is true that through one's work alone it is difficult to specialize on one narrow phase of engineering. Rather, the experience is broad and all inclusive and the older officers are generally all around engineers. Within limits one may choose the nature and location of assignments. At least one's desires are considered in the matter of assignment.

(Continued on page 96)

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What Price, Diplomas?

(*Continued from page 78*)

learn about engineering, a desire to apply himself to the training of his mind to thereby improve himself and become a more useful citizen. Then the college begins to do things with him. Finding him with a boundless hunger for learning, it tosses before him, with a careless gesture, more learning than he could absorb in several lifetimes, while it puts him through a training course so rigorous that by mid-quarter he is hovering between sanity and inanition. If he survives the onslaught, he finds he has little leisure to think of self-improvement and greater opportunity for service, being engrossed in the more immediate problem of "getting by." He does not want a failure chalked up against him, with its attendant disgrace. He does not want to appear "dumb" in competition with his classmates. He does not want to drop out of the social life of the campus, of which he has probably seen enough to wish for more. The idealistic motives that brought him here are scrapped—he may even conceive a positive distaste for engineering and determine never to have aught to do with it, but he will keep up the pace to avoid "starting something he couldn't finish." From being bombarded from all sides with knowledge, he gradually develops a psychological defense. He grows a thick shell, almost knowledge-proof, lest he be overwhelmed with learning. From then on, any fact that is put in his possession is against his bitter opposition.

As he grows in wisdom, he becomes proficient in learning, just the right amount to pass a course, until he eventually reaches such a degree of efficiency that he finds he has leisure to devote to things that are of interest to him—athletics, perhaps, or the manifold "activities" of the campus, or society, or campus politics. Into these he puts his heart, while by a methodical daily stint he keeps up his class work.

The type of student I have just described has long been held up as a terrible example of what a student should not be, but it seems to me he is, or should be, an asset to his school and a useful member of society. He learns possibly as much during his four years as the most assiduous bookworm, though what he learns has little relevance to engineering. When he is supposed to be acquiring a knowledge of calculus, he is instead acquiring skill at pitching a spheroid across a plate, or nosing out news for the Daily, or laying a careful campaign to annex the presidency of his class,—no mean courses of training, for physical agility, facility at writing or finesse in politics are, in certain situations, quite as much to be desired as a knowledge of differential equations.

It seems to me that this type of a student comprises a majority of engineer students, but, of course, there are exceptions. There are students, many of them, who never lose that avidity for learning that characterizes the first quarter fresh-

(*Continued on page 98*)

BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS.

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

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Our Lake and Stream Levels

(Continued from page 71)

the future general public welfare, so far as it is within our power to visualize future demands.

Will our lakes again return to the stages they have occupied in the past?

It would, of course, be presumption on my part or on the part of any one to attempt to predict natural phenomena for the distant future. Leaving out of consideration the lowering and destructive effects of geologic processes too gradual to observe and such slow or more violent changes which take place in the shape of the earth's crust from forces which operate in the interior of the earth, I think we are justified in analyzing present conditions and make conjectures for the future in the light of what we know of the past.

Precipitation records, more or less complete, available for the state cover a period of 88 years. Prior to 1880 only a very few stations were maintained and only after about 1890 were stations generally distributed over the state. To those who take the time to study these records, present lake and stream stages need not necessarily be alarming. Data show that we are passing through a period when the rain and snow fall generally over the state as well as the nation has been below the mean for several years. Records for the past two years will probably disclose worse drought conditions over the nation as a whole than has been experienced for 40 or 50 years. With the exception of 1919 when there was a very slight excess over the mean, Minnesota has had a continuous deficiency below mean in precipitation for eight years.

At first thought, this might indicate a serious situation. Reference to past low records, however, gives the consolation that similar if not worse conditions have prevailed in the past. Rain and snow fall records for the 11 year's period including 1885-1895, with the exception of 1892, show the moisture supply to have been continuously below the mean. We have no authentic records on what were the conditions of our lakes and streams at the end of this period, but whatever they may have been, we know they returned to normal and extreme high stages during the wet period 1901-1909, and again between 1912-1916. We may confidently expect wet years to return and with them a restoration of lake and stream stages.

It is only rational to conclude, however, that due to the operation of agencies other than precipitation, the same gradual lowering which has gone on throughout the ages, continues at present, and that reckoning in terms of generations, there is a cumulative lowering and destruction which will ultimately mean a complete disappearance of most of our lakes. To what extent we should concern ourselves with an evolution which takes place through geologic ages rather than human eras is a subject for conjecture. Changes in the shape of the earth's crust are beyond human power to influence. Lowering of the lakes by the natural erosion of the outlets, for instance, is not. That our efforts should constantly be directed towards eliminating and retarding all destructive elements is a public policy worthy of constant consideration in the treatment of all of our development problems.

What, if anything, can be done to conserve our lakes for the future?

The construction of a permanent dam or spillway in the outlet of a lake will aid in its maintenance and conservation in several ways. The crest of the spillway can be made to define the elevation below which the lake cannot be further lowered by the escape of water over the surface through the outlet. The spillway can be made of the same elevation as the bottom of the natural outlet in which case the only effect it will have will be to prevent the lowering of the lake by further erosion. If it is constructed to an elevation higher than the natural outlet it will not only prevent further lowering by erosion but will establish a new and higher minimum at all times. This new minimum will be higher than the elevation of the spillway when there is water flowing out of the lake. During protracted dry spells when evaporation exceeds the supply of run-off from the tributary area, there will be impounded behind the spillway, a reserve supply to meet evaporation and seepage demands not available for these purposes in a state of nature, after the lake elevation has receded below the outlet.

The artificial control of outflow from a lake can also be made to stabilize its elevations and prevent extreme natural fluctuations, a thing greatly to be desired on lakes where shore lines are in demand for residential purposes. In this respect, and to a more or less degree in all respects, the artificial control of outflow is a problem peculiar to each lake, the technique of which should be left to an engineer with a knowledge of hydrology and who can properly visualize the factors and forces which are the cause of natural objectionable stages and can convert them into agencies that will create more desirable conditions without unduly disturbing and jeopardizing the rights of riparian owners.

The most serious obstacle to the artificial treatment of lakes in our state arises from the fact that the rights of riparian owners to the use of the shore line to the waters' edge are defined by natural conditions. It is made unlawful for a person to disturb the natural elevation of a lake no matter what such elevation may be. The judges of the district court and county boards, however, may raise, lower, and otherwise improve meandered lakes in the interest of the public health, navigation and the general public welfare by ascertaining to what extent riparian owners will be affected by any needed improvements, adjudicate their rights and provide for the assessments of the costs of the structures and damages to property.

The rights of riparian property owners with respect to stages of meandered bodies of water as against the rights of the public to the most advantageous use of such waters have never been as specifically and clearly defined by statute in Minnesota as in other states where water is not so abundant and where its presence and use assume a more vital relationship to agricultural and industrial expansion. The state supreme court, perhaps, has gone further in defining such rights than has the legislature in providing orderly procedure to be followed in establishing them.

Our present law authorizing the fixing of lake levels needs to be redrafted. The state should be declared by a special statute to have an undisputed and perpetual easement in the beds of meandered lakes and streams up to their average high elevations to which stage they may be raised at any time for the purpose of improving navigation, public water supply and promoting the general public welfare, and a procedure outlined whereby the judges of the district court shall be given jurisdiction over every piece and parcel of land to be effected by any proposed change of natural levels. A law more conformable to practical consideration than our present statute is needed.

More thought need be given to the equitable assessments of costs. Who are the beneficiaries in proceedings to conserve our lakes? What should be the measure whereby such benefits should be determined? Should lake shore owners bear the total costs of lake improvements or is there a sufficiently real general public benefit to merit a distribution over the country or state or both of a portion of the costs? These are matters which should be given intelligent thought and legislation enacted to meet the situation.

There are certain limitations surrounding the improvement of lakes which should be kept in mind and which

(Continued on page 96)

Heat Treating Grey Cast Iron and Semi-Steel

(*Continued from page 75*)

ture. It was also deducted that a very close approximation to the critical temperature was made from the chemical analysis as follows:

Critical Temperature = 730° C + (28° x % Si) — (25° x % Mn).

2. The transverse strength varies on a straight line relation with the tensile strength.

3. The relation of hardness to ultimate tensile strength was noted. The graph of this relation showed that Brinell hardness numbers are proportional to ultimate strength, while the scleroscope hardness numbers do not seem to show any relation to the ultimate strength. Ordinarily Brinell hardness is considered proportional to ultimate strength and scleroscope hardness to elastic limit. This relation seems to be borne out here in cast iron since the elastic limit of cast grey iron is a variable quantity depending on many things and ranging from zero to near the ultimate strength.

4. Micro-graphs were a very good indicator of physical properties and greatly aided in arriving at conclusions. The accompanying micro-graphs are characteristic of the heat treated specimens.

Conclusions. 1. Proper heat treatment can greatly improve the general properties of grey cast iron and semi-steel. One of the important results is a uniform hardness and the elimination of massive cementite under annealing.

2. To properly heat treat, the correct critical temperature must be located and the temperature carried only enough above this to insure all parts being heated above the critical. This can be determined by ordinary thermal analysis.

3. The critical temperature of grey cast iron and semi-steel can be calculated with a fair degree of accuracy from the chemical analysis according to the following formula:

Critical Temperature = 730° C + (28° x % Si) — 25° x % Mn).

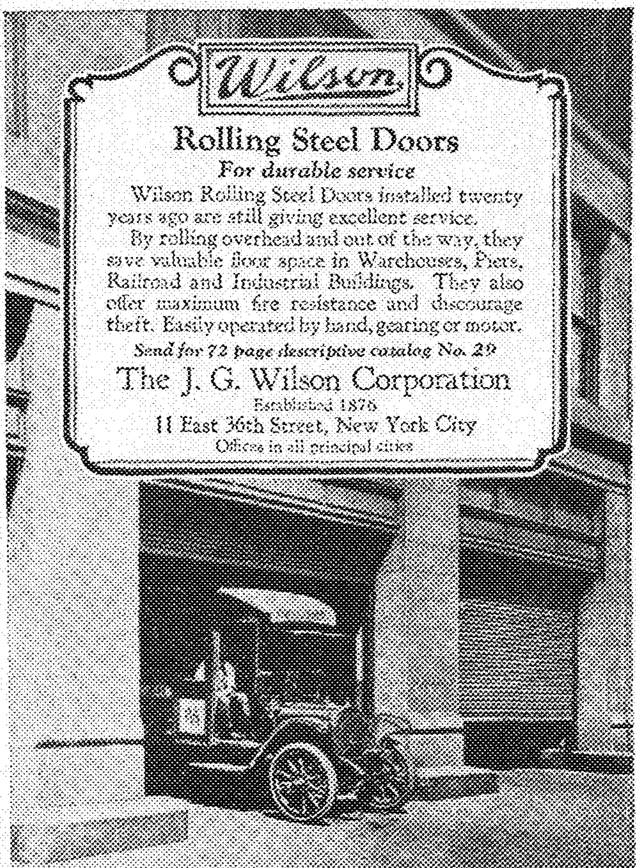
4. Carbon is oxidized when subjected to a quench from just below critical temperature.

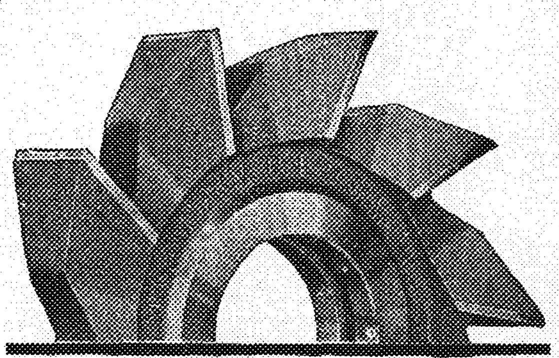
5. The best combination of properties was obtained by heat treatment T-1 (heated to 870 deg. C (1600 deg. F.), held for 3 hours, cooled to black in furnace and then air cooled). This was the heat treatment recommended by the Schaap process. This produced a uniformly soft product with only a slight reduction in strength properties.

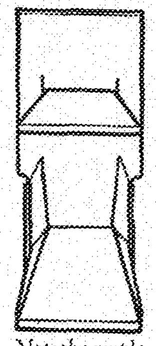
6. Holding at high temperature for long periods of time or cooling very slowly such temperatures produces extreme softness, but also greatly reduces the strength properties.

7. To overcome the difficulty of dimensional changes, grey cast iron may be machined, and then subjected to a quench to produce hard iron which is not affected by intermittent heating and cooling below the critical.

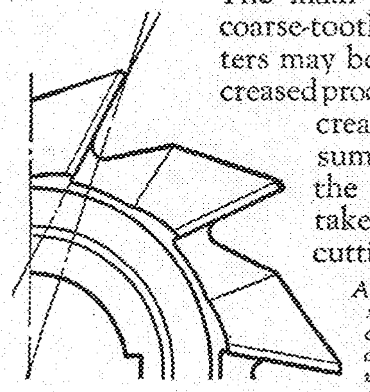
8. The properties of both grey cast iron and semi-steel can be greatly varied by heat treatment and the possibilities of improving and controlling these properties offer great prospects of practicability. To do this, additional systematic research is necessary for the coordination of chemical composition, physical properties, and correct heat treatment along with a study of the micro-structures. This, with the use of the ferro-alloys in cast iron and semi-steel, will help to extend their field of usefulness and prevent somewhat the further encroachment of the other metals and alloys.







Note the ample chip space between the teeth



At left—The drawing shows the increased angle of undercut and the well backed up teeth

With an Engineer in the Army

(Continued from page 88)

Many of the projects in which the Corps of Engineers is interested are of more than local importance. In the engineering problems involved, some of them rank with the largest undertakings in the country. Consider the Wilson Dam at Muscle Shoals. Surely the construction of such a structure is no trifling job, but one that calls for the highest engineering skill and technical knowledge. The Wilson Dam was built by the Corps and many engineer officers have been identified with this work. Thus service in the Engineers may lead to connection with the major engineering projects of the time.

Becoming identified with even some of the lesser projects which appear huge in comparison with many of the construction jobs with which prominent engineers in civil are connected, leads to acquaintance with the best men in the profession. To any engineer, contact and the exchange of views with the recognized leaders in the profession means much and there are splendid opportunities for that very thing in the Corps.

Service in the Engineers affords ample opportunity to travel and become acquainted with the different sections of the United States as well as with our outlying possessions and foreign countries. It is true that engineers in general are nomadic. But I believe that with the certainty of troop assignments in Hawaii, the Philippines or Panama, and the possibility of special civil assignments in Alaska, the army engineer has exceptional chances. To me this feature of the service appeals very strongly and I welcome each change of station. Sometimes the new station is not recommended highly and has its drawbacks, but there are always compensating advantages. After some years of service, it is almost impossible to go on a new assignment without meeting old friends and acquaintances.

The charge has been made in the past that army officers hold themselves aloof, that they intentionally limit their circle of friends among civilians. If that was true in the past I am sure it is quite untrue now. It is less likely to occur among engineer officers who are thrown in intimate contact with civilians in their civil work. Do not feel, therefore, that by seeking service in the Corps you become a person apart from the community life. Indeed, an officer on district work can and should enter heartily in community affairs.

From the duties enumerated above, it may be readily deduced that an engineer officer is never finished with schools and study. True, the study is primarily of military subjects, but the habit of study becomes ingrained and one need never travel in a rut. I consider, that to many, the opportunity for study is of decided importance.

Briefly, I believe that a young engineer may find in the Army opportunities for an assured income, for a liberal variety in his work so he need never become stale, for connection with the greatest of engineering projects, for travel and acquaintance with many parts of the world, for contact with leaders in the profession, for modest social standing, for the liberalizing acquaintance of worth-while people and finally, for service in a brotherhood whose motto is "Essayons."

Our Lake and Stream Levels

(Continued from page 92)

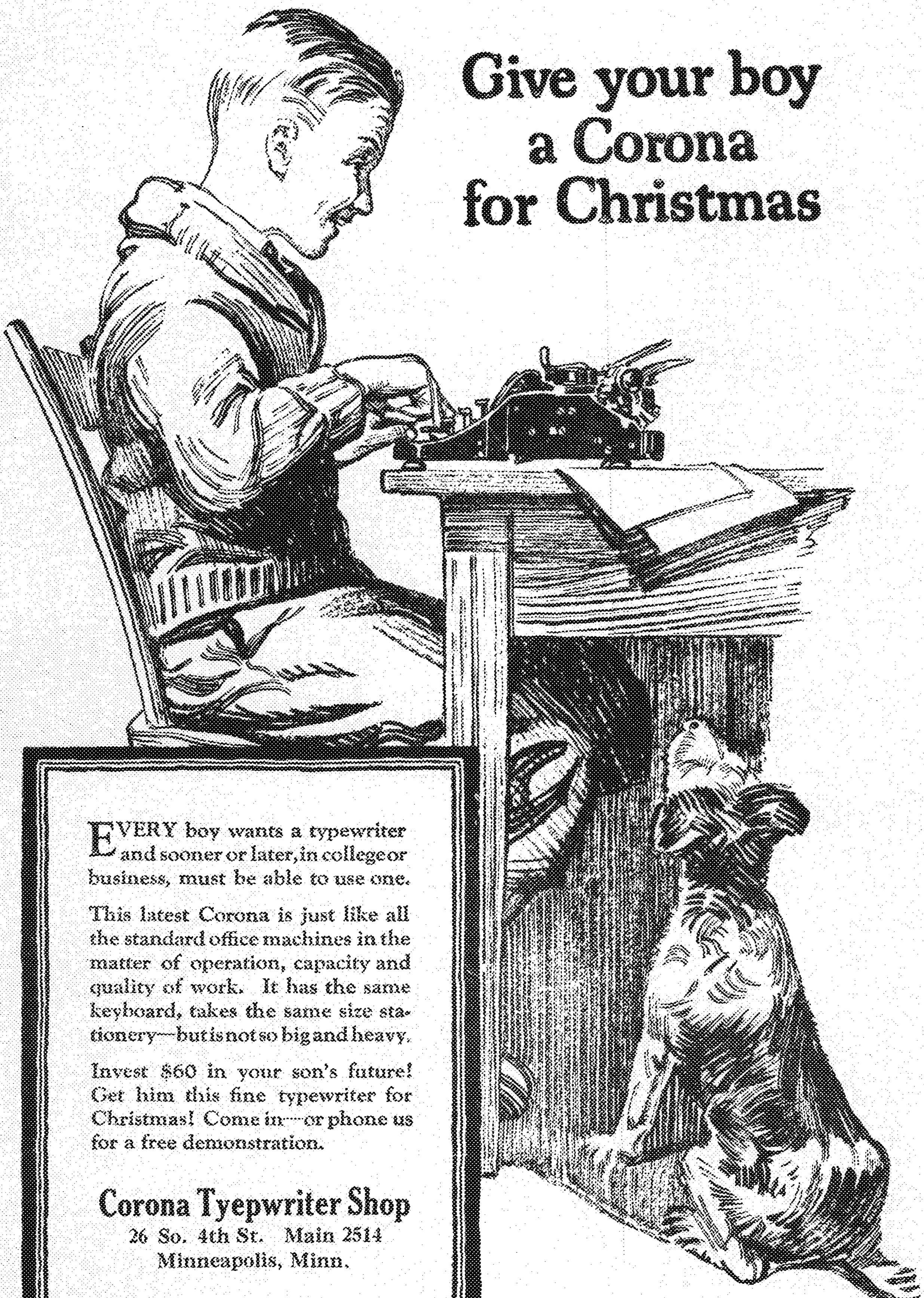
the best laws and procedures cannot be made to overcome.

I think it may be said without a supporting argument, that for all practical purposes, it is not economically feasible to raise by artificial structures, the natural stages of a lake which lacks a natural surface outlet. Such a body of water will rise when the supply from all sources exceeds the demands of evaporation and seepage, and lower when opposite conditions prevail. Except to the extent that it may be possible to better conserve the run-off waters from the area which supplies such a lake, when dealing with normal development problems within such an area, natural stages should be accepted as the best that may be expected.

The construction of a dam in the natural outlet of a lake after the surface has lowered so that water has ceased flowing through the outlet, will in no wise affect the stage of such a lake. This fact is so obvious that the statement of it would seem superfluous. Yet the number of projects for the restoration of higher lake levels under just such circumstances, which are being discussed and promoted at present, would seem to justify an emphasis of this point.

And lastly, the engineering of the forces of nature and of the physical structures necessary to accomplish the desired results are proving relatively simple as compared with the engineering of the conflicting interests and view-points of those to be affected. A sharp conflict of effects of high and low stages prevail on nearly every lake. Extreme high stages and stages above normal are almost, if not quite, as objectionable as those below the mean. Both high and low natural stages are tolerated because there is no one on which to fasten the blame for either. Let some one organization or authority, however, construct a dam, culvert or spillway to define or control the outflow, be such a structure ever so carefully and effectively designed, those responsible for its construction are at once placed on the defensive as soon as the stage rises to a point where some property owner construes it to deprive him of his "rights." The farmer, who at low stages cuts hay and otherwise makes use of the bed and shore line of a lake at low stages to increase his income, suffers a direct loss when the higher elevations prevail. As against him the owner of residential property looks upon the lower stages as depriving him of the best use of his holdings. The material and mercinary clash with the aesthetic in nearly every case. Both have to be given due consideration and properly evaluated if lasting results are to be obtained.

The matter of the restoration to desirable levels of our lakes and the conservation of our waters in general for future use and enjoyment are subjects which should have been given serious consideration long before this. But they are subjects of the kind to which it is difficult to direct public and legislative attention except when an actual emergency exists. We are today in about the same position in regard to our lakes and streams as the proverbial Missourian found himself with respect to his leaky roof. When it did not rain it did not leak. When it rained he could not repair it. When it rains abundantly there is plenty of water in our lakes and streams. When it does not rain there is none to conserve.


Give your boy
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EVERY boy wants a typewriter and sooner or later, in college or business, must be able to use one.
This latest Corona is just like all the standard office machines in the matter of operation, capacity and quality of work. It has the same keyboard, takes the same size stationery—but is not so big and heavy.
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What Price, Diplomas?

(*Continued from page 90*)

man. To such as they, the matter of an instructor holding his class fifteen minutes overtime means only an additional opportunity for absorbing knowledge. If assignments are long and hard, they console themselves by contemplating the excellent grasp of the subject they will thereby attain. Such men crave education. They are an enigma to their classmates and often unpopular, but they are present in every class and form perhaps one-tenth of the student body. Upon graduation, they frequently make excellent engineers. (In any reorganization of the course, they must be taken into account. They are a small but important element.)

So we have, let us say, nine-tenths of the students with a "passing" interest in their work and one-tenth interested in learning for its own sake. The smaller group, after graduation, designs bridges and transformer plants, writes textbooks and research reports, and reads papers before meetings of the Tau Beta Pi which you and I, Ingvald, cannot understand. For that matter, of course, we cannot understand the textbooks that they write, but that is neither here nor there.

The members of the other group are not so successful in engineering. After leaving school, either by graduation or by the less formal ministrations of the Student Work Committee, they hover between mediocrity and oblivion as long as they follow engineering, but generally break away from it, going into contracting, selling, bootlegging, or law, and eventually succeed about as well as the others.

Each of the above groups has a sort of contempt for the other, but this is merely because, being so different, neither can comprehend the other. As a matter of fact, and of the dean's records, both classes are valuable to society, and are valuable largely because of what they learn in college. The designer is a success because he learned the fundamentals of design, and the politician is a success because he learned the principles of politics, in college.

Both of these groups, then, should go to college, but it seems to me a mistake that both should be put through the same course of training. To include the slow with the swift, the idler with the worker, inevitably means that, neglecting the failures, the pace of the class must be the pace of the slowest man, and that lectures and text must be confined to matters which the dullest can understand. This is an injustice to the brilliant one-tenth, and a hardship to the indifferent nine-tenths, who can only keep the pace by an effort which perhaps costs them sleepless nights or a sacrifice of time spent on matters in which they are more interested.

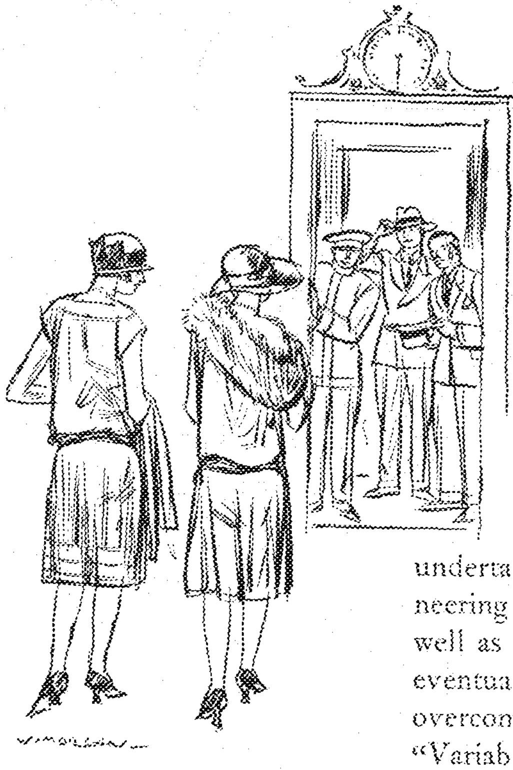
Such is the problem, and for a solution I submit, with proper diffidence, the following, without wishing to embarrass the Society for the Promotion of Engineering Education, which may have worked out a plan radically different from mine:

I would adjust the speed and complexity of the courses to the capabilities of the brilliant one-tenth, and let that one-tenth take the course. This would enable them to learn about twice as much as they do at present, which would please them mightily and entitle them, upon graduation, to a diploma which would be a certificate of capacity far above the normal. Then I would enroll the other nine-tenths as *special* students, with no requirements as to attendance or grades, requiring only that they be present for the "scrap" and the Engineer's Day parade. You might require such a *special* student to agree to attend a class whenever he felt that, for his own good, his time could most profitably be spent in such a class. This would relieve class room congestion. At the end of four years of such attendance, give the man a diploma. The diploma must, of course, differ from the regular diploma to avoid the practice of a fraud on employers who insist that a graduate of an engineering school should have some knowledge of engineering. It might be made of the same color and dimensions as the ordinary diploma, but with a distinctive legend, such as "MAGNA SINE LAUDA."

As far as that goes, who ever exhibits his diploma anyway? A classmate of mine who got a job running a breaker plow last year, used to read his diploma to his horses before starting work, but he is an exception. For social purposes, such a diploma would be as good as any, and most of these *specials* would never follow engineering anyway.

Such, in brief, is my proposal as to how the college may best meet the problems of the hour, and I trust that it will be helpful to the authorities, since if it is not, it will mean that I have spent an entire evening to no purpose.

Going Up



R. W. Owens

EVERY time you go up in a modern building having high-speed elevators (the Chicago Athletic Club, for instance) you are lifted by the ingenuity of at least one Westinghouse engineer who is barely ten years off the campus.

Until three years ago, high-speed elevators invariably required direct electric current. There was no practical method of using alternating current, and since many districts are supplied only with alternating current, a serious handicap existed.

It was possible to employ a motor generator to convert alternating current into direct current, but when that was done no practical system of control was available if the elevators were to be operated at high speed. The suggestion was made that the control be accomplished by varying the voltage of the generator and (among others) to a young man of thirty-three—R. W. Owens, Illinois '14, now head of the direct-current section of the motor engineering department—came the special problem of designing an electric generator that would perform as one had never performed before.

Many were associated in the undertaking, for it involved pioneering in control apparatus as well as in generator design, but eventually all difficulties were overcome, and there emerged the "Variable Voltage Control System for Electric Elevators", now standard throughout the building industry.

Here you have the type of problem that confronts the design engineer in an organization like Westinghouse. Not all are as large as this, or lead to such sweeping results. The design engineer works for the customer. He starts with an analysis of the customer's needs and develops apparatus to meet those needs.

His responsibilities are varied and heavy. The jobs of the direct-current section of the motor engineering department range from motors for driving ventilating fans to those for dumping whole cars of ore at the docks. A force of 1,000 men is constantly occupied building the motors designed by this section.

The question is sometimes asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents? Or are they forced into narrow grooves?

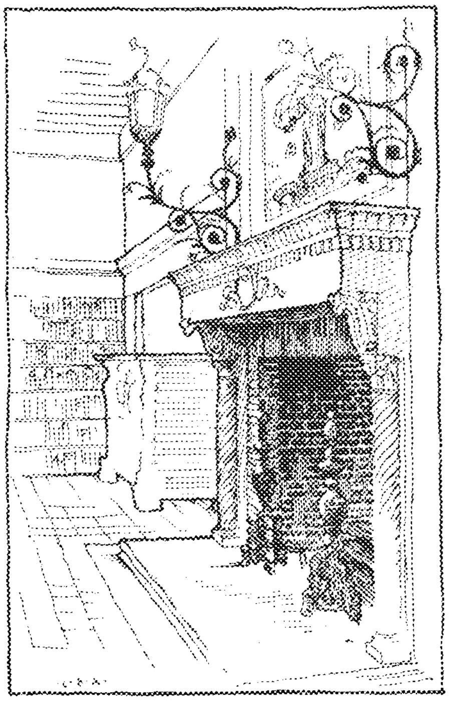
This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came with the Westinghouse Company within the last ten years, immediately after graduation from his university.

Westinghouse

The Lund Press, Inc., 416 Eighth Ave. So., Minneapolis

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges of the University of Minnesota



JANUARY
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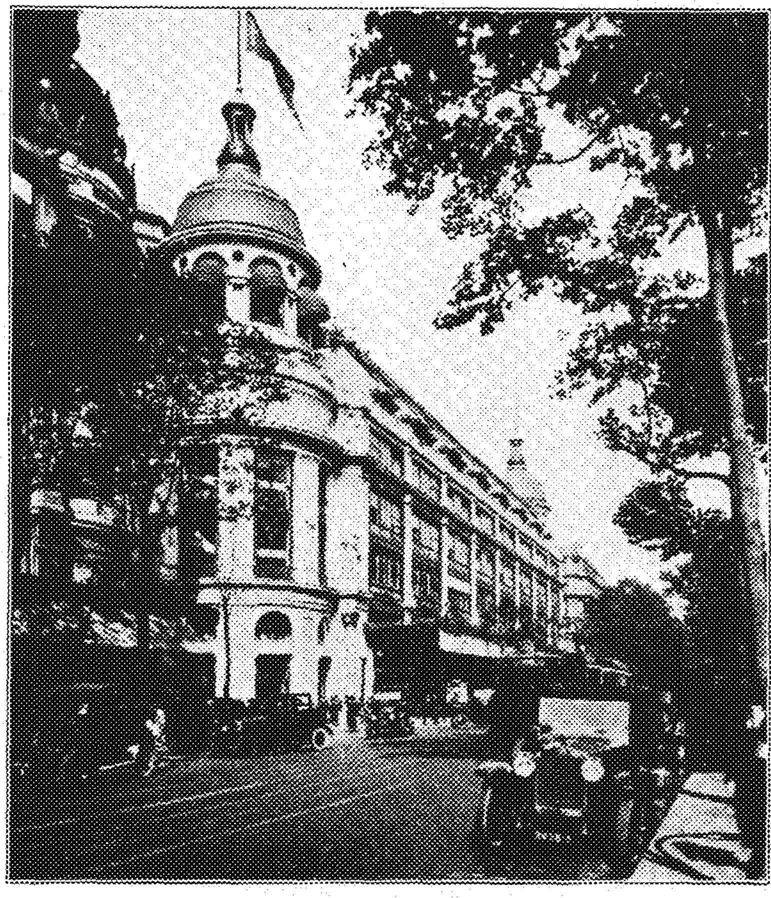
VOL. VI. MINNEAPOLIS, MINN. NO. 4.

Member Engineering College Magazines Associated

A BOND BETWEEN NATIONS



THE visiting French General stopped his hostess with a gesture as she was explaining rather volubly how to use the Otis Automatic Elevator in her Park Avenue residence.

"Spare yourself the trouble, dear Madam. I shall need your help in finding my way about this vast city; you will have to explain to me a hundred intricacies of your American life, from the best manner of facing a large audience of your compatriots to the best manner of eating your Indian corn, but at least I am as familiar with your elevators as you yourself. Between floors I am at home, for your Otis Elevators are as indispensable to Paris as to New York, no matter how wide the difference between the two cities."

Every city, every separate building presents its own problem, which has been solved, in all parts of the civilized world by the Otis Elevator Company.

European cities do not have the high buildings that are constructed in this country, and therefore their elevator service is not as intensive, but Otis elevators serve the needs of their business life the same as they do in this country.

The Grands Magasins du Printemps illustrated, is one of the large department stores of Paris, and contains fifteen Otis Elevators and seven Otis Escalators. Many French apartments have installations of Otis Automatic Elevators.

OTIS ELEVATOR COMPANY

Offices in all Principal Cities of the World

The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

VOLUME VI. MINNEAPOLIS, MINN., JANUARY, 1926 NUMBER 4

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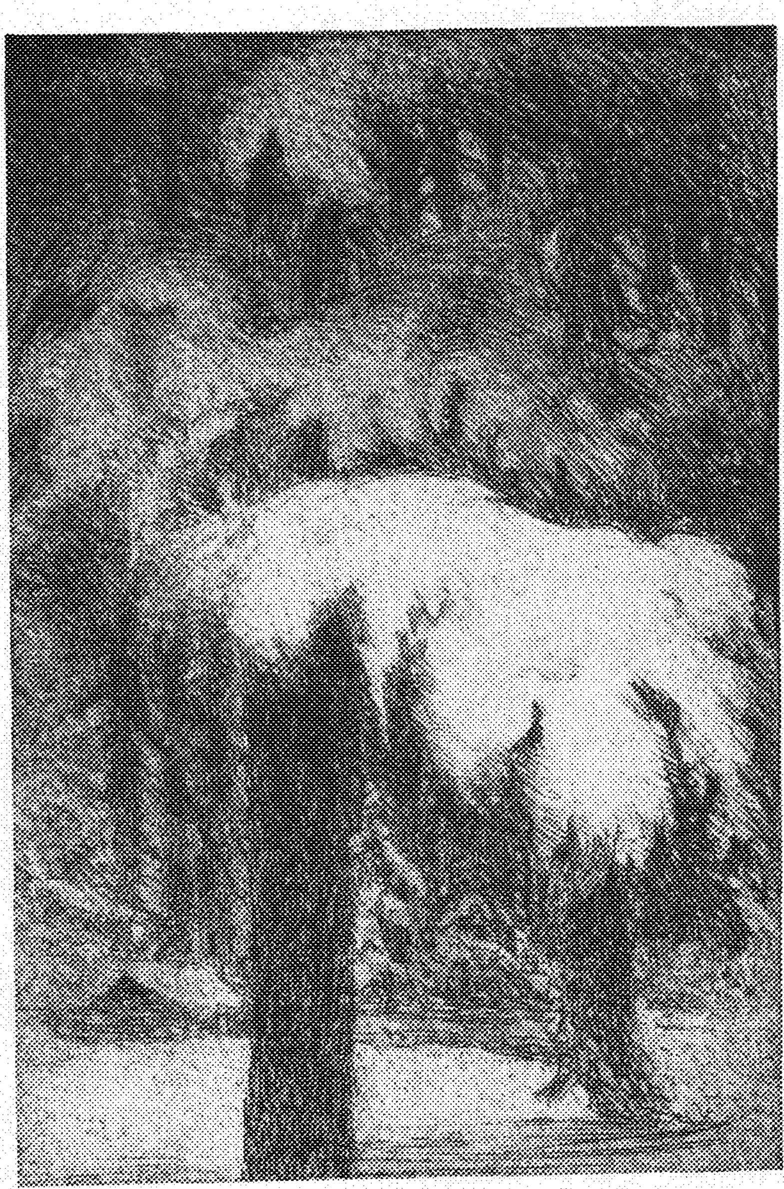


WINTER AMONG THE PINES

From an etching
by
S. Chaiwood Burton
Dept. of Architecture

"When Winter Comes"

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI | JANUARY 1926 | Number 4

Religion and the Engineer

Engineering training essential for ability of clear reasoning; knowledge of science increases the conception of God's working in the Universe

By REV. B. M. McCULLOUGH, C '16
Pastor, Calvary Presbyterian Church, Minneapolis, Minnesota

IT would take a psychologist of great insight and perhaps a greater imagination to explain why our minds so seldom connect religion and the engineering profession. In the thoughts of many they have about as much association as resistance coils and eggplants. Although there is no particular reason for their dissociation, it is the usual thing to say that an engineer is not interested in religion, it being intangible and thus negligible. Some Sages of the Slide Rule relish the idea of themselves as "rough birds" that relegate the things of the soul to some tenderfoot college. Anyway, the general public would not commend an engineering college as the proper place for preparation of preachers. Here's a surprise for you! Glance over the alumni list and notice the number of fellows who have changed from the engineer's khaki to the clergy's cloth. They were trained to say "HCL" with becoming respect and meaning, and now they are saying with even more fervence "HOLY." When you first hear of the transformation, it is easy enough to say after a preliminary survey, "Oh! so he wasn't able to meet the gaff as an engineer." But engineers are supposed to be men trained to investigate before bringing forth conclusions. There may be, after all, a very vital connection between engineering and religion.

Where, for instance, could a fellow find a more thorough schooling in logics than in the little old class in Integral Calculus. Perhaps you couldn't follow the minister's line of argument in the last sermon you heard, because he hadn't studied Solid Geometry. He had filled his soul with logic, and that was good, you know, but he had never learned to pigeon-hole his data. Though he knows the great truths of religion, if he cannot lead a clear thinking audience through each step of his reasoning, we call him "dry." He should have gone to an engineering college.

At least, there is one engineer-preacher alumnus who thanks his lucky stars that his mind underwent the preparatory training of a civil engineer. Then there is that ordeal of deep thinking. God has such depths into which a keen mind can delve; the more a person thinks, the deeper can he dive. Where, tell me, can there be found a deeper mental pool than the understanding of logarithms, their derivation and uses? Or where can a man reach higher into the infinite power of God than to see His Universe as a student does in the engineer's course in the Mechanics of Astronomy?

> *How many of us, in our busy every day round of affairs, fail to give the more serious things of life ample consideration. We believe that this article by Rev. Bruce M. McCullough, pastor of the Calvary Presbyterian church of Minneapolis, is quite a distinctive one, both because of its content and also because of the fact that McCullough is a former graduate of the civil engineering department before entering training for the ministry in theological seminary.*
>
> —THE EDITOR.

The intricacies and the unfailing consistency of mathematics has always held a charm for me. Professors of Mathematics have as yet not reached the limits of the possibilities of all the various combinations of numbers, which always turn out right in the end, unless, of course, the slip stick acts up. What a Master Mind it must have been that worked out such a system and had it ready for us to investigate. And what young fellow is there who is so smothered in materialism that he does not have conversation with God Himself while he is studying the elements of geology, though he may be compelled to take the course and sleeps through a one o'clock class.

The more you know of geology, the more you delight in God, your Maker. Pious ignorance, undoubtedly, has the faith in the saving grace of God that will lead to Heaven, but it is educated godliness that knows the thrill of a deeper devotion to an Almighty God when His glories are more clearly seen.

There is, in fact, a far closer connection between engineering and religion than we are apt to realize at first, and even the "rough bird" can afford to think of it. The trained mind of the engineer with his broad scope of knowledge and interest in the fields of nature and science, put him in one of the best positions to know God, and to appreciate God is religion.

To appreciate God as Christ revealed Him, is Christianity. It elevates a man's life to know God, shows him a wider horizon so that he can "lift his eyes to the hills" of God from whence comes his inspiration and strength for a larger piece of engineering in the needy old world. But let me tell you that the man who knows about God and doesn't know God, is cheating himself. He is like some dolt who stands in the presence of some famous, great-hearted statesman but refuses to become acquainted with him and talk to him. It is a pinched life for the man who is not willing to spend enough time to get acquainted with the Great Engineer of the whole world.

Religion makes a mighty good combination with engineering; each aids the other. A man with both can build roads and buildings and machines, and enter into the more human interest, caring not only that the machines are perfect but that the people who use them are happy. Indeed, religion can never be merely a sideline, can never be shut up in a separate compartment of life. That is why the so-called religion of some men is such a dismal failure. If it's real religion, it's permanent, a fixture in every department of life, coloring every fact, effecting every action, guiding every decision, opening up in each project the higher purposes of work and setting forth clearly those great final aims of engineering.

Engineers have forced the clouds to disclose their secrets; the innards of the earth no longer hold terror for us. The still air which resounded with songs of rejoicing on that Night of long ago is now filled with music from far and near. The engineer has made the world a clean, safe place to live in. He will save the Universe from the skeptics' proposed bow-wows.

Horizontal Waves to Eliminate Static

Polarized radio light system of transmission being perfected by Minnesota alumnus will free reception from Nature's interference

By David Grimes, E '19

Chief Engineer, David Grimes, Inc., New York City.

LIKE all things new, most things are old! Radio developments are no exceptions to this rule. Dr. Alexanderson, chief engineer of the General Electric company, recently created a great public stir by his announcement of horizontal radio transmission. He then showed that it was rather to be expected as the result of certain radio work done by Hertz in 1887. As a matter of fact, Hertz actually polarized his waves both vertically and horizontally as one of his proofs that the electro-magnetic waves he had discovered were one and the same as light. All of which takes us back to the beginning of things.

A certain gentleman by the name of Bell conceived one day about 1877 that one's voice could be superimposed on a beam of light and by proper apparatus could be taken off the beam at some distant point and translated back into sound. He conducted very successful tests on such a system in Washington about the same year. Bell, then, was really the father of wireless telephony. Yes, the same man who invented the telephone, Alexander Graham Bell.

This sort of a system had its drawbacks as smoke could interrupt it. Bell thought that even as red light travels through dusty or misty atmosphere better than violet, so would some lower color in the spectrum, than red, travel through smoke while red might not. He carried on tests with beams of light down in the heat band of the spectrum. Of course, such beams are invisible to the eye but nevertheless are very real, just the same. Bell exhibited such a wireless telephone at the Chicago World's Fair in 1892. It was listed as Bell's Thermophone but it was referred to many times as Bell's *Radiophone* because of the radiating nature of heat, the medium used for carrying the voice.

Hertz, just prior to this, as mentioned, had been working with beams of light of even lower color and even better penetrating ability. Hertz knew his waves were electro-magnetic in character but wasn't so sure that they were one and the same as ordinary light waves, except for frequency or wave length. He conducted several tests to prove the similarity. He polarized the new waves in much the same manner as light waves may be polarized.

For the benefit of those who have forgotten more about physics than some of us ever knew, let it be stated that an electro-magnetic wave (all forms of light, both in and out of the visible spectrum) travels as a vibration at right angles to its path. Thus a wave motion set up in a rope is similar to an electro-magnetic wave. Tie a rope solidly at one end to a post. Take the other end in the hand and snap it up and down quickly. A wave will pass down the rope from the hand to the post. The vibration, however, will be up and down, or at right angles to the length of the rope.

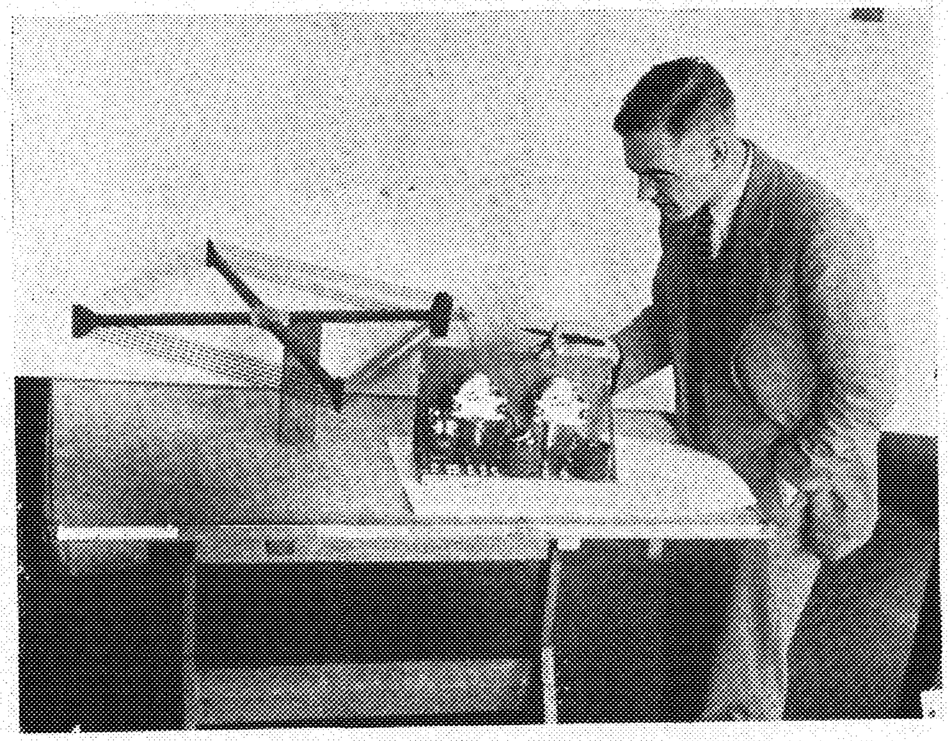
Now, ordinary light is caused by millions of vibrating electrons and naturally all these are not vibrating in the same plane or direction. Some are vibrating up and down—others back and forth, etc. These light beams travel outward, then, with their transverse vibrations in all planes, horizontal and vertical. By passing a complex beam of light through a grating or special crystal, all of the vertical vibratons can be wiped out, only the horizontal ones remaining or vice-versa. This is called polarizing the light beam.

Radio waves are caused by the same vibrating electrons. These electrons vibrate up and down between antenna and ground only, of course, much more slowly than in the case of visible light. In the early days of radio, the natural tendency was to string a wire up in the air and to connect to the earth. This polarizes the electro-magnetic wave at the start as the electrons all move up and down. This is a vertically polarized radio wave. Radio stations in use today are of this type.

As the art progressed, it was found desirable to add a large top section to the antenna and this, of course, adds some horizontal waves to the outgoing vertical. At present, the broadcasting stations send out a wave that is about 80 per cent vertical and 20 per cent horizontal. This ratio varies considerably between stations as it depends on their antenna construction.

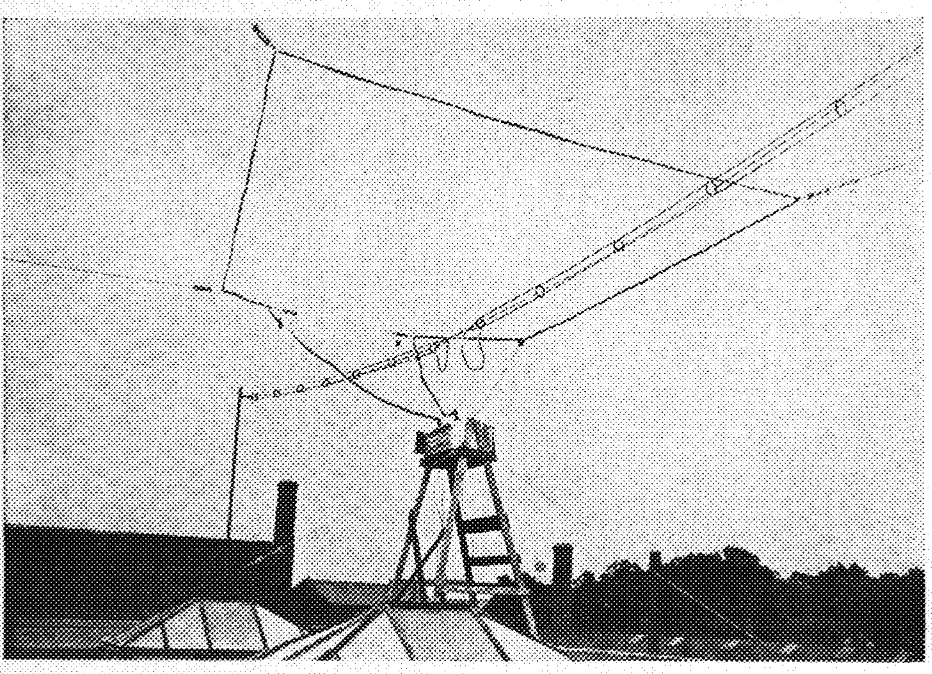
With this preliminary outline off our mind, we now proceed to discuss all of this from the standpoint of static. Static is divided into two classes—man-made and natural. The natural static is by far the greatest nuisance to reception and man-made static can be reduced at its source. Natural static, therefore, presents the real problem and it is in this connection that horizontally polarized waves come to our aid.

Natural static is caused by sudden electrical discharges occurring throughout the atmosphere either as mere 'condenser' currents or as actual bolts of lightning. These static charges build up between clouds and the earth and the sudden discharges must necessarily take place between these two elements. Such discharges are, therefore, vertical and the resulting electro-magnetic wave is ver-



THE RADIO RECEIVING SET

David Grimes is shown here explaining the operation of a receiving set which employs a horizontal loop for picking up of signals sent out on horizontal waves.



ANTENNA SYSTEM USED AT GRIMES STATION 2MQ

Two cage aerials comprise the horizontal antenna, one being used as counterpoise. Two turns of wire supported by glass insulators form the horizontal loop. Experiments started here in 1922.

tical. Since this discharge is highly damped by resistance, the tuning is very broad and all attempts to materially reduce static interference by tuning have failed. Furthermore, our present receiving aerials are specially built to pick up vertical waves, because our transmitting stations are designed to send out vertical waves. Therefore, our present receiving systems are ideal for recording all of the static disturbances in existance.

Now, it is a pretty hard thing to change nature, especially when this change involves the force of gravity. We must leave the clouds and the earth where they are. Static disturbances will always be vertical—we cannot change them. But, it is an easy matter to change our transmitting stations from vertical to horizontal waves. Instead of setting up the vibration of electrons between the antenna and ground, the vibrations can be set up horizontally between one group of wires called an antenna and another group of wires erected on the same level, called a counterpoise. Then the vibrations will be horizontal.

In order to receive such a horizontal wave, a horizontal receiving system must be used. Thus, if a loop is used, the loop must be laid flat for best results. If an antenna is used for reception, a counterpoise on the same level strung in the opposite direction must be used as a ground.

It is well known that static can be greatly reduced on a loop set by laying the loop horizontally. But with the present system of broadcasting, the signals also fade out when this is done. Vertical waves are not picked up by such horizontal receiving systems. It is true that some signals and some static will still be heard but with greatly reduced volume. This is because the present broadcasting stations do not send out pure vertical waves. The horizontal aerial top sends out a little horizontal energy. Also, a cloud, wide in area, acts in the same way and some slight amount of static can still be detected with the loop laid flat.

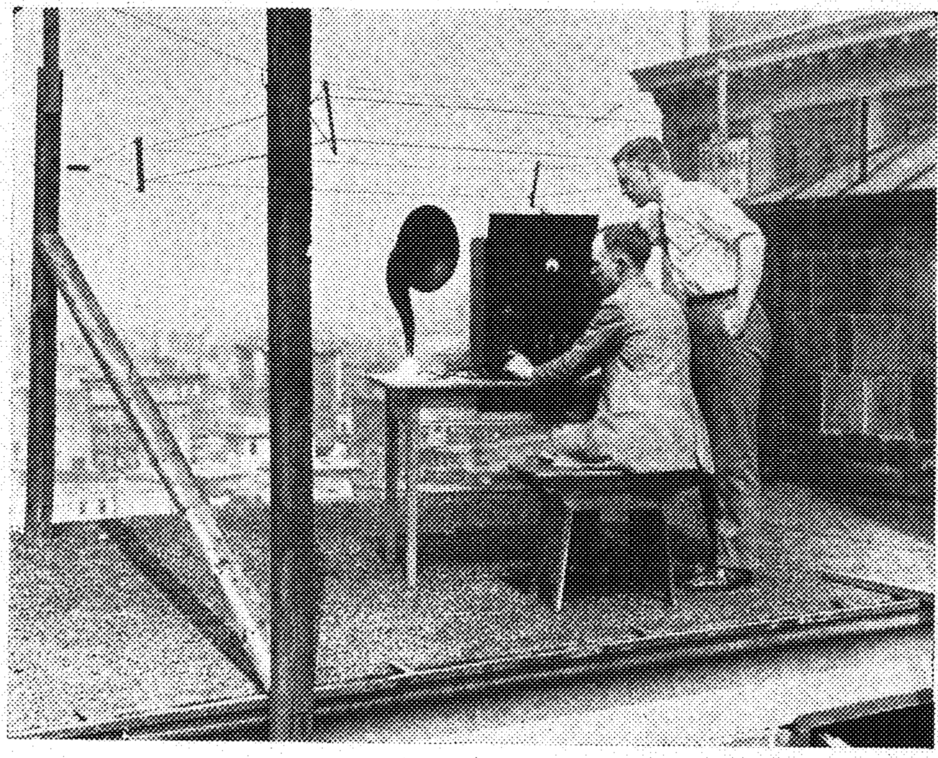
With pure horizontal broadcasting, the program will not be heard with the loop upright in the best position for static reception, but will roar in with the loop flat—its poorest position for static pick-up. Thus static is eliminated not by the old impossible tuning attempts, but by a simple application of polarized waves, so well known in the physics of visible light.

Simply stated, then, static is haphazard, uncontrolled and natural radio. By nature, it is polarized in the vertical plane. Broadcasting is controlled radio and to absolutely free it from interference with nature's radio, it should be polarized in the horizontal plane.

All of this sounds easy! It did to me when I first reasoned it out back in 1922. I was studying some of Hertz's writings when the thought of polarizing radio waves for static elimination struck me.

Needless to say, we set about building a station to test the theory. All of our reception test proved that static faded out on the horizontal plane. It was only necessary to prove horizontal transmission possible and small transmitters in our laboratory gave encouraging results. Many difficulties were encountered in the working of the larger station. Capacity to earth tended to twist the horizontal wave into two vertical waves traveling almost 180 degrees out of phase. It was found necessary to erect the horizontal aerial and counterpoise as far as practically possible from earth. Incidently, the system has not yet worked successfully more than about 20 miles, which would seem to indicate that horizontal transmission does not follow the curvature of the earth, but travels out through space in straight lines similar to visible light.

(*Continued on page 130*)



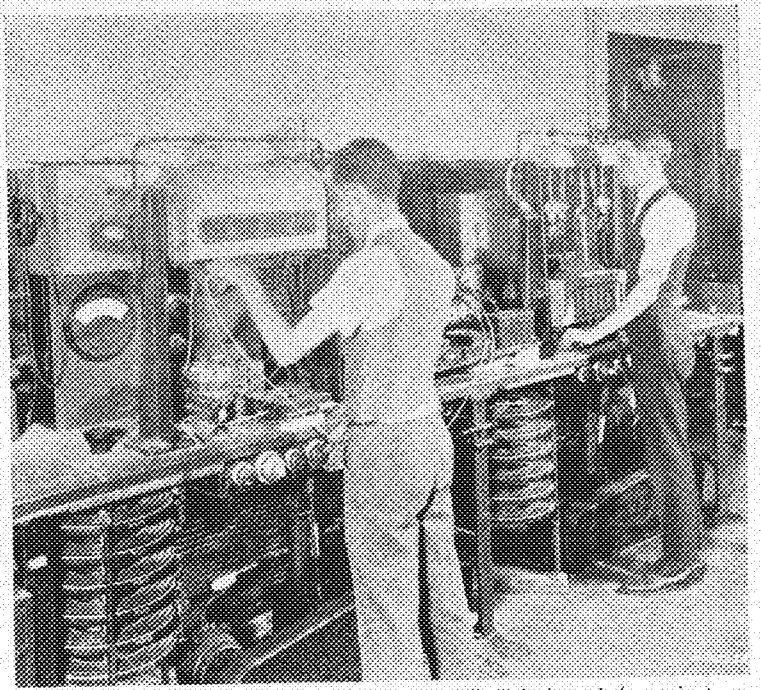
LISTENING IN ON HORIZONTAL WAVES

Signals being sent out from Grasmere, Staten Island, 10 miles south across New York harbor, are being received by David Grimes, chief engineer (standing), and E. O. Thompson, assistant chief.

RESEARCH—
The Cornerstone of the
Telephone Industry

Interesting and constructive work carried on in Bell Laboratories for advancement of the art of communication

By E. C. MANDERFELD, B. S. '21, E. E. '23
Research Engineer, Bell Telephone Laboratories, Inc., New York City.



IN THE VACUUM TUBE LABORATORY

Two tube exhausting benches where the air is being thoroughly pumped out of the various kinds of electron tubes being developed for experimental use

EDITOR'S NOTE: This is the fourth of a continuation of articles taking up the opportunities for a technical graduate in the many fields of endeavor. Another important branch will be discussed in the February issue.

DURING the past year the general public has been greatly interested in several new scientific developments, prominent among them the commercial transmission of photographs over telephone wires, the orthophonic talking machine and the artificial larynx. Yet the public and even many engineers seldom realize the vast amount of research which is the foundation of any new development as named above. It is the purpose of this article to describe briefly the Bell Telephone Laboratories in which these and many other devices were brought into existence or developed to their present state.

Bell Laboratories as a company came into being January 1, 1925, to take over the laboratory research carried on for many years by the Engineering Department of the Western Electric company. The latter was itself a consolidation of laboratory work carried on at various places since the inception of the Bell System. The Laboratories are specifically charged with the task of studying and developing systems and ideas which will enable the Bell System to give better and cheaper communication service.

The Laboratories differ radically from most other research organizations in that the latter are merely departments of large industrial concerns. Bell Laboratories is a corporation itself whose stock in trade is ideas.

The personnel of the Laboratories consists of engineers, physicists, chemists, metallurgists, mechanics and many other classes of workers totaling in all over 3,700 employees. Practically all the activities of these employees are carried on in well equipped laboratories located in a large thirteen-story building at 463 West street, New York City. For the purpose of better concentration on the various problems at hand the organization itself is divided into five major groups excluding the building and maintenance and certain commercial groups. These five groups are broadly referred to as Research, Apparatus Development, Systems Development, Engineering, Inspection and Patent. The activities of these various groups are quite well defined by their respective titles, yet of necessity they constantly overlap and intermingle so that in the study of some problem probably each of these groups helps to contribute some particular specialized piece of information. Thus each problem always receives the benefit of attention of experts in any field. Such division of work in no way limits the scope or initiative of the individual worker and does provide for a large amount of cooperative talent.

Thus the Research group concerns itself mainly with the development of fundamental scientific physical principles. The problems studied are sometimes narrow and specific and then again broad, involved and intricate, requiring years for a final solution.

The Systems Engineer is intimately associated with operating problems. Any speeding up in making telephone connections or the rendering of cheaper service is naturally desirable, especially when it is considered that approximately 41,000,000 telephone calls are made each day in the United States. The average call between two subscribers in the same city where connections are made entirely by operators, requires that nearly 200 contacts be made or broken. Some of these are made by the hand of the operator and the rest are made by the relays. With mechanical switching, however, this figure of 200 falls into insignificance as compared to the 2000 contacts which are necessary for the completion of a mechanically switched call.

Such extraordinary complex circuits are developed by many minds and require long periods of time. Development work is continually in progress to keep pace with the greater demands of the telephone system and also incorporate new ideas which are constantly occurring to the men who work in this fascinating field of engineering. Yet, what a circuit will do is largely determined by the apparatus which is used. Relays, for example, must operate with certain minimum or limiting currents which are dependent upon the circuits of which they are a part. When such limits are determined, the problem of design becomes one for the Apparatus Development group but such problems are continuous so that there is always a program of fundamental investigation and design. What is true of relays is equally true of other items in the telephone plant, whether desk sets, plugs and jacks, repeating coils or condensers.

In each case fundamental studies are always in progress. Materials are investigated not only to determine new possibilities but to be informed of variations which may occur in materials already in use. New methods of measurement and investigation are developed and general relationships are established between such factors as the operating power requirements, the size, the materials, the manufacturing conditions and the factory adjustments.

The Inspection Department insures

(Continued on page 126)

Writing Technical Articles

Good introduction, attractive and clear style, organization of thought, conciseness and precision, high points of a well written story.

By W. Otto Birk
Associate Professor of English, University of Colorado, Boulder, Colorado.
Western Vice-chairman, E. C. M. A.

EVERY magazine writer should aim to make his article attractive and clear. Though ridiculously obvious, it is pertinent to say that magazines are published to be read. Technical magazines, moreover, are designed primarily to give information. The chief problem, then, in writing for these magazines is that of attracting and holding the reader's attention through the interesting and lucid presentation of the subject.

Attractiveness in the writing of technical articles, however, is often misunderstood. It is nothing artificial. It is not trickery intended to fool a reader—to make him think that he is to read something that is not in the article. This kind of false attraction does more harm than good, as it discredits the subject or the author. It indicates that the subject lacks interest, or that the author is incapable of finding it. Attractiveness must be got out of the subject and not superposed upon the subject. No article can be more attractive than its subject matter will permit. Neither can a technical article be made attractive to all technical men. Most of these men read their magazines as a part of their business, and if some are not interested in a new type of automatic switchboard, for instance, all the art of the writer can seldom make them interested. This condition, however, excuses no author for failing to present all the interest that his subject contains.

This statement can be best illustrated through a discussion of the title and introduction of an article. The title, whether topical or active, should give not only an index to the subject, but should state specifically the phase of the subject treated in the article. In order to enhance the attractiveness, it should include the feature. In explaining a new method of patching concrete roads, for instance, the title, "Concrete Roads" is indefinite, misleading, and uninteresting. "Patching Concrete Roads" is more definite, but lacks attractiveness because it does not contain the feature. "New Method of Patching Concrete Roads" is better: it is more complete and it creates interest; furthermore, the interest is derived directly from the subject-matter.

The introduction should follow similar principles. Perhaps no part of an article is more abused than the beginning. Most writers know that the body of an article should give the information that they wish to convey, but the introduction, they seem to think, is like the puffing and slipping of a locomotive attempting to start on a difficult grade: it makes a lot of noise, but it gets no place. Now an introduction should get some place quickly, especially in a technical article. Its purpose is two-fold: it should give all preliminary information necessary for a proper understanding of the article, and it should create interest.

The preliminary information must vary, of course, with the subject-matter. It may state more specifically and completely the phase of the subject treated: it may eliminate some irrelevant phases of the subject; it may enumerate the points to be covered; it may give background (the history of the subject or the reasons for its importance); or it may define uncommon and important terms. Whatever its particular function, the introduction should be brief and direct. In writing technical articles, particularly, the first sentence should be significant. In order to avoid wandering, a good plan to follow is that of making the initial sentence a rephrasing of the title, so as to include more of the feature and to limit the article to a narrower phase. As an example, under the title of "New Method of Patching Concrete Roads," a suitable beginning would be "Patches made in concrete roads by the new method that has been used experimentally for two years by the State Highway Department have proved economical and durable." Other beginnings, to be sure, are possible, but those of the above type lead quickly into the subject, present some preliminary information, and create interest—interest in the subject-matter—by presenting the feature, or the most important information.

Attractiveness, in other words, is a manner of presenting the subject-matter in its best light. It is not spreading an artificial gloss over the subject-matter.

Since technical articles seek primarily to explain, attractiveness is dependent largely upon clearness. In fact, these two qualities are so closely related that it is difficult to consider them separately. The reader's attention must not only be attracted; it must be held. And it cannot be held unless he can understand easily. No matter how much he may be interested in the subject, he will not read long if he must ferret out what the writer intended to say. He has a right to expect that the article be clear enough for him to understand readily. Remember that magazines are published to be read. The writer *must* serve the reader.

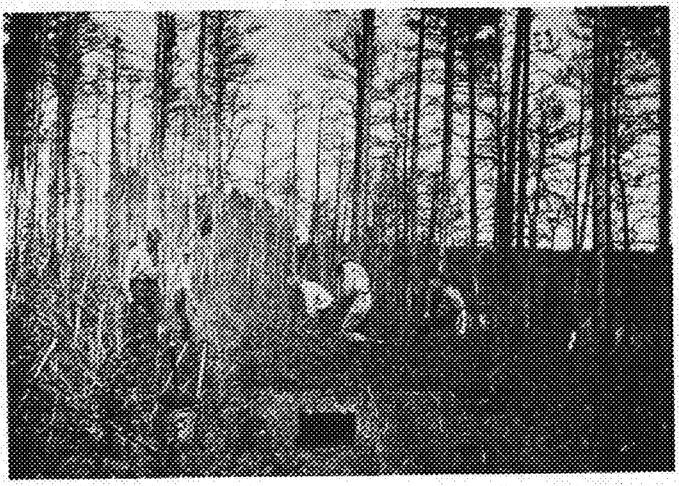
In order to be clear, an article should be concise, precise, and well-organized.

Conciseness means to many writers—mostly inexperienced—nothing more than bare information expressed in sentences that read like a combination of severely compressed ten-word telegrams. Nothing could be farther from the truth. Every technical article should be brief and to the point; but since the purpose of writing is to produce an effect as well as to convey information, it should not be blunt and curt. Auxiliaries, prepositions, and articles, for instance, should never be omitted when it is natural and proper to include them. Their omission makes an article inelegant and frequently unintelligible. These words are a part of the English language and should be used. Conciseness means the absence of wordiness. For example, "a brass screen" is better than "a screen that is made of brass"; "This prohibits the use of coal for generating power" is better than "This makes the use of coal for generating power prohibitive"; and "Investigation will find these filters efficient" is better than "If we investigate the matter, we shall find that these filters are very efficient."

Fine writing, furthermore, should be avoided. To tell that the crane in a steel mill picked up a ladle of molten metal and carried it to the ingot molds, one need not say that "The giant crane picked up its livid burden of molten metal and swung it through the dim recesses of the corridor while the sparks flew from it like stars shooting in the sky." This kind of writing is in no sense good; yet it is frequently found, as was the above, in amateur contributions. Unless the writer's opinion is clearly expected, a technical article should be objective and not subjective; that is, it should tell of things as they are and not as they impressed the author. The above quotation tells not so much what happened, as how the event affected the writer. Since the chief interest in most technical articles is in the results expressed, they should be written from an impersonal point-of-view, that is, the third person, passive should be used. For example, instead of saying, "First we placed the motor upon a block and then we attached the belt, etc."; or "First place the motor upon the block and then attach the belt," say "First the motor was placed upon the block, and then the belt was attached."

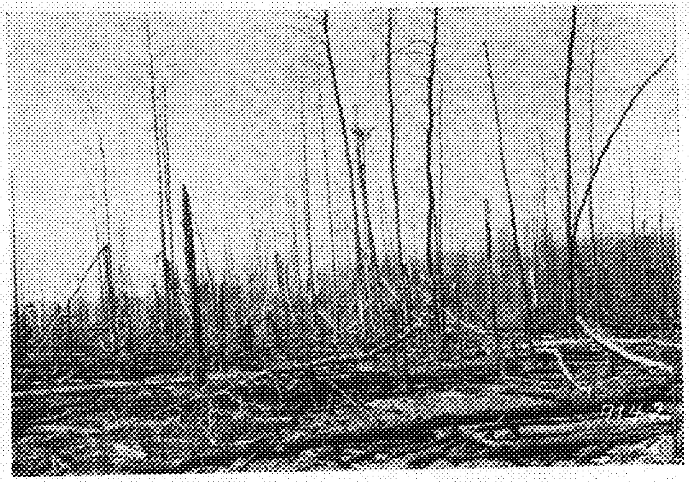
Preciseness in technical writing pertains mostly to the use of exact words and dimensions. It is as important in technical as in legal writing. In fact, the former often is the basis of the latter. Furthermore, most technical articles aim to give information that the

(*Continued on page 132*)



REFORESTATION

Forest Rangers are here planting seedlings to replenish the growth wiped out by a previous fire. This photo was taken one year afterwards.



IN THE WAKE OF FIRE

Blackened stumps, a charred tree standing here and there remain as a witness of the forest fire, the destroyer of Nature's handiwork.

Conservation of Our Resources

Problems of saving and utilizing the products of mine, forest, field and stream present themselves to the Engineer for solution

By RAYMOND P. CHASE, B. A. '03
State Auditor of Minnesota.

IT has been well said that waste is the child of abundance and the mother of want. The Colonists found on their arrival in America an abundance of those things most desired to promote human happiness. There was no demand for the exercise of any form of restraint in the use of these gifts of nature. Since then our people have been exploiting these natural resources with an abandon unparallelled in the world's history. So strong has been the impression that our resources are inexhaustible that it is now difficult for us to realize that we must call a halt, plan for the future on economic lines, and adapt ourselves to the new conditions that confront us. It is not alone the voice of the pessimist that is calling for sane conservation but that of the watchman on the tower telling us of the approach of a new dawn.

In the country's infancy the forests were leveled, wild game destroyed without let or hindrance and the waters despoiled of their fish. Even harmless birds did not escape man's destroying hand. This work of devastation continued until the denuded hills no longer served to prevent freshets in the rivers; deer, moose, buffalo and other game found their sanctuaries gone, salmon and other fish deserted the polluted streams, and the fields, robbed of their fertility, refused to give their accustomed increase. Thoughtful men began to take notice and sound the alarm but the absence of a definite plan delayed matters until in 1907, Theodore Roosevelt, taking up the theme in his wonted vigorous manner, compelled the people to give heed to the importance of conservation. Since that date the public has manifested a sporadic interest in this momentous topic.

There is much confusion as to the real meaning of the term, conservation. In this article it is not taken to mean a mere saving of our resources but their careful utilization in the best interests of the whole people and for all reasonable time to come. The East having exhausted her resources, called loudly upon the West to close her doors at once, and tightly too, so that future generations might enjoy the gifts of nature; but the West had other ideas and little progress was made.

The states are now making systematic studies of their resources. Minnesota is not idle. Her soils are being studied with a view to preventing their depletion. Those deficient in the important elements are being brought to standard as rapidly as possible by the aid and advice of the College of Agriculture and other agencies. Children reared in unproductive farm areas lack the physical and mental qualities that are so needed in the struggle for existence. This fact has been proven by a close study of conditions in several of the older states and sections of Europe. Dr. Hubert Work, Secretary of the Interior, recently said:

"We cannot exhaust natural sources of food supply and weaken the race. We cannot pass on blindly to a point where one season's drought would put a prosperous nation in want. The fertility of our soil must be conserved or restored when lost or our boasted civilization will fail. When the lime has left the land and has been deposited in men's arteries, the end is not far off. We are in time to forfend this situation."

A phase of conservation recently brought to public attention, is the destruction of bird sanctuaries and the accompanying loss of bird life. With the disappearance of our feathered friends comes the alarming increase in the number of insects that prey upon the crops and torment humanity itself. Entomologists declare that the destruction of bird life has permitted the number of insects to increase a million fold. The crop destruction by these pests has been estimated to have reached the enormous total of $800,000,000 in 1924.

Forests

Perhaps the most glaring disregard of the necessity of careful husbandry was shown in our dealing with the forests. As early as 1749 Benjamin Franklin, noticing this trend of affairs in Poor Richard's Almanac, urged forest conservation.

This country at the time of the Revolution had within her present boundaries, according to J. R. Simmons, Forester, New York State Forestry Association, 5,000,000,000,000 board feet of timber, a supply ample to cover with one inch boards nearly three-fourths of the State of Texas. Two-thirds of this has been cut or destroyed. Forty-three percent of our total land area was originally covered with forests, now but twenty-five per cent remains so. More than 81,000,000 acres once producing timber, are now waste spaces producing nothing, while 250,000,000 acres are poorly stocked or growing but a portion of what they are capable. We are today cutting our timber four and a half times as fast as it is growing. Lumbermen formerly selected the choicest timber, permitted fire among the slashings to destroy all else, and moved their mills to new fields. When the move to new fields became less profitable because of the cost in transporting the forest products to market, they awoke to the very necessity of utilizing the remnant of a once proud domain. Great burners that once consumed every part of the log but the board and the dimension stuff fell into disuse and finally disappeared.

From conservation in the mill the idea spread to the forest. It first made its appearance in the lumber camps in the form of cutting everything clean, the mature with the immature, down to the smallest possible size. More thoughtful lumbermen, especially in the south, conceived the idea that the more profitable plan was to take only the ripe trees and leave the young to grow and reseed the land. This innovation was tried in Louisiana where it was discovered that a profitable crop of timber the same as other crops, can be grown upon land in a remarkably short time. European countries have practiced timber culture for centuries, though Frederick the Great was the first to practice reforestation on a comprehensive scale when he planted to fir, the sand dunes along the Baltic.

Two important factors enter into the matter of silvi-culture and discourage its general adoption: taxes and the ever threatening forest fire. Because of the former, there is a wide spread demand that the state or federal government undertake this important work. Minnesota started to do her part in this work by submitting a Reforestation Amendment to the people for their approval at the time of the last election. But this amendment was defeated by those who supposedly had been clamoring for it. So far as the fire menace is concerned, the duty is largely upon the state in co-operation with private interests. The railroads are acting jointly with the Forest Service in fire prevention work. Whereever their tracks pass through a forest area, a man on a small light handcar or speeder follows each train through the forest watching for possible fires set by cinders from the locomotives. Thus the fires, if any, are apprehended and extinguished before damage is done.

All will admit that the suppression of forest fires is the prime factor in reforesation of any kind. Some doubt is expressed as to the practicability of artificial planting, largely because of the vast tracts of waste lands suitable for forest culture.

New England has many concrete examples of what may be done and has been done along this line. It has been shown that a stand of 35,000 board feet per acre may be grown in 50 years. In Europe no more timber is cut in any one year than is grown. It is said that by this method a forest of white pine produces an annual revenue after thirty years, of over six dollars per acre.

The State of Michigan, as well as some other states, has made a good start in the matter of reforesting her cut-over lands by passing the following legislation:

1. A timber tax bill recognizing timber as a crop, separating the tax on land from the crop.
2. A fire appropriation of $500,000.
3. Tripling the capacity of the state nursery.
4. Permitting the state forester to sell the products of the forests.
5. Empowering the conservation department to change opening and closing dates of hunting and fishing seasons when a dangerous fire hazard exists.

Lands devoted to the growth of hardwood timber are exempt from all taxes save one of ten cents per annum per acre, and pine lands, five cents. At the time the forest crop is harvested the state will receive twenty-five per cent of the net proceeds.

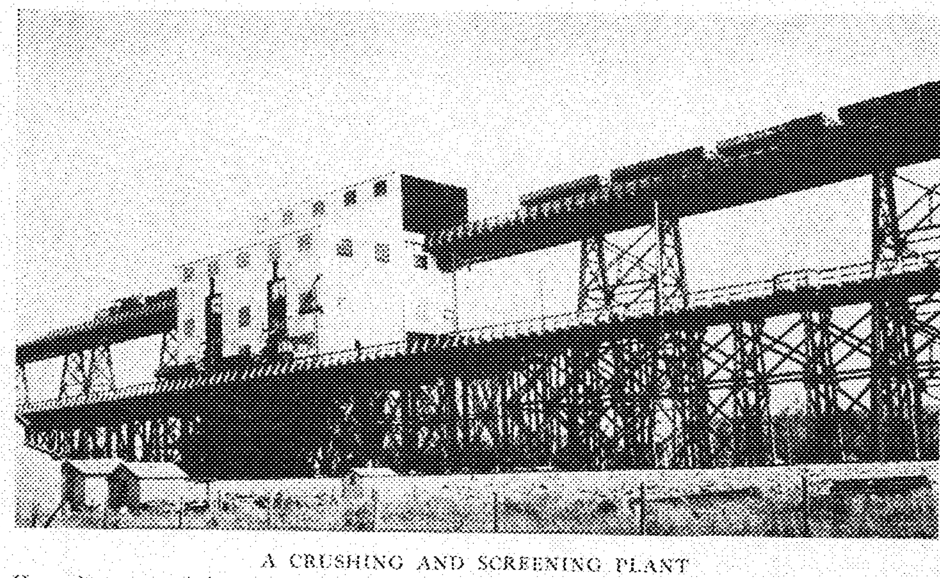
Mining.

In 1923, of the iron ore produced in the country, our State furnished 64 per cent, its value being close to 66 per cent of the total value of the product, and in 1924, 60 per cent of the output and 62 per cent of the total value. This record can be maintained for many decades if our vast stores of low grade ores can be drawn upon. The move to utilize these is a phase of conservation. Mine operators on the Western Mesabi Range years ago saw the need of beneficiating the sandy ores there. As a result of the efforts of their engineers, one-sixth of Minnesota's 1924 shipment of iron ore was beneficiated. To begin with, only iron ore mingled with free sand was thought capable of being washed or otherwise beneficiated but as time went on, the subject received more attention until today there are plants washing, drying, crushing, screening and sintering iron ore that otherwise would be of little value. The end is not yet, for many companies are making careful studies of the problems while the Mines Experiment Station at the University of Minnesota is going deeper and deeper into the matter. Men from the station have gone abroad to study processes in other countries. At the present time, an addition to the Experimental Station building is being made to house equipment for investigation and development of commercially possible processes of reducing low grade iron ores. Today all necessarily removed iron bearing material not readily made merchantable by present known processes is sampled, classified and stocked in separate piles. On some state-owned land, four separate classes of this material are made.

Perhaps the longest step in the use of our enormous deposits of low grade iron ore and by far the most important one, will be the development of a commercial means of magnetizing the hematite ore material and robbing it of its iron by magnetic concentration. The whole scheme of conservation and beneficiation is, of course, dependent upon costs, a larger portion of which is taxation. The Minnesota Tax Commission reports 1,303,579,273 tons remaining unmined as of May 1, 1925. With an annual output something like 40,000,000 tons it is plain that the state cannot hold its lead as an iron ore producer for more than 25 or 30 years to come unless new ore fields are opened or the low grade deposits can be made to surrender their iron content by way of a cheap process of beneficiation.

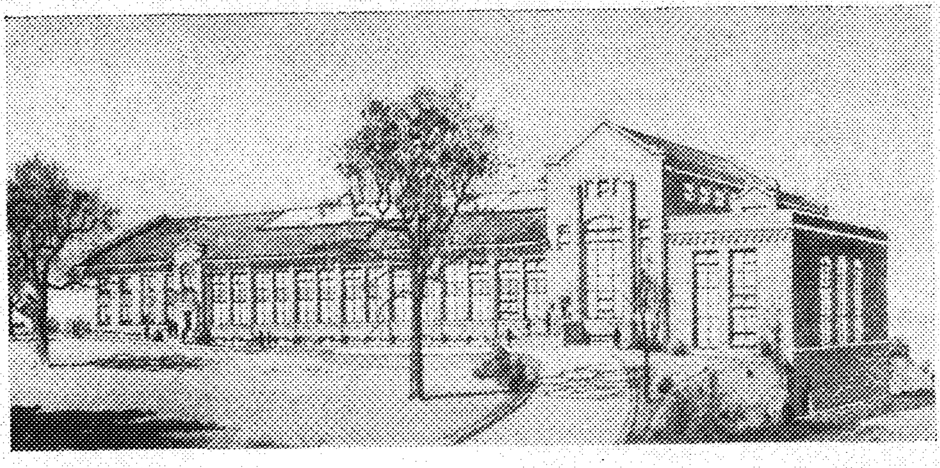
Success in the campaign to reduce these non-magnetic iron bearing rocks to magnetite and then to remove the iron, must depend upon the initiative of the engineer. To him we must look and upon him rests the burden of the task. The rewards in general will be generous.

The process is comparatively simple. By taking away an atom of oxygen the



A CRUSHING AND SCREENING PLANT

Here, the output of the Mesabi Mountain pit, a state-owned mine located at Virginia, Minnesota, is pulverized and then shipped to blast furnaces for further treatment.



MINNESOTA MINES EXPERIMENT STATION
One of the most important developments under way here by the State and the U. S. Bureau of Mines is the process of utilizing low grade ore for commercial use.

hematite ore becomes magnetite and hence magnetic. The larceny of the oxygen is accomplished by heating the ore in a "reducing atmosphere," that is, in a closed receptacle in contact with carbon or some other strong affinity of oxygen. The carbon in this heated condition robs the hematite iron ore of a portion of its oxygen supply leaving the ore magnetic. In theory this is simple but the ingenuity of the engineer must devise a mechanical means for doing this. By use of present known devices the iron thus magnetized may be separated from the tailings. The Mines Experiment Station at the University of Minnesota has done much along this line and has proven the correctness of the principles involved. The present over-development of Minnesota's mines will, of course, retard the immediate introduction of this process on a wide scale, but it will come in time.

Blast Furnaces

A blast furnace that reduces iron ore to pig iron, that is, cast iron, is a comparatively recent comer upon the stage of the use of steel. From the earliest ages men made steel directly from iron ore in the Catalan forge. The process was of necessity slow as well as expensive. The advent of the blast furnace and its product, cast iron, revolutionized the production of iron and steel. When the Bessemer process of steel-making was perfected another forward step was made. This process, demanding a special grade of iron ore, Bessemer carrying .045 per cent in phosphorus or less, soon convinced the steel makers that another change would be advisable as to the quantity of Bessemer ore available was limited, so the open hearth process of steel making was developed. Today the distinction in price at least, between the two grades of ore, Bessemer and non-Bessemer, has largely disappeared. This fact will assist materially in developing many of Minnesota's mines, especially those of the non-Bessemer class.

The ore from Minnesota almost wholly moves down the Great Lakes to the furnaces there and in the Ohio River Valley where it is smelted. The reasons for the long trip to the furnaces are; first, that the furnaces and steel mills were already located there when Minnesota's ore was found; second, the coal and limestones were also there and it was found to be more economical to take the ore to the furnaces than to bring the coke and limestone to the ore and take the pig iron back; and, third, the primary steel market was in the East. Times are changing and the Middle West is becoming an important market for iron and steel. To this influence is to be added the fact that transportation costs are tending to decentralize industry as evidenced by great manufacturing firms seeking to establish plants nearer the consuming markets. This tendency was sensed years ago by the great steel manufacturing interests when the steel mills at Gary, Indiana; Duluth, and Chicago were built. That these plants have found it profitable to operate in the localities, recent additions and improvements indicate. Is it too much to expect that this constant western trend will continue until ultimately the fuel will be brought to the ore?

Blast furnace economy is receiving much attention now from our scientists and the field is a large and important one. For many years they have felt that a more direct process of making steel from ore might be found. Several direct methods have been developed on small scales but none has reached such proportions as to become a serious competitor of the blast furnace. The steels thus made are said to be superior to the ordinary ones. The primary difference between the two systems appears to lie in the composition of the gas used. A New York engineer who has given the problem close study, claims that the poorer grades of fuel, lignite and peat, produce a much larger volume of this special gas than coking coal. This fact makes the process of more than academic interest to Minnesota where the raw products, iron ore and peat, exist in abundance and shipping facilities are of the best or soon to be made so by the construction of a canal to the sea and a six foot channel in the Mississippi River.

Another means of reducing iron ore is via the electrical furnace. The primary factor in this is an abundance of cheap power. Our hydro-electric resources though undeveloped will not fully suffice, so here again our vast peat bogs may be made to come to the rescue in the time of need. Electricity from peat produced gas may not be visionary.

Slag

One of the most important moves in conservation of recent years has been the utilization of blast furnace slag. Blast furnaces heretofore have had as one of the important overhead charges, the disposal of slag. Scientists and engineers

(*Continued on page 124*)

RIVER CONTAMINATION IN MINNEAPOLIS
View taken of the Mississippi river in the vicinity of Minneapolis, showing pollution of river water that exists in the neighborhood of many large cities of the U. S.

Formulas in Industrial Management

Mathematical methods of providing and maintaining precision of control in use by executives for scientific control of business

By Jay L. O'Hara
Lecturer in Economics, University of Minnesota.

The past decade and a half has witnessed a remarkable development in American industry of what, for want of a better name, may be called scientific control of operations. One of the aspects of this development, which should be of interest to the engineer, is the increased use of mathematical method in the providing for and maintaining of that precision of control which justifies the designation "scientific" as applied to modern management.

In the problems which industrial executives most constantly face in the maintenance of control of operations, there are usually present a number of variables. Unless these variables are given due weight in the rendering of decisions or in the developing of standards, it is practically impossible to predict what should be the outcome of any given combination of productive factors, and in the absence of this knowledge of what any given outcome should be, there results—not control—but drift.

Probably the first positive application of the mathematical method to the problem of production control was made 25 years ago by Carl Barth at the Bethlehem Steel Works, when he took the experimental data compiled by Dwight V. Merrick, Henry L. Gannt and others working under the direction of the late Frederick W. Taylor and evolved a formula for the determination of proper lathe feeds and speeds, depending upon depth of cut, number and hardness of tools, hardness of stock, and diameter of work. From this formula he then devised the Barth slide-rule, which has become almost as well known as the Taylor-White high-speed tool steel which had its genesis in the same set of metal-cutting experiments. The important thing for our present purposes is the development of such formulas and their application to the problems of executive control. For example, the Westinghouse company has, within the past six months, developed standard metal ratios for various castings which furnish criteria for the relation between the metal charged into the cupola and the metal shipped in the finished casting. In the formulas from which these ratios were derived, three variables were employed, namely: area, excess weight (gates, sprues and risers), and shipping weight. It requires but little exercise of the imagination to perceive in how many and various connections this type of formulization can be made of service to the executive.

The type of formula used in the solution of non-technical executive problems is analogous to, though not identical with those just suggested. This is the case because many of the variables are independent—or at least no functional relations have as yet been established experimentally—and as a consequence, arbitrary values must be assigned to them pending the establishment of a casual relationship. In illustration of the kind of formula which I have called non-technical, I shall use what is known as the Babcock Base-wage Formula, developed by Geo. D. Babcock when he was Production Executive of the Franklin Manufacturing Company. The formula has for its purpose the determination of the proper base-rate for individuals or homogeneous groups of workers, in view of the various factors, variable and constant, which should influence the wage rate. The formula is as follows:

$$R = \left[\left(\frac{K[r(1+Pi+Px+PyNy)+Rm](1+2Pp)}{Ps(1+1.3Hs-.3Pp)(1+.35+Po)+Vs} \right) (Pt+Pd[1+.5Pp]) \right] C$$

R = base hourly rate.

K = a constant, when Ps = 100%; it is solved for by the substitution of standard values for other symbols in the formula.

r = a fundamental hourly rate. It is a constant, calculated as the lowest rate of pay under pre-war (1913) conditions, to be corrected by the expression (1+Pi+Px+PyNy), in which:

Pi = the percentage increase in living costs compared with a 1913 base and corrected periodically by reference to recognized index-numbers of prices;

Px = an arbitrarily selected percentage allowance for each additional process or operation known by the person to receive the wage. Judgment must be exercised in the determining of allowance so as to make it an incentive to develop versatility on the part of the workers and yet not be prejudicial to the capable but less versatile workman.

Py = a percentage allowance for each year of connected service;

Ny = number of years of such service;

Rm = a fixed charged rate per hour, which is not actually employed in calculating the base rate, owing to complexities which its use involves;

Pp = percentage of premium earned on standard time allowed;

Ps = percentage of worker's efficiency with standard task time figured as 100%;

Hs = standard time allowed, in hours, for doing the work;

Po = percentage of time absent or late;

Vs = value of work spoiled in process by worker;

Pt = per cent of task time to total time worked during the pay period;

Pd = per cent of non-task or day-work during the pay period;

C = co-operation and conduct, figured as a percentage with a base of 100%. This is obviously the most important single variable in the equation and consequently requires the greatest care in the assignment of a value. In the hands of an unscrupulous executive it is the "joker" of the formula.

It is apparent that a formula as complicated as this is not practicable for general use because of the added labor entailed in the calculation of payroll. Nevertheless, there are certain observations concerning it which may be worth making. In the first place, the location of the various factors in the equation is more or less arbitrary, for example, C might be included in the expression for the correction of r and assigned a different value. A considerable amount of experiment is necessary in ascertaining the degree of influence any one factor should exert upon the result. Secondly, in the assigning of values to the arbitrary items, executive initiative is demanded, but once selected, these values, such as Px and Py, become shop constants per process and per year respectively, and as such are as fair to one worker as to another, whereas, if the assigning of the base wage is left wholly to the unguided judgment of the foreman or the employment manager, there is no semblance of assurance that base wages will reflect differences in value of different workers to the employing concern. Thirdly, there has been, in recent years, a marked tendency among representative industrial firms to employ simpler but similar formulas in the setting of standard wage rates. The reason for using this more complex equation was to indicate something of the number of variables which are involved in the problem, whether they are given recognition in practice or not.

With the development, during the past five or six years, of so-called standard costs, a new field for the use of formulas in management has opened up. A standard cost may be defined as what it should cost to do a given piece of work under good working conditions and employing a good workman. It is the cost which should be realized and not exceeded as a typical condition. Where cost standards are used, there is an evident need for a comparison between

(Continued on page 130)

The Story of

KILPATRICK AND PEARSON

The Crooning Cowboys

as related to the Editor

George Pearson — *Porter Kilpatrick*

Two Architectural Students Tour the Orpheum Circuit During Summer

A FEW years ago, in the cattle-rustling town of Sheridan, Wyoming, there lived an ambitious freckle-faced youngster by the name of George who used to give the natives great cause for comment on his ability of back-fence yodeling. Many an afternoon as he trudged home across the sand dunes so characteristic of the great wide open spaces where men are men and the plumbing is on the outside, he would sing to himself the songs of the cow-punchers, and before he had reached the age when it was necessary that he go away to complete his education, in his repertoire were many of the ditties that the cattlemen sang as they swung in the saddle or gathered around the bunk-house fireplace after a day's rodeo. About the same time in a small Main street village in Minnesota by the name of Adrian, a slender youth called Porter was busy entertaining the neighborhood kids by giving shows in his father's barn for the grand price of four pins. Often during recess at school, his playmates would crowd around him and he would have to run home for his banjo and sing and play a few songs for his playmates before they would let him go.

Time passed on, as it does in any well written story, and a few years later, we find George attending the University of Wyoming and Porter down at Grinnell college in Iowa. After going two years to Wyoming, George came to Minnesota and the same fall, Porter also decided to finish his education at the University of Minnesota. It happened that George was a Sigma Nu from Wyoming and one night when the boys had finished dinner, George and Porter found out that the other could sing.

From then on, rollicking songs were a nightly occurrence around Ninth and University avenue as their acquaintanceship and ability grew. Their fame soon spread to other houses on the campus and it was not long before they were asked to sing at many fraternity and sorority events. They later were taken in to the "Whip-poor-wills," a campus aggregation of singers. It then became so that no campus event of consequence was a complete success without the appearance of George and Porter. They sang at the Junior Ball, the Senior Prom and many other events, and were easily the headliners in "Mona Lizzie," musical fantasy presented April 17 and 18 of last year by the Arabs, engineering men's dramatic organization.

Their fame soon passed beyond the campus. University theatre-goers at the Orpheum one night last spring were more than mildly surprised to see Blossom Seelye, then headlining the bill, come out between acts leading blushing George and Porter by the hand and presenting them to the audience with these words:

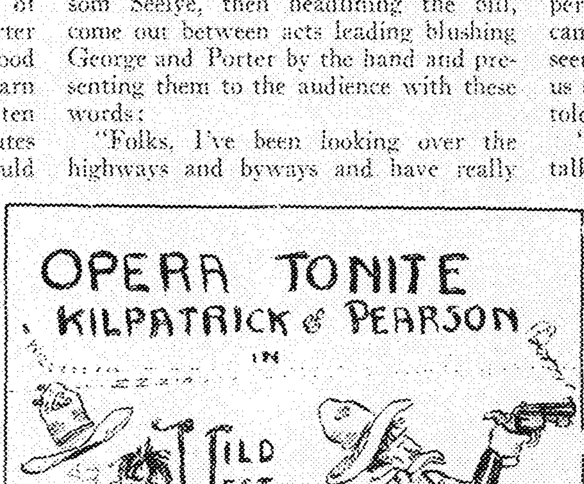
"Folks, I've been looking over the highways and byways and have really found a couple of real cowboys. My God, folks, they're hot!"

They were very enthusiastically received that night and responded to more curtain calls than any other act had obtained for a long time.

"How did it happen that you attempted big time stuff?" I asked George and Porter the other afternoon as they were sitting across from me at their drawing boards in the architectural drafting room. George looked at Porter and Porter hesitatingly started.

"Well, we kinda thought that we would try our luck, so we went down one afternoon and talked to the Orpheum management. The boss didn't give us much encouragement but, anyway, he sent his assistant out to hear our act. During the latter part of the performance, Mr. Phelps, the manager, came in himself and listened to us. He seemed more or less pleased and he told us to do our stuff again. We were then told to come back later.

"After the next try-out, we got to talking with Phelps," George continued, "and by happy circumstances found out that he had at one time lived out West. Through our conversation about the wide open spaces, we became quite well acquainted. Maybe it was this and perhaps it wasn't, but anyway, we made our first appearance soon after at the Orpheum, filling in for a bill that had missed their train. That's how we came to go on the stage.



"The first performance, we were scared as the deuce and as we were going off the stage after the last curtain call, Porter's sawhorse caught in the curtain and we had an awful mixup, much to everyone's enjoyment. It went off pretty well, everything considered, and then we started in earnest to work up the act.

(*Continued on page 128*)

AROUND THE WORLD WITH OUR ALUMNI

Chemists

'24—A. G. Zima is with the Minnesota Crucible Steel Co., Minneapolis.

'25—Lester L. Johnson has a fellowship in chemical engineering at the engineering experiment station.

'25—John B. McKee is taking graduate work in chemical engineering at Minnesota.

'25—Murray M. Sprung is taking graduate work in inorganic chemistry at Minnesota.

'25—Paul L. Covell is working in the Bliss Laboratories, Minneapolis.

'15—Leslie R. Olsen, chief chemist for the International Milling company of Minneapolis was re-elected vice-president of the American Association of Cereal Chemists at their convention in St. Louis last June.

'22—Betty Sullivan has returned from France and is now employed as a chemist for the Russell Miller Milling company of Minneapolis. Her address is 1014 17th avenue north. She was at one time an associate editor of the Techno-Log.

Civils

'09—Ell Torrence, Jr., is slated for the office of vice-president of the Minneapolis Real Estate Board. He previously has served on the Board of Directors. He is in the real estate business in the Twin Cities, being affiliated with Thorpe Bros.

Editor's Note:—The 1924 class of civils have followed an excellent idea, namely the publishing of a little news letter by one of their number and the sending of it to every member. We understand that other classes are doing this but the one printed below is the first that we have seen. We sincerely hope that more will follow. This one is from the pen of Spike Garzon, former alumni editor of the Techno-Log and whose address we have to change every once in a while. Very glad to hear from you, Spike.

Taveras, Florida, December, 1925.

Through this Christmas number of the "Dirt Sheet," we of the class of 1924 wish you of the class of 1924, a Merry Christmas and a happy and prosperous New Year.

This sheet has been in evidence more or less since we departed from the senior room. There has been no regular name given to it. Some of you have called it one thing and some of you have called it things we cannot mention in print. I wish to hear from every one of you as to a permanent name for it. We will vote on the names presented and the winner of the contest will be given a slug of the finest corn "shine" in the state of Florida. Such a prize is well worth trying for. I can personally guarantee that.

We have with us for this publication, letters from Oustad, Lund, Herberg, and McCrady. Oustad wrote on the stationery of the engineering department of the city of Los Angeles, Cal. His work is on municipal improvements such as paving, sidewalks, curbs and sewers. His two brothers who are also engineers, are working in the same office. Geo. Bestor was in to see him. We are glad to hear that George is that far on his trip around the well-known world. Oustad spent two weeks with the 63rd Artillery of Fort Scott, San Francisco, at Santa Cruz the first part of October. No doubt it was not all fun as he spent $63.50 to repair his car. Always use two hands for driving. Lund thought that he had been dropped from the list. I am sorry, R. V., if you have not received these "interesting sheets." We try not to pass anyone by. Any time you're in doubt, write us a letter. Lund is trying to change the campus so that when we come back in 1929 for our first big reunion, we will be forced to get a map to find our way around. Any important changes that the Department of Buildings and Grounds wish to make must be approved by the class of 1924. Kindly remind them of that, R. V.

Herberg writes an interesting letter concerning his work and play. "Sanford Hall" continues in the engineering end of the underwriting game. He is very enthusiastic about it and recommends the work for a young engineer. At the time he wrote, he was in a terrible part of the world called North Dakota, but he expected to be back in Minnesota in time to punish a turkey on Thanksgiving.

Old man McCrady finally kicked in with his four bits. I promptly sold the stamps and went around the corner to find the "man who has it." Mac is so hard after the sheckels that he has not much time to write us any news. Mac, we want to hear how the boys are getting on with the job of running or ruining the country. Since you are our only Washington correspondent, you must take care of that job.

In order to fill up this sheet, I must tell you of my trip down here and what the boys in Florida are doing. I met Carl Erickson in Chi., as I came through. I was not able to catch the train that night due to complication which set in just before train time. If any of you get to Chi., look Carl up. He is a very good host. In fact, one of the best. Shortly after I arrived here, I had a wire from Pete Larson who is at Bradenton, Fla. The outcome of several wires back and forth was that Pete Van Harrington and I met in Tampa on Armistice Day. It was a regular celebration and I don't wish to fool you. George Sprehn is also at Bradenton but he could not join us due to the presence of his wife and family. We took in the sights of Tampa like a bunch of "hicks." The three of us had dinner at a cafe where you can get it and the check called for an expenditure of $27.40. I arrived back here some time in the morning on the rim with two flat tires in the rear seat of the car. It was a great trip. Pete and Van came to see me on Thanksgiving and we ate turkey in Orlando. We expect to spend Christmas in Cuba. I am looking for more news from the boys. Sincerely,

Spike Garzon.

'25—Charles Prichard has accepted a scholarship and will work in the highway department of the experimental engineering laboratories of the University of Minnesota. He is making a special study of asphalt paving mixtures.

'25—Joseph P. Lushene left for St. Petersburg, Florida, on Dec. 4 to work on a hydrographic survey of Tampa Bay. He says that he expects the work will take all winter. Mr. Lushene is a deck officer in the Hydrographic and Topographic division of the United States Coast and Geodetic Survey. His present address is U. S. S. Hydrographer, Box 417, St. Petersburg, Fla.

'25—Dwight Burns, Arthur Gobeli, and Carl Gerdes, all graduates of March, 1925, are now working for the Santa Fe railroad and are located near Lubbock, Texas.

'25—Carl Gerdes is running a gun for the Standard Oil company and is located at the Port of Spain, Trinidad, S. A., in care of the West India Oil company. He is, perhaps, the furthest away of any of the '25 class. If you write him and don't get an answer for a couple of months, please don't cuss him as it takes three or four weeks for a letter to reach him.

'25—Frank Starr and Ed Brownell are with the Northern States Power company. Frank is working on hydro-electric plant measurement in Minneapolis and Ed is in Wisconsin.

'25—The State Highway Department has had a good many of the boys during the summer. Clarence Burley was at Owatonna, Herb Dungay at Jackson, Eddie Hendrickson at Winona, Farmer Pete was at Red Wing, and Roland Schmidt at International Falls when last heard of. Schmitty never could keep away from those northern girls. Gus Hansen and Garvin Peterson were also inspecting this and that. Most of the jobs were inspection of materials, so for highway men's addresses, use their home town as they have probably changed location by this time.

'25—Ed Quinn and Harry McAndrews, both ex-highway men, are working for the Minneapolis Steel. Mac is drafting.

'25—Milt Nordstrom and Arndt Duvall are working for the Missouri Bridge department. They visited friends around school during their Christmas vacation.

'25—Hamilton Craig is in Boston on a steel erection job for the Illinois Steel company. Baked beans and fish are his everyday menu, he writes.

'25—Among those who have gone into construction work are Eddie Fulton, manager of the western branch of Peppard and Fulton company, who is erecting bridges, John Ward, who is engineer of everything for the Hanford Produce company of Sioux City, Iowa, engaged in building design and refrigeration work, Clarence Blue who is with W. D. F. Lovell of Minneapolis, now being at Geneseco, Illinois, engaged in the erection of a post-office, and H. C. E. Peterson, former civil editor of this magazine, who, after roaming the wild and wooly west, has settled down to a job with his father who is in the contracting business.

'25—Phil Hartman was always a bouncing good boy, so H. C. E. says, that is why he is working with Goodyear. He is at Akron and is working around the plant in preparation for a rating as a Goodyear technical man. His work will then be plant analysis.

'25—Bill Brose and Thors Berg who went with the Marion Steam Shovel company, after training for sales work in the various departments, are now on the road.

'25—C. W. Thompson is doing municipal work in all branches for the city of Aurora, Illinois.

'25—E. B. Youngquist is designing for the Concrete Steel Company of Minneapolis. Harold Beese is doing drainage surveying for G. R. B. Elliot in this city also. Bill Auxer has hung out his shingle and is doing surveying with a '24 graduate.

'25—Clifford Hendricks is with the Tri State Telephone company and is the proud father of a baby boy.

'25—Now for some real information. Some of the fellows have seen fit to take a wife. If this information hits you as it did us, we know that you will have a real laugh out of it. Wolf, O'Brien, Carlbom, Waldor and Brose are the newly-weds.

(Continued on page 122)

NEWS FROM THE TECHNICAL CAMPUS

School of Mines Graduate Conducting Novel Work

Mr. Roland B. Queneau, a graduate of the School of Mines in 1923, is at present conducting a novel work in Springfield, Ohio, under the employ of the Pitometer Company of New York City. The work in Springfield consists of locating leaks in the waterworks system there. In conducting work for the Pitometer company, Mr. Queneau has traveled to various parts of the country, and has just recently come from Cleveland, Ohio, where he had done some work.

According to the paper in Springfield the work has been very successful, as shown by the account below.

"An underground river fed from a broken joint in a city water main carrying more than 200,000 gallons of water per day into Buck creek through storm sewer drainage was discovered yesterday morning by pitometer officials.

The giant leak was found in the middle of the 2100 block in Harshman blvd. A hissing sound that could be heard for several hundred feet led to the discovery.

The broken main revealed the largest water main leak in the history of the city consuming water at the selling rate of $7,300 per year.

Pressure in the Harshman blvd. district jumped five pounds on the pumping station guages when city water employees repaired the break.

Roland Queneau, pitometer representative, experienced considerable trouble in locating the "underground river" because the water was being carried off in the rock strata to the sewers.

Neighbors living in the vicinity reported the "hissing sound" as a probable gas leak. But no defect was found until the pitometer official located the giant gusher.

From figures supplied by city officials the one leak will more than pay the city's bill for the entire pitometer survey. The contract with the pitometer company called for $6,700.

The survey which was started two months ago will not be completed by Queneau until Nov. 1. Thus far three pitometer men have worked on the water leak probe saving the city more than 630,000 gallons of water per day.

When the survey was launched it was estimated that the city was losing at a selling rate of $50,000 per year. The survey was recommended by George Cotter, superintendent of the waterworks, and approved by the city commission.

The campaign against water leaks was seen as an important factor in the city water supply this year due to the prolonged drought and the jump in the city's water consumption of several million gallons per day.

Pitometer engineers fulfilled the agreement in their contract with the city this week when they reached their assigned quota of 400,000 gallons per day of leakage from the city water distribution system.

R. B. Queneau, detail engineer representing the pitometer company in the completion of the Springfield survey, announced that the total number of leaks found, reported and repaired had reached 430,000 gallons per day.

The city commission voted to spend $6,700 for the survey of the city mains with the provision in the contract that the pitometer company save the city that much money in detected and repaired leaks in the water system.

C. R. Bird, of Detroit, personally opened the survey at the city pumping station. The work was then turned over to J. F. Burkin for a probe of the mains, and to R. B. Queneau for detailed subdivision work.

It is estimated that the probe will be continued until the latter part of October, Queneau announced yesterday, as the entire city has not been covered."

Foreign Mission Board Honors Alumnus Who Died in China

Details of the death of Reverend Van Tuyl Stinson of the 1911 electrical engineering class have recently been received by his friends. He was killed November 27, 1924, in a saw-mill accident in Hoihow, Hainan, China. A formal memorial resolution was adopted by the executive committee of the Board of Foreign Missions of the Presbyterian church, in whose services Stinson was at the time of his untimely death. This resolution follows in full:

"The Executive Committee of the Board of Foreign Missions at its meeting December 1, 1924, was greatly grieved to learn by cablegram of the sad death of the Rev. William Van Tuyl Stinson on November 27, 1924, at Hoihow, Hainan, China, as the result of a saw-mill accident. Extensive operations on new Mission buildings are at present in progress at the Kiungchow Station, Hainan, and inasmuch as Mr. Stinson was an expert in engineering, it was probably in connection with this construction work that he accidentally lost his life.

"William Van Tuyl Stinson was born on November 8, 1889, in Minneapolis, Minnesota. From early childhood he revealed a marked inclination toward mechanical and constructive activity and he very naturally took extensive manual training work during his course at Central High School, Minneapolis, where he was graduated in 1907; then followed a course in engineering at the University of Minnesota from which he received the degree of electrical engineer in 1911. During his junior year in the University a clergyman who was a friend of his family urged him to study for the Christian ministry; but at that time he did not feel called of God to this life work and he continued with his profession and became connected with several manufacturing and commercial concerns. After several years, he felt definitely called to give his life to full-time Christian service and for further preparation entered the Presbyterian Theological Seminary at Omaha, Nebraska, from which he was graduated in 1917. He applied to the Board of Foreign Missions for appointment as an ordained missionary from Minneapolis Presbytery and on January 2, 1917, was appointed and was assigned to the Hainan Mission, sailing on the 1st of September and arriving on the field on October 11 of that year.

"In the Hainan Mission, Mr. Stinson has been related to the Kiungchow Station and has devoted himself with deep earnestness and far-reaching influence to the evangelistic work in the city itself, in the surrounding villages and by long, difficult and sometimes dangerous itinerating trips in the more distant parts of the Island. He has written inspiring accounts of his chapel and street preaching, as well as his evangelistic trips in to the primitive conditions of the outlying districts. Large posters, colored pictures, graphophone music and other expedients were employed to attract the people and present the gospel. A narrative of the vicissitudes of one such inland, itinerating tour across flooded streams closes with the following paragraph: 'One's experiences help one in getting the meaning of the Bible and this one trip has thrown a good deal of light on Paul's meaning of being in "perils of Water" and so forth. As he managed to come through them all and preach the Gospel even unto Rome, so we hope to come through high waters and perilous regions and work for the establishing of His Kingdom here.'

"Like the great missionary apostle, Mr. Stinson also preached the Gospel in season and out of season, carrying the message of a crucified, risen and living Savior to distant peoples, many of whom have turned to the Lord. With fine courage and true loyalty, he was consecrated to his God-given task. Like Paul, he could say, 'I have fought a good fight, I have finished my course, I have kept the faith: henceforth there is laid up for me a crown of righteousness.'

"The immediate relatives of the deceased are two sisters; to them and to the many friends both at home and abroad who are personally bereaved, the Board extends its heartfelt condolence in the sad and sudden death of this loyal servant of Christ whose departure is a real and deeply felt loss in the foreign missionary enterprise of the Church."

Delegates Attend Honorary Fraternity Conventions

Prof. J. V. Martenis, Clifford Comfort, and Carl Fornfeist attended the national convention of Pi Tau Sigma, honorary mechanical engineering fraternity, at Urbana, Illinois, November 5, 6, and 7. Prof. Martenis is faculty adviser of the local chapter, and is supreme secretary of the national organization. Plans were made at the convention for the publication of a quarterly magazine to be called "The Condenser," and to the Minnesota chapter was alotted the responsibility of editing the paper during the first year. A model initiation ceremony was held at which W. L. Abbot, president-elect of the American Society of Mechanical Engineers, was made an honorary member.

Diversion from the routine business was supplied by a special game of golf between Professors Leutwiler of Illinois and Prof. Martenis of Minnesota, with Prof. Goodenough of Illinois and Carl Fornfeist doing the caddying. As a final treat, the delegates attended the Illinois-Chicago football game.

Hilder W. Bergman was the delegate from the Minnesota chapter of Eta Kappa Nu, honorary electrical engineering fraternity, to the national convention held recently at Purdue University, LaFayette, Indiana.

School of Chemistry Offers New Courses

Several new courses have been offered in the School of Chemistry this year. These courses are Magneto-Chemistry by Dr. Taylor, Technology of Cellulose by Dr. Montonna, Photo-Chemistry by Dr. Sarver, and a course in mathematics applied to chemistry, given by Dr. McDougall.

Two Prominent Senior Civils Spend Vacation In South

Two prominent senior civils, Edward Gould and Leslie Croswell were exposed to Southern climates during Christmas vacation, when Eddie visited his parents in Florida and Croswell treated his parents likewise in California.

Mr. Gould was especially impressed with the train service he encountered on the Florida East Coast R R where they run twenty passenger trains a day each way, said passenger trains all giving the right of way to freights and becoming from three to twenty hours late. After meeting his folks he spent most of his time driving around to various points of interest. Near Lake Okeechobee he drove on Conners Highway, a paved toll road which parallels one of the largest canals in the country, and here saw several triangulation stations built by Carl Aslakson, C. '23. The land along this road was drained to 18 in. below the surface, and except for the raising of some sugar cane, was of little value.

There are several large developments along the coast, among which are subdivisions for cities which extend from five to ten miles back from the coast into the everglades. This land is valued at from $500 to $1,000 per acre. Other places he saw were Hollywood-by-the-Sea, a former swamp, and Coral Gables, where most of the moneyed people live. At the latter place, the big new Miami Biltmore Hotel was under construction. The buildings in Coral Gables are all built of brick or tile, probably to keep building costs high. The city contains two schools for women and a military academy; Miami University will soon be built there. Mr. Gould said that Miami with its skyscrapers, overflowing traffic and no parking space was the New York of the South. The city has five men to every woman. Miami is connected to Miami beach by a causeway which is a combination of a large fill and a bridge.

At Fort Landerdale he saw Venetian City in which every lot has a street frontage and a canal backage. While in Palm Beach, Eddie said he passed by the Royal Poinciana Hotel which is open two months of the year and has a minimum charge of 35 dollars per day. Here he gained information about a gambling house that is reputed to do more business than Monte Carlo or even C. E. summer camp.

Mr. Croswell also saw several interesting things but couldn't remember as many as Mr. Gould. He left Minneapolis in a snowstorm and woke up a day or two later in time to see the Mormon Temple in Salt Lake City, also through a snowstorm. He met his folks in Los Angeles and then spent a week or more driving around the state. In Los Angeles he saw Seventh and Broadway, the busiest corner in the world, and the engineering school of the University of Southern California, which consisted of a red shed about 100 ft. square and one story in height. Driving North he saw at Curver City the largest movie set (used in the production of Ben Hur) that was ever used, and saw some real stuff in soll another set. In Santa Barbara he saw a brick ex-hotel and an eight story steel building which was entirely unhurt by the recent earthquake.

A heavy fog prevented him from seeing San Francisco, so they drove west passing near a large dam being built by the A. S. C. E. for a washout test. While in Pasedena, "Fuller" saw the Washington-Alabama football game at the Tournament of Roses. He stated that the Washington team would have been much superior to the Alabama team had it not been for the injury to Wilson but that either team would have been easily beaten by Michigan. (He saw the game at Ann Arbor.) He was only three blocks from the stands which crashed before the game. This construction was terrible and hereafter such structures will be made to pass city specifications.

Croswell drove home with Garvin E. Peterson, another civil, in Pete's big black open car, and they were somewhat cold the last two or three days of the trip which they made in the fast time of six days.

Students Enroll In Naval Reserve Aviation Course

When the Navy recently announced that a limited number of engineers would be offered a complete course in aviation under their direction, it met with an immediate response. The proposition offered by the Navy is this. The engineering student is to join the Naval Reserve in a special aviation course. He receives preliminary training in airplane construction, airplane motors, aerial navigation, and allied subjects in Minneapolis at the Naval Reserve Armory, which is located on the Calhoun Boulevard near Lake street. One class meeting is held each week during the whole school year. Upon completion of this course, the student goes to the Great Lakes station, located near Chicago. Here additional ground school training is given and actual flying of airplanes is encountered. The student is first taken up with an instructor, and is flown about a bit in order to get used to the feeling. Then the student is allowed to handle the controls with the instructor watching him and ready to assist him if needed. After the student has become familiar with the plane, he takes it up alone on a solo flight, and continues this until he has spent 30 hours in the air. Then he is transferred to the Hampton Roads Station, where the finer points of flight are brought out. On completion of this he receives his commission as ensign in the aviation reserves of the navy.

The student receives no compensation for his preparatory work done in Minneapolis. At Great Lakes and Hampton Roads, the pay is that of a seaman, and amounts to about $50 a month. Upon receiving a commission there is retainer's pay given which amounts to about $250 a year if two weeks are spent in flying during each year, and if meetings at the Naval Reserve Armory are attended.

Those passing the flight physical examination and now taking up the course are Lloyd V. Berkner, Lawrence A. Clousing, Albert A. Cooper, Keith N. Krieger, Ralph H. Sanielman, Arthur Slattum, Donald T. Stevens, Richard Hanson, Ross Machachek, and Edward C. Clark.

Although the quota is almost filled, there is still opportunity for any one interested in this work, and who is able to pass the examinations to enter the course, by coming Thursday evenings, which is the regular meeting time, to the Naval Reserve Armory.

A number of University of Minnesota men have taken up the course and have already received their commissions, the course being given every year, starting a few years after the war. Those who have completed the course are Archie MacDonald, Leon Dahlem, Carl Luethi, Douglas Campbell, Clarence Lund, Joe Meagher, Douglas Masker, and W. L. Saunders. The course is under the command of Lieut. S. E. Weld, with Ensign F. O. McKay, executive officer, and Ensign E. W. Mirrill in charge of instruction.

Experimental Laboratories Conducts Numerous Tests

"Experiment." Without the existence of this word, or what it signifies, advancement would have no meaning. In science, business, or whatnot, what is it that is the fore-runner of some great achievement or advancement? It is experiment. It goes hand in hand with progress. For this reason, the Experimental Engineering Laboratories of the University of Minnesota have become well known as a source of professional information on many improvements resulting from extensive experiments along different scientific lines.

Every day, letters are received by the Experimental Department, asking for information upon which they know they can depend. There are many points which, to some persons, may seem of only minor importance, but which in reality are exceedingly important, and which require extensive experiment. Some such questions are: "What kind of insulating material is best suited for a house? What mixture of concrete will be set in cold weather? What paint is best suited for a radiator in a heating system?"

Every year, thousands of such questions come to Professor F. B. Rowley, director of the Engineering Experimental Laboratories, to be answered by him or by some other staff member of the department. Besides furnishing facts from a specialist's standpoint to the thousands of questions, this department is continuously at work obtaining new determinations of facts by experiment.

Evidence that there is usually some certain type of apparatus or machine which is commanding most public interest, is indicated by the nature of the questions which are received by the Experimental Department. For many years the tractor was the outstanding center of interest among the mechanics of the Northwest, and also business men and investors. Questions were received by the Experimental Department concerning certain phases of the functioning and construction of such machines. Then, as competition tended to reduce the number of factors, public interest seemed to suddenly shift to the oil-burning type of heating plant for the home. Judging from the number of inquiries on this phase of experimental research, public interest in the oil-burner has surpassed everything else for the past two years. However, this year the interest seemingly has dropped off sharply, and as yet no new public hobby has taken its place.

The Experimental Engineering Laboratories building was erected in 1911. It is used by all engineering departments except the electrical, as this department has its own laboratories in the new electrical engineering building. However, numerous "electricals" still perform some of their incidental mechanical work in this laboratory. In the course of a year, this experimental building is used by between 600 and 700 students of engineering, among which are senior chemical engineers, senior and junior mining engineers, mechanical, electrical, and civil engineers.

The appearance of the inside of the Experimental Laboratories gives one the impression of viewing a "machinery hall" of exhibits. But each one of these numerous machines has a distinct and useful purpose in obtaining valuable experimental data. These machines are the tools with which the future engineers of the University of Minnesota are receiving some of their most practical training.

Civil Engineers of 1911 Hold Monthly Meetings

The civil engineering class of 1911 is still retaining the school spirit of their days at Minnesota. The members who live in the Twin Cities and vicinity hold a monthly reunion in the form of a club get-together. Members from other cities occasionally come to Minneapolis to take part in these meetings, which are held in a Minneapolis hotel. At these meetings they revive the friendships and spirit that they attained during their college days.

The following Twin City men are members of the club:

Herbert P. Arneson, who is employed as an estimator for Toltz, King & Day, St. Paul; Francis C. Boerner, architect and engineer of Minneapolis, and member of the firm of Croft and Boerner of Minneapolis; Ernest B. Croft, partner of Croft and Boerner of Minneapolis; Edward H. Enger, architecture engineer for the Board of Education; Ralph M. Godnett, St. Paul water department; Michael J. Hoffman, assistant maintenance engineer for the State Highway Commission, St. Paul; Ingwald Kvitrud, member of the firm, Kvitrud & Madsen Co., of Minneapolis; George A. Maney, who is an assistant professor at the University of Minnesota; Clyde Methven, division engineer for the State Highway Department, St. Paul; Ervin Miller, assistant bridge engineer for the State Highway Department, St. Paul; Lewis Mitchell Roth, sales manager for the Kalman Steel Co., St. Paul; Sigvel J. Siverson, contractor and engineer of S. J. Siverson Co., St. Paul; Marcus U. Swedberg, contracting engineer, Minneapolis, and Arthur C. Walby, who is in the insurance business in Minneapolis. Other members of the class are Arthur Ainslie, assistant engineer, N. P. R. R. at Staples, Minn.; William P. Cottingham, city engineer of Gary, Indiana; Axel F. Elfstrum, Structural Engineering Bureau, San Francisco, Cal.; David P. Friedman, who deals in ladies' furnishings in Duluth, Minn.; Carl J. Johnson, local manager of the Dakota Utilities Co. of La Moure, N. D.; Reuben A. Mark, partner of A. M. Wold-Mark Construction Co. of Brookings, S. D.; George C. Mattison, ranger, St. Thomas, Virgin Islands, commanding the C. & G. Survey steamer; Martin J. Orbek, assistant engineer for the Holland, Askerman & Holland, at Ann Arbor, Mich.; and Sidney H. Smith, city engineer at Mitchell, So. Dak.

Construction Begins On Mines Addition

Construction has begun on a new $4,000 addition to the mines experiment station to house an open hearth furnace, which will be used for experimental purposes in testing low grade Minnesota ore.

The addition to the experiment station will greatly increase the research range. At present the mines building houses a Bessemer furnace, which is an enclosed blast and in contrast to the exposed open hearth furnace.

With the increasing amount of low grade iron ore that is being thrown on the dumps in Northern Minnesota, it is very necessary to find experimental means to reduce the ore to iron or steel through some cheap process. Several introductory experiments at the University of Minnesota have shown such favorable results that further research work will be carried out.

With the construction beginning at this time, the completion of the addition within a month will be made possible.

Potter to Give Report at Belgium Meet In Fall

Orrin W. Potter, an instructor in the department of drawing and descriptive geometry, recently received word that he had been elected to write a paper covering his research work on heat-treating of metals, to be delivered before the European Foundrymen's Association meet, which will be held in Belgium next fall. An exchange paper representing the American association, which includes also Canada, is selected annually to be given before the old country convention.

Mr. Potter has won national recognition during the past year for his investigations concerning the heat-treatment of cast iron and semi-steel and presented a paper on this subject last fall at the national convention of the American Foundrymen's Association, which was held at Buffalo, New York. An excerpt of this paper appeared in the December issue of the Techno-Log. The paper which will be given before the European convention will be translated and printed in many technical publications in both continents. The details have not been completed as yet, but in all probability, Mr. Potter will personally present the manuscript.

This branch of research is practically new, Potter being among the first to obtain results on cast-iron, there being much data on steel, non-ferrous and malleable materials. He has spent five years in the foundry business and practice before teaching and since then has been actively connected with the industry. He has prepared many papers and lectures in reference to metallurgy. As a result of these activities, Mr. Potter has been elected to honorary membership in the Twin City Foundrymen's Association.

Many Lectures Given at School of Chemistry

During the latter part of the fall quarter, a number of important lectures were given at the Chemistry building. These lectures were arranged for by the School of Chemistry, the Chemical Society and the Graduate School.

Among the first was one given by Dr. Cottrell of the nitrogen fixation laboratory at Washington, who spoke about "The Future Aspects of Nitrogen Fixation." This lecture was sponsored by the local branch of the American Chemical Society, as was also a talk by Dr. John A. Wilson. Dr. Wilson is chief chemist for the A. F. Gallun and Sons company of Milwaukee. His lecture was concerning his investigations in the "Chemistry of Leather."

In the special series arranged by the School of Chemistry two talks were given; one by Dr. Kendall of Columbia University, and the other by Dr. C. G. Derrick, formerly head of the research department of the National Aniline Co. Dr. Kendall spoke on the "Rare Earths" and Dr. Derrick on "The Development of the Dye Industry in This Country."

Dr. Martin Fischer, a well known authority on organic chemistry, lectured on "Colloids in Medicine" and was sponsored by the graduate school.

Large Companies Interview Seniors About Employment

Representatives from several eastern manufacturing concerns will soon consult members of the senior class concerning future positions. Mr. F. H. Seeger of the Cutler-Hammer company was here last December and Mr. M. M. Boring of the G. E. as well as the Westinghouse man will be here during the next two months to talk with the graduating class about the merits of their companies.

Newkirk Lecturer Here On Interesting Research Work

An interesting lecture was given by Mr. B. L. Newkirk of the Research Department of the General Electric Company, on December 11, in the engineering auditorium. This talk told of the results of his work in the Research Department on shaft whipping, dynamic unbalancing, and gyroscopic phenomena. It was through the inducement of several of the leading engineering colleges that Mr. Newkirk was persuaded to give a series of talks on applied mechanics.

A sample machine was used in conjunction with suitable slides to illustrate more fully the characteristics of dynamic unbalance. He has applied many of his ideas on shaft whipping to the machines at the General Electric company with unusual success. Moving pictures are used to facilitate the study of shafts and bearings in motion. He has also patented a machine for the dynamic balancing of engine shafts in automobiles and has published two or three papers on his research work which give a somewhat different explanation of the above phenomena.

Mr. Newkirk is a graduate of the University of Minnesota and received his Ph. D. degree while studying in Munich, Germany. He was also an instructor of mathematics in the college of Engineering and Architecture for a period of ten years.

Enrollment Shows Decline From Fall Quarter Registration

The following is a summary of the comparison of the enrollment in the College of Engineering and Architecture for the fall and winter quarters of the year 1925-26. The freshman class showed the greatest decrease, there being 428 in the fall quarter and 372 in the winter quarter, thus making a decrease of 56.

In agricultural engineering there is an increase of two over the fall quarter. In the pre-business course there was a decrease of three. Interior decorating showed a drop of two students. The department of architecture lost 17, there being 146 in the fall and 129 in the winter quarter. Architectural engineering made a gain of five students by having 33 registered in the fall and 38 registered in the winter. Civil engineering, also, showed a gain having 244 as against 239 in the fall. The enrollment in electrical engineering dropped from 424 to 405 while the mechanicals also dropped from 180 to 173. The unclassed students in engineering also showed a large decrease in enrollment, decreasing from 59 in the fall quarter to 32 in the winter. Taking all departments together the total enrollment in the fall quarter was 1,104 and the present total enrollment is 1,041, making a decrease in registration of 53.

C. Ralph Bennett Resumes Thursday Literary Readings

During the last school year, C. Ralph Bennett, instructor in English, inaugurated a weekly reading hour to which all students and any others interested were invited. The readings which were in no way connected with class work proved quite popular and have been continued this year.

Selections are read from modern authors chiefly, including poetry as well as prose. The usual hour is made up of a one-act play, a short story, and some poetry. The readings are given each Thursday afternoon at five o'clock in Room 107, main engineering building.

Minnesota Junior Colleges Offer Engineering Courses

Five junior colleges in the state of Minnesota offer courses in engineering. These are located at Hibbing, Virginia, Eveleth, Ely and Coleraine. Each of these junior colleges is in connection with the high schools at the respective places, and are the only ones so connected except for the junior college at Rochester, which, however, does not offer a course in engineering, but deals more with the teaching of preparatory medical subjects. There are other junior colleges in the state, but these are either independent or endowed institutions, and offer little in the way of engineering education.

All five of these junior colleges offering courses in engineering are to be located on the range which is natural because of two reasons. First, the type of industry carried on there leans toward engineering, and second, the ore tonage tax has made possible the support of the schools. In fact the tax has provided so abundantly for the schools, that the very best type of equipment and facilities are provided for the teaching of the engineering subjects. At Hibbing especially, do the splendid facilities show up. They have there an electrical laboratory upon which the designer spent two years with the result that nothing has been missed in an effort to provide for easy and quick adjustment of the apparatus in the carrying out of an experiment. All apparatus is of best type, and includes generators, delicate meters, switchboards, in fact practically everything which is available for use at the University of Minnesota. Surveyor's instruments are of the highest grade. The pattern-making shop includes beside all the regular planers, buzz saws, band saws, sandpaper machines, etc., a whole battery of turning lathes, each with individual electric motors. The machine shop, foundry, and forge shops are all in keeping with the other departments of the school. The foundry here would make Mr. Moffet, foundry instructor at Minnesota, somewhat envious.

The splendid facilities offered here, of course, are not as good at all of the junior colleges throughout the state, but the equipment of all the junior colleges offering engineering courses is comparable with that used at the University. The fact that such fine material is available for the instructor to work on is a strong point in the securing of first class teachers to come to these schools. The instructors are for the most part, very well trained and have had some experience, although perhaps not as wide an experience that an instructor at the University has. Training is very thorough and graduates are admitted to junior standing at the University of Minnesota without examination upon the presentation of credentials showing sixty credits and sixty honor points. Because of this affiliation, students of these colleges will be admitted to any other institution on the same basis as students of the University are admitted. Representatives of the University are sent annually to inspect these various junior colleges to see that they maintain a high standard. According to University authorities, students from these colleges have stood up as well scholastically as the average studen at the Minnesota has. Of course, there is a slight disadvantage presented to the exceptional scholar who, coming from a junior college to attend the University, deserves honors, but is unable to get them because his status at Minnesota has not been able to be established in the short time he is here. However, this is merely a disadvantage and if he proves to be of the type deserving of honors they will most likely be bestowed upon him.

Hibbing offers the most complete courses in engineering; there being courses in mechanical, electrical, civil, chemical, and mining engineering. The full two years of all these courses are offered and the course of study includes everything that is required in each separate course given elsewhere. The subjects studied in the first year are the same as required here at Minnesota, even the course numbers are the same. However, Rhetoric is omitted the freshman year, making a total of 15 credit hours taken the first year. Rhetoric is then substituted in place of an elective in the second year, thus making a total of 18 credit hours carried during the second year. Credits are figured the same as they are figured at the University. The fact that the junior colleges are on the semester plan, however, somewhat complicates things. There are two parts to the semester and three parts to the quarter system, so a semester credit is given 1½ times the value of a quarter credit.

Honor points in all junior colleges are decided in the same manner as they are decided at the University as a whole, although a little different from the way they are decided in the engineering colleges here. Each credit with a grade of A receives three honor points; each credit with a grade of B receives two honor points; a grade of C, one honor point, and a grade of D, no honor points. The grade D in the engineering college here receives ½ honor point, or at least is given that rating when figuring out the averages of the marks for students in the engineering college, because honor points as such have no meaning to the engineer as they are not essential to his graduation, which is the case in the other colleges on the campus. Rulings in the colleges are much the same as our rulings in regards to marks, attendance, and reasonable advance in studies. There are different minor rulings in each separate college, but in general the University rules are followed.

The Hibbing school has a mines assaying laboratory comparable with that at Minnesota in equipment, but not in size. The other colleges do not give the detailed courses in engineering that the Hibbing school does. At Virginia, the first year is basic, but in the second year, the course does not branch out into the several departments. That is, the second year still deals mostly with fundamentals of engineering, but introduces a course called "Elements of Engineering," which is an introduction to the development, principles, materials, safety, and general application of electrical engineering. Then if the student wishes to continue his training at some other institution, he can with little difficulty obtain credit for this course as an elective, and take the required work which he missed in the course offered at the junior college.

The Itasca Junior College at Coleraine follows the idea in the giving of the engineering course as does the Virginia Junior College. Fundamentals are for the most part the subjects taught. In the sophomore year all students are required to take a course in electrical engineering, even if they do intend to follow a different course at some other institution. The course in electrical engineering then can be substituted for one of the elective courses which would otherwise be taken, and thus receive credit for all the work taken at the junior college. There does not seem to be sufficient demand for the other engineering courses to warrant the giving of them at this institution, and the condition is similar at the junior colleges in Eveleth and Ely.

Not the least of the advantages of the junior college system is the financial saving made possible to the students living in the district where it is located. The students will for the most part be able to live at home, or obtain room and board cheaply.

An agreement supposedly made by the junior colleges, which provided that they all should charge a nominal tuition fee, but this does not seem to have been followed out. There is no charge for tuition or laboratory fees at either the Virginia or Hibbing schools, although there is a definite tuition of $25.00 per semester at the Itasca Junior College in Coleraine if the student is a resident of Independent School District Number Two, which is the district that the Coleraine college covers, or a tuition of $40.00 per semester if the student is a non-resident of the district. Beside this, there is a charge for the usual laboratory fees. It is not definitely known whether the Eveleth and Ely institutions charge tuition or not, as no bulletins from either school were available, but it is thought that they do charge a nominal tuition, due to the said agreement between the various colleges. Books and supplies are able to be purchased at cost by the student at most of the junior colleges, and are given to the student at the Hibbing Junior College.

Other inviting features of these schools are the large swimming pools, gymnasiums, stage furnishings, and comparatively small classes to each instructor. There usually is present a full line of student activity which includes athletics, dramatics, social functions, and organizations. The scholastic requirements for entrance into the engineering courses are practically the same as are the entrance requirements to the engineering college here at Minnesota. Students in engineering need higher algebra and solid geometry for entrance, and should have high school physics and chemistry. If work in mathematics is deficient it will be necessary to take this work without credit before subjects in college which depend on these can be taken.

For adults, who, regardless of maturity, wish to improve and develop themselves in their vocations, opportunity is provided to carry subjects in a day or night school in such manner as not to interfere with their occupations in the community. They are not asked to present credentials of previous work. Courses of this character are planned with a view to giving practical aid, and will be given in any subject taught in the junior college in case there is sufficient demand for them.

Theodore Corbett Attends National A. S. M. E. Convention

The Minnesota student branch of the American Society of Mechanical Engineers was represented by Theodore Corbett at the national convention held in New York December 1 to 4. This is the first time that the Minnesota branch has been represented by a student member, and plans are being worked out to send a delegate each year.

Exactly thirty-nine student branches had representatives at the convention, and according to the report made before the local branch December 12, the Minnesota organization compares very favorably with the others.

ENGINEERING as a recognized profession is but 75 years old. In that comparatively short space of time, it has risen to a place of high importance in the present order of society. Each year the technical schools of the country are attracting an increased number of high school graduates to the study of engineering. Yet, a survey conducted recently by the Society for the Promotion of Engineering Education showed that well over half of these students have little or no understanding or a very poor understanding of the nature of engineering work.

The survey included approximately 4,000 students, or about 20 per cent of the entering freshmen admitted in 1924, so chosen as to make the results representative of the entire country. Each student was asked to write a brief statement of the conception of engineering and the papers were graded by faculty members. Only about 15 per cent had a clear, exact understanding of their chosen profession.

For four years, this fifteen per cent will go forward in their college work always having before them a definite undrstanding of the place they will fill in the engineering world. The other 85 per cent will perhaps do the same work in school, but they will proceed only under the handicap of an incorrect or incomplete notion of their ultimate goal. It is true that they will probably acquire a true conception of engineering before their college course is completed. But then they are in a position similar to that of the man who, having heard much of the joys of swimming, elects to make his first attempt in deep water.

As he may have natural ability along that line, so may they show a natural aptitude for engineering, and their choice prove to have been wisely made after all. But on the other hand, they may find their abilities not at all suited for engineering. And, though no one would contend that their time spent in the study of engineering is entirely wasted, still it might more profitably have been applied to some other subject.

The engineering college would do well to make available in the high schools of the state, information as to the full scope and precise nature of engineering, not with the intention of luring everyone into this profession, but to clear up every vestige of haziness surrounding the profession.

THE University populace, students, faculty, and administrators should, it would seem, be able to interpret the laws of the land and thus obey them with a greater degree of accuracy than the man who has not had any connection with a higher education. In spite of this fact, our campus seems to support an abundance of scofflaws. While their scoffing does not take the form of banditry or manslaughter, there is an open disregard for the rules that govern the conduct of the ordinary man. It is possible to overlook the absent-minded professor who parks on the yellow curb or forgets the parking lights, but the grandstanding student whose main interest in life is to attract attention to himself by means endangering the lives of his fellows cannot be ignored. Perhaps these offenders are afflicted with a mental complex. Maybe their ego has led them to believe that they have a superior mind, and, being supermen, need not consider everyday law as applicable to them. If such is the case, these men (and women) must take care that their minds do not lead them in the ways of Loeb and Leopold, who were also, in their own eyes, supermen.

The traffic code is the one most flagrantly violated. Yellow curbs are lined with cars, cross-walks are blocked, and No Parking signs seem to be meaningless ornaments. During the major part of the day the narrow street in front of the administration building is made more narrow by cars sandwiched in between signs that read—NO PARKING ON THIS STREET. Two hundred feet away in plain sight, two acres of excellent parking space are used by maybe a dozen cars. Between classes, there is a frenzied activity among the motors on the campus. Drivers vie with pedestrians in getting to classes first. Speed is paramount. Danger and the chance of snuffing out a human life is only a minor thing. With cutouts open and klaxon howling or French horn squawking an insufficient warning, cars tear across the campus like bandits pursued by a gunsquad. Now with icy pavements drivers purposely accentuate a skid in rounding a corner by jamming on the brakes.

All this jam is aggravated by double parking while a friend runs into the P. O. or a Beau Brummell clinches a hot date. Some few, looking for an open space, swing obliquely across the street and park at an angle with the curb and on the wrong side of the street. There can be no excuse for this last offense.

Is it a wonder that some universities have ruled the student car from the campus?

WITH OUR AUTHORS — — —

We are indeed fortunate to be able to present this remarkable story, "Horizontal Waves To Eliminate Static" by David Grimes. This is noteworthy for two reasons at least—that the elimination of static is the biggest problem in radio communication today, and that Grimes, who has become known the world over as the inventor of the inverse-duplex circuit, is a Minnesota man. He is now the chief engineer of a million dollar firm that bears his name, one of the largest advertised concerns in the country.

Engineers go into many lines of endeavor. Rev. Bruce M. McCullough is one who has entered a field far remote from the usual. After graduation, McCullough entered theological seminary and only recently received appointment to the pastorate of a prominent Presbyterian church in Minneapolis. In reality, our author is still in the profession, though a "Life Engineer," the greatest profession there is.

Every Minnesotan is proud of his state. Each one of us believes that the Gopher prairie is the best little patch of ground in God's creation. However, we of today must take care so that those who are to come will enjoy this Eden of ours. Conservation is the theme of Raymond P. Chase, our state auditor, and the story, showing as it does, the relation that the engineer bears to the situation, is presented very fittingly in the technical student publication of the states' own university.

Across the Editor's Desk

These Few Paragraphs

Everyday, a score of little matters of interest find their way into the TECHNO-LOG'S office—perhaps it's a new kink on how to make the old slipstick read more accurately, maybe a bit of gossip, or it may even be an inspiration that one of the staff had while walking over to school one of these fine snowy mornings. We believe that these bits of thought should find a place in our magazine and accordingly, you are now reading "Across the Editor's Desk." As its names implies, the contents will be gathered from the strays which find their way to the editorial desk. This is a distinct innovation and we hope that it will be interesting and of benefit to everyone concerned.

The New Year

Much has been said about New Year resolutions, but aside from their purely moral context, what have they to do with us? We think that it is not too presumptious to believe that last quarter a good many of us who are now scanning this page nearly went into a state of coma as a result of last minute cramming. It's sad but true, that this hastily gulped down knowledge does not stay with an individual long after finals. Therefore, we propose this resolution: A little study every day is good when finals are far away. The editor joins you in this vow of the condemnation of procrastination.

Student Opinion

Now that we are all set for 1926, here's a new thought to consider. Student opinion has an important part to play in educational systems. By this, we do not mean the radical sentiments of one or two, but the concerted thoughts of a group of students, these should always be considered seriously by our superiors. Just as the purring turbine is the culmination of the designer's thoughts, so is the graduate the product of a course of training. In the process of manufacture of this turbine, many flaws were found and the plans were often changed that it might be perfect. In like manner, there are often mistakes made in the business of teaching and in many cases these are alone evident to the student himself. This brings up the question, should a student find fault? Honest constructive criticism is always an asset, and an instructor who refuses to consider such, automatically signifies that he has learned all that there is about pedagogy. Whenever an idea occurs to you, walk up to your professor after class and tell him about it. You perhaps will be wrong yourself but in any event he will think it over seriously with the result that mutual benefit will result. Try it!

FACULTY SKETCHES

OTTO S. ZELNER

HERE he is—our congenial friend on the faculty, Otto S. Zelner, associate professor of surveying—caught in a view typical to the profession which he teaches. Although nowhere can be found a more staunch supporter of Minnesota, Mr. Zelner comes from Michigan, first announcing his arrival in the Wolverine state by a husky squall in a corner of Kent county, Michigan, way back in the days before—well, you can guess.

He entered high school at the age of 16, his parents moving to Caledonia, Michigan, from which institution he graduated, being president and valedictorian of the senior class, besides captaining the baseball team. The next two years were spent in riding a carriage in a saw mill and selling hardware, enabling him to prepare for further education.

Since the high school at Caledonia did not have the required standing to permit its graduates to matriculate at the state university, Mr. Zelner took a year and a half more training at the high school at Grand Rapids, Michigan. In addition to his studies, he excelled as guard and fullback on the football team, and was also on the baseball, basketball and track teams, finding time meanwhile to be a member of the Glee Club and also a class officer. He entered the University of Michigan in 1900, taking a civil engineering course and graduated in 1905. Again he was active in sports, for three years playing tackle on the engineers football team, a catcher on the Engineering College nine, and was active in the University Glee Club and the University Band. He was elected to membership in Phi Mu Alpha, national musical fraternity, a chapter of which he helped form here at Minnesota.

The summer after graduation was spent as instructor in a surveying camp of the University of Michigan; later on he was an instrument man on the power development survey on Huron River which runs through Ann Arbor. He was next employed with the U. S. Lake Survey, working out of Detroit, and then was with the survey work on the preservation of Niagara Falls. He has been connected with work on all of the Great Lakes except Superior, and on all of the connecting rivers.

The year 1907 is an important one in his history for it was then when he was married to Miss Flora Thompson of Detroit. Her true Scotch name explains why Zelner never worries about his domestic financial troubles. They have two daughters, Harriet and Margaret.

In 1910, Mr. Zelner came to the University of Minnesota, being offered an assistant professorship. His first work here was in the survey and layout of the Elliot Memorial hospital, the underground tunnels, etc.

It would be difficult to enumerate all of the varied activites that he has been engaged in here, but we will start out. He has served as head of a committee on intra-mural athletics, as member of senate committee on inter-collegiate athletics, chairman of subcommittee on eligibility, committee on athletic grounds, and was active in stadium-auditorium drive. He designed the playing field in the Memorial Stadium, was chairman of the building committee of the University Y. M. C. A., has been a member of the Engineers' Bookstore Board since the inception of that institution, is a faculty advisor to professional fraternities, is in charge of orientation course, and in addition is chairman of engineering faculty committee on intra-mural sports, is an Arab, a Knight of the Northern Star, a member of Chi Epsilon, honorary civil engineering fraternity, an honorary member of Theta Tau fraternity, and a member of the Alpha Sigma Phi fraternity.

He is very much interested in music and has been very active in the promotion of the choral work at this school, and has participated in many musical productions, faculty quartettes and otherwise. Oh yes, before we forget, he is a member of the Society for the Promotion of Engineering Education, Engineering Society of Minneapolis and the Minneapolis University Club.

In the Night

Often we have passed by our college during the evening hours and have noticed lights burning in the various buildings and other signs of activity. Several days each week from 7:30 till well after 10 o'clock, several hundred students, whom we never see or never hear about, use our classrooms, perform tests in the laboratories and puzzle over examinations. These are extension students, some, perhaps, old enough to be our parents, who each night leave a happy fire-side and seek to better their knowledge through the courses offered by the extension department of our own University. Though this work does not carry college credit, such subjects are open so that the student may better fit himself in a side line or supplement his regular training. Most of these have not had the chance to attend college when young but are now seeking to regain some of the lost opportunity. We admire these persons—they who come in the night for learning, and it should make each of us more appreciative of our present opportunity,—that we will make the most of it while we are here and think twice before quitting.

Who Works Hard?

It's funny but true that each of us thinks that no one else is as busy as he is and no one else puts in the time that it is necessary for him to spend in order to get the coveted sheep-skin. The architects burn the proverbial midnight oil till evicted by the janitor, then go elsewhere to finish that problem; the civil engineers just about live in their drafting rooms; the electricals brave electrocution, spend long hours in the main laboratory and produce voluminous reports; the mechanicals are ever designing new creations of steel when not teasing an obstinate Diesel to percolate; our neighbors, the chemists, brave the fumes of death, and we have heard of a miner who had his vacation from classes on Sunday morning and that was only for two hours. Yes, it's a fact that all are hard pressed. Who works the hardest? We will avoid the direct answer, but it's a fact that we *all* do.

AROUND THE WORLD WITH OUR ALUMNI

(*Continued from page 115*)

Mechanicals

'16—Herman W. Skon, a graduate of the mechanical engineering department in 1916, has been recently named a new instructor in mathematics and mechanics in the engineering college at Minnesota. Since graduating from the University, he has been an instructor at the United States Naval Academy and has taught at the Dunwoody Institute. He left a position as a consulting and research engineer to accept his present position.

'17—I. L. Johnson is field engineer for the Minneapolis Steel and Machinery company and is living at home, 2225 32nd avenue South.

'18—Oliver S. Hagerman was married to Miss Kathryn Louise Hinricks on November 28 at Glen Ridge, New Jersey.

'20—Knox A. Powell has left Pittsburgh and is now living in Moore, Pa. His address is 903 Lafayette Ave. Mr. Powell writes, "I have been very much interested in the expressive arts, writing and speaking for engineers, since early college days. Engineers have the stuff to lead the world out of its woes to a larger extent than any other profession. What they need is the ability to 'put the fodder on the ground,' to use Dr. Fosdick's words, 'so that anybody from a giraffe to a jackass can get it.' Contact counts."

'22—The marriage of Hazel Beidleman and Chester Bros took place Wednesday evening, August 26, in the Hennepin Avenue Methodist church. They motored west and are now at home at 5336 First avenue South.

'22—C. F. Olmstead has left the Mahr Manufacturing company of Minneapolis and is now with the Diamond Iron Works, working on oil burning furnaces.

'23—Chester Marshall is still working for the Northern States Power company, but he has been transferred from the High Bridge plant to the main office in Minneapolis.

'23—Arthur W. Sear has given up his job as draftsman for the Nordberg Manufacturing company in Milwaukee and accepted a position as Instructor in mechanical engineering at the Armour Institute in Chicago.

'23—Word has been received to the effect that John, better known as 'Dinty' Moore, who is with the inspection department of the Hartford Insurance company at St. Louis, Missouri, has been transferred to Cincinnati to take complete charge of the work in the territory comprising Ohio, Kentucky, Tennessee, West Virginia, part of Pennsylvania and Indiana. John is remembered for his campus activities, being the engineering representative on the All-University council as well as many other things.

'23—Sheldon H. Hibbard, who was formerly designing mechanical engineer for the Clyde Iron Works of Duluth, is now mechanical, structural, and estimating engineer for the National Iron company of Duluth.

'24—Professor Martenis received a card from Harley "Red" Langman announcing the birth of a daughter, Enid Adelle. Congratulations, Red. Mr. Langman is with the Proctor & Gamble company and lives at 200 South 15th St., Kansas City, Kans.

'24—George F. Berry is now with the Northern States Power company at Sioux Falls, South Dakota. He is engaged in work on combustion engineering and power plant operation.

'24—Page M. Sartell started working with the Minneapolis General Electric company as inspector after he graduated. Later he passed a civil service examination which secured him an appointment as junior mechanical engineer in the laboratory of the aircraft factory at the League Navy Yard, Philadelphia. He says that he finds the work very interesting and recommends this kind of work for young mechanical engineers.

'24—Captain Walter D. Luplow was called to Minnesota recently by the serious illness of a member of his family. He is stationed at the Engineer's Corps, Fort Humphreys, Virginia.

'25—Herman Beseler is doing graduate work at Minnesota. He will be remembered as captain of last year's rifle team and also as co-managing editor of this magazine.

'25—E. L. Ludvigson is in Cleveland, Ohio, taking the technical apprenticeship course of the White Motor company. He is in contact with graduates from Boston Tech, Indiana, Syracuse, Toronto, Alabama Tech, Harvard, Wisconsin, Ohio State, North Dakota, and Cornell. His address is 2056 East 100 street, Cleveland, Ohio.

'25—Bill Donnelly is with the Proctor & Gamble company at Cincinnati, Ohio. He says that he is gaining valuable experience in the reconstruction and rearrangement of the Copra mill. He is under the direct supervision of Don Marshall, E. E. '19, Minnesota.

'25—Roland Holmes is with the Westinghouse Air Brake company at Wilmerding, Pennsylvania. He is in a class of 19 taking the technical apprenticeship course, most of the men representing the eastern colleges; one is from the University of Turin, Italy. Mr. Holmes was married soon after his graduation and took his bride east with him. They are living in East McKeesport, Pennsylvania.

'25—Reuben A. Jacobson who was with the Northwestern Bell Telephone Co. for a while after his graduation, entered in the student course in which he was engaged in testing work. He left them recently and is now with the Electric Machinery company, Minneapolis.

'25—Dallas Dale is employed by the Detroit Edison company as designing engineer. His work is along the line of heating and ventilating. He says that the work is interesting and gives him valuable experience.

Mines

'10—G. Gordon Stewart is now located at 663 5th St., San Bernadina, Cal.

'18—Roger W. Gannett, a research worker in the field of economic geology, died November 21 at Grass Valley, California, after a sudden operation for appendicitis.

Mr. Gannett was one of the most brilliant students who ever matriculated in the School of Mines, according to Prof. Frank F. Grant of the department of geology. He had won a wide reputation for his study of various metallic ores, and was working in the United States Geological Survey service at the time of his death.

Mr. Gannett accepted a position at the Michigan Agricultural College, East Lansing, Michigan, and was on leave from work there at the time of his death.

'20—Announcement is made of the marriage of A. Kittredge Bailey, Jr., to Miss Irene Gutenez of LaPaz, Bolivia, a niece of the former president of Bolivia. The marriage took place in LaPaz, but the young people will make their home in Llallagua, Bolivia, where Mr. Bailey is assistant manager of the largest tin mine in the world. Mr. Bailey has made his home in South America since his graduation. Next year he plans to bring his bride to the United States on a visit.

Electricals

'97—Geo. L. Chesnut writes that he is very glad to get the Techno-Log and learn the whereabouts of his old "college chumps." He has left Houston and is now living in Dallas, Texas.

'06—Paul Bunce, who has been superintendent of traffic for the North Dakota division of the Northwestern Bell Telephone company since 1921, will go to Omaha the first of November as superintendent of traffic for the Nebraska division.

'06—The design of the new truck type switchboard being manufactured by the Westinghouse Electric & Manufacturing Company is the latest achievement of M. Cornelius, who is a member of the Switchboard Engineering Department of that Company. Mr. Cornelius has established an enviable record with the Westinghouse Company and is now in charge of the application and design of truck type switchboards.

'09—Among the prominent Minneapolis realtors who were mentioned for election as directors of the Minneapolis Realtors Board was Ben B. Walling.

'17—C. M. Carlson is now living at 1358 Edmund avenue, St. Paul. Mr. Edmund is electrical distribution engineer for the St. Paul Gas Light company.

'22—Alva Merritt is taking the graduate student course in Supply Sales with the Westinghouse Electric company. His address is 583 South Oakland avenue, Sharon, Pa.

'22—Arnim G. Olson is now living at 112 So. Maple avenue, Oak Park, Illinois. Mr. Olson is field engineer for the Public Service company.

'24—Chauncey Green recently left the hospital where he has been laid up for a while. He is employed as projectionist for one of the down town theaters of Minneapolis.

'24—Harold Dahl left recently for Philadelphia where he will take over the eastern branch offices of the Electric Machinery company of this city. He has been engaged in development work with that firm since his graduation.

'24—Harold C. Marcroft was married to Miss Evelyn Lucille Buck on October 20, 1925, at Leroy, Minnesota. Mr. and Mrs. Marcroft are living at 112 Crawford avenue, Dixon, Illinois. Mr. Marcroft holds the position of Assistant System Operator for the Northern Illinois Utilities company and says that he likes Dixon and finds his work very interesting.

'24—Report has it that Iver Johnson went through Minneapolis on his way to the West coast where he will be employed by the Brunswick Phonograph company. He has been taking the G. E. test course at Schenectady, New York.

Conservation of Our Resources

(Continued from page 112)

were consulted in an effort to solve this problem and within a short time announced that Portland cement could be made from this material. This turned a waste product into an entirely satisfactory cement and another liability changed position on the iron and steel ledger.

While the present blast furnace of Portland cement is excellent, the scientists are not fully satisfied but are searching out means for its improvement. E. C. Eckel of Washington, an authority on iron ore and Portland cement, recently published an article in which he maintains that a cement made from the slag of a blast furnace operating on Titaniferous iron ore is superior in many qualities to the ordinary Portland cement. This he is pleased to call Titan cement. He further claims that it is more resistant to chemical action than ordinary Portland cement and that its weight can be varied to a greater degree more resistant to chemical action than without reducing its strength. This is important if the claims can be substantiated in practice. Mr. Eckel maintains that a small blast furnace similar to those used in the reduction of copper ores can be operated successfully in the production of Titan cement, leaving pig iron as a by-product. The importance of his announcement deserves considerable attention especially in Minnesota where there are many million tons of Titaniferous ores awaiting development. Here, then, is a very important field for research.

Lakes and Rivers

The scientist and engineer ever have been the pioneers in securing the largest returns from materials and turning waste into profit or in the work of conservation. Numerous wastes from industrial plants have been turned to useful purposes. For many years, the problem of garbage disposal in the large cities was an exceedingly expensive one until the sanitary experts gave it their attention. Now New York City and several other large municipalities actually turn city garbage into profit. What these men have done with garbage in the large metropolitan districts soon must be undertaken here if Minnesota lakes and rivers are to be kept pure and free from city and industrial sewerage. The problem confronting the Twin Cities and other Mississippi River communities is engaging attention at this time.

Many rivers formerly teeming with fish have become so befouled by sewerage that only fish of the roughest kind can exist therein. This is especially true of the Connecticut River that formerly offered refuge to great schools of salmon. The State of Massachusetts came to the rescue of the Boston Metropolitan district and established proper sewerage disposal means. In many European cities all sewerage is filtered through materials and the water purified before being returned to the natural water courses. The filter material used in many cases is peat as it has a large capacity to absorb. After use in the filter this material becomes a fertilizer of the highest order.

The rapid increase in the use of gasoline and oil may soon develop into a serious menace to fish and bird life here as it already has in the eastern states along the Atlantic. Our lakes and streams are now for the most part pure and should be kept so, but in order to do this, teeth must be put into the law as it now stands. Closely allied to maintaining their purity is the task of preventing their drainage except for the very best of public reasons. An admirable advance was made recently when the State Supreme Court refused to permit the lowering of Swan Lake in Nicollet County. The Commissioner of Game and Fish, with the co-operation of the Isaak Walton Leagues, is doing a great work in this respect. It is true, conservation will repay every effort enormously.

The value of lakes from all standpoints depends largely upon the stability of the stage of water. The rapid fluctuation of water elevation of a lake is one of the greatest factors for destroying its use for boating, fishing and hunting. Fish have certain areas of water for spawning purposes. When the water is raised above or lowered below the usual level, these grounds become less adapted to that purpose. This is particularly true in lakes used as storage basins. There seems to be an abundance of evidence to sustain this contention in the history of the lakes of northern Minnesota that have been used for these purposes along the Mississippi River. It has been reported that the fish formerly occupying such lakes are gradually being reduced in number and that experts of the Commissioner of Game and Fish have found increasing difficulty in securing catches for the spawn. Where fish spawn in shallow water it appears that they readily adapt themselves to spring freshets, but where the water is artificially raised or lowered at other times of the year much difficulty is encountered. Kabetogama, whose water stage is changed often by the dam at Kettle Falls, appears to offer evidence of this fact.

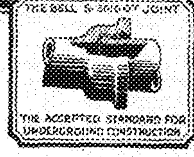
Ducks and other game birds have certain feeding and nesting grounds. Wild rice and celery, which form a large part of the diet of water fowl, grow in water of a certain depth. When the water stages are artificially raised or lowered the plants die. Many years must elapse before these plants are able to adapt themselves to new locations. In the meantime great numbers of the birds go elsewhere. In the wildest parts of northern Minnesota moose feed upon certain water plants which are destroyed by the changing of the water elevations, due to beaver dams recently constructed. An acre of water suitably cared for is quite equal to one of ordinary arable land considering all its possibilities. No lake should be drained or its water stage materially raised without the best of reasons and having in mind the rights of future generations.

Conclusion

The practice of conservation is not to be confined exclusively to the field of our natural resources, nor does it mean discontinuing the use of natural gifts, but demands that all things be required to yield their full returns for both present and future generations of humanity.

Problems thought to be incapable of solution have been solved by the scientist. The physician and the surgeon have cheated death in thousands of cases. The most abstruse questions of government and finance have been answered. Industrial obstacles have been overcome and waste materials have been saved and converted to the service of mankind. Lands refusing to support crops have been compelled to yield to the science of agriculture and unproductive areas have been reforested. Minnesota has been endowed by nature with many precious gifts.

An important duty of the scientist is to bring to the problems of life the assistance of the laws of nature. In doing this he must always bear in mind that history records many instances where the discoverer of new scientific laws and the pioneer in unfrequented fields of human activities have been ridiculed unmercifully. It was but yesterday that electricity was popularly considered but the plaything of an idle scientist, that navigation of the air was held to be a delusion of the mind of many Darius Green's, but the progress of events has abundantly justified the persistance of the supporters. Those who raise their voices and use their powers to advance the cause of conservation, whether it be the prevention of forest fires, the aiding of reforestation, preservation of lakes and streams, protection of wild life, or utilization of our natural recources and present industrial wastes, shall not fail to receive, ultimately, the thanks of a grateful people.


THE BELL & SPIGOT JOINT
THE ACCEPTED STANDARD FOR UNDERGROUND CONSTRUCTION

Research, the Cornerstone of the Telephone Industry

(*Continued from page 108*)

by studies and development of inspection methods, that the manufactured product conceived and designed through the efforts of the first three groups, shall not lose between its conception and its commercial utilization any salient contribution of these other groups. If the specifications, manufacturing limits and the like should be so placed as to admit to commercial service imperfect instruments, even to a very small percentage of the total number manufactured, the damage to the operating telephone companies would be considerable. On the other hand, if these limits are set too conservatively and result in the rejection of an appreciable percentage of the manufactured product, then the cost and efficiency of manufacture are uneconomical. Fundamental studies of a theoretical and mathematical character and a careful and exhaustive analysis of large volumes of data are required in the consideration of this and related problems.

The Patent Department is not directly concerned with the original development of a device or a system. Its primary function is to insure adequate patent protection. Whenever a new device or system has been developed and appears to have features of originality or uniqueness, it is referred to the Patent Department. This group studes the design thoroughly, frequently conferring with the inventor, until all details are fully understood. A search is then made of the patent records and if warranted, a patent application is filed. The Patent Department also has the responsibility of keeping in touch with the progress of the communication and related arts by scrutinizing patents granted in the United States and foreign countries.

From the preceding it may be observed that the major portion of activities of the Bell Laboratories are concerned with communication problems. Such study, however, frequently evolves many interesting and valuable by-products. Such was the case with the artificial larynx. This device is of untold humanitarian value to those few unfortunates who through disease and surgical operation have lost their vocal cords, and hence can no longer speak.

When such an operation is performed, the wind-pipe is sealed through the skin of the neck; this allows the patient to breathe. Through metal and rubber tubing the artificial larynx takes air from this opening. The larynx itself is similar in operation to the small reed whistles supplied on toy balloons. As air is forced out of the lungs through the flexible tube it is set into vibration by this reed device producing vibrations of various frequencies. These multi-frequency air waves are conducted to the mouth by a small tube about the size of an ordinary pipe stem. The mouth cavities then resonate the desired frequencies and these sounds are emitted from the mouth. With such a device, persons who have been dumb for many years were able to learn to speak with considerable clearness with only several hours practice. Yet this valuable device was developed incidentally while making fundamental studies of speech and audition.

Similarly, the study of the behavior of complicated electrical systems used in the transmission of electric waves at voice or radio frequencies suggested the possibility of designing a mechanical system to transmit mechanical vibrations according to the same principles. This led to the creation of an acoustic reproducing method which reproduces phonograph records with a fidelity heretofore unknown.

The study of the electron emission from hot filaments evolved a most useful by-product in the form of a new type of Braun tube type oscillograph. This device has found a very valuable place in the study of high frequency currents especially as employed in telephonic transmission. In this type of oscillograph, the moving element is replaced by a stream of electrons which due to their small mass and inertia can follow current fluctuations up to several million cycles.

Many other equally interesting examples could be cited to portray the work of the Laboratories. As an organization it is the largest research company in the world and its efforts are devoted primarily to the study of the communication art. It has a scientific atmosphere contributed to by men of widely different experiences. Many of them entered directly upon completion of their college training. Some have come to the Laboratories with special experience in the operating telephone companies and have brought with them a practical familiarity with operating requirements. A considerable number were formerly connected with academic research laboratories and teaching positions. Thus the aggregate whole forms a colorful organization of co-operative talent devoted to further study and advance of the art of communication.

The Crooning Cowboys

(*Continued from page 114*)

"After about a week of practice, we booked at the Seventh Street here and then our big time started for good. They billed us as 'Kilpatrick and Pearson, the Crooning Cowboys,' and after filling a week's engagement at the local theatre, we started on the road. The next place we played was Des Moines, Iowa. It happened that Isham Jones and his orchestra were also on this bill and we got very well acquainted with this famous exponent of jazz. He was a very agreeable chap, giving us many valuable pointers on our act."

"It's funny how many people that you find out you know when you appear on the stage," Porter said. "I had gone to Grinnell and every night many of my former acquaintances would come backstage to renew old times. Every once in a while, various individuals came back and asked us to let them join the act and in one instance a former cowboy brought his lariat with him and did his bag of tricks for us."

"One of the funniest incidents of the trip," George broke in, "was when a bunch of cow-punchers who were holding a rodeo a little ways from Des Moines, came over to see us. Many of them had worked on my dad's ranch back home and it seemed very good to see them again."

"Most every day we would receive 'mush' notes in our theatre post office boxes, but we soon learned to spurn these precarious missiles of admiration. These are a standing joke among the talent, but greenhorns always fall for them at first.

"Next we went to Rockford, Illinois, and played there a week. The theatre there was a rather small one and as it was now in the middle of summer, we will always remember the 'hot' time we had in that city. The audiences were often non-receptive and it was generally a hectic week.

"Tell us something about audiences in general," I implored them.

"The start is the big thing with audiences," they replied. "If you lose your listeners at the first, it is hard to get them with you again. There's something in the feeling that makes you want to do your best when the people on the other side of the foot-lights show their appreciation. We can always tell when we hit a college crowd—there's something about them,—as soon as we go on, we know that they are with us from the beginning.

"A day's work usually consisted of three or four performances. The afternoon crowds are good, the dinner ones, though, are not so attentive. They usually come there for a rest and to read the papers, but the audiences at night are the best. Our act usually went over the biggest with the crowds that appreciated music, and this was in most cases those that came in the evening. We usually followed the curtain riser, but at some towns we got other places on the bill.

"After finishing at Rockford, we went to Chicago where we played for four weeks. It was there that we played the Majestic, which is the largest vaudeville theatre we were ever in. We also booked out to Elkhart and South Bend for a week each. During our run in Chicago, we stayed at our chapter house at Northwestern University, it being only a short ride out of Evanston. Most of our spare time was spent in seeing the Windy City and its environs. Once we went up to Milwaukee and nearly missed the boat back because of George becoming too interested in the habits of some monkeys in the zoo there. When we had finished our run in Chicago, school was only a month away so we pulled up, to use the theatrical phrase, and hot-footed it for home. George went West and I spent my vacation at home."

"What do you think of theatrical people," I asked them.

"They are a fine lot," they both replied of one accord. "Lots of folks think that they are invariably bad, but they are human like the rest of us, some better than others, but the people which we associated with last summer were the finest we have ever met. They are hard workers. Between acts, they criticise each other and what seems enjoyment to the audience is in reality real labor for them. All talent belongs to the National Vaudeville Association, perhaps more commonly known by its initials. This association is a sort of union of vaudeville talent and is maintained for the betterment of the profession as well as looking out for aged actors when they become to feeble to follow their work. All actors are accorded special rates at hotels and usually a town has one place where actor's make their headquarters.

"All of our work was obtained through a booking agent, a system which all acts use. The agent arranges all the tours and other details and receives a percentage as his salary. We were fortunate in securing favorable bookings and had we desired to continue our work, we could have had a straight booking until after Christmas, including the Pacific coast in our itinerary. Some acts take a long time to work up. We were unusually fortunate, as many who have been in the profession for a long time are not yet doing big time. That's the way it is with actors—some have been on the stage since they were children and in many instances they can trace their ancestry for several generations back as being affiliated with the bright lights.

"Some of the best known talent we played with were Hibbit and Hoffman, comedians, Lord and York, Burton and Lehman, also comedians, Orville Stamm's musical revue, and Isham Jones.

"The play is, perhaps, one of the most encouraging parts about acting. It averages from two to five hundred dollars a week or more for a combination of two. Payment is prompt and it is given in crisp twenty dollar bills. One unfortunate thing is that it seems to just sink away—where, we couldn't tell, though actors are not extravagant and on the whole save a good share of their salary.

"Many of the talent bring their children with them as they go around the circuit. These kiddies, because of their contact with the world, are extremely sharp and brilliant and often we have noticed the little tots watching their parents antics from behind the scene, a most serious look covering their face. Billy Miller used to set his little daughter in a chair to watch him during the process of his act, she remaining motionless, so intent was she on watching her daddy sing and dance."

"Tell the readers of the TECHNO-LOG something about your act," I asked them.

"Well, we dressed up like a couple of cow-punchers from away out west. Porter had his banjo, and astride our sawhorse ponies, which were of the cabinet-shop variety and painted with black and white stripes, we came riding out on the stage.

"George's broncho had the pet name of 'Go het, Charlie.' Usually we opened with 'With A Couple Rotten Voices and An Old Banjo.' Then we would crack wise jokes, sing some more and so forth. If we knew the orchestra leader, George would call out, 'Well, boys, how's the show coming?'

"'Fine.'

"'Well, we'll soon stop that.'

"Most of our songs were ballads or western stuff. The ones that made the biggest hits were 'Hi-de-ood-li-de-aa,' 'Cowboy Joe,' 'Free, Single and Disengaged,' 'The Blues Ain't Nothing But a Good Man Feeling Bad' and a popular one, 'If You Hadn't Gone Away'."

"Were there any incidents?" I queried.

Porter was first to speak. "This is one

(*Continued on page 134*)

Formulas in Industrial Management

(*Continued from page 113*)

the actual realized cost and the standard cost, in order to determine whether or not the various jobs or processes are being performed as efficiently as they should be. To provide for this comparison as a matter of routine control, a large number of cost variation formulas are used. These are, for the most part, very simple equations which are used to guide the clerical staff in calculating the variations in cost resulting from variations in time, wage or salary rates, total productive efficiency, material quantity or price, distribution costs, idle time, etc.

A similar development is found, as an aid in financial management, in the use of ratios which express the result of some current aspect of operation in terms of some presumptive causal factor. For example, we have the ratios of operating profits to total capital employed and to total volume of sales; the volume of sales to total capital; the ratio of costs to volume of sales, and volume of sales to average inventory; as well as the ratios of gross and net earnings to volume of sales. These and similar figures when retained from period to period and used for purposes of comparison are of help to administrative officials in judging comparative general efficiencies and thus in providing for general control of operations.

Horizontal Waves

(*Continued from page 107*)

These tests of ours had been under way more than two years, when the General Electric company announced their "recent discovery" of horizontal waves and predicted their early adaptation to broadcasting. Subsequent tests on their part showed that they still had some of the early difficulties encountered by our investigators some two years before. The General Electric official tests on horizontal transmission from Radio Station WGY were conducted about a month ago. Our recorded results in New York City showed that their transmission was over 90 per cent vertical and that their 10 per cent horizontal transmission was poor.

We have since conducted additional tests over our station 2MQ on Staten Island and preliminary installations have been made for our experiments on Station WAAM in Newark, New Jersey. The satisfactory solution of this problem will probably take several years as the work done so far appears to be only the foundation.

It is suggested that this field lends itself well to further research by college students and offers certainly a splendid opportunity for original and pioneer work in one of the most rapidly developing industries the world has ever known.

INDUSTRIAL BUILDINGS SHOULD BE WELL LIGHTED.

From the employer's viewpoint, the big difference between men who work out of doors and those who perform tasks inside the building, is the factor of light. Daylight furnishes sufficient illumination outside during the daytime working hours for men to pursue their tasks efficiently and safely. But the proposition of getting enough daylight into the interior of industrial buildings, requires some thought.

It is not a difficult problem by any means, and any employer can take advantage of daylight and utilize it for lighting his building during the daytime, if he desires. It is an excellent light, especially suitable for the eyes, reducing eye strain and eye weariness to a minimum, and has the great economic advantage of costing nothing.

To utilize daylight to the utmost, we must first provide means for allowing daylight rays to enter the interior of buildings in sufficient quantity—namely, proper and adequate windows and skylights. Many excellent instances of buildings designed with a due regard to the importance of daylight lighting can now be seen in many of our industrial cities. Such buildings present the appearance of being practically all windows—"window walled," as they are termed—and this type of daylight construction is coming rapidly into favor, because it constitutes a more healthy building for large numbers of employes, both from the lighting and ventilation standpoints.

Among those who have constructed this type of modern industrial building may be mentioned: The Shredded Wheat Co., Gillette Safety Razor Co., Lyon & Healy Piano Co., H. J. Heinz Co., Corona Typewriter Co., Skinners Macaroni Co., Grape Juice Co., Dodge Bros., Nelson Valve Co., Piston Ring Co., Remington Arms Co., and a great many others.

The Larkin Co., Philadelphia, has erected a building almost entirely glass, 85% being windows, and the Loomis Breaker, operated by the D. L. & W. R. R. Co., Nanticoke, Pa., is literally a glass house, being 93.5% of glass. The new buildings of the Winchester Repeating Arms Co. have an average glass area of 68%.

An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 57.6%.

These figures indicate how important the subject of lighting is now considered by employers of industrial labor, and how well the idea has been carried out by the architects and engineers, in order that all parts of a building may receive sufficient daylight. But, in addition to providing ample window space, there is another factor which is equally important, and that is, equipping the windows with the proper glass.

The bright direct rays of the sun should not be permitted to strike the eye, and we must provide a means for reducing the glare to rays which will not be too bright. This is accomplished by glass especially manufactured for industrial windows, known as Factrolite. This glass possesses the property of breaking up the intense rays of the sun and diffusing the light into the interior of the building in proper portions, solving the problem of sun glare.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.

Writing Technical Articles

(*Continued from page 109*)

reader can use and so if statements are not exact, they are useless. Caution should be needless, of course, against such gross misuse of words as "The iron solution that was held in suspense in the water settled to the bottom of the tank, taking with it the sentiment." But hardly less excusable is the indifference that calls a voltmeter, for instance, an instrument or a device for measuring voltage, or a shafting a steel rod with pulleys. As the above examples show, inexact words always call for many more words to define them. The result is that the writing is neither precise nor concise.

Though words should always be exact, dimensions need not be. An author's purpose sometimes permits or requires generalization. In most technical articles, though, exact dimensions are expected. The reason is evident. In a novel the author may say that the summer house is a stone's throw from the river; but in a technical article that aims to give usable information, the author may scarcely say that the machine shop is located a stone's throw from the foundry. Too much depends upon who throws the stone. Similarly indefinite are dimensions qualified by "about," "nearly," and "approximately." When the nature of the subject demands exactness, be exact!

The main factor in clearness is organization. People read in order to understand and remember, but they can do neither unless the thoughts are related and sequential. Every subject, of course, has its own peculiar problem; but no writing should be attempted until the problem has been determined, and some definite plan has been adopted. One of the first steps in writing an article is to decide upon its purpose. The inexperienced will do well to phrase this purpose in a complete sentence, and, if necessary, write it down, so that he can keep it before him while he is writing; for instance, "The purpose of this article is to show the difference between the manufacture of Bessemer steel and of open hearth steel." If not written, this kind of statement should be kept clearly phrased in the mind. It should then govern the composition of the whole article. The title, initial sentence, introduction, and article proper should be shaped to fulfill this purpose. Every sentence and every paragraph should reflect this purpose. If they do not, the article lacks proper organization. A good test of the organization of an expository article—and most technical articles are expository—is to reduce the paragraphs to sentences, combine those sentences into a summary paragraph, and then reduce this paragraph to a single sentence. If this last sentence is similar to the statement of purpose, the article is well organized. Though this test is too severe to be adhered to rigidly, it will help to eliminate harmful digressions that side-track the reader's attention and muddle his understanding.

For those who wish a more thorough discussion of the writing of technical articles, the following books are recommended:

Watt, Composition of Technical Papers. McGraw-Hill Book Co., New York. 1917.

Rickard, Technical Writing, Second Edition. John Wiley and Sons, Inc., New York. 1923.

Thompson, Technical Exposition. Harper and Brothers, New York. 1922.

Harbarger, English for Engineers. McGraw-Hill Book Co., New York. 1923.

Frost, Good Engineering Literature. Chicago Book Co. 1911.

Swetland, Industrial Publishing, United Publishers Corporation, New York. 1923.

The Crooning Cowboys

(Continued from page 128)

on George," he said. "It was the last performance and we were in a hurry to get off the stage and pack up, when George's pony had an accident. One of its castor hoofs caught in a hole in the stage flooring and George took a beautiful somersault over the equine's head. This drew a big laugh and we were called back so many times that we nearly did miss that train."

Not to be daunted, George moved a little closer. "This one is on Port. When we were at Northwestern, swimming used to take lots of our spare time. It happened that we were bunking in a double decker and one morning I was awakened by a peculiar noise. Porter was dreaming and all of a sudden he leaped from his upper berth in a perfect swan dive and struck the dresser, taking half of the handles off in his descent. It took two osteopaths to get the boy fixed up.

"We noticed a distinct difference in stage managers at the various theatres which we played. At some places, they would nearly adopt us, so eager were they to accommodate Porter and myself. Other places they were hard-boiled and unwilling to co-operate with the actors at all. The stage director at the Seventh Street here was the best fellow we met in our entire tour. The orchestra leader is the person who really puts the show across. In some instances, the talent incorporated them in their act.

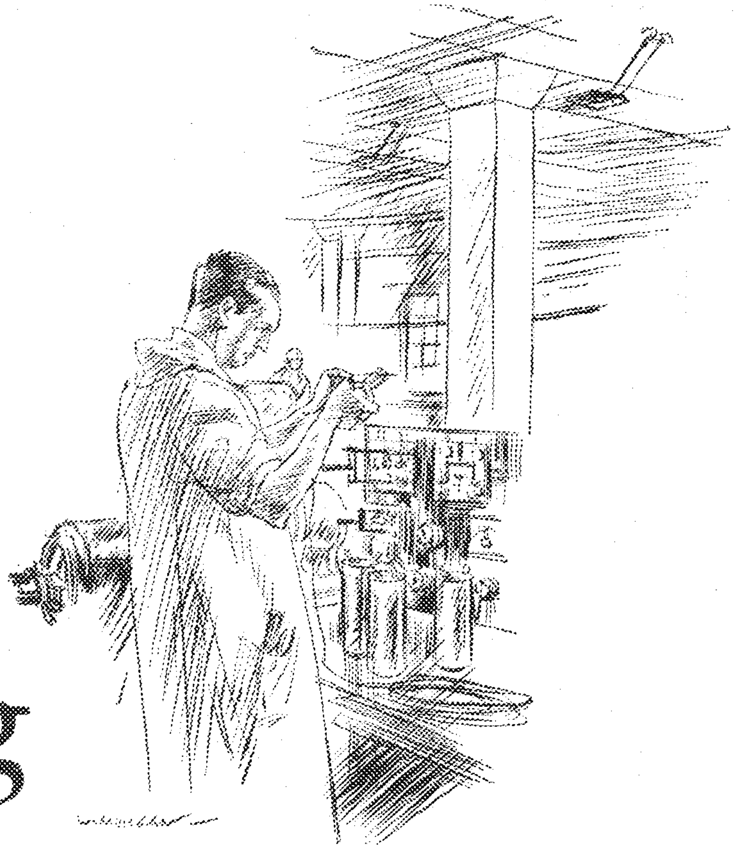
"Every Monday morning we would eagerly scan the critic's columns for their comment and once they even published our photos. We are glad to say that in every instance their remarks were ample with their praise of the Crooning Cowboys."

"Do you plan on ever going back on the stage for good?" I asked them.

George shook his head and Porter said, "It's a great life but we wouldn't like to do it for good. Perhaps we will go on again for a while, but it's really a pastime, not a profession with us."

"Well, we've got to get that sketch problem ready for tomorrow," George said, so both of the Crooning Cowboys turned to their drawing boards and sharpened their pencils.

Lab Lightning



Douglas F. Miner

SOME of the men at Clark University mentioned it first. "Doug surely lives in the Lab," they remarked. Later, too, at Worcester Polytechnic Institute, instructors made the same comment. And Douglas F. Miner, himself, agrees that he did—and does. That makes it unanimous.

"Big league lab work" was his aim as he turned to Westinghouse after graduation in 1917. But not until his return from overseas service two years later could he settle down to the lab. Now—at thirty-three—he's in charge of experiments at our Engineering, High Power, and High Voltage Laboratories, with a staff of twenty-five to direct.

He can unleash artificial lightning of 5,000,000 horsepower in 5/1000 of a second. At his bidding the world's largest single-unit transformer will step current up to a million and a quarter volts.

He has demonstrated the greatest artificial arc on record—fifty-five feet in length. To further his experiments a single generating plant, capable of producing on short circuit a million horsepower, has been erected.

There is a practical reason for these super-tests—for this equipment in advance of what the world uses now in its daily work. This, for instance, is frequently the attitude of a Central Station customer: "Of course your apparatus meets our needs today—takes every test to which we can put it now. But what of 1950? Will this insulation stand the load we will use then? And how many volts will these arresters bear?"

They come to Miner for the answer. He gets it from the laboratories. He produces under a roof the same conditions which nature, or time, may be holding in store for Westinghouse equipment.

Such is the pioneering of Westinghouse Laboratory Engineers. They are "experimenting in the tomorrow"—the step between research and application. They are finding growth, reward, congenial work, while following a bent for trying things out.

The question is sometimes asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents, or are they forced into narrow grooves?

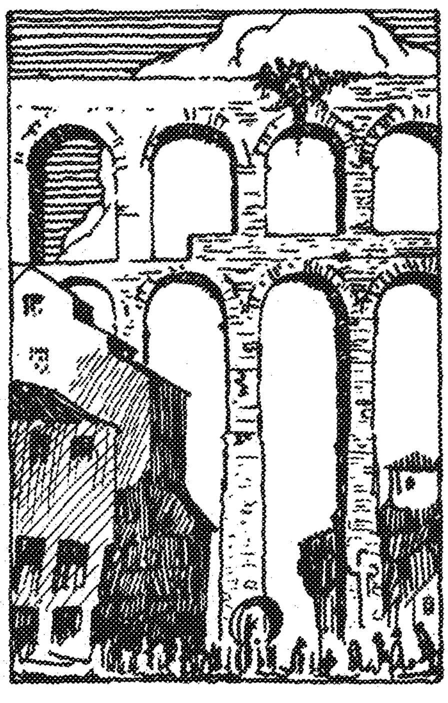
This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came with the Westinghouse Company, within the past ten years, after graduation.

Westinghouse

The Lund Press, Inc., 416 Eighth Ave. So., Minneapolis

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges
of the University of Minnesota



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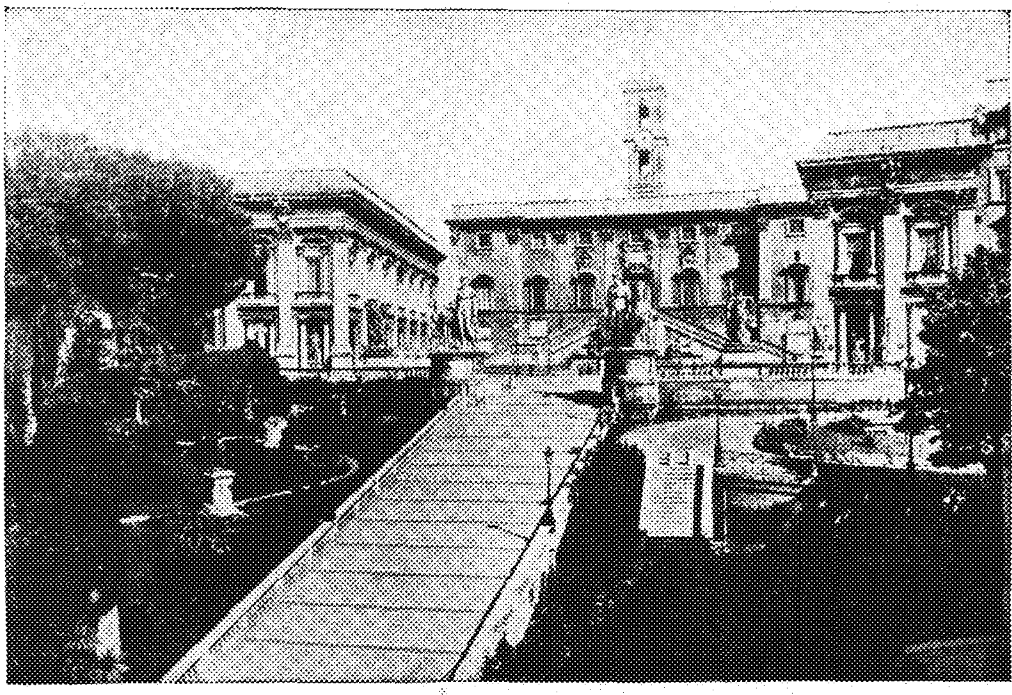

Esperanto May Not Be Practicable

but the idea of a universal language is a good one. In the Middle Ages and the Renaissance, scholars and diplomats from all parts of the civilized world could carry on their conversation in Latin. Until recently, French performed the same service to the polite world. It is now prophesied that English will be the international language of the future.

But meanwhile there is a good deal of confusion, and ambassadors from distant countries must frequently rely on interpreters. Therefore, it is fortunate for the hungry traveler that the menus of restaurants everywhere still employ French. And it is fortunate, too, that if he wish to ascend to a higher floor of a building in any of the great cities of the world, the single word OTIS will bring him directions for reaching the elevator.

The Palazzo del Campidoglio, Rome, is built on one of the seven hills of Rome and at present houses the Municipality of the City of Rome. The original building on this site was a temple of Jupiter in the Roman era, the construction being started by Tarquin the Elder and completed by Tarquin the Proud.

During the Empire of Vitellius and Vespasiano it was burned three times and was reconstructed by Domitien. In the Middle Ages it served as a temple to consecrate the Poets of the time.

The present building was erected by Michel Angelo on the ruins of the ancient building, and it contains an Otis Elevator.

OTIS ELEVATOR COMPANY

Offices in all Principal Cities of the World

THE UNIVERSITY OF MINNESOTA

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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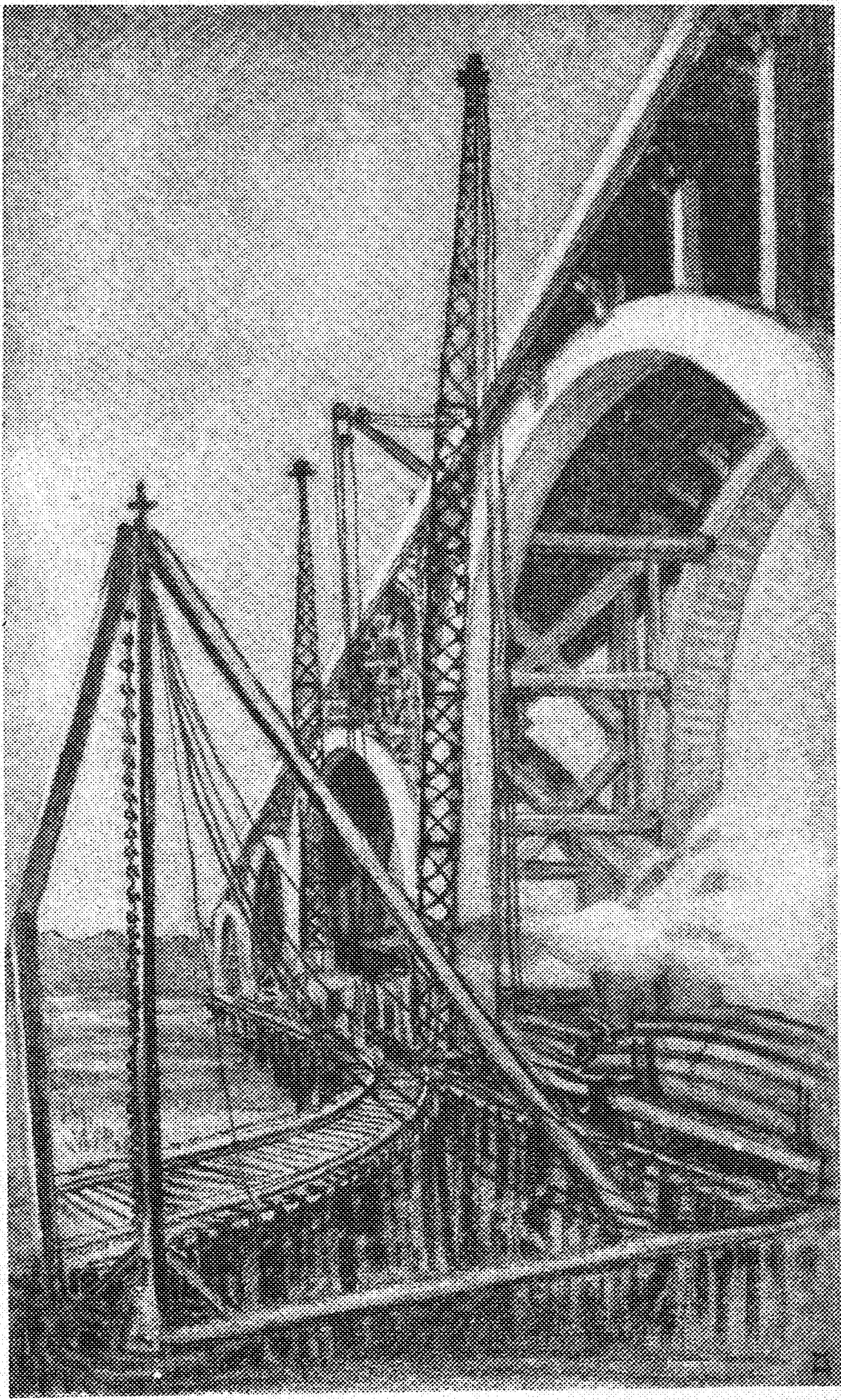


Building a structure of man-made rock
over the mighty Father of Waters.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI | FEBRUARY 1926 | Number 5

To Be or Not to Be—Chemical Warfare

Use of gas is most humane of present day methods of combat; war records show that of those wounded, less than two per cent die

By Vlon N. Morris

Teaching Fellow, School of Chemistry, 1st Lt., Chemical Warfare Reserve

On a certain day of April in 1915 the Germans turned loose on the hapless defenders of a given sector of the allied lines a cloud of chlorine gas. This cloud left in its wake a trail of horror and death whose enormity has seldom been equaled in the world's annals. Immediately afterwards, in order to strengthen the morale of the Allies and to damn the Germans (as they well deserved to be damned), a fierce denunciation of this type of warfare was broadcast to the world. So firmly planted in the fertile field of public opinion was this propaganda, that it exists even today, and is becoming a serious menace to the plans for proper provision for our national defense. Fostered and encouraged by a certain Pacifist-Radical group in our nation, this propaganda has been so often reiterated that it is very difficult for the ordinary citizen to recall that the Allies were at least on a par with the Germans as regards chemical warfare at the close of the war; and it is next to impossible for him to realize that chemical warfare when carried out between armies prepared for it is by far the *most humane* of the modern methods of warfare.

It will be of interest to give a historical review of the agreements and discussions regarding chemical warfare, which have in reality been an outgrowth of this misguided public sentiment against its use.

The Versailles Treaty drawn up at the close of the war contained the following statements in regard to chemical warfare: "The use of asphyxiating, poisonous or other gases and all analogous liquids, materials, or devices being prohibited, their manufacture and importation are strictly forbidden in Germany." While this prohibition may appear very drastic on paper, it is apparent to anyone who is at all acquainted with German industries that it could not be enforced. Germany knew it could not be enforced. She is, in fact, openly manufacturing chlorine and phosgene just as she did before the war, and is exporting the latter gas to the United States. Thus this first attempt at chemical disarmament failed utterly, even though it was directed at a defeated nation.

Realizing the impossibility of enforcing the Versailles Treaty, the project

> *When the word "chemical warfare" is mentioned, all of us shudder with its deadly meanings of death or injury. The author in this article points out very clearly that this system of combat, when waged with both combatants properly protected, is one of the most humane methods of modern warfare. Wars of the future, if there be more strife, will be a battle of scientists' wits. The use of chemical gases will be one of the salient methods and must be considered very seriously.*
>
> —The Editor.

was phrased somewhat differently at the Washington Arms Conference in 1922. In direct opposition to the advice offered by the military and chemical experts present, the plenipotentiaries of the five powers drew up the following statement at this conference: "The use in war of asphyxiating, poisonous or other gases and all analogous liquids, materials or devices having been justly condemned by the general opinion of the civilized world and a prohibition of such use having been declared in treaties to which a majority of the civilized powers are parties—

"Now to the end that this prohibition shall be universally accepted as a part of international law binding alike the conscience and practice of nations, the signatory powers declare their assent to such prohibition, agree to be bound thereby, between themselves, and invite all other civilized nations to adhere thereto."

While the plenipotentiaries of all the powers signed the agreement, it does not become effective until ratified by all the home governments. Several years have passed, but it still remains unratified. Fortunately there was at least one nation which had men in power who could not be swayed from the path of logic by silly sentimentality.

Not content to leave the issue in the pigeon-hole where it justly belongs, our delegate at Geneva brought it up again last summer. The proposal as stated in the Geneva protocol differed in two respects from that of the Washington Conference, the most important difference being that, whereas the Washington agreement was not binding until ratified by all the governments, the Geneva protocol becomes binding upon all nations who have ratified it, as soon as they so ratify. The statement of the latter agreement runs in part as follows:

"Whereas the use in war of asphyxiating, poisonous or other gases, and of analogous liquids, materials or devices, has been justly condemned by the general opinion of the civilized world; and

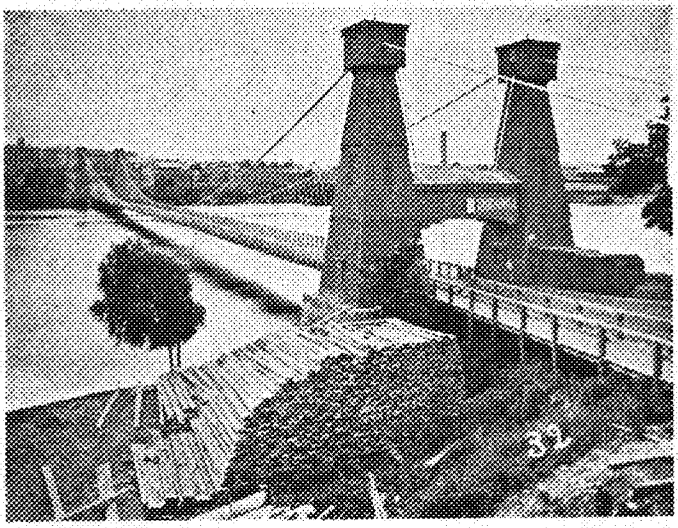
"Whereas the prohibition of such use has been declared in Treaties to which the majority of powers of the world are parties: and

"To the end that this prohibition shall be universally accepted as a part of international law, binding alike the practice and conscience of nations:

"Declare: That the High contracting parties, so far as they are not already parties to Treaties prohibiting such use, accept this prohibition, **** and agree to be bound as between themselves according to the terms of this declaration."

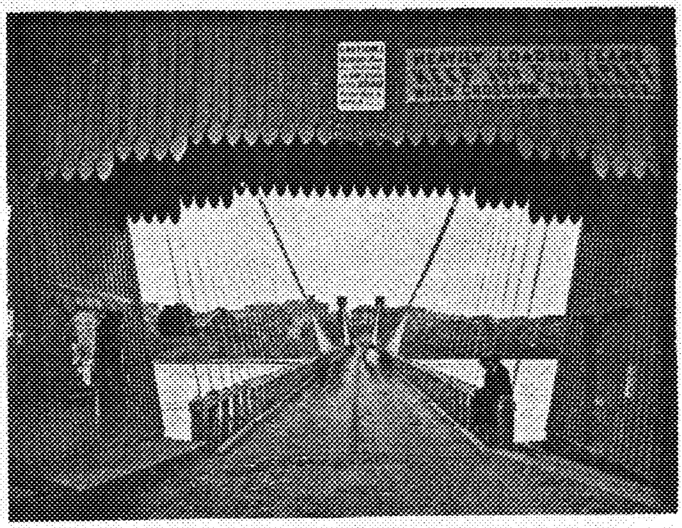
This meeting was called for the express purpose of considering an agreement regarding the traffic in arms. There was no intention of discussing chemical warfare, so that the action of our delegate, which was taken without the advice of the War or Navy Departments, seems to have an unfortunate attempt to give our country an outstanding place at the Conference. It is to be hoped that the present Congress will not follow in the steps of our delegate.

(*Continued on page 158*)



OLD WIRE SUSPENSION BRIDGE

Opened in 1855, this structure between Minneapolis and Nicollet Island was the first to cross the Mississippi river. Its span was 620 ft. long.



LOOKING THROUGH ENTRANCE ACROSS ROADWAY

The wood stiffening trusses along the sides of the roadway are clearly visible. Vertical deflection of the cables is 47 ft. Note the signs of warning.

Minnesota Bridge Construction

Our present day reinforced concrete design supersedes the timber, wire suspension, wood and iron truss structures of the past

By Walter H. Wheeler, E. M. '06

Special Engineer for Hennepin County, Minneapolis, Minnesota.

From the Gear of Theta Tau.

THE progress of bridge building in Minnesota has naturally kept pace with the progress of this art in all the civilized world, and especially that in the remainder of the United States. However, the availability and relative costs of the various materials for constructing bridges, the ability to finance their construction, the size and character of the rivers and streams to be bridged and the volume and kind of traffic to be provided for, all exert their influence upon the progress of bridge construction.

The fact that Minnesota is comparatively a newly settled area which outgrew its position as a frontier state in only the last half-century automatically confines its progress in bridge construction to approximately the last 75 years.

Before Minnesota had emerged from its "wild west" days, many great and notable bridges had been built in the civilized world. We may even go back to the days of the Greek and Roman empires to find examples of great and famous bridges which still hold their place among the notable engineering works of the world, and were great achievements in their day.

It is said that the art of bridge design began to become an exact science about the middle of the last century, and that prior to that time there were no well recognized methods of analyzing the stresses in bridge structures. Engineers and builders of bridges relied upon experience and trial methods to attain the desired results. If the structure did not collapse, it was a success; if it did, it was rebuilt heavier than before, and this operation was repeated until an acceptable structure resulted.

The writer has been unable to find any record of the first bridge built in Minnesota which was of sufficient importance so that one might say that it was the first. It was probably a wooden structure.

In the early days of Minnesota, the finest and best selected timber for bridge construction could be had at a very low price directly from the forests and mills of the state. Consequently that was the material of which most bridges were constructed. These early bridges and many of the later ones, including some that are being built now, were of wood, either pile trestles with caps and stringers to carry the bridge floor, or wooden trusses.

Within the time that Minnesota has been building bridges, two new materials for bridge construction have been developed, namely, steel and Portland cement concrete. These two materials are used in the construction of our so-called "permanent" bridges.

It would be interesting to trace the relationships of prices of materials and labor to the evolution of bridge design and construction, but space will not here permit.

The old Wire Suspension bridge from Minneapolis to Nicollet Island and thence by wood trestle to St. Anthony is said to be the first bridge built across the Mississippi river. This bridge was in its day considered a great engineering achievement, as indeed it was. The opening in January, 1855, was attended by very elaborate ceremonies including a mile-long parade and a banquet and ball. One observer records that he saw 61 sleighs in the parade. Mr. S. M. Griffith was the engineer and designer; he was made much of at the celebration and toasted and feted very generously; he in turn toasted the mechanics who had worked on the construction and credited them with much of the success of the work.

The suspension span of this bridge was 620 ft. long. The roadway was 17 ft. wide. The suspension cables had a vertical deflection of 47 ft. and were carried on wooden towers. There were four cables, each consisting of 500 strands of No. 10 charcoal iron wire. There were wooden stiffening trusses along each edge of the deck. The total cost of the bridge was $36,000. The bridge was built by a corporation consisting mostly of residents of Minnesota, and was operated as a toll bridge, with charges of 5 cents for each pedestrian, and 25 cents for each team or horse-drawn vehicle. The bridge was posted with a notice which permitted only one "heavily loaded team" to each 100 ft. of bridge. The Hon. H. H. Sibley was one of the speakers at the opening of the bridge.

In March, 1855, a high wind tore the deck from this bridge and broke the castings to which the cables were attached. The damage was repaired before summer, and the bridge served until its replacement in 1875.

In 1858 the Wabasha Street bridge in St. Paul was completed across the Mississippi. This bridge differed widely in design from the one in Minneapolis. The length of the main span was 240 ft., and it had a clearance of 90 ft. above low water to provide for river transportation. There were three through-trusses built of wood and set with the bottom cords level and the roadway sloping. They were supported on high stone piers, and the roadway was divided so that there was one line of traffic on each side of the middle truss. The writer could not determine definitely from available photographs the type of truss used, but it seems to have been built along the lines of a double-intersection Warren truss.

The bridge was privately owned, and was operated as a toll bridge until it was made free by the city in 1874. It was built by the St. Paul Bridge Co., and the city records of St. Paul show that in 1857 the City Council subscribed $50,000 to the cost to complete the bridge. This was replaced in 1875 by an iron truss bridge with a wider roadway.

In 1875 the old Wire Suspension bridge in Minneapolis was replaced by a new suspension bridge having stone towers, a wider roadway and sidewalks; in all respects is was a considerably larger and stronger bridge than the first one; it was designed by the same engineer. This bridge later carried the street railway. It cost $230,000. It was replaced in the late eighties by the present steel-arch bridge, with a 57-ft. roadway and two 10-ft. sidewalks, and designed to carry the loads of modern traffic.

Iron bridges were first built in the state about 60 or 65 years ago. One unique example of the earlier iron bridges is State Bridge M-32 on trunk highway No. 20 at Preston, built 65 years ago. It is a clear span "bowstring" style of through-truss, with very light web members. The span is 120 ft., roadway 16 ft., panel spacing 10 ft., top chord built up of two 6-in. channels and two 10-in. plates, bottom chord eye bars. The bridge is posted for a safe load of four tons, is of wrought iron, in an excellent state of preservation, and the workmanship is of the best.

Another unique structure is the old covered wooden bridge at Zumbrota. It is typical of a considerable number of such structures built in the earlier days, and is said to be the only one of this type remaining in Minnesota. It is a wooden lattice-truss structure. The span is 116½ ft., roadway 16 ft., and the bridge is enclosed in a wooden housing. There are quite a number of these covered bridges in the New England states, and they add a touch of interest to the landscape and highways. It seems to the writer it would be desirable to preserve the one at Zumbrota if it were possible to do so. The bridge is rated by the state highway department for a safe load of 10 tons and is in good condition. When it was taken over by the highway department there were four layers of flooring on the bridge, totaling about 12 in. in thickness. Apparently it had been the practice to lay new floors over the old ones. The state highway department removed the old floors and put in a new one.

State Bridge M-49 at Garden City, built in 1880, is a wrought iron structure of a design no longer used. The main span is 176 ft. and the roadway 16 ft. The shorter end span is of more recent construction, and seems to have been added after a washout had occurred. When a new floor was laid on this bridge recently, it was found that the top flanges of the double channel floor stringers were so badly corroded that the workmen who were laying the floor drove several nails through the flange of one of these stringers, thinking they were nailing into the wood nailing-strip. When their mistake was discovered, an examination was made at once, and the old beams replaced before the floor was laid.

The view of bridge M-203 at Warroad, shows the old wood pile trestle which is typical of many that were built in the state and served their purpose well until time and the demands of modern traffic made it imperative that they be replaced. The roadway of the old bridge was 16 ft. The modern concrete and steel low truss bridge, replacing the old one, has a 20-ft. roadway and one 5 ft. sidewalk.

State Bridge No. 3700 in Lake of the Woods county replaced an old wooden bridge similar to that at Warroad. This bridge also had a 20 ft. roadway and 5-ft. sidewalk. It was completed about a year ago, and is a good example of a modern steel deck-truss bridge with full riveted connections.

State Bridge No. 3945 at Le Sueur was formerly a 3-span wrought iron bridge with balanced swing span, counter-weighted at the short end. The old bridge had a 14-ft. roadway and was completed in 1875. It was replaced recently with a modern steel bridge shown in the cut. The new bridge has a 20 ft. roadway.

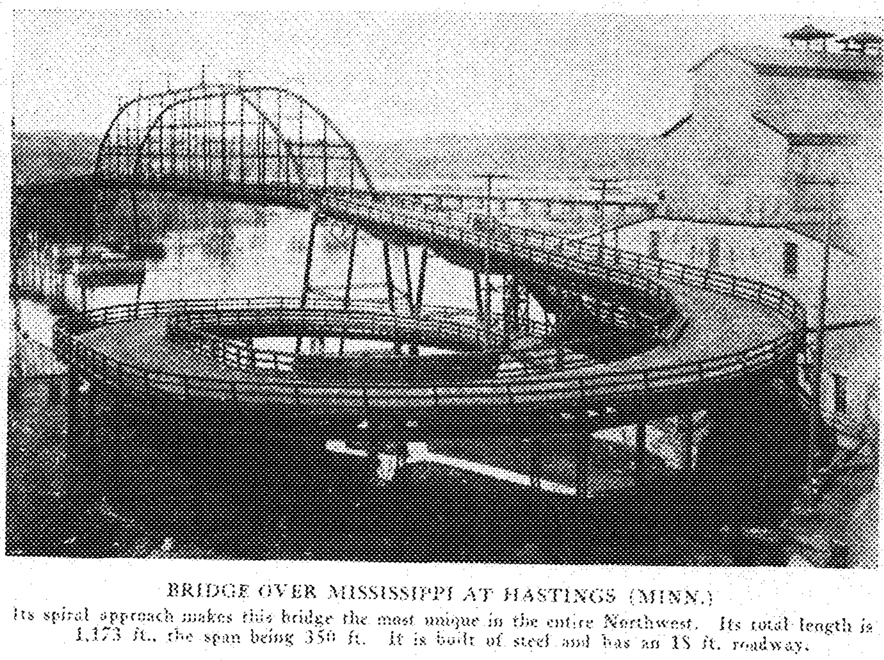
State Bridge M-6 is a wrought iron hand operated swing bridge built in 1879. The swing span is 250 ft. long over all. The roadway is 16 ft. The panel spacing is 16 ft. 7 in. The bridge is rated for a 10-ton load, and is in good shape. It was recently refloored with 36-ft. stringers which stiffened the bridge materially. The new wearing surface on the floor is Tarvia X paving.

Bridge M-341 is an example of a small wooden truss bridge, of which there were formerly many in the state. It was replaced in 1922.

Bridge M-202 is another type of wooden bridge also in common use in earlier days. This bridge was replaced recently by a new bridge. The road for the new bridge was relocated so that the old bridge could be used as a detour. During construction of the new bridge, a venturesome 10-ton caterpillar tractor attempted a crossing on the old bridge. The frail wooden structure, frightened by such a dangerous looking animal, promptly collapsed into the bed of the stream, taking the "cat" with it. It is reported that the driver was not injured and the "cat" was rescued, but the bridge was no longer passable.

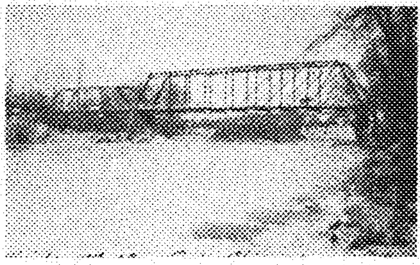
State Bridge M-157 near Motley is a 140-ft. span steel truss pin-connected bridge of a general type in common use in the earlier days of steel highway bridge construction. It has a 16-ft. roadway, is rated for a 10-ton load, and is in fairly good condition.

State Bridge M-131 near Wells is a type of low-truss steel-angle highway

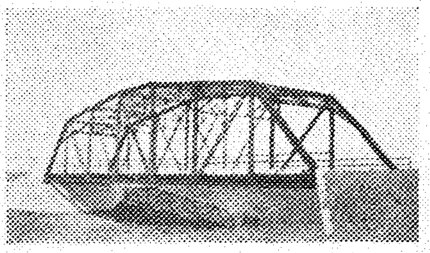


BRIDGE OVER MISSISSIPPI AT HASTINGS (MINN.)

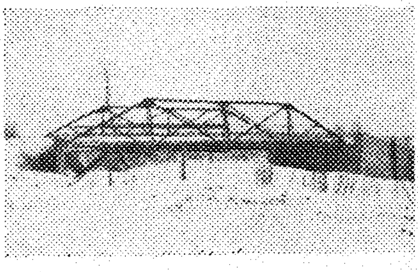
Its spiral approach makes this bridge the most unique in the entire Northwest. Its total length is 1,173 ft., the span being 350 ft. It is built of steel and has an 18 ft. roadway.



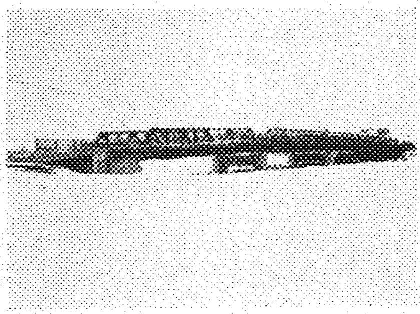
M-49, At Garden City. Built in 1880.



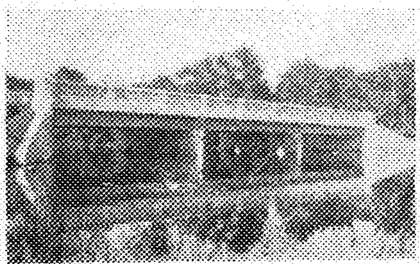
No. 4232, Typical of Modern High Truss.



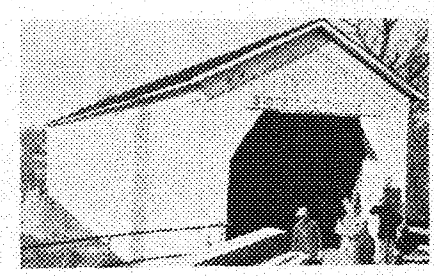
M-131, Near Wells, a Type Now Obsolete.



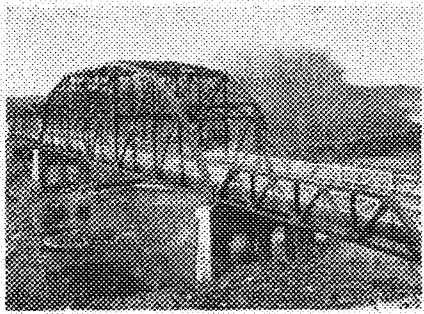
New Warroad Concrete Low Truss.



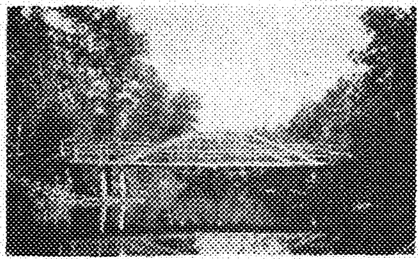
No. 3800, Concrete Girder Now Built.



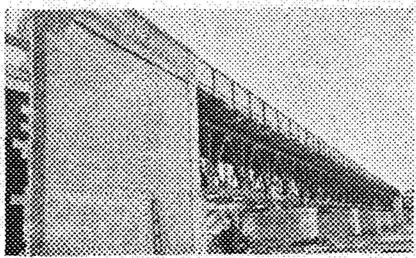
Covered Wooden Structure at Zumbrota.



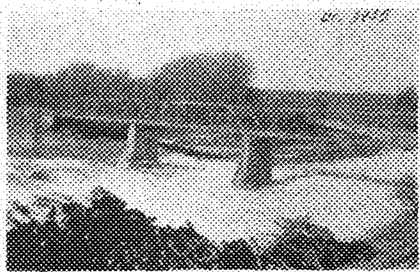
Swing Span, Built in 1875 at Le Sueur.



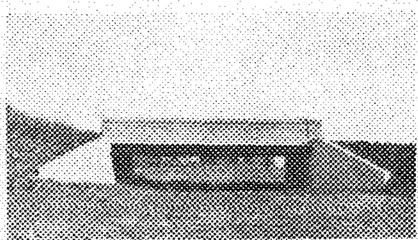
M-341, A Type Formerly Much Used.



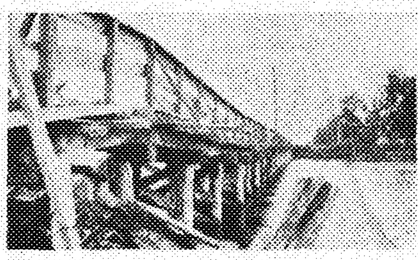
No. 5700, In Lake of the Woods County.



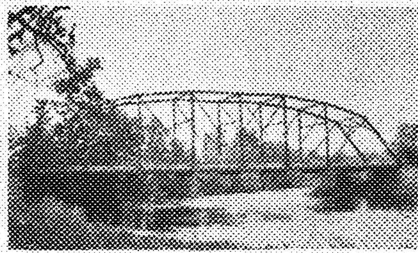
No. 3945, Replacing Old Le Sueur Bridge.



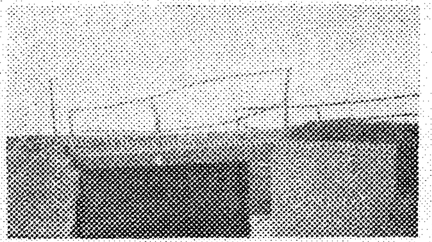
No. 4233, Representative Present-day Type.



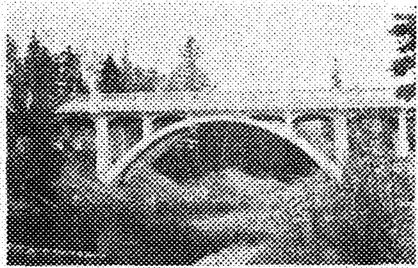
M-203, Old Warroad Pile Trestle.



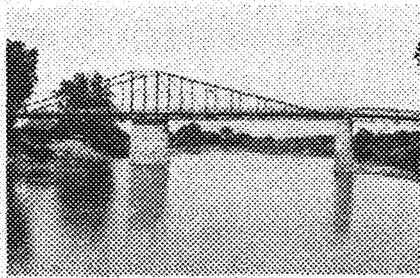
M-197, Near Motley, An Early Type.



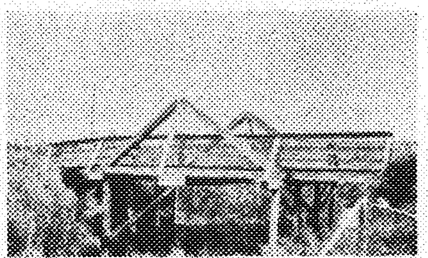
M-193, Near Marshall, No Longer Standing.



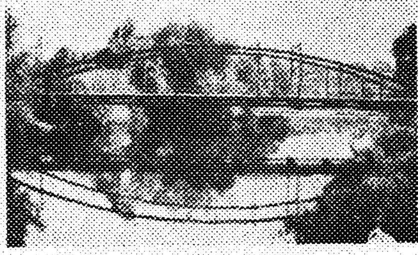
No. 3601, A Modern Rib-arch Design.



M-6, Built in 1879, Still In Use.



M-202, Formerly a Popular Type.



M-32, At Preston, Built 65 Years Ago.

bridge built quite extensively some 20 years ago. It was found unsuitable for modern traffic conditions.

State Bridge M-139 was located near Marshall. It was typical of some of the earlier small concrete bridges, built under the old system without much engineering or supervision. This bridge was replaced by a bridge similar to No. 4233, which is representative of this type of small bridge now being built under the direction of the state highway department.

The recent bridge collapse at Albany is instructive and interesting from an engineering standpoint. The bridge was a low-truss pin-connected steel structure. A large bus traveling at high speed to make a grade beyond the bridge produced such violent vibration by its impact that one of the pins jumped out of place and allowed the bridge to collapse. The bus cleared the gap but left the marks of its differential on the ends of the stringers where it left the bridge.

State Bridge No. 4232 is typical of the type of high-truss steel bridge now built by the state highway department. State Bridge No. 3800 is a typical reinforced concrete girder bridge. State Bridge No. 3601 is a typical reinforced concrete rib-arch bridge. Little comment is necessary on these bridges. By comparison with the older bridges previously described, the photographs tell the story.

This paper would not be complete if it failed to note the influence which the state highway department has had upon bridge building in Minnesota.

In 1905 the state legislature passed a law which created the state highway commission, consisting of three men who served without pay. The commissioners were appointed by the Governor. In January, 1906, the commission appointed the Hon. Geo. W. Cooley as secretary and chief engineer, and he served in that capacity until the winter of 1917-18. In 1911 a one mill tax was levied by the state for road and bridge work, a bridge department was established, and the work of the commission expanded. In 1918 the legislature changed the law to provide for a single commissioner who should devote all his time to the office and receive a salary therefor. Mr. Cooley resigned and Mr. C. M. Babcock was appointed. In 1919 the Babcock Amendment to the constitution which provided for an automobile license tax for road purposes was submitted by the legislature to a vote of the people and was carried at the next general election. In 1921 the legislature set up the machinery for the operation of the amendment. This amendment added greatly to the funds available for highway purposes, including bridges, and resulted in another expansion of the activities of the state highway department. At the present time most of the county bridge work in the state is under the general direction and subject to the approval of the state highway department.

There can be little doubt that the establishment and development of the state highway department has resulted in greatly raising the average quality of bridge design and construction, and has influenced the standardization of highway loads. It is perfectly true that under the old order many bridges of excellent design and construction were built, but they were perhaps more the exception than the rule.

No attempt will be made in this brief review of bridge building in Minnesota to deal with railroad bridges. They are in a special class; their design and construction is usually handled by the engineering staff of the railroads, and competent consulting engineers are usually employed on large work or work which requires the services of engineers having special knowledge for the work in hand.

The bridge over the Mississippi at Hastings, commonly known as the Spiral bridge, was built in 1895. It is a steel structure 1,775 ft. long, with an 18-ft. roadway and one 5-ft. sidewalk. The main span is 380 ft. and the clearance above mean low water is 73 ft. The bridge is elevated to avoid using a draw span, making it necessary to have a steep approach on the Hastings end or to use a spiral. The spiral was adopted, and it proved to be a satisfactory solution of the problem for the traffic conditions at the time it was built.

The stone-arch bridge over the Mississippi in Minneapolis, although a railroad bridge, should be mentioned, as it is an outstanding example of its type.

The Lake street bridge over the Mississippi which connects the cities of Minneapolis and St. Paul, and the bridge over the Mississippi at Fort Snelling are examples of modern steel-arch construction.

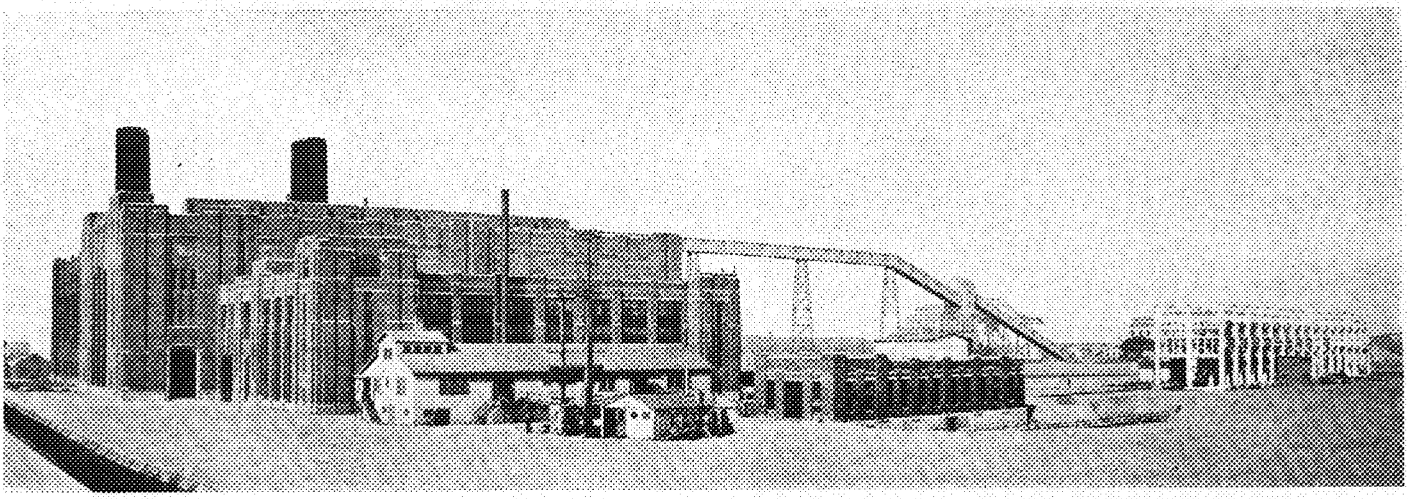
The 42nd Avenue North bridge over the Mississippi in Minneapolis is a steel through-truss bridge with a reinforced concrete approach on the west end.

The 3rd Avenue bridge over the Mississippi, built in 1916, is the first large reinforced concrete bridge to be built in Minnesota. It is 2,260 ft. long, has a 56-ft. roadway, a double-track street car line and two 12-ft. sidewalks. The arches are of the Melan type, reinforced with structural steel. The bridge is a beautiful appearing structure, is advantageously situated and carries considerable heavy traffic. It is reported to have cost about $887,000.

The Franklin Avenue (Cappelan Memorial) bridge over the Mississippi in Minneapolis was the second large reinforced concrete bridge to be built in Minneapolis. It has a central span of 400 ft., two spans of 199 ft. each, and two spans of 55 ft. 6 in. The main span is at the middle. The bridge is very plain architecturally, which adds materially to its beauty and gracefulness, and it makes a beautiful picture when seen from the river drive on either side of the stream. It is 1,033 ft. long, and has a roadway 40 ft. wide, with an 8-ft. sidewalk on each side. It is designed to carry a double-track street car line. The deck is about 105 ft. above the water level in the river, and the foundations of the main span are on bed rock 20 to 30 feet below the water level. The design is two-ribbed arch. The cost is reported at $990,000. It replaced a steel bridge of early design. Both the Third Avenue bridge and the Franklin avenue bridge were built by day labor under the supervision of the city engineer. The Franklin avenue bridge was re-named Cappelan Memorial bridge by

(*Continued on page 160*)

THE FORT SNELLING-MENDOTA BRIDGE OVER THE MINNESOTA RIVER.



CRAWFORD AVENUE STATION OF THE COMMONWEALTH EDISON COMPANY, CHICAGO

A general view of the first section, capable of 160,000 k. w., comprised of three units of 50, 50, and 60 k. w. respectively. Its size will ultimately be increased to 1,000,000 k. w., thus making it one of the largest in the world. The plant was put in service November 14, 1924.

Shall We Enter the Utility Business?

Electric distribution companies offer splendid opportunities for every engineer in both technical and non-technical branches of work

By Ralph W. Liddle, B. S. '21
Editor, Edison Round Table,
Commonwealth Edison Company, Chicago.

Editor's Note: This continues the series of articles concerning the opportunities for engineering graduates in the many lines of technical endeaver. The fifth number of the series will appear in the March issue.

EVEN if by some form of mental hokus-pokus all the others could for a moment be eliminated, beaten, or forgotten, one outstanding advantage of the utility business would remain unchanged and certain. It is its stability. There is something about this business that encourages one to sleep nights, to forget about periods of depression and inactivity; something that suggests homes, and hobbies, and pleasures, and freedom of personal development, and security. The utility business is big, and it is solid.

About these things young men claim only a moderate concern, and we will not be accused of letting off any of our heavy ammunition early. Of all the characteristics of the utility business, stability is the most bragged about, and bemoaned. It brings men, and money, into the business—and keeps them in. It keeps men out, and gets them out, and makes them glad they stayed out, they say. This stability is a cheering circumstance much of the time, but what some young engineers have said about it at other times has no place in a magazine of this sort.

An electrical engineer friend of mine was on a student course with a large manufacturer. In one letter he had determined to leave the company. In the next it appeared that business was on the pick-up, and that now "the pick-up was on the pick-up," so he stayed on the job.

When we say the utility business is stable, we mean that the only thing that varies is the rate of growth, or, if you don't mind, the pick-up of the pick-up. Without a doubt dozens of electric light and power companies have not had a reduction in annual gross earnings in the last twenty years, some of them, perhaps, never since they began business.

If the prospect of working in an industry that is now only a 40-year-old infant; that has been truly revolutionary in its effect on the civilization of which it is a part; that has grown rapidly and without interruption throughout its life; that becomes more useful and indispensable as it grows—if these things arouse your interest—then the electric utility field is modestly suggested for your consideration.

Shrewd men hesitate now to discuss the point of saturation in the use of electricity. Their predictions have been disproved so often that such statements have become bad form, not to say careless. I remember reading an article, about in 1919, which gave it as the considered opinion of certain engineers that 30,000 kilowatts was the undoubted maximum reasonable capacity of turbo-generators. Units of double this rating are now in service, 75,000 kilowatt units are in order, and 100,000 kilowatt machines are planned. Such incidents show the danger involved in predictions.

Before going into much detail about the electric utility business I have tried to indicate that its growth is continuous, that it is actually rapid, that it is accompanied by technical developments in great variety—and to suggest that this is perhaps the biggest and broadest of all fields open to the electrical graduate. In addition, there is in utility work a strong element of human service, which has slight influence with the average young man, but which has kept able men in the business long after financial reward has ceased to be a consideration.

When I was a senior engineer, it was thought that the utility companies were among the worst offenders in the matter of low salaries, and that no prospective employer offered what we were really worth. It is likely that the same opinion is now held, regardless of what changes have taken place. However, the steady expansion of electric utilities in recent years must have created a sufficient demand for young engineers to make their salary offering equal to the average. They are getting the men, and very often their choice.

It is undoubtedly true that all prospective engineers are not engineers at heart. Some of them are cut out for lawyers, accountants, salesmen, advertising men, and so on. There is use in the utility business for nearly every variety of ability. There is necessarily a high percentage of technical men in a utility organization, which means keen competition among young men if a considerable number of them are doing similar work. This suggests the desirability of choosing branches that are less crowded with men of equal training, and those that appear to be in line for expansion.

The interest of utility people centers on different subjects at different times. In the early history of the business most of its problems were technical in character. For a period of several years, until recently, these topics have been non-technical. Beginning about eight years ago it was municipal ownership, then regulation, then customer ownership, then public relations, and now consolidations, super-power, interconnection, and massed production, which are engineering matters. Proper rate structures were in the early days, and still are, an important problem.

While the order in which they are listed may be questioned, these examples indicate that at a particular time there is likely to be a major trend of development, which also has some bearing on the opportunities offered. Load building and improvement of load factor, rural and railroad electrification are other matters of current interest.

While the electrical student is mentioned most often in this discussion, the utility business also offers excellent opportunities to the mechanical engineers. Boiler room and steam turbine efficiency is a matter of continuous study and experiment. The construction of stations, overhead and underground lines, requires the services of many civil engineers.

The engineering student who is reasonably sure he wants to do design or research work may do better with some manufacturing company, but for the greater number who are uncertain or who feel they are not "born engineers" the light and power company has much to offer. There is plenty of design and research work to be done, and there is a much greater variety of semi-technical work.

A considerable number of all the possible lines of work open to electrical engineers are represented in a large light and power company. He is in a position to make an intelligent choice of his future work because of this opportunity for observation, and is able through transfers from one department to another to "try out" the different branches more easily than if he had to go with new companies each time. It seems unnecessary to list a number of lines of work that could be covered in this way. It is sufficient to call attention to the variety and invite comparison with similar opportunities in other fields.

In connection with commercial work, it has been the experience of some companies that it is easier to train an engineer for commercial work than it is to teach a commercial man the technical matter he must be familiar with. The result is that power and lighting salesmen, statisticians, accountants, advertising men, and many other classifications are recruited from the young engineers—that were to be.

A graduate's engineering training is necessary in the utility business, even if he uses it only indirectly, because it prevents him making mistakes in dealing with technical matters. If he has acquired the ability to think clearly and independently, which is supposed to go with engineering training, that will also be useful.

It has been observed that many technical graduates arrive at the door of industry with the idea that they wish to go into some sales branch. About 30 per cent of a recent group of 100 registered this desire. At the end of the training course some 6 per cent were in sales work. Based on whatever tests could be applied, including experience, only this number were suited to it. This is obviously not a criticism, and it suggests that many graduates "adopt" this sales notion because of the alleged greater opportunities and financial rewards.

Sales work and other semi-technical classifications now absorb about 20 per cent of the engineering graduates coming to one large company. It seems certain that a man will make the best progress in work he likes and is adapted to, and that this problem is more important to him than information as to which branches are best.

Among young men now on the job with utilities, there is no agreement as to which branch does pay best. Each will mention exceptions to any theory one advances. If a man is making good progress he will think his branch pays well and offers the best opportunity. If he is not making good progress, other branches will, to his mind, be better in many or all respects. The reasonable conclusion is that there is not much difference—that it depends on the man.

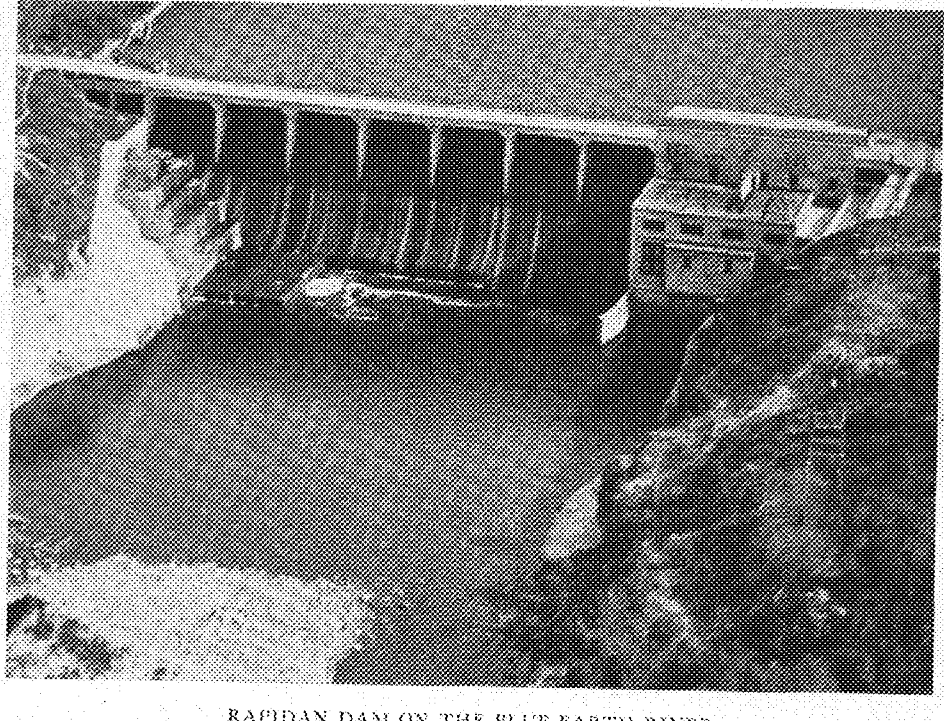
An engineer friend of mine engaged in employment work lays much stress on this vocational consideration, and makes this suggestion: Try to make an accurate analysis of yourself, early. The best means at hand will probably be a friend, or several, if possible, including an older person, who will give you a frank, serious opinion of your special abilities, your peculiarities, your weak and strong points. To make sure of a frank opinion it might be well to pick out a few enemies for critics. The important thing is to get the truth, before you have spent valuable time in an unsuitable line of work, or with the handicap of many faults that could be eliminated. It is notoriously difficult to see ourselves as others see us, and yet these others may determine our success as well as ourselves.

The present trend toward consolidation and inter-connection of utility properties has been mentioned. The problems which accompany it—of transmission, larger scale production, distribution, interchange power contracts, regulation and financing, broader public policy—all present opportunities for the young man. I will not argue the questions of large versus small companies—or going into business for yourself—with anyone, but I do think the large company offers the best opportunity for perhaps the first five years for every young engineer. For myself, I will take the large company all the time, and the larger the better.

When one sees the steady growing figures of investment, output and earnings of the electric utilities it might seem that this is an uninteresting business, comparatively. It just grows, and there's an end to it. There is a lack of action, of excitement, using these terms conservatively.

It depends on how much you can see.

(*Continued on page 168*)



RAPIDAN DAM ON THE BLUE EARTH RIVER

The utility engineer is needed not only in the large companies of a metropolis but also in the operation of smaller outlaying plants like this 22,000 h. p. station near Mankato, Minn.

William F.

'Bill' Stout M'05

inventor of the

ALL-METAL AIRPLANE

By PAUL B. NELSON

By Permission of World's Work

William F. Stout

It was a gloomy afternoon at the Detroit Club. Suddenly into the lounge room, briskly stepped a lean slender man, a shock of slightly gray hair topping his quick energetic face. His thick lensed glasses only seemed to magnify the ready and twinkling smile that continually flitted about his countenance.

"Hello, Bill!" greeted one millionaire.

"C'mon over here, we're just starting a little game," rang out from one manufacturer whose name is found on the radiators of thousands of automobiles.

"Say, Bill, have you heard this one?" and instantly William F. Stout, inventor of the all-metal airplane and the most popular man in Detroit today, was surrounded by the elite of the nation's largest car manufacturing city. A remarkable personality, combined with an over-abundance of geniality, a ready smile and a sense of humor—an ability to tell stories—millionaires couldn't help subscribing to his aeronautical project—and now they slap each other on the back.

"—And Ole said to Pete—I skall tink I go—" Bill Stout's specialties are Swedish dialect ones—but we must get back to our story.

* * *

He was a Methodist minister's son. Forty-six years ago, the Reverend James F. Stout walked down the streets of Quincy, Illinois, proclaiming—"You bet, it's a boy." Like all preacher's children, people thought him a little worse from the rest. It might have been true that during one of his father's sermons, he would amuse himself by folding toy airplanes out of the leaves of a hymnal or perhaps in Sunday School, he caused the neighboring class to go into paroxysms of joy by floating miniature gliders over their heads, fashioned out of the Sunday School paper.

When he was out of his teens, he entered Hamline University in St. Paul. After two years with French, Greek and the teachings of Plato, William decided to take up engineering and accordingly registered for a mechanical engineering course at the University of Minnesota.

Preacher's budgets in those days were not very large and Bill worked his meals at the old Hutchins Restaurant as well as at the College Inn. Writing had always appealed to him and by contributing to the Minneapolis Times and several small magazines, he secured the necessary funds for text-books and incidentals. Military drill was compulsory in those days, too, everyone wearing neat gray uniforms with black stripes. One of his proudest moments in college life was when he was promoted from Corporal to Major all at once, but only 'drum' major, as he humorously relates.

Bill used his eyes too much. Sitting up late writing after the morrow's lessons were done began to weaken his sight and during spring quarter of his second year, he was advised by doctors to leave school. Furthermore, he was warned not to use his eyes for at least two years, lest permanent blindness result. Undaunted and with eighty-five dollars in his pocket, he set out two weeks later for Europe. Bill worked his way across the Atlantic on a cattle boat on which he met a fellow, his own age, by the name of McRae who came from the University of Kansas, and was similarly taking passage for the old-country. Together they toured the continent for seven months, going through Ireland, England, Belgium, Holland, Germany, Switzerland and France. All of this time, Stout was writing and illustrating articles on his travels which he sent back to the Minneapolis Times.

When they could raise money no other way, the two boys would go out on a street corner in the evening and one of them would play the mandolin or guitar while the other, usually Stout, drew pictures on a Blackboard, giving chalk talks, after which they would pass the hat among the crowd and thus obtain enough to move on the next day. Stout still has the guitar which he carried all during that summer in Europe and on which are the maroon and gold streamers, which a little Dutch girl in Holland tied on in person.

Late that year, Bill wound up in London, a homesick, lonely boy—and penniless. After searching a week for work, he took passage on a freighter. The first three days out he was unable to eat the food but eventually won the good graces of the cook who gave him the job of peeling several bushels of potatoes each day. As he puts it, "I started as Dick Roustabout and sailed into Boston ten days later with the high-sounding title of carpenter's maid."

Coming back to St. Paul, he obtained a regular position with the St. Paul Dispatch conducting a department for boys under the nom de plume of Jack Kneiff. Knowing the joy that an American boy can get out of a jack knife and an old stick of soft pine, Stout told in his columns how to make things that interested boys. The feature "took" with the youngsters of the Northwest. The Dispatch even established a shop in their building where boys could come and make the things that they were reading about. At this time, he was also instructor of manual training in Mechanics Arts High School in St. Paul. Boy Island at Bald Eagle, a truly boy's enterprise, was founded under Stout's guidance.

Though still hindered by weak eyesight, he continued his writings by the use of the typewriter, though he was constantly warned by physicians of the danger of going blind. Nevertheless, his work prospered and in 1908, the newspaper sent him, or rather he and his wife, to Europe so that Stout could get new ideas for his Boy's page. To show that two could travel as cheaply as one—on a motorcycle—they toured over 6,000 miles through Germany, France, Switzerland, Austria, Holland, Belgium, Norway, Sweden, England, Scotland and Wales. It was during this trip that he met Octave Chanute, who was in France lecturing on principles of aviation which the Wright Brothers, his associates back in this country, were testing out. Meanwhile, Stout, among other things, wrote articles on this subject, and with his own illustrations sent them back to the newspapers.

Perhaps it was the rocky roads of Norway, or maybe the mountain passes of Switzerland that lead him to believe that motorcycles could be improved, at any event, upon his return to this country, he designed and built a new and radical type of motorcycle, and from this phase of work came into direct contact with the automobile industry which was then just starting on its growth. He was made chief engineer and designer of the Schurmirer Motor Carl company and developed a new motor truck.

It was in 1911 that Stout was sent to Chicago to cover an airplane meet, where he attracted the attention of the Chicago Tribune, who offered him a position which could not be refused. He started work for them, writing feature articles on aviation as well as concerning the automobile industry. In a short time, he also wrote for the "Motor Age" of which he later became technical editor, and "with the capital of one shoestring," as he remarked, established "Aerial Age," the first aerial periodical to be published.

Stout has always been a friend of the boys. While engaged in the publishing business in Chicago, he founded the Illinois Model Aero Club, composed of boys of high school age. These fellows, he taught the fundamental principles of aviation and how to make models that would really fly. Later, nearly every one of his former students followed branches of aviation during the War. Two became successful designers and builders of aircraft and one of them today is building a very successful small plane, namely the Laird two-passenger plane.

Early in 1914, Stout went to Detroit with the Scripps-Booth company successively as chief engineer, advertising manager and general sales manager. During the time that he was advertising manager, he originated many novel schemes of publicity and put over a very effective campaign which emphatically placed that car on the market and before the public. He was the first to make up advertisements, "framing" them with generous white space, believing that this would attract the public's eye far more readily than an advertisement crammed full of black type. Stout is accredited also with making the first roadster model car. Story has it that one day as he was walking through the plant with officials, they were talking car improvements, and Bill, an idea coming to his mind, got hold of a piece of chalk and then and there drew on the rough factory floor the first plans of a roadster. The car was immediately built and won the whole-hearted approval of the public at once.

From the time of his first trip to Europe in 1903, he had been actively interested in aviation and through his many and varied illustrated articles on this subject, had gained a considerable reputation nationally as an expert on aeronautical problems. In 1916, Stout joined the Packard Motor company as chief of their newly organized aircraft division, which they had established for the purpose of studying and determining the needed improvements in aircraft and to find out in what particular way that they could help in the development of aviation.

Then came the war.

The Packard engineers were called to Washington to help in the design of the Liberty motor, and Stout naturally was one of the men to do so. He did not go into uniform but remained a civilian and acted as technical adviser to the Aircraft Board, working directly in conjunction with Mr. Coffin, the chairman of the board. While thus engaged, he had access to all the government records with reference to improvements of airplane construction that were under way in every part of the world. It was while studying and classifying all available data on improvements to planes that he conceived and began the development of the thick wing, internally trussed machine.

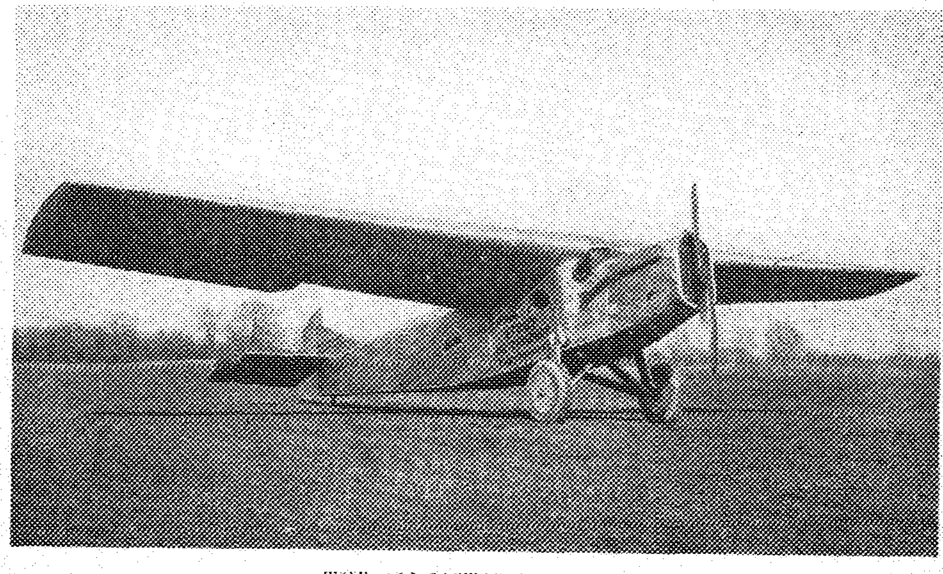
His plane was purely an original idea—nothing like it had been flown in the world before. The experts and engineers of that day, seeing his plans or reading his newspaper articles telling of this new creature, laughed at him and regarded him as a dreamer. While there were many efficient fighting planes in those days, no successful bombers had yet been made. There was much speculation as to what the ideal machine would be, and especially a bomber.

While riding on a train between Washington and Dayton, where the army had its technical center, Stout was explaining to a group of flying experts his idea of a perfect airplane. The story is told that one of the government's experts overheard him and phoned ahead to Washington with the result that Stout was ordered to remain at McCook field and build this machine. It was a unique one, its wings resembling those of a bat and so internally trussed that the enemy could not shoot away the braces. Stout set to work and in 1918, the first machine of this type, built entirely of veneer, was flown at McCook field. The first flight was more or less of a success, though army engineers disliked its bulkiness and inability to be easily maneuvered.

The armistice put an end to further governmental experiments and Stout took his original plans and went back to Detroit. Under the firm name of the Stout Engineering Laboratories, he again started work on a thick wing plane for commercial use. He had no sooner started than in 1920, the after-the-war financial depression hit the automobile industry and everything went flat.

Nevertheless, with unboundless enthusiasm coupled with his share of optimism, he carried on.

Stout had always been a whittler. By night, he became "Jack Kneiff" again and carved and thought. He invented a mechanical golfer. This little toy was built in the form of a miniature man at the end of a club, whose actions could be controlled to hit a tiny golf ball. A novelty company bought it and the large royalties which it brought, often tided Bill Stout and his loyal staff of helpers through a perilous period of depression.



THE ALL-METAL PULLMAN

Built to carry over a ton, eight passengers and their baggage can be easily accommodated. Planes similar to this one are today engaged in mail and express service.

They worked in an old factory building, the basement being the only dry place when it rained. Late in 1920, the first commercial thick wing airplane was successfully flown. It was not perfect. The results of this machine convinced Stout that metal alone could not be used. The material available at that time did not possess the strength and durability necessary. However, he used what he could find and kept building.

Every year for three years he turned out a new machine, each in turn an improvement over the previous type. Finally in February, 1922, after a period of very intensive experimental and development work, he completed and flew the first all-metal plane in America. His dreams were at last beginning to materialize in a preliminary form.

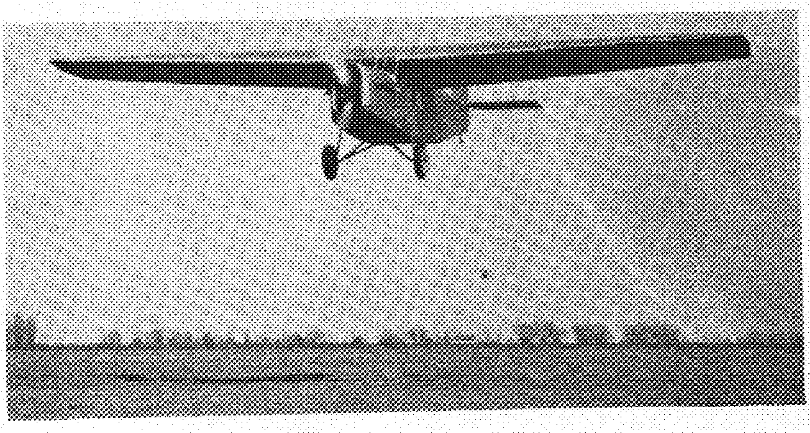
He interested the navy in a metal plane to be used for torpedo work. This was tested by a Navy Board which came up to Detroit to inspect it. The hydroplane crashed to the ground on its second flight and with it went the Stout Engineering Laboratories. He was forced to close out in bankruptcy with a huge loss. Stout relates that he lost over $120,000 on this contract.

Did he quit? No! When the Lord gave Bill his English vocabulary, he forgot to put that word in.

He believed in this all-metal machine. He wanted money and accordingly set about a scheme for raising funds which is unparalled in American financial history.

Selecting one hundred of the most prominent engineers, manufacturers and capitalists of that city, he wrote them each a letter. As a matter of fact, they were blue-printed to save the expense of typing, and the diagrams which he enclosed were colored by hand to save printing costs. He put his case very concisely before them—that he wished to build a thick wing airplane for commercial use, that this would make Detroit the aero center of the world. He did not promise dividends. He merely asked for an investment to get the thing started. Bill was a wonderful letter writer. Business men of Detroit are like business men anywhere else. They won't part with their dollars unless they are assured that they will come back with more of the same specie. When the letters did not come back very fast, he did not sit down and wait for more replies but saw each man personally. Soon he had more than enough to start his developments anew, with such men as Alvan Macauley, president of the Packard Motor Car company, George M. Holley, owner of the Holley Carburetor company, Edward D. Stair, owner of the Detroit Free Press, William B. Mayo, chief engineer of the Ford Motor company, and even Henry Ford himself, on his letterheads as being stockholders.

(Continued on page 164)



The *Maiden Dearborn* in Flight

Facts About the Stout Air Pullman

BUILT strictly for the earning of dividends through the carrying of loads through the air, safety has naturally been made the fundamental of the design. While greater strength has been given to this machine than any previous transport plane, yet it is 700 pounds lighter than its nearest competitor in wood and cloth. It has a spacious cabin, muffled engine, housed-in pilot, and extreme vision, it is ideal for either passenger or freight work. The size of the plane has been chosen to fit the greatest range of commercial use, and the widest plan of operation fields possible with present day conditions, taking it for granted that money-making aviation must start with things as they are, and not as they will be or should be.

The Air Pullman is a seven passenger and pilot cabined transport designed for airline work with tank capacity for 6 hours fuel: the major items of design were laid out for the most possible hours per day in the air, with all assemblies and units so arranged that they may be instantly inspected and quickly replaced.

The main cabin is equipped with six deep upholstered seats and with plenty of leg room for the tallest of passengers. At the front of the cabin in plain vision of all passengers is an air speed indicator and alti-meter. In its aerodynamic layout the plane also resembles in some features the Fokker transcontinental plane, but does not at all resemble it in structure. The Fokker plane is of wood veneer and steel tubing with cloth covering and 1200 pounds heavier than the Stout product, which is all-metal. This plane is also said to be 40 miles an hour faster than the Fokker transcontinental job with the same engine.

The plane is of the long tail type with an adjustable stabilizer and counter-balanced rudder. The wing is of tapered section double convex and of high speed variety. The wing unit is divided into three sections: the center part of which fastens down on the fuselage by six large bolts to the three main spars. The two tips are detachable for shipping and transportation purposes or for replacement in case of damage.

A wing of really thick section is used, the main spar being almost 3 ft. deep on a chord of trifle over 12 ft. at the center. The fuselage hangs below these wings and is fitted with semi-circular windows which swing on a pivot to give one an unusual view in the air. There is nothing to obstruct perfect vision, the wing being above, and one can look cross country clear to the horizon with the wing above shading him from the direct rays of the sun. Even the pilots have perfect vision in every direction except up and to the rear, but they can see the horizon in every direction, can see their own landing gear, and practically every part of the plane from the pilot's seats.

The engine installation is very exceptional and every part more accessible than in any other installation we have seen. The base of the engine mount fastening to the fuselage is extra wide giving great rigidity to the installation and at the same time placing the structural work far enough from the engine itself so that one can reach in and get at everything. The engine is a standard Liberty 400 h. p., but fitted with a new intake manifold which is the latest development of the Air Service. The landing gear of this plane is worth more than passing mention, for it is a big step toward safety. In the first place the landing angle of the ship is just 16 degrees, so that once the tail skid gets on the ground there is no tendency to nose over. Added to this is a chassis with no axle, with no cross tube to catch on weeds or brush and thus make trouble.

The shock absorber cords are arranged outside the planes on either side at the top of the chassis tube and work with a sliding guide plate.

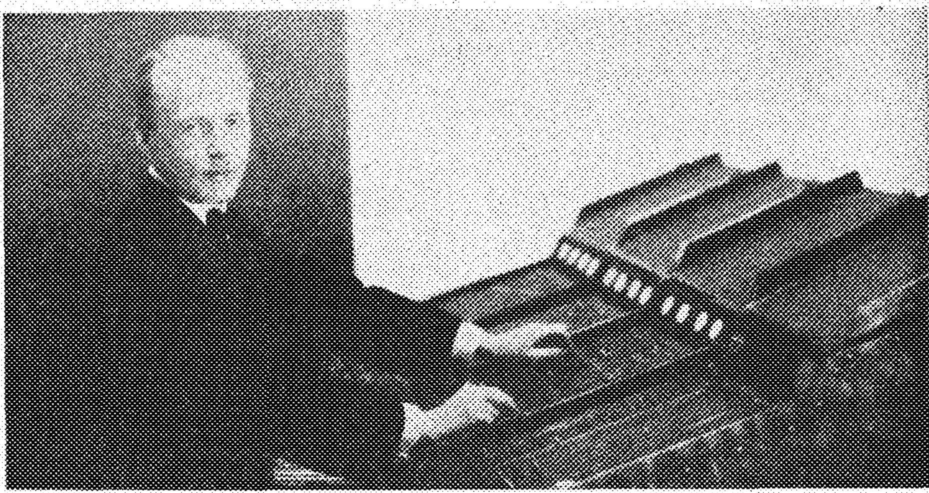
This plane is particularly designed with reference to the carrying of air mail along with express matter, a spacious compartment for mail being provided. With a load of one ton the plane will make approximately 5 miles per gallon. The wing load on the wing is about 9 pounds and the power load 14, so that the actual performance can well be gauged by those who know design.

It was first introduced to the nation's air-minded at the Dayton air races in 1914, and was the subject of much comment at this event. The purchase of the Stout Metal Airplane company by Henry Ford occurred early in August, 1925. Previous to this, Ford had inaugurated his Detroit-to-Chicago aerial express line using a Stout air pullman converted into a freight plane. On July 1, this service was increased, a line being started to Cleveland. This service handled emergency parts needed at the various Ford branches and which were thus carried much more quickly than even fast express. More branches of this have been established and only recently a fast mail line between Detroit and New York City has been instituted using an all-metal airplane

CLAVILUX

ORGAN *of* LIGHT

By F. J. HALBKAT



THOMAS WILFRED AT THE CLAVILUX KEYBOARD

SCIENTISTS have tried for ages to co-ordinate sound and color, to find the apparent relation between them. Man has long ago harnessed sound to do his bidding and produce music for his amusement, but light has been more elusive of control. Electrical and optical developments of the last half century have aided greatly in the growth of the art of using light. But this art is still young and must hold greater things in store than any of the other forms of art since it uses as an instrument one of the greatest powers of the universe, Light, the fountain head of all life.

Many and various machines have been built in the development of a method of control of light. Thomas Wilfred started 21 years ago with no foundation other than the failure of his predecessors. Out of his study and investigation, he has built a machine which gives control over the three factors necessary to success: form, color, and motion. Clavilux is to light what the organ is to sound, it manipulates light as the organ controls the air it uses in building up musical tones. Instead of the wind chest, there are a number of sources of white light. In this all the possibilities of color lie as sound in the wind of the organ. These light organs have been built in various sizes as the wind organ has. Some are portable, as the one demonstrated here was, others are large instruments built into homes in the so-called music rooms, with keyboards not unlike and fully as elaborate as those of a modern organ.

The artist seated at the keyboard of Clavilux, by playing on the stops and keys, releases the light desired, molds it into form, then colors it to suit his fancy and finally adds movement. He has at his command a variety of patterns, and movements. He can control the intensity of color and the speed or tempo of movement. These color forms, vague and sensuous, cannot be described in our limited vocabulary of triangles, ovals, squares, and the like. They are entirely different from anything ever seen before. Shapes come into being with majestic slowness, then dissolve and reform as from a cloud of luminous gas. Sunsets are built up or an Aurora shimmers in hundred fold glory, then fade away only to re-form more beautiful than before. The emotional effect of the picture is startling, like that of music, yet infinitely more subtle, more evasive, and calling on a sense not fully developed or active. The human mind strives to understand it all, then gives up, and is lost in the enchantment of the fairy world before it. The watcher is carried far into dreamy space and floats lazily there almost a part of the abstract scene before him.

PROGRAM

PART ONE

Introduction - - - *Mr. Wilfred*

a. *Op. 42—Sketch. Asymmetrical forms ascending.*

b. *Op. 39—Triangular Etude.*

c. *Op. 34—Chicago Nocturne. Study in Depth and Majestic Motion.*

d. *Op. 29—Single form advancing, opening, rising-closing, receding, falling. Accompaniment double form, rising.*

e. *Op. 30—A Fairy Tale of the Orient.*

PART TWO

Introduction - - - *Mr. Wilfred*

f. *Op. 27—Light and Shade. Study in graceful motion.*

g. *The Factory.*

h. *The Ocean.*
Two projected four dimensional settings for a fantastic play.

i. *Op. 36—Grotesque. A visual Syncopation.*

j. *Op. 37—Joy. Double form revolving. Accompaniment swinging and expanding.*

Mr. Wilfred tells how he made one of his compositions, The Chicago Nocturne. He was walking along near the water front one clear moonless evening, when he came to a stairway heading down into "utter blackness." A whim lead him down the stair onto a wharf backed by large warehouses, and jutting out into the Chicago river. He followed around the whole horizon with his eyes, saw dark sky filtering light through the girders of a nearby bridge, the lights of the city, the murkiness of the river, and put it all into this light picture. First all one sees is the blackness of the night, then, seemingly as the eyes become more accustomed to the darkness, tall stark steel girders can be seen silhouetted against a sky of midnight blue. As the picture moves or the scene changes, the lights of the city come twinkling on, factories across the river take form, the red navigating light on the mid-stream pier shows like a ruby against the black lattice work. Below it all, on the river surface wavers a reflection blotted in patches by the smoke of the river craft. Then the living picture fades into blackness and the watcher is back in the auditorium.

The use of an enlarged Clavilux to light stages in the future is predicted by Mr. Wilfred. The lights of today are controlled from a mammoth switch board behind stage, operated by several men under the direction of the master electrician who follow the cue sheet. They merely pull levers and do not see the effects they produce. "What would happen," says Mr. Wilfred, "if the pipe organ of today were operated on the same basis? Instead of the manual played by one man, there would be a long wooden panel back stage with levers on it and a number of assistant organists, one for each octave probably, would pull these levers at the command of the master organist who read the music. What a bedlam would reign!"

Going still further into the future, the inventor predicts that cities will build "Temples of Light." Temples with ornate fixtures and architecture, walnut ceilings and woodwork and a large circular screen upon which an orchestra of light consisting of a number of players at instruments in an orchestra pit will play the compositions.

To those who have seen, these predictions are not as far away as they seem. The wonder of it all still lingers. The rich, vivid colors, and often fantastic shapes seem part of a dream in a mystery fairyland. Wilfred, by use of light, paints a picture equal to Dante's Paradise. He took his hushed watchers along wonderful, untrodden roads, closer to creation than they had ever been before.

NEWS FROM THE TECHNICAL CAMPUS

Garrick Theatre Chartered By Senior Engineers

A meeting of the senior engineers was called by the president, George Mork, on January 21, at which it was decided to accept the offer of Finkelstein and Ruben and to "take over" the Garrick theatre for a week. Arrangements were completed within the next few days whereby seniors sold tickets for the theatre for the week of January 30, receiving a certain percentage of all tickets disposed of by them. The picture showing that week was "Mike," Marshall Neilan's latest comedy drama.

The money made in this enterprise will be used to cover the deficit incurred during Engineers' Day last year, which was caused by a much smaller attendance at the Brawl than was expected. The payment of this sum will enable the juniors to proceed with their plans for this year's Engineers' Day with a clean slate.

At the same meeting plans were started for a big "Senior Blow-out" to be held March 6. The committee in charge is George Mork, chairman; Kenneth Foster, Barton Juell, and James Johnson. The party will be held at the Columbia Club House. Tickets are a dollar and a half per couple. This is expected to be the biggest and best party ever held by the class of '26.

Prominent Scientists On Chemistry Lecture Course

Prof. W. D. Harkins, a member of the faculty of the University of Chicago, gave an illustrated lecture at the chemistry auditorium January 12. He spoke on "The Formation and Disintegration of Atoms," and brought with him two samples of sodium chloride of different atomic weights.

On January 19, another lecture under the auspices of the graduate school was given at the chemistry auditorium. Dr. Robert Chambers of Cornell Medical college, New York, spoke about the "Physical Properties of Protoplasm." Dr. Chambers has recently perfected a microscope by means of which he can study the behavior of amoeba.

Dr. W. A. Noyes of the department of organic chemistry of the University of Illinois spoke about "International Scientific Relations" on January 27. He has spent considerable time attempting to re-establish the union of scientists which existed before the war.

George E. Martin Addresses Junior Civil Engineers

George E. Martin, consulting engineer for the Barrett company, addressed Junior Civil Engineers on the use of tar in highway construction and maintenance, January 19. The address was made at the lecture hour of the class in Highways and Pavements, and the use of slides brought out his points very vividly. He reviewed the construction of penetration macadam roads briefly, after which he illustrated approved methods of repairing water-bound and penetration macadam, and gravel roads by the use of tar products.

Mr. Martin is an authority on bituminous road material, having served six years as head of the Highway Engineering Department of Purdue University. He left Purdue in 1920 in order to take his present position with the Barrett Company in Chicago.

Former Engineering Dean Is Threatened With Loss of Sight

DEAN FREDRICK W. JONES

Threatened with blindness, Dean Frederick W. Jones, former dean of the College of Engineering and Architecture of the University of Minnesota, and now of the Academy Department at Yale, underwent an operation for a cataract on his right eye November 16. The operation was performed at the Knapp Memorial Eye Hospital in New York City. Cataracts have developed on both eyes, and as soon as possible an operation will be performed on the left eye.

He will be remembered for his remarkable work in our own physics and engineering departments prior to 1909. Immediately after his graduation from Yale in 1884, he was asked by President Northrup to accept a professorship in physics at Minnesota. He accepted and prepared himself for the position by two year's study in Berlin and Zurich, after which he took hold of the physics department and made it one of the strongest in the University. He introduced laboratory work with the use of improved apparatus that he brought from abroad, and also started several courses in electrical engineering. He became dean of the College of Engineering in 1902, and was very instrumental in building the college up to an enviable position among engineering schools before he was called to Yale in 1909.

While at Minnesota, Professor Jones was very active in the promotion of athletics, and for some years served as Faculty Director of Athletics. He helped start and coach the first University football team, and also supervised the construction of Northrop Field.

He was present at Minneapolis a year ago last November for the Illinois game and the dedication of the Memorial Stadium, and also participated in the official opening and dedication of the new electrical engineering building.

A. S. M. E. Plans to Aid in Freshman Orientation

It has long been the custom of the college of engineering and architecture to conduct an orientation course for entering freshmen to acquaint them with the advantages and details of the various branches of engineering and thus aid them in making their course selection.

This year the A. S. M. E. is planning to carry on this valuable work. The society, in a recent meeting, arranged to conduct an inspection trip for all first year men through the mechanical department.

The plans allow for a complete inspection of the equipment and operation of the department. The inspection will be made during the afternoon while classes are in session in the various buildings. In this way the men may see for themselves the type of work that they may come in contact with. The trip through the power plant should be of special interest as it is representative of power plant operation which is one of the most important items in the mechanical field. The men will come in contact with the instructors of the various mechanical subjects, and so may gain first hand information as to the benefits to be derived from the mechanical branch and the character of the work of that department.

Dean Leland, when told of the plan, expressed his desire to help and assure the society that they had the support and cooperation of the faculty. He said that all freshman classes would be excused some afternoon in the near future, that the inspection tour might have full attendance.

A committee has been selected to complete the arrangements for the inspection which will take place some afternoon during this quarter.

The A. S. M. E. has urged that the other student engineering societies take up this work in their respective departments as it is the opinion of the society that this type of work is invaluable in aiding the new men to get into the line of study for which they are best fitted.

Telephone Line Induction Investigated by Swenson

Important discoveries regarding common disorders of public telephone lines are expected to be made soon by the department of electrical engineering which is now conducting experiments under the supervision of Prof. G. W. Swenson.

The apparatus resembles a clothes line in appearance and has been erected in the upper halls of the building. These lines can be made to carry excessive currents. Telephone lines are strung close by and the effects of induction on telephone lines by the transmission lines will be studied.

Carl Fornfeist Elected President of Pi Tau Sigma

Carl Fornfeist, senior engineer, was elected president of Pi Tau Sigma, honorary mechanical engineering fraternity, at the semi-annual elections held January 28. Other officers chosen at the same time are Theodore Corbett, vice-president; Frank A. Trexler, recording secretary; Albert Cooper, corresponding secretary; and J. Edwin Coates, treasurer.

Student Branch of A. I. E. E. Conducts Inspection Trip

The Minnesota branch of the A. I. E. E. held its meeting at the High Bridge Station in St. Paul Monday, January 31. Mr. C. H. Colvin of the Northern States Power company gave a very interesting talk on "Super-power" in which he discussed the company's transmission systems, whose network extends from southern Minnesota to all adjacent states, also the purpose and location of the new High Bridge Station.

Mr. Colvin stated that the previous generating stations were insufficient, particularly as many of them were hydro plants whose power supply fluctuated with the seasons and climatic conditions. It was necessary to supplement these with a steam plant which could supply the power shortage during the dry seasons. When the hydro-electric stations could supply the load, these could stand by with one unit floating on the line as an emergency. Mr. Colvin brought out in his talk that the location of a steam central station depends on the following things: proximity to the center of load, a large supply of water for the condensers, ease of getting coal to the plant, and a storage space for coal to tide over strikes or other trouble. He also showed how the High Bridge Station ideally fits these requirements in that it is very near the load center of the system, is on the Mississippi, close to the railroads, and has plenty of space for coal storage. Another point brought out was that the boiler grates were of the underfeed type which would burn any coal common to this region, thus enabling the company to buy from the most favorable market.

Upon completion of the business of the meeting, an inspection trip was made through the plant which was of special interest to the several members of our local branch who attended.

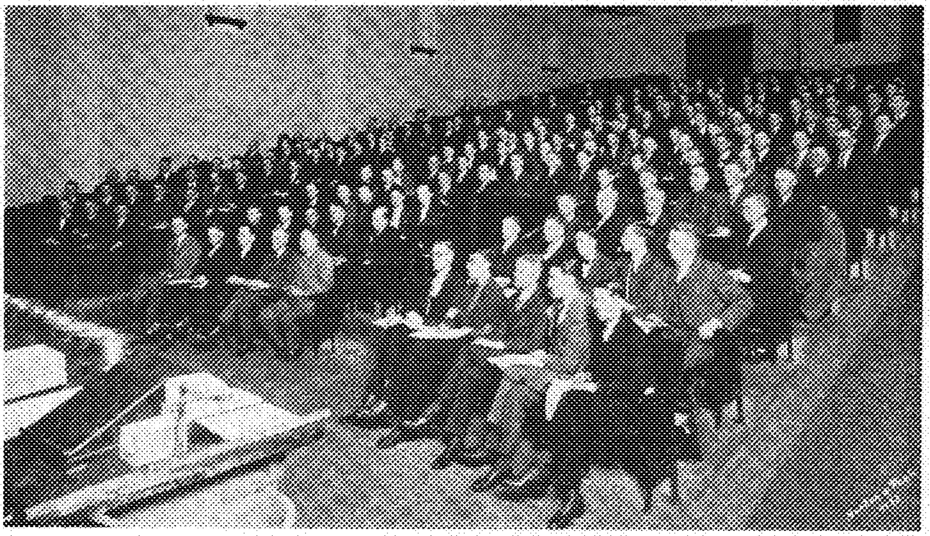
9XI Transmits 2 Messages In Esperanto To South America

Two messages, written in Esperanto, were transmitted to a station in Buenos Aires, Argentina, by the University's radio station 9XI recently, operators in charge of the set stated. The two radio telegrams were written by Prof. J. C. Sanderson of the School of Mines, prominent authority on Esperanto in the Northwest, and were addressed to friends in the foreign country.

As Esperanto is radically different from the context of ordinary messages, operators at the other end of the 6,000 air line asked for a repeat and after sending the message twice, it was successfully recorded. This is the first time in the history of local stations that a message in this tongue has been sent by radio.

Senior Engineers to Have Official Photographer

The Senior Engineers have appointed a committee consisting of Ed Young and Cliff Anderson to make arrangements for the senior pictures. Negotiations are being made with some of the best downtown photographers. One of these will be appointed as the official senior engineer photographer and work will be started soon so that the class of '26 may have their photographs placed in the Main Engineering Hall with the preceding classes.



A NIGHT CLASS IN CONCRETE DESIGN

Over 250 interested engineers, contractors, and builders as well as many students are attentively absorbing the latest methods of making concrete as given at the recent co-operative short course.

Design of Concrete Mixtures Is Popular Two Week's Course

A short course in design of concrete mixtures, for two weeks beginning January 18, with an evening class meeting four night a week, was offered as a co-operative course between the College of Engineering and Architecture, and the Portland Cement Association. It was conducted under the direction of Prof. M. B. Lagaard, of the University of Minnesota, and Frank S. Altman, District Engineer of the P. C. A. This course was offered primarily for architects, engineers, and contractors of the Twin Cities, but all interested were invited to attend the class, which was given free of charge.

About 250 men took advantage of the opportunity and registered for the course. The bulk of the instructing was done by J. W. Kelly of the Structural Materials Research Bureau, Lewis Institute, Chicago, assisted by L. M. Bergford of the Portland Cement Association, of Duluth. The course is based on work done by the American Society for Testing Materials, and its purpose is to give instruction in methods of designing the most economical concrete mixture for any particular purpose. Bulletins distributed by the P. C. A. are used as reference texts, and include "Design and Control of Concrete Mixtures," and "Standard Specifications and Tests for Concrete and Concrete Aggregates" as reprinted from A. S. T. M. standards.

F. R. McMillan Speaks

Professor F. R. McMillan, of the Lewis Institute, Chicago, addressed the Concrete School on "Water Ratio," January 18. This lecture constituted the first meeting of the short course in concrete which was offered by the University last month. Prof. McMillan's address was built about his statement that "the strength of concrete is dependent solely on the proportion of water to cement so long as the aggregates are clean and structurally sound." This law holds for any mix that is plastic and workable. The proportion of cement to the aggregates or the grading of the aggregates does not affect the strength of the concrete for a given water ratio if the above conditions are followed.

This lecture was especially interesting to anyone connected with the University of Minnesota in as much as Prof. McMillan spent 14 years here; five years as a student and nine years on the factulty as assistant professor in concrete after which he was succeeded by Prof. M. B. Lagaard. During the war, Prof. McMillan took charge of the testing of concrete ships for the Emergency Fleet Corporation. He made a test of the first large sea-going concrete ship in the world, the S. S. Faith, and later tested the first government ship, the U. S. S. Atlantis. His tests were made during launching, in service during storms at sea, and during dry-docking. These tests are in the form of measurement of stresses in the keel beam and other framing of the ship by use of strain gages. Several concrete ships were built, and although not as successful as expected, some few are still in coast-wise freight service. He also tested steel ships in France during the war.

Mr. McMillan became connected with the Structural Materials Research Labratory, Lewis Institute, in 1925, and is a nationally known authority on the water ratio, which theory was first introduced by Prof. D. A. Abrams in 1918.

Abrams Gives Address

The School was treated to an unexpected pleasure January 28, when Professor Duff A. Abrams, of Lewis Institute, Chicago, spoke to the class. Professor Abrams has been in charge of the Structural Materials Research Laboratory, Lewis Institute, since 1914, and probably knows more about concrete than any other living person.

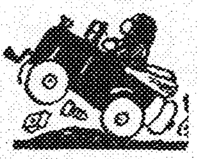
His address treated of methods of obtaining a good job of concrete, and he stressed particularly the importance of the water ratio in the design of a concrete mixture. He said that the two fundamentals of concrete are, first, the required strength, durability, etc., and, second, workability, and that engineers are just beginning to wake up to the fact that the secret of the strength of the resulting concrete lies in the problem of workabilty. It has been found entirely practicable to specify concrete mixtures on the basis of water ratio.

A test building was erected in Chicago under the supervision of the Structural Materials Research Laboratory, and the specification of the concrete mixture was made on the basis of water ratio with little or no attention paid to the grading of the aggregates except that the ratio of sand to coarse aggregate should be between one-half and one.

AROUND THE WORLD WITH OUR ALUMNI

Architects

'24—Olaf Fjelde, not content with merely being a member of the Department of Architecture of the University of Idaho, is active in a number of student activities. He was chairman of a committee which decided the merits of the decorations of the various fraternity houses at the recent Homecoming celebration and also was instrumental in bringing to that university an exhibit of modern paintings which attracted wide-spread attention.



'24—Chas. H. Hinman was married to Ruth M. Russell at Cleveland, Ohio, on October 28, 1925. They motored home in some pretty chilly weather, according to Mr. Hinman, who is working for C. W. and George L. Rapp, Architects, of Chicago. Mr. and Mrs. Hinman are at home at 502 Keeney street, Evanston, Illinois.

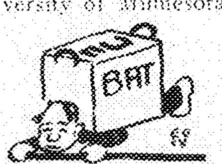
'25—Dean Rankine and Ferdinand J. Brimeyer are rooming together at 4838 West Madison street, Chicago, Ill. Brimeyer is with Joseph C. Llewellyn, architect, and Rankin is in the design department of the Concrete Engineering company of Chicago. Both men report that they are enjoying their work very much.

Chemists

'97—It is with extreme sadness that we record the death of Mrs. Herbert C. Hamilton, which occurred on November 29th at Detroit, Michigan. Mr. Hamilton is a chemist and pharmacologist with Parke, Davis and company of that city.

'02—Edgar W. Rice has a very sweet job judging from information we have received that he is chief chemist at the National Sugar Refinery at Yonkers, N. Y. He has had charge of all the chemical work much of the time in the past and now is in complete supervision. He is conducting separate investigation on the use of animal charcoal in the refining of sugar, concerning which little is known.

'22—Lester Stone, president of Phi Lambda Upsilon, honorary chemical society, took his final oral examination for a Ph. D. degree on January 29. Mr. Stone is an assistant in Chemistry at the University of Minnesota.



'25—Charles Johnson is making batteries his business now. He is working for the National Lead Battery company and is located at Kansas City, Kan. Now we can cuss Charles when the starter won't turn the engine over on a cold morning.

Civils

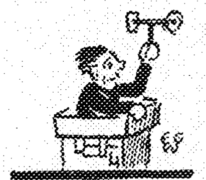
'89—Numbered among the Florida boosters we find Clarence Stanley Coe, who is located in the midst of the boom. He is County Engineer for Duval County at Jacksonville, Fla.

'04—R. C. Smith has been appointed chief engineer of the Minneapolis, Northfield and Southern railroad. Mr. Smith was in the engineering department of the Minneapolis and St. Louis road for 10 years.

'05—Franklin R. McMillan spoke on "Water Ratio" at the short course in concrete mixing given at the University of Minnesota during the latter part of January. Mr. McMillan is now with the Lewis Institute of Chicago, Ill., in the structural material research laboratory. Formerly he was at Minnesota for 14 years, being assistant professor in concrete. During the war he was engaged in the testing of concrete for the Emergency Fleet Corporation. He conducted tests of several large sea-going concrete ships for the Government. Mr. McMillan became connected with the Lewis Institute research laboratories in 1925, and is now a nationally known authority on the water ratio for concrete mixtures.

'07—L. E. Ashbaugh, who is hydraulic engineer for the J. G. White Engineering Corporation of New York, left for Mexico recently to make engineering investigations for his company.

'13, C. E. '14—Benjamin Wilk is in Chicago with the Universal Portland Cement company and is serving as the assistant western manager of the service bureau. Mr. Wilk is at present in charge of an investigation of wind stresses on chimneys which is being carried out in Duluth by the Universal Portland Cement company co-operating with the University of Wisconsin, the Army Air service, and the University of Minnesota. The investigation is expected to cover a period of about a year and when finished will give the most complete information on wind pressures yet available.



The chimney on which the investigation is being carried out is a 310 ft. structure of concrete; 170 ft. from the bottom, there are two trusses projecting 36 ft. from the chimney from which will be run pressure tubes to a central control board so that the pressure on the chimney and the pressure at points 30 ft. from the chimney can be measured simultaneously. McMillan strainographs will be used to record the stresses under high wind. Temperature readings will also be taken over the whole structure.

'22—H. B. Palmer is working for the U. S. Army engineers and not for the Wisconsin civil service as was stated in the December issue.

'24—Martin E. Nelson is working on concrete analysis and research at Alhambra, California, in connection with a test dam which will be built on Stevenson creek. This dam will be built for the sole purpose of experiment with the result that it will be tested to destruction. He is working with a Mr. Slater, formerly of the Bureau of Standards.

'24—Richard Dedic left the Northern States Power company last year and is now working as junior engineer for the United States Lake Survey. His address is Survey Office, Old Custom House, Detroit, Mich.

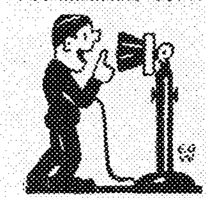
'25—George Cornell has left the Soo Line railroad and is now working in the bridge department of the Northern Pacific railroad.

'25—E. W. Nelson is working in the U. S. Army engineers' office at Grand Rapids, Mich.

'25—Neal Bartholomew, writing from Paducah, Ky., says, "The sunny South is all wrong. So far, it has rained every day." Bartholomew is working at Paducah, the town made famous as the birthplace of Irvin S. Cobb, in the construction department of the Illinois Central.

Electricals

'03—Barry Dibble is conducting a private practice of consulting engineering at Redlands, Calif., and writes that he will be very glad to see any Minnesotans who chance to come his way. He was formerly project manager for the United States reclamation service.



Ex '05—Since 1905, Max Ricker has been in the employ of the Northwestern Bell Telephone company, and is now being transferred from Waterloo, Iowa, where he was district traffic chief, to Fargo, North Dakota, where he will be superintendent of traffic for the state.

'09—We are always glad to hear from our alumni who graduated before most of us in school now knew that there was such a place as the University of Minnesota. Walter C. Beckjord sends a word of encouragement and says that he finds the Techno-Log very interesting. Mr. Beckjord is the chief engineer for the American Light & Traction company, New York City.

'11—Albert H. Mittag was married to Miss Sadie Randall early last October. Mittag is in the Consulting Engineering Department of the radio works of G. E. at Schenectady.

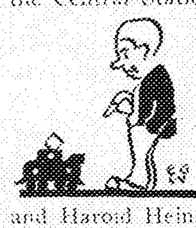
'23—Elmer Engstrom, after spending his Thanksgiving vacation at his home in St. Paul, left for Kahuka, Hawaiian Islands, where he will represent the G. E. company in the installation of a high power radio transmitter built by that firm for the Radio Corporation of America.

'23—P. N. Williams has finished his course in the General Electric Test Department and is now salesman in the Minneapolis office of the same company.

'23—F. W. Wilson, employed in the engineering department of the construction division of the General Electric company at Chicago, is stationed a month at the main offices in Schenectady in the interests of the engineering problems of the Chicago district.

'23—C. C. Schweiso is now a manufacturer's direct sales representative for radio and electrical appliances and is located at 237 Plymouth building, Minneapolis.

'25—O. H. Borchert spent a few days in the Twin Cities recently on his way home from Chicago where he has been attending the Central Station Institute.



'25—Hugo Hauft, Emil Steinert, A. McEwen, W. P. Koch, and Harold Heins are now with Westinghouse Electric and Manufacturing company at East Pittsburgh, Pa. Hugo Hauft and Harold Heins are going into electric railways, McEwen into industrial motors, and Steinert and Koch into research.

'25—Clement R. Tunnell was flying with the Naval Reserve at Hampton Roads this summer with Joe Meagher. He returned in early fall and was employed with the State Highway Commission until recently when he left for the Schenectady works of the General Electric company.

'25—Willard W. Wieland is now with the Ideal Electric Company at Mansfield, Ohio.

'25—A. D. McEwen is with Westinghouse at East Pittsburgh. His address is 431 South Avenue, Wilkinsburgh, Pa.

Electricals

'25—Carl C. Nelson is enrolled in graduate work in electrical engineering at the Massachusetts Institute of Technology, Cambridge, Mass.

'25—George Shavor and Sanford Bordeau are working for the Electric Machinery company of Minneapolis.

'25—Gaylord F. Gilman has left the Western Electric and is now with the American Bridge company working in the engineering department. His address is Riverside Hall, Gary, Indiana.

'25—Raymond H. Holmes is working in the distribution department of the Minnesota Power & Light company of Duluth.

'25—Raymond W. Keller has left the Curtis company of Chicago and is now in Minneapolis working for the Washburn-Crosby company.

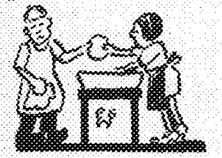
'25—Kenefick Robertson is in charge of the sub-station of the Northern States Power company at Centerville, South Dakota. He was a former editor of the Techno-Log. He writes that he will be glad to hear from any of his former classmates and that life is dull in a small town.

'25—The marriage of Robert Burlingame and Miss Alice Fiesler of Minneapolis has recently been announced. Bob was custodian of the electrical laboratories while in school and is now in the engineering department of the Northern States Power company.

'25—Harry Winslow is taking graduate work in the department of physics with the purpose in view of going into industrial research.

'25—Harold Heins is with the Westinghouse company at East Pittsburgh doing art work in their publicity department. He was art editor on the 1925 Gopher, and is a member of Pi Alpha, honorary art fraternity.

'25—Roy Franzen is with the Western Electric company at Chicago, Illinois.



'25—Charles J. Cosandey and Evelyn K Graber were married in Minneapolis on September 18, 1925. Mr. Cosandey has a fellowship in the electrical department of Iowa State College at Ames. Their home address is 218½ Hayward avenue, Ames.

'25—Clarence Thyberg and Einar Johnson are both employed by the Western Union company at Minneapolis in their engineering department.

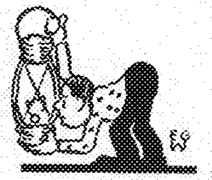
'25—Henry Reed and Ikel Benson, who received teaching fellowship in the Department Electrical Engineering last spring, are engaged in research relative to characteristics of synchronous motors and generators. Part of this work is being done in conjunction with the Electric Machinery company of Minneapolis.

Mechanicals

'11—Leo E. Owens perhaps has one of the most interesting and unusual occupations of any of the old '11 class. He is assistant machinery superintendent of the New York World, one of Gotham's largest papers. He can be reached in care of that concern at 63 Park Row. The supervision of machinery of a large printing plant is no small job and often work must be done at all hours that the wheels of the press are kept turning.

'20, ME. '21—G. L. Tuve, instructor in mechanical engineering is again on the teaching staff after one year's absence during which he was assistant professor of Steam Engineering at the University of Montana, Bozeman, Montana, in the absence of Professor Eric Therkelsen. He was in charge of the Heat Engines and Steam Power courses and of the mechanical laboratories. For the past two summers, Mr. Tuve was test engineer for the Public Service company of northern Illinois at Chicago. While in this employ, he had charge of tests on two 30,000 kw. turbo-alternators and other equipment recently added to the Waukegan and Joliet generating plants of the company.

'22—John S. D. Clark, who was for a while district methods man for the Northwestern Bell Telephone company, is now facility supervisor for that same company. He has changed his address, also, and is now living at 3846 Colfax avenue North, Minneapolis.



'22, M. E. '23—C. F. Olmstead has left his position as chief engineer of the Mahr Manufacturing company, Minneapolis, to become technologist for the American Association of Oil Burner Manufacturers. His present address is 350 Madison Ave., New York.

'22—The address of Ralph Hilgedick has been found. Address him at 73 Langford Park Place, St. Paul. He is a mechanical engineer with a large automobile concern in that city.

'23—Karl W. Keiser after taking post graduate work at Minnesota is now with the National Lead company at Brooklyn, New York.

'23—Glen M. Larson is very actively engaged in musical activities in the Twin Cities, appearing with several orchestras and bands. Last winter, he played a continuous engagement at the Lyceum theatre.

'24—Stanley B. Tuttle left the Fulton Iron Works company on August 15, 1925, and is now working in the experimental department of Fairbanks, Morse and company. His address is 629 Park avenue, Beloit, Wisconsin.

'25—Thomas Caswell is with the General Electric company at their Schenectady works.

'25—Russell E. Backstrom who was granted a fellowship in the experimental engineering department is working on a special problem of industrial research under the direction of Professor Fowley, director of the laboratory.

'25—Herman F. Beseler after completing his fall quarter of graduate work, is now with the Garter-Mayhew Manufacturing company of Minneapolis. Herman is in their design department and draws everything from threshing machines down, as that firm is one of the largest grain machinery firms in the northwest. He will be remembered as last year's co-managing editor of this publication, captain of the rifle team and a few other such sundry activities while at school.

'25—Leonard Hoisveen, former president of the technical commission, is now a sales engineer for Alan G. Cary of St. Paul, a dealer in mechanical equipment. His address is 432 Endicott Building.

'25—Folmar L. Bjerre who was with the Charles L. Pillsbury consulting company is now in the engineering department of Washburn-Crosby Milling company of Minneapolis.

Miners

'08—J. S. Peterson is in Los Angeles engaged in heating and ventilating engineering.

'19—Sidney A. Frellsen, a former faculty member of the department of drawing and descriptive geometry, is now a consulting engineer with offices at 1523 East Lake street, Minneapolis. One of his specialties is lot surveying and municipal platting.

'20—Jas. D. Wheeler is working for the Richmond Petroleum company, doing geological work in Barranquilla, Colombia, South America. At present he is mapping and reporting on the district following a study of oil conditions.

'21—F. J. Hamernik is at present employed in the metallurgical laboratory of the American Brass company at its Kenosha branch, Kenosha, Wisconsin.

'23—C. James Smith died last August at Coronado, California.

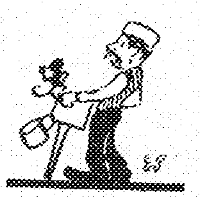
'23—Robert W. Persons is a sales engineer in the rock drill sales division of the Ingersoll-Rand company of New York City. His address is 11 Broadway.

'23—Donald H. Wolfer is a geological engineer for the Campbell Oil company of 111 Cambridge avenue, St. Paul.

'23—How his precious Sigma Xi key, which he was awarded during his senior year for original research, was lost in crossing an African stream was recently related to friends on the campus in letters from Henri LaTendresse. One day as he was going through a native village, he noticed a sparkle of gold among the oily locks of a native's wife and discovered upon closer investigation, that she had found the precious fraternity badge and had reshaped it into an ear-ring. Henri didn't mention, but we suppose, that this native still has the key on her aural member. LaTendresse's series of escapades read like a story book, but he is now with an English firm in Rhodesia engaged in geological survey. While on the campus, he was noted for his prowess as a heavy-weight boxer, winning several titles.

'23—Another miner who likes Minnesota too well to wander far away is Anthony Sjolander who is an engineer in the construction division of the Engineering Department of the Northern Pacific railroad. His address is St. Paul in care of that company.

'23—All mines graduates do not go to the ends of the earth as evidenced by John N. Searles who is complacently enjoying Minnesota sunshine as a highway engineer at Wabasha, Minnesota.



'23—Another Minnesotan in Africa's wilds is John L. Middleton who is prospecting for Societe Internationale Forestiere et Miniere du Congo which in other words means that he is on the lookout for gold, diamonds or anything else he sees in Belgian Congo.

'25—George A. Johnson is at the Maryland plant of the Bethlehem Steel company located at Sparrows Point, Maryland.

'25—Howard P. Sherman is engineer for the Stanley Mining company of Biwabik, Minn. Until the shipping season opens, he will be in the main offices at Duluth, Minn.

The
MINNESOTA TECHNO-LOG
University of Minnesota

WHAT details of instruction, what primary requisites are necessary in an English course as given to technical students? Is this study important enough to be included in the crowded four year curriculum of courses designed for engineers? These questions have long been a subject of discussion among educators, but the busy engineers have turned their backs to the more material side of training with the result that it is still unanswered.

First of all, the study of English, by that we mean, elementals of grammar, syntax, punctuation, instruction as to correct writing,—is obviously extremely important to all, and more so, if anything, to those who undertake a technical course. It is treason to be an American and yet not be able to use the language correctly in all its many and beautiful applications. Mathematics is the tool used by engineers when they talk to one another. By the use of English, the trade tells the whole outside world what they are doing. It is a common cry that the profession of engineering in general has not received its just recognition, that the "fat boy," who, behind his cigar, exploits the capital for a building venture, is fully acclaimed, and they who design the structure, making it safe for human travel, are shut out when public praise and commendation is due. This is true, or rather has been true in the past. How can this situation be bettered? We think that if every student receives such training as that which will teach him to express his own thoughts clearly either by writing or by speech, in a matter of a few years, the world will become aware of the fact that this profession is the one doing things, not the boys behind the mahogany tables. Such publicity must come from the trade itself—engineers must sing their own praises.

What procedure should be followed in the instruction of this all-important art? English is English, no matter if you are in a Christian mission in Japan or in Room 106 Main Engineering. However, the course must be specially considered and designed from that given to other students. A different student body is present, conditions of study, environment and attitude are different than from anywhere else. All freshman engineers dislike the study right off the bat. It is reminiscent to them of the days not so long ago in the red brick high school back home, when they spent laborious hours in creating sketchy fragments on "A Bowl of Pansies" or even perhaps "The Coming of Spring." And now, this selfsame thing confronts them.

A year's course in English cannot give training in fundamentals of grammar a complete survey of the literature of the world, and teach the pupil to express himself by writing. Perhaps it is not wise to lengthen the course—then what is the most important of these three? Instantly we say, the fundamentals of speech, and then the study of writing. All engineer's should have the knowledge of the best literature and be conversant with it, but this could be received by outside reading or by elective courses. The importance of fundaments is paramount. Most frosh come down to school sadly lacking in grammatical instruction. If these rough spots are not touched up at this time, more will go out into the world, as many are today, saying—"I want it bad," or "There isn't no thing like that."

If a graduate lacks the power of self-expression either in writing or as a speaker, he leaves school handicapped.

The rhetoric course has failed if it does not instill in every pupil the ability to record the thoughts of his brain on paper. Few if any of us will become writers, but every day opportunity is given where this ability would manifest itself to good advantage. In business letters, private correspondence, the writing of short news notes for a paper, even, perhaps, an article for a trade or technical journal—these are all times when the graduate will need his training in this line. We can learn to write only by writing. Theme writing should stimulate imagination—make a person think along new lines, teach to be observant of the things on every hand, create new thought, and instill perhaps a sense of alertness. Theme subjects should not on the extreme be fantastic nor foolish; we have seen some so grotesque and bizarre in their entirety as to have no reason whatsoever.

Technical writing is a further study that has been utterly neglected by the English Department. As a continuative and elective course, this specialized and highly applicable branch does not exist. Students are not that cupidious that they will clamor for a course like this, it must come from the department itself. We are fairly well acquainted with the teaching methods of the English Department of a large western university. Technical writing is one of the main features of that division at this institution and real results are forthcoming. Other technical colleges throughout the country have real live departments. This fact alone leads us to wonder why Minnesota has no such course. The enrollment would not be extremely large at any event. That cannot be expected but to a certain percentage in every class, this would prove helpful to bringing out in its full glory their latent power of self-expression. Some of us, perhaps, see the advantages of the art of writing. Should this be denied all?

And then about English instructors. No one seems to be overly anxious about this branch of pedagogy. However, it can be made whatever it is desired. Though men of letters, those engaged in instructing the supposedly "hard-boiled" specimens of modern day college youth, should be engineers in spirit. To fully understand their subjects, they should know the peculiar feeling of achievement when the first slipstick is purchased, how it feels to work a whole afternoon in an evil smelling shop or laboratory, how it is to carry nineteen hours of studies and sling hash at the same time. They must know the ancient and time honored traditions of St. Pat, what field day means, and the glories of Engineer's night at the Gayety. Then and only then will the department understand their subjects and be able to map out a line of study that will bring results.

It can never be done by Hawvaad men who know not the difference between a parabola and a monkey wrench. English and Engineers—always.

Across the Editor's Desk

East or West

Uppermost in the minds of every senior nowadays, as spring approaches and with it June and graduation, is the thoughts of what will we do. Shall it be the East, the West, Florida on the South, or perhaps Minnesota, and even the old home town. Engineering students should feel the concern that large industrial firms have in them, when they place special emphasis on gathering college men to their company, making a careful and extended search among the technical schools of the country. Other professions do not seek their employees this way, there are plenty of them and they come easy.

Most of us don't know whether to nor what to do. Spurred on with the thought that there is plenty of room at the top, we will make a choice after a while and then get out and see really how much we know and then cease to wonder why they don't pay more than a hundred per for a graduate engineer.

Anent Short Courses

We can never learn it all. This, though very obvious, should not be disheartening. Our ambitions should lead us to know just as darn much as we can—that's the point. A few weeks ago, a group of men gathered for a two week's evening school short course in the matters of the use of concrete. These were college graduates, professors, contractors, in fact everyone interested in this phase of the building trade. The tradesman who had not been beyond high school rubbed elbows with the college professor, they were one—all eager in learning something new.

Interdepartmentals

A word or two about inter-departmental courses. These should be very carefully gotten up so that the material presented will be of use to the student. For instance, an electrical, when taking his heat engines, wants to learn the general laws of thermo-dynamics, the various kinds of apparatus used in generating steam in central station work, and the like. When the civil comes over to the electrical department, before he leaves he should know among other things that if he ever builds a crane with the intent of lifting a body with large inertia, he should use a series wound direct current motor; if he wants a constant speed motor for his work, he should use a synchronous one. He must also learn the rudiments of alternating currents, the use of transformers, and the like. The courses must not be how to mend the family flat-iron—insert a fuse plug—type, and they cannot include the life history of Maxwell and Ohm. They should be an intensified orientation.

FACULTY SKETCHES

CHARLES A. MANN

CHEMIST, musician, royal prince of a good fellow—Dr. Charles A. Mann, head of the chemical engineering department of the University of Minnesota—these are synonymous. Again we find the subject of our sketch from a native state, this time from Milwaukee, Wisconsin, where Doc first drew breath away back in those days when that city had a name for something except being on Lake Michigan. He attended the grade and manual training high school of that city. At the early age of nine, his musical tendencies began to make themselves manifest. When he was but fourteen, he was a professional musician, playing trombone, viola and cello, and was active in high school and amateur orchestras. He played in the municipal band in Milwaukee as well as with other large aggregations, and was for three years connected with a symphony orchestra and a theatre orchestra, all before entering university.

With the intention of taking up electrical engineering, combined with a business course, he started at the University of Wisconsin in 1905. However, after a semester's work, he changed to the newly organized department of chemical engineering. His college career is punctuated with evidences of his scholastic and musical talents. He was a member of the university orchestra and band, belonged to the Engineer's Club, and was on the Art Committee of the "Badger," Wisconsin's year book. When a junior, he was elected into membership of Tau Beta Pi, and Phi Lambda Upsilon, honorary scholastic and chemical fraternities respectively. He also joined Alpha Chi Sigma, professional chemical fraternity. In his senior year, he became leader of the University band, and during the next eight years, this organization under his direction grew in membership from 30 pieces to two bands of 60 members each. They took a 65 day trip in 1915 to the Panama and San Diego Expositions, giving concerts throughout the West and covered more than 10,000 miles in their itinerary. During his college days, he played in theatre orchestras and also gave musical instruction to earn a livelihood.

In 1908, when a junior, the big event occurred. Miss Lillian E. Shorthill of Marshalltown, Iowa, became Mrs. Mann. He graduated in 1909 and returned to school as an assistant in the Pharmacy Department and to take graduate work, receiving his Master's degree two years later. During this time, he made Scabbard and Blade, military fraternity, and Sigma Xi, honorary research fraternity. He was a member of the Wisconsin National Guard for seven years as director of the First Regiment Band. In 1911, he became director of the University Symphony Orchestra. The same year he was made an instructor in chemical engineering and continued his work towards a Ph. D., which he received in 1915. During this time, he did consulting work for several Wisconsin industries and was connected with the Northern Chemical Engineering Laboratories. It was in 1916 he was called to Ames as associate professor to organize a chemical engineering course and to install the laboratory.

War times saw him engaged in sulphur resource investigation, and under his direction plants were installed to extract toluene from city gas for the making of T. N. T. He helped develop a 16-inch semi-steel gas shell at the Hart-Parr company at Charles City. He was also consulting chemical engineer for the Des Moines and Omaha Gas companies. In 1919, he came to Minnesota as associate professor of chemical engineering. A year later, he was made full professor and in another year head of the chemical engineering department. The course was re-shaped and laboratory re-equipped with the result that Minnesota's department was recently given ranking with the leading colleges in the country. Enrollment also took a big jump to 140.

Dr. Mann is a friend of the student and has interested himself with many of their affairs. He has been a faculty member of the Board of Directors of the Engineers Bookstore since its inception, was for several years a faculty adviser of this magazine, is a faculty advisor on the Chemists Student Council, as well as being a member of the symphony orchestra here. He is at present the district deputy of the Alpha Chi Sigma fraternity for the north central states.

Here's the Arabs Again

We understand that the Arab's, engineering men's dramatic club, held a meeting the other night and made some definite plans for its future existence. In the past, they have put on very creditable and distinctive performances, the "Blue God," "Requiqui," "Caliph of Colynos," "Mona Lizzie" are all startling examples of the latent talent that the erstwhile undemonstrative students possess. The stagecraft in these productions was marvelous, due to the efforts of those in the department of architecture, where the club first originated a few years ago. It would be a shame, in view of past performances, to let the idea and the club cease functioning. More than ever, there is ability in the student body, lying dormant, ready to be brought out by such an aggregation as this.

Those of more dramatic forwardness affiliate themselves with the more energetic clubs on the campus. Those whose inclinations lead them to do otherwise, are waiting for the next production. That it was an example of unfairness that the club should be penalized into having no production this year on account of a slight technicality which is overlooked many times in the other dramatic organizations, goes without saying. Meanwhile, Arabs, a purely product of the engineering colleges, marks time in their tents until another "Blue God," yea, even another "Mona Lizzie" will burst forth into being.

St. Patrick's Day

And now, the more lighter part of our discourse. It won't be long now until St. Pat's Day will be here. Freshmen, ask your advisor about this patron saint of the Knights of the Slide Rule. Who is he, where does he come from, where does he go? He's here all of the time in indomitable spirit and each year manifests himself on Engineer's Day. For a whole year we have been with our books. Again on this day, we will throw care to the four winds and show the whole world with particular reference to the University campus what Engineers are doing.

To Be or Not to Be—Chemical Warfare

(Continued from page 141)

who took such hasty and ill-advised action.

So much for the action of diplomats who have either ignored the advice of military and chemical experts or who have neglected to avail themselves of this very important source of information. Let us now consider the reports and opinions of technical men, military leaders, and far-seeing statesmen, who have given serious consideration to the possibility and advisability of prohibiting chemical warfare.

In considering this phase of the matter, it might be well to first mention the opinion regarding chemical warfare, which was expressed by General Pershing before the Congressional Military Affairs Committee, when the latter was considering the Army reorganization on November 5, 1919. The quotations below are taken from the Congressional records.

Senator Fletcher: "****Would it be safe for us to say that the use of poison gas is inhumane and that it will never be permitted again?"

General Pershing: "No; decidedly not; because we cannot trust the other fellow. ****I think we ought to go on with our investigations in the matter and encourage our chemists in every way."

Representative Green: "It is not more a question of sportsmanship****?"

General Pershing: "I cannot see very much difference myself in methods of killing."

Representative Hull: "General, what do you think about the use of poison gas in warfare?"

General Pershing: "I think it would be very well to avoid it, but we have tried it before and it did not work.**** We might come to an agreement not to use it and the other fellow might spring it on us some dark night."

As already mentioned the findings of the subcommittee on gas warfare at the Washington Conference were entirely disregarded by the main committee when the latter drew up its agreement. An endeavor was made at various times to obtain a copy of the report of this subcommittee which included among its members such eminent men as Edgar F. Smith, dean of American chemists, M. Mayer of France, and General Fries, head of the Chemical Warfare Service in this country. While it was apparent that the opinion of such able scientists and military men should be available to the general public, it was not until July, 1925, that "Industrial and Engineering Chemistry" was able to secure and publish a copy of the findings of this committee. The suppression of this report is typical of the opposition which the Chemical Warfare Service has encountered. The report is so concise and logical as to merit publication in full.

Washington Conference
Report of the Subcommittee on Poison Gas

After a careful study of the subject of chemical warfare, the Subcommittee on Poison Gas is of the opinion that any convention for regulating chemical warfare should take into account the following considerations:

(a) The Subcommittee does not at present see how to base a limitation of the use of poisonous gases on their physical, chemical, or physiological properties, and attention is drawn to the fact that many high explosives produce toxic gases that frequently cause death as do those termed chemical warfare gases.

(b) It is not possible to prohibit or supervise research in respect to such gases as are used in chemical warfare, and there is no possibility of being certain that all countries would abide by an agreement to communicate the results of their research.

(c) Owing to the enormous use of potential warfare gases in peace, it is impossible to take effective steps to prohibit production of these gases. Of the gases actually used in the World War several are extensively used in peace. These include such useful materials as chlorine, bromine, phosgene, chloropicrin, and hydrocyanic acid gas, with others which are likely to come into use at an early date. It would only be possible to restrict production of such gases by a universal international regulation of chemical industry and commerce, giving to each and all the nations the means to provide for its own needs, but no more.

(d) Chemical warfare gases which are not used in peace time have a chemical constitution akin to that of materials in common use. The result is that it would be possible during a period of strained relations to prevent a potential enemy, should he so desire, in spite of agreements and the threat of very severe penalties under international law, from manufacturing gas on a large scale only if limitations of the nature of those mentioned in the preceding paragraph were placed on peace industries, such as the dye industry.

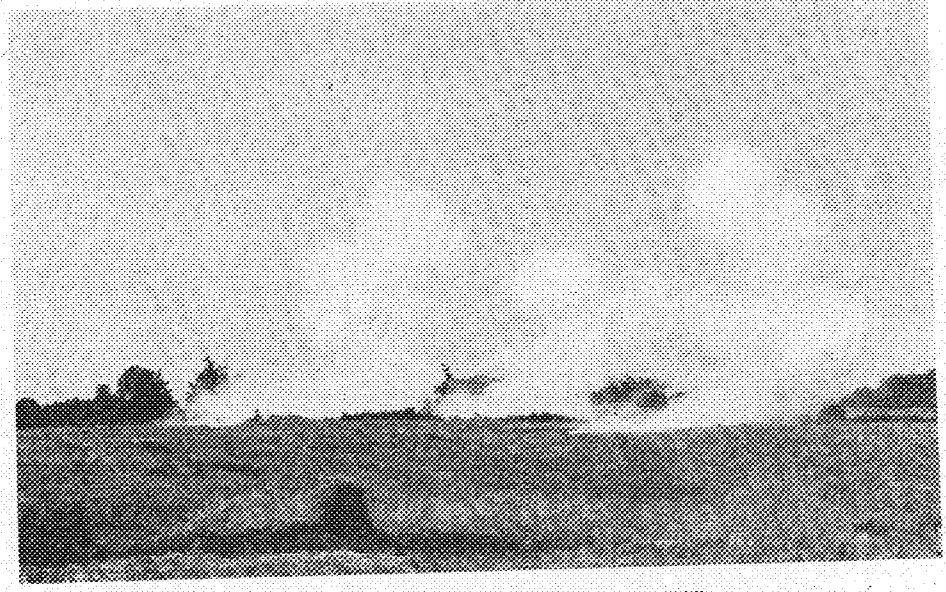
(e) Even if only one Power in the world refused to keep an international agreement to abstain from using poisonous gases on its declaration of war, the general agreement would automatically be nullified.

(f) The probable result of the employment of gas by an unscrupulous enemy, contrary to agreement and in the absence of a sufficiently severe penalty under international law, would be so serious that no country dare accept the risk of being found unprepared to meet it. In order to prepare gas masks it is essential to manufacture gas in order to discover the materials necessary for protection.

(g) Since many high explosives produce gases that injure in the same manner as warfare gases, limitations on the use of the latter would probably result in misunderstandings immediately on the outbreak of war.

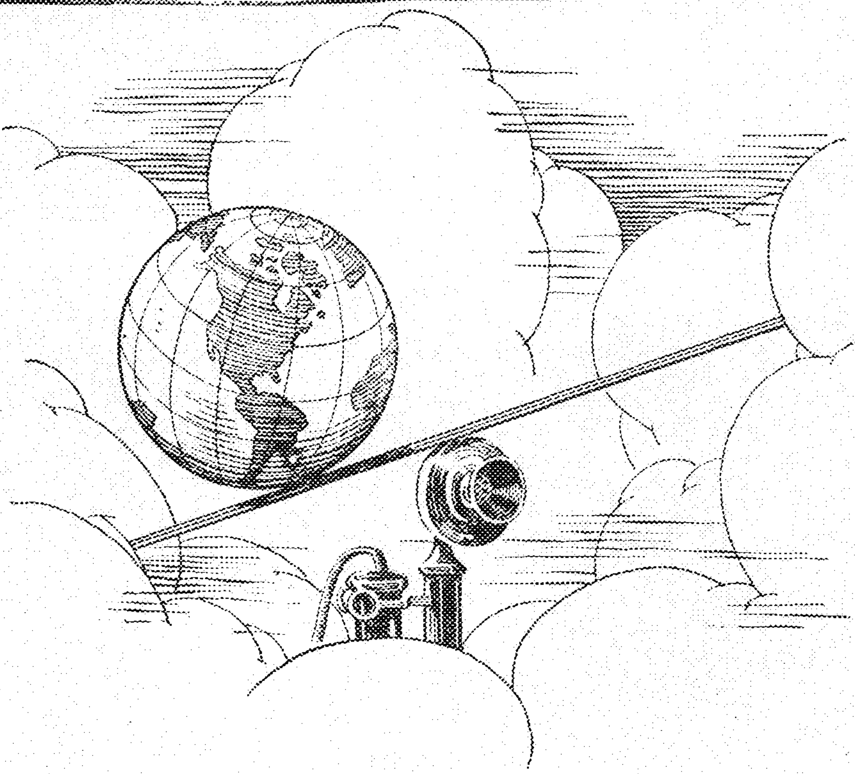
That the League of Nations realized the danger of any nation being lulled into a sense of false security by means of agreements prohibiting the use of chemical warfare is indicated by a report of the third committee to the third assembly in September, 1922. This report stated, among other things, that: "The Temporary Mixed Commission **** agreed that, although conventions forbidding the use of gas in time of war might have a great moral value, yet no

(Continued on page 162)



AN ATTACK ON A MACHINE GUN NEST

Clouds of strong oleum gas emanating from shells, cover the ground with a blanket of death and permeating every inch of the enemy's stronghold, bring death or a hasty retreat to the unprepared.



Minnesota Bridge Construction

(*Continued from page 145*)

the city council of Minneapolis in honor of the late F. W. Cappelan, who was city engineer when the bridge was begun.

In the city of Duluth, there is a unique bridge known as the Aerial or Ferry bridge, built across the entrance to Duluth harbor in 1904. It is said to be the only one of its kind in America. It was designed to meet special conditions, and has successfully done so, replacing a steam ferry which cost $11,000 a year for operation. This bridge has transported as many as 7,781 persons an hour. The length of truss is 393 ft. 9 in. The total weight of the carrier and car when the car is fully loaded is about 120 tons.

In the city of St. Paul there is also a notable bridge known as the High bridge over the Mississippi. This bridge is of steel construction of the tower and truss type. It is purely a highway bridge, and does not carry street car tracks. It is built on a four per cent grade. It has a roadway 24 ft. wide, and two eight-foot sidewalks. This bridge was partly wrecked by a tornado in the summer of 1904, but was repaired and is still in service.

There is now under construction in St. Paul a new bridge at Robert street over the Mississippi.[1] This replaces a steel through-truss bridge which was in a good state of preservation but too narrow to carry modern traffic. The old bridge had a roadway 33 ft. wide with a double-track street car line in the middle and two 10-ft. sidewalks. The new bridge will have a 56-ft. roadway and two 10-ft. sidewalks. It will be of reinforced concrete, except the main arch which is two-ribbed, will rise above the deck at midspan and will be structural steel enclosed in concrete. A temporary bridge provides for traffic while the new one is under construction.[2] The foundations will be carried on piling driven in the bed of the river and capped with concrete. No movable span will be required, as the bridge is to be high enough to permit navigation on the river.

Construction has begun on the piers for another reinforced concrete arch bridge over the Mississippi in Minneapolis at Cedar avenue. The work is being handled under the day labor system.

Another reinforced concrete bridge is under construction over the Minnesota river and the valley from Fort Snelling to Mendota. This bridge will be one of the largest reinforced concrete highway bridges in the world. It is 4,119 ft. long over all, 120 ft. high above the water, and the foundations are being sunk to bed rock at a depth of approximately 70 ft. below the water surface. The bridge is designed to carry a double-track street car line. The roadway will be 45 ft. wide with a 6-ft. sidewalk on either side of the roadway. The construction is two-ribbed arch with spans 304 ft. center to center of piers, and there are 12 full arch-spans, one three-quarter arch at the Mendota end and a short trestle approach at the Fort Snelling end. The floor of the bridge will be flat slab construction supported on columns from the arch-ribs. This bridge will form an important link in the highway system of Minnesota, and is a long needed improvement. The contract price is $1,870,000 for the bridge complete, or about $7.50 per square foot of deck area. This is a low cost considering the height of the bridge and the depth of foundations. Designs were made for both a steel-latticed truss bridge on concrete piers with reinforced concrete floor, and for the concrete arch bridge which is under construction. The concrete bridge, according to the bids received, will cost about $100,000 more than the steel bridge, but was preferred by Hennepin county and its selection approved by the state highway department.

Another reinforced concrete arch bridge, the "Ford Bridge," is being constructed over the Mississippi between 42nd street south in Minneapolis and Edsel avenue in St. Paul, just above the "High Dam." A cableway supported by movable towers carries form materials, sheet piling for the coffer-dams, and concrete out over the river to where they are being used.

The concrete plant, one of the best in the northwest, is built on the Minneapolis side of the river just at the foot of the cliffs. Materials are dumped from trucks into chutes at the top of the cliff and go by gravity flow directly into bins above the mixing drums. The mix is proportioned by weight in a hopper resting on the lever system of a large dial scale. From the drums, the mixed concrete is transported up by belt conveyor to the cableway bucket loading platform at the top of the bluff. It takes four minutes for the mix to be transported from the mixing drums to the forms in bed of the river.

The entire works are run with electric power supplied from two generators driven by Diesel engines.

When the steel arch bridge at Fort Snelling was built in 1907, a bid was submitted on a reinforced concrete arch bridge, and according to this bid the reinforced concrete bridge would have cost practically the same as the steel bridge. At that time the reinforced concrete bridge was not regarded with favor, and the steel bridge was built.

Minnesota Bridges have developed as those of the world, only during a shorter period of time. Materials used have changed rapidly; wooden trusses given way to steel and steel to concrete. Some say the limit of concrete spans is reached.

Some lessons can be learned from a study of the progress of bridge building in Minnesota which it may not be amiss to mention. It is apparent that the tendency in highway bridge design has been toward increased loads, increased width and toward the more permanent types of construction. The present highway bridge specifications of the state provide for a 20-ton tractor with 15 tons on the rear axle. The standard width of roadway was increased in 1915 from 16 ft. to 20 ft., and in 1924 to 24 ft. on secondary highways and 27 ft. on primary highways, except for high-truss steel bridges which hold to 24 ft. Pin-connected steel bridges have given way to riveted bridges. Steel bridges, because of the higher cost of maintenance, are giving way to reinforced concrete, where the cost of the reinforced concrete is not prohibitive. In England the early iron and steel bridges were riveted construction. The pin-connected bridges are coming into favor for some uses, whereas in America this tendency is reversed. It is well for bridge designers to keep this evolution in mind when planning new bridges, as it is reasonable to expect the future tendency of bridge requirements will be in the same direction as it has been in the past. Where the more permanent types of construction are used, probable future requirements must be carefully considered.

In so brief an article is is impossible to take up all types of bridges or even representative structures of all types. There are, for example, in the state movable-span bridges of different types such as swing, left and bascule and different varieties of these, some of which have been mentioned. It is not the writer's intention to overlook any bridges which may be regarded as mile stones of progress, and if he has done so he hopes to be forgiven.

The writer wishes to thank the Minnesota Historical Society, The Minnesota state highway department, Mr. J. Swan of Dakota county, and the city engineers of Duluth, St. Paul and Minneapolis for the assistance which they have so kindly given him in securing material for this paper.

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1 See Vol. IV, No. 7, page 9 of Minnesota Techno-Log for complete description.

2 See Vol. V, No. 6, page 9 for details.

To Be or Not to Be—Chemical Warfare

(*Continued from page 158*)

treaty stipulation could certainly prevent secret preparation for chemical warfare. There is only too much reason to fear, after the experience of the late war, that any country fighting for its life will avail itself of whatever weapon it may find it possible to use effectively. It is therefore necessary **** to anticipate that if another war breaks out, chemical weapons will be used."

It is also very interesting to note that the Temporary Mixed Commission of the League of Nations undertook a very thorough study of the problem and issued a lengthy report on July 30, 1924. The report, which was compiled by experts from France, Italy, Germany, Belgium, Denmark and the United States, was of course, ignored by the delegates who drew up the Geneva protocol several months later. The essence of the report is that preparation in chemical warfare is essential to all nations. The concluding sentence is worthy of being quoted.

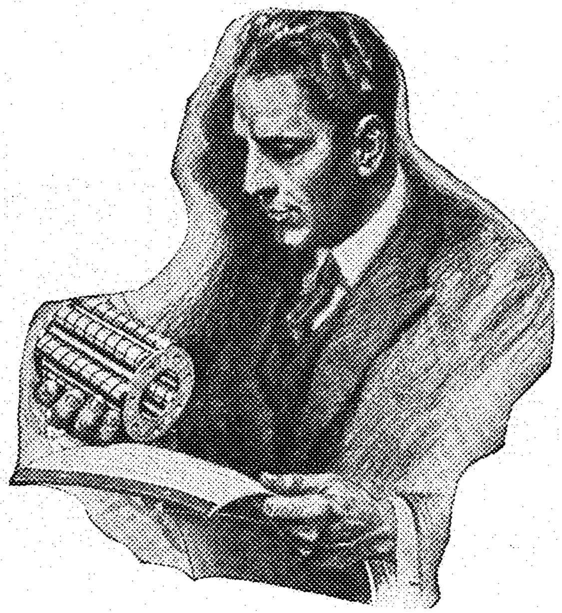
"Noting, therefore, on the one hand the ever increasing and varying machinery of science as applied to warfare, and, on the other, the vital danger to which a nation would expose itself if it were lulled into security by over-confidence in international treaties and conventions, suddenly to find itself defenseless against a new arm, it is, in the opinion of the commission, essential that all nations should realize to the full the terrible nature of the danger which threatens them."

This resume of the reaction of scientific, technical and military men towards the proposal to abolish chemical warfare may well be concluded by briefly mentioning the recent resolutions adopted by certain prominent national organizations. The American Legion at its Seventh Annual National Convention in October, 1925, expressed "its continued interest in the proper development of our Chemical Warfare Service," and deprecated "any movement to interfere with or handicap its present work and usefulness to our country." Shortly before this convention just mentioned, the American Chemical Society, in convention at Los Angeles, California, called attention to the fact that the Geneva Conference was without technical advice and consequently took hasty and ill-considered action. As a consequence of this fact, and in view of the report of the Chemical and Military experts at the Washington Conference, the American Chemical Society went on record as being strongly opposed to the ratification of the Geneva protocol on poisonous gases.

While many reasons tending to prove the unsoundness of any attempt at the prohibition of chemical warfare have been given in the preceding material, some of them may well be given special consideration.

Among the outstanding reasons for not abolishing chemical warfare is that, despite the very popular misconception to the contrary, this type of warfare is by far the *most humane* of all the modern methods. What could be a better indication of the relative humanity or inhumanity of a mode of warfare than that given by statistics regarding the dead and permanently injured? With the assumption that the ratio of total casualties to the deaths and permanent casualties is an accurate gauge of the relative humanity of the various types of warfare, let us investigate the statistics available on this subject.

(*Continued on page 160*)



Bill Stout and the All-Metal Airplane

(Continued from page 150)

Out of these experiments came the commercial thick wing all-metal airplane which is being used on airlines between Cleveland, Detroit, Chicago and New York today. This was built without reference to government contracts, government inspectors, government rules, government designers, etc., etc., as Stout relates perhaps with recollection to red-tape encountered while in the employ of the army.

One day, Edsel Ford discovered the commercial values of these planes and started a study of the subject. The quickness with which he grasped the possibilities of aviation from a commercial standpoint is reminiscent of his father's keenness in sending out new things of utility to the public, to use Mr. Stout's exact words. Ford's interests grew to the extent to taking over the entire company. Stout moved out to Dearborn where Ford built him a complete factory and cleared a large landing field, in short doing everything possible to further this phase of aviation, without any reference to immediate profit.

"The idea in doing this," says Mr. Stout, "is to find out just what aviation is good for, where it will fit into a program of service, and then to start quantity production and the installation of this service in a world-wide way."

The first move before the building of more planes of that type was the institution of actual airline service between Detroit, Chicago, and Cleveland, carrying Ford express and emergency matter between the branches.

These planes have now been in service for over 11 months without a single casualty of any kind, and have covered a distance of more than seven times around the world, with a regularity greater than the railroads between these same points. Only recently, papers of the northwest carried front page photographs of the all-metal machine, now identified solely with Ford, being put into service carrying mail between Detroit and New York. Prominent in the foreground was the postmaster of Detroit, other government officials as well as Henry Ford. Bill Stout didn't happen to be on the photo but his achievement spoke silently through the giant metal bird of the air in the background. The vast extent of the research work being undertaken at Dearborn for the Ford Motor company is not understood by ordinary industries who base themselves on a dollar basis. What does he mean by giving this fellow Stout a playground where he can fuss around with that metal machine of his? Maybe Ford remembers those days of experiment with his own gasoline buggy and the early hardships of an inventor.

The name of Ford is universal the world over as the man who popularized the small motor car for the masses. What will he do with the aviation and the metal airplane, the kind that does not crumple up in the air, the kind that can be made automatically in quantity production?

That it will become a commercial reality is not doubted. The skies of tomorrow will be dotted with planes, all-metal ones, carrying passengers and freight far and wide—all possible because one man—a minister's son, didn't quit when the first plane crashed, but used what he had and made one that flew—and interested Henry Ford. We are proud of Bill Stout, M '05, journalist, designer, engineer, promoter, but best of all, a real Minnesotan.

To Be or Not to Be—Chemical Warfare

(Continued from page 162)

From the Official Report of the Surgeon General of the Army for the year 1920, the following data is available regarding all army casualties in the war:

Died on the field of battle . 34,249
Wounded, admitted to hospital 224,089

Total casualties 258,338
Of the wounded admitted to hospital, totalling 224,089
the number suffering from gas alone was 70,552

leaving for all other weapons—bullets, shells, etc. . 153,537
Of those suffering from gas alone, totalling 70,552
there died in hospitals only 1,221
In percentage *less than 2% died.*
Of the total casualties (including deaths on field of battle and wounded admitted to hospital) 258,338
there were caused by weapons other than gas 187,586
Of there there died 46,449
Or in percentage *more than 24% died.*
While of those due to gas alone (including deaths on the field of battle) *less than 2% died.*

These figures go on to show that among the wounded that recovered there was eleven times as much blindness per thousand among those struck with bullets, shells, bombs and shrapnel as among those suffering from gas alone. The report further shows with regard to those left crippled through loss of extremities (legs or arms) or loss of their use, the following were from bullets, bombs, etc.

Loss of one or more extremities 4,428
Loss of flexibility in one or more joints 4,719

Total 9,147

Gas caused none of these disabilities.

Statements have been made that gas caused tuberculosis as an after effect. On page 103 of the report of the Surgeon General is found the following paragraph:

"One hundred and seventy-three cases of tuberculosis occurred during the year 1918 among the 70,552 men who had been gassed in action. The number of cases for each 1,000 men gassed was 2.45. The annual rate of occurrence for tuberculosis among all the enlisted men serving in Europe in 1918 was 3.50, and in 1919, 4.30 per 1,000****"

The above is a most remarkable showing. In brief, it proves that in the year 1918 there were 1.43 times as many cases of tuberculosis per 1,000 among all troops in France as there were among the gassed, and that in 1919 there were 1.75 times as many cases per 1,000 among all the troops as there were among the gassed troops. These figures show that gas actually prevented tuberculosis.

In order to ascertain whether or not there is any reason to suspect that any other after-effects might be expected to ensue as a result of gassing, the following action was taken by the Office of the Chief of the Chemical Warfare Service. 3,500 letters were sent to experienced physicians in this country and Europe. In addition, the Journal of the American Medical Association published a copy of the questionnaire that was sent out, and requested that physicians, who had not been communicated with but who were familiar with the subject, fill out the questionnaire and send it to the Office of the Chief of the Chemical Service. While there may be a few isolated cases to the contrary, the replies received show that the great majority of the physicians answering were of the opinion that there were no after-effects resulting from exposure to warfare gasses.

In this connection it should be mentioned that a gas wound, which is necessarily in contact with powerful chemicals, is absolutely sterile. The surface of the lung, throat or body is, therefore, in the very condition that the surgeon struggles to obtain before he performs an operation. That, however, does not preclude the possibility of a burn from mustard gas becoming infected later, but the danger of such infection is less than in the case of a bullet wound, a scratch by a nail, or a bite by a mosquito.

Another reason for believing that chemical warfare should remain is that it goes hand in hand with the scientific advance which is the pride of the modern age. Why should we praise our scientific methods in everything else while attemptingg to limit our soldiers to the use of tactics which ignore the latest scientific developments? No ar-

(Continued on page 170)

Shall We Enter the Utility Business?

(Continued from page 147)

If the "action" were slow, it would be slowest in the largest companies. Circumstance has placed me, at least temporarily, in a position to observe much that is taking place in one large company, and things happen with a rapidity that leaves nothing to be desired. It seems sometimes as though every department, even every individual, in addition to turning out the daily work, is working on a pet idea, or is dogging the heels of some manufacturer who has one. Soon it shows in a new efficiency record, a new or better application of electric service, new apparatus, new methods, new plans. The utility business is anything but standardized. Its methods and its machines are changing continually, as they have since the industry began.

To calmer souls all this would no doubt be taken as a matter of course. To me it is the source of positive thrills that are more vivid and effective than any of the artificial type. This is real; it is doing a most necessary thing in a big way, for thousands—millions—of people. It is giving greater leisure, comfort, pleasure, and finer things to all of these. One is proud to be a part of it.

It seems pertinent to mention here that utilities, individually and through their national and regional associations, are endeavoring to co-operate with engineering schools by the establishment of special utility courses, by aiding in the selection of proper electives, and by giving opportunity for practical work on the job for both students and instructors.

Several large companies have training courses for engineering graduates, in which they are assigned for certain periods to different departments. Instruction classes, lectures by company officials, and inspection trips are often included. The value of these training courses to both the graduate and to the company is apparent.

Then many persons, after being with a larger utility concern for a time, may elect to go with a smaller company. The experience gained in the large organization will be of immediate value in his work and will probably aid in the future development of the smaller company.

The day of the typical small town electric light plant is definitely passing. In the more densely populated sections of the country, it is already past. Towns which once had only dusk to midnight service, of questionable reliability, now receive full 24 hours service over transmission lines and very likely at lower rates.

The trend towards interconnection means better and more economical service for the customer. It need not mean consolidation under one management. Interchange power contract and power agreements are being worked out even by rival organizations because they increase the security of service and lower the reserve capacity required. Since the trend is toward larger systems, it is always wise for the young engineer to obtain his experience in the largest company in which he can find satisfactory opportunity.

The sole distinction I achieved at school was of being one of the last group to graduate under the old general course in engineering. From this distance, and since it is now probably forgotten, I feel free to comment on it. As I remember, the first two years were the same as other engineering courses; the third year was half elective, and the fourth year all elective. Too many scheming young technicians used this liberty to take on a number of "snap" courses, thereby permitting them to do justice to their more important social and athletic affairs, and still get an honorable discharge. This opinion may not be authentic, but I believe it is what caused the discontinuance of the general course. One must have some standards.

The plans which superceded the general course were probably designed to achieve the same result in a better way, and it is to be hoped they succeeded. The cause is a worthy one. It seems to me that there was then too much incentive for an engineer to take specialized technical courses which he individually was unlikely to use or need, and there was too little incentive and guidance in the selection of suitable general or commerce courses.

By going "general" I took all but two of the required electrical courses, and in addition got accounting, business law, public speaking, and business finance, not to mention astronomy. We took accounting with the commerce students without the pre-requisites I hope they had. I remember it as the meanest course of my four years, and among the most interesting.

All of which is to say that these non-technical courses have proved valuable. The graduate coming into the utility business will certainly not regret having taken any or all of them, and others, in addition to central stations, transmission, and other technical courses having a direct bearing on electric light and power. I suppose astronomy could be omitted, as all wide-awake students take a certain amount of that.

If I am allowed one suggestion to engineering graduates, it is that once they are on the job they forget they ever saw a college. I regard it as a matter to be discussed only on direct questioning, not to be introduced as a subject of conversation, and never to be offered in support of an idea or a statement. The percentage of college men in business is not large, and diplomacy is a desirable trait. The sort of man one is, and the kind of work one turns out, have much more weight than one's degree, family tree, etc. Because one is proud of his school, or his training, is no reason for talking over-much about it; it should show in him and his work.

The recent graduate is usually annoyed by the prospect of putting in a few years getting experience, at the end of which time, he is told, he will be ready to begin the climb to success. The value of experience is something one is not likely to absorb at college, but in the course of a year or so of work one gently becomes convinced that there is a great deal he doesn't know; that these old timers are not all narrow and seedy; that things might not be perfect if he were boss. There is an alternation in frame of mind that occurs in all of us, that none of us foresee, that does no damage, and which must be what these men mean when they talk about "a year or two" of experience.

In preparing this article I have purposely avoided searching for material written along similar lines. It may not be accurate, but it is original. It also seemed unnecessary to describe in detail the functions of various departments, even if space permitted. In recommending the large company I have omitted, as a "rubber stamp," the advantages of observing and associating with men that have become leaders in their chosen field. To me this is important; to some it is merely sales talk. Statistics and graphs, of which the utility business boasts a plenty, are also omitted purposely.

In order that this story may not, in its enthusiasm, have the appearance of propaganda made to order because it would be well if something good was said, I want to include this personal material.

My father started a small town electric light plant in 1909. He has owned three small properties, two of which he built complete. I was "apprentice" in the utility business at that time; have been in it since, and expect to remain in it permanently.

I do not think there is any other business in the world in which one man can serve so many, so well; in which he can take greater pride, and get more of what men live for.

INDUSTRIAL BUILDINGS SHOULD BE WELL LIGHTED.

From the employer's viewpoint, the big difference between men who work out of doors and those who perform tasks inside the building, is the factor of light. Daylight furnishes sufficient illumination outside during the daytime working hours for men to pursue their tasks efficiently and safely. But the proposition of getting enough daylight into the interior of industrial buildings, requires some thought.

It is not a difficult problem by any means, and any employer can take advantage of daylight and utilize it for lighting his building during the daytime, if he desires. It is an excellent light, especially suitable for the eyes, reducing eye strain and eye weariness to a minimum, and has the great economic advantage of costing nothing.

To utilize daylight to the utmost, we must first provide means for allowing daylight rays to enter the interior of buildings in sufficient quantity—namely, proper and adequate windows and skylights. Many excellent instances of buildings designed with a due regard to the importance of daylight lighting can now be seen in many of our industrial cities. Such buildings present the appearance of being practically all windows—"window walled," as they are termed—and this type of daylight construction is coming rapidly into favor, because it constitutes a more healthy building for large numbers of employes, both from the lighting and ventilation standpoints.

Among those who have constructed this type of modern industrial building may be mentioned: The Shredded Wheat Co., Gillette Safety Razor Co., Lyon & Healy Piano Co., H. J. Heinz Co., Corona Typewriter Co., Skinners Macaroni Co., Grape Juice Co., Dodge Bros., Nelson Valve Co., Piston Ring Co., Remington Arms Co., and a great many others.

The Larkin Co., Philadelphia, has erected a building almost entirely glass, 85% being windows, and the Loomis Breaker, operated by the D. L. & W. R. R. Co., Nanticoke, Pa., is literally a glass house, being 93.5% of glass. The new buildings of the Winchester Repeating Arms Co. have an average glass area of 58%.

An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 57.5%.

These figures indicate how important the subject of lighting is now considered by employers of industrial labor, and how well the idea has been carried out by the architects and engineers, in order that all parts of a building may receive sufficient daylight. But, in addition to providing ample window space, there is another factor which is equally important, and that is, equipping the windows with the proper glass.

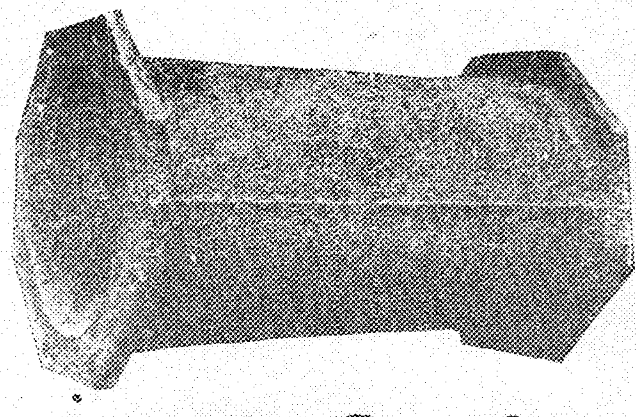
The bright direct rays of the sun should not be permitted to strike the eye, and we must provide a means for reducing the glare to rays which will not be too bright. This is accomplished by glass especially manufactured for industrial windows, known as Factrolite. This glass possesses the property of breaking up the intense rays of the sun and diffusing the light into the interior of the building in proper portions, solving the problem of sun glare.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.

220 Fifth Avenue,

St. Louis. New York. Chicago.



Still in Service After 250 Years

A HUNDRED years before Napoleon was born, before his wars scourged Europe, before the French Revolution raged, this Cast Iron Pipe was laid, in the reign of Louis XIV, to supply water to the fountains of Versailles.

To the patient researches of M. Blanc, Chief Inspector of the Water Service of Versailles and Marly, into dust-covered volumes in the garrets of the Palace of Versailles, we owe the proof of its antiquity.

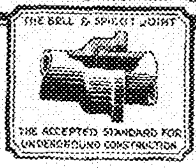
A report from the Director of the Water Service, M. Blanc's chief, says: "From their actual state of preservation, which is excellent, excepting the assembly iron bolts, these conduits seem to be able to furnish service for a very considerable time longer."

The high resistance of this Cast Iron Pipe to corrosion may be judged from the clearness of the fine "parting line" produced by the old horizontal method of casting.

THE CAST IRON PIPE PUBLICITY BUREAU
Peoples Gas Building, 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

To Be or Not to Be—Chemical Warfare

(Continued from page 166)

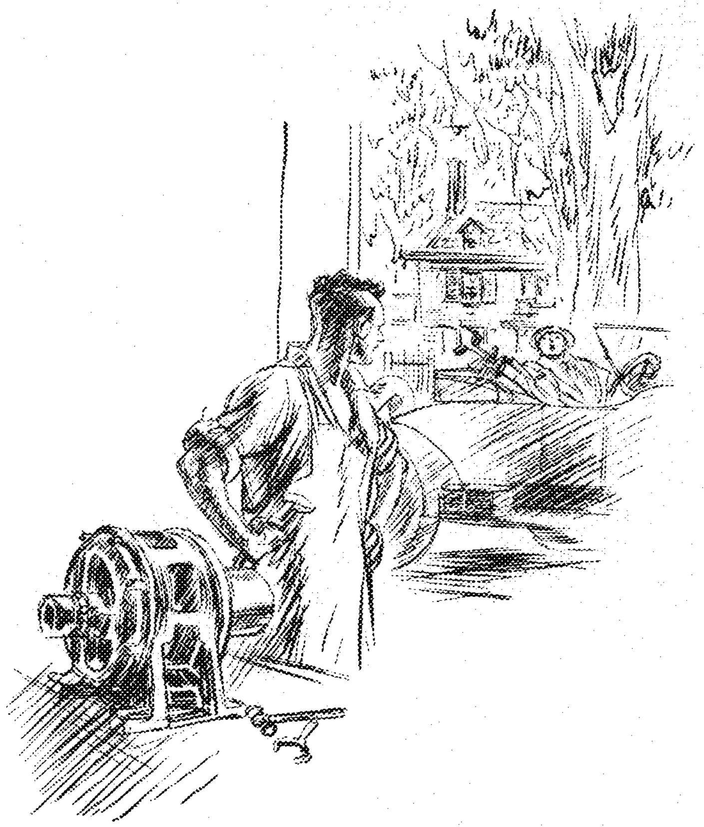
tempt in all history to outlaw an efficient weapon of war has ever been successful. The same outcry was raised against the introduction of gunpowder as is raised against chemical agents today. Yet gunpowder continued to be used and at the present time has no sentimental opposition to overcome.

Probably the most important reason of all for maintaining an active interest in a knowledge of chemical warfare lies in the danger to which any nation will expose itself by not doing so. Warfare gasses have such extensive industrial uses, can be manufactured relatively so cheaply, and are so closely associated with other peacetime chemical activities that enormous quantities will always be available for war purposes by any nation having a well developed chemical industry. Since warfare gasses are readily applicable to every form of warfare, whether on land, in the air, or on the water, the danger of a deadly surprise attack will always exist unless every nation recognizes that gas warfare is a perfectly proper method of warfare, and treats it accordingly.

In conclusion, it may be stated that, while the abolition of warfare in general may well be the laudible aim of everyone, the prohibition of one cheap, effective and humane weapon as the consequence of an antagonistic wartime propaganda is far from laudable. As long as war is still a possibility it is inexcusably dangerous to allow it to be possible for our nation to become a victim of an unscrupulous enemy who might fail to remember his promise to abstain from the use of chemical agents. It is most certainly to be hoped that the present Senate will be thoroughly cognizant of this danger when it is called upon to take action on the question of ratifying the Geneva protocol.

The question is sometimes asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents? Or are they forced into narrow grooves?

This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came with the Westinghouse Company within the past ten years, after graduation.



One Man's Summer Vacation

W. C. Goodwin

HAVE you ever seen a man dash out from a crowd along a busy street, stop a runaway team, and save many from danger? That wins newspaper headlines.

But it is only two horses—and it happens once in a blue moon. Every hour in industry horsepower up into the millions is tamed to man's control. Runaway apparatus is instantly checked. Electric controllers protect operators and the public. They safeguard motor and machine.

Thereby hangs a story of control development, involving W. C. Goodwin, Penn State 1915. Goodwin spent his summer vacations tinkering with rotating apparatus—testing motors and the like. He came to Westinghouse. Control Engineering was a magnet for Goodwin, even during his training period. When the separate Control Engineering Department was formed in 1917 Goodwin was in it. Next he was made engineer in charge of the section to design and develop new control equipment. Now he has nine assistants.

The Control Engineer may be called upon, as Goodwin was, to meet such an emergency as this: The war was on. Battleships were to be propelled by electricity. Upon the starting, reversing or stopping of the main propulsion motors without the loss of a second, the fate of the ship might depend. Goodwin designed control to do that.

Or in industrial application, the Control Engineer may add to human safety, as Goodwin did. In rubber mills, hands of operators sometimes are caught between powerful rollers. A fraction of a second may mean an arm—or a life. Goodwin's new combination control apparatus has greatly reduced the time in stopping the motor.

Control Engineers must know the industry with which they are dealing—steel, rubber, textile, railroad—and then literally "fit the control to each order." In seeing the job through the customer's eyes—Control Engineers find themselves most at home with Westinghouse.

Westinghouse

The Lund Press, Inc., 416 Eighth Ave. So., Minneapolis

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges
of the University of Minnesota

MARCH
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VOL. VI. MINNEAPOLIS, MINN. NO. 6.

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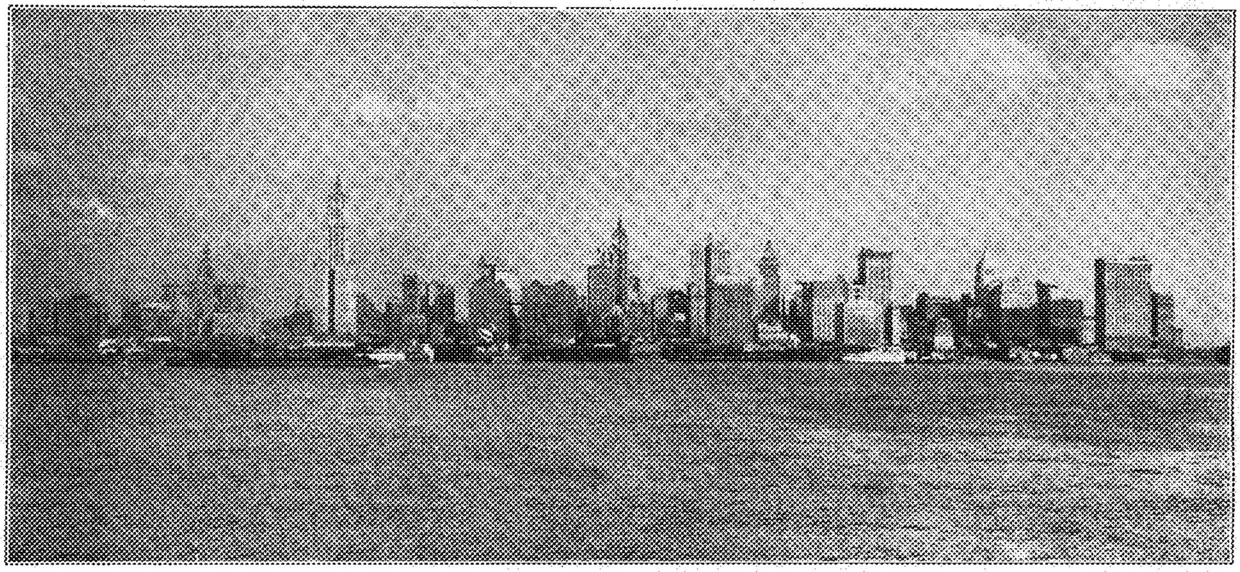


FROM FANCY TO FACT

In the "Manchester Guardian," one of England's most famous newspapers, there has been a series of American sketches written by a travelling correspondent. His awe at New York's "giant skyscrapers" seems even to have surpassed the wonder which most Europeans feel when they first gaze upon that skyline. "But," he continues, "the electric lift made the skyscraper a fact."

In these words he has expressed very tersely a truth which many of us have come to take for granted. Nothing could be more fantastic than the sight of those mighty towers climbing up through the many-colored mists of the great city; nothing could be more dream-like. And yet, nothing could be more useless were it not for the thousands of Otis Elevators which are busily plying within those high walls.

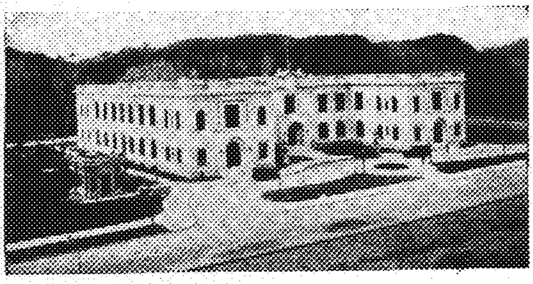
The skill of architects and engineers has created a vision, a mirage wilder than any of the "cloud-capt towers" of fancy. But the Otis Elevator has made the skyscraper a fact.

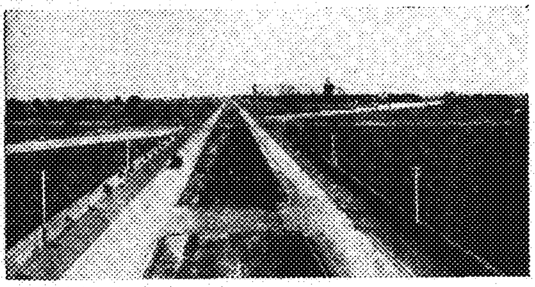
There are over 17,000 Otis Elevators operating in New York City, ranging from the lowly hand-power elevator to the 800 ft. speed automatic signal control elevator for intensive office building service. All elevators in New York carry more passengers per day than the combined subway, elevated and surface car lines, amounting to ten million people per day.

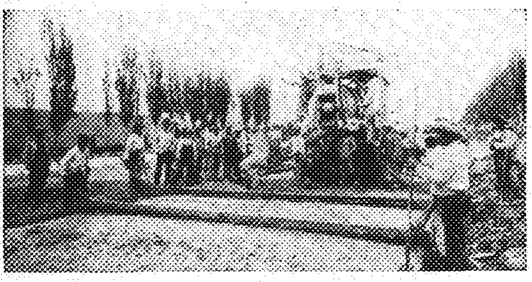
OTIS ELEVATOR COMPANY

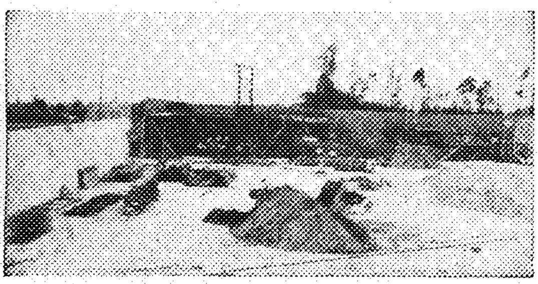
Offices in all Principal Cities of the World

The Incas would not know the Peru of today









Construction activities of The Foundation Company in Peru are changing the old order. The layout for the modernization of Lima, Cuzco and thirty other cities is comprehensive and has been carefully planned with this progressive republic.

The Office Building of the Ministry of Public Works would do credit to any community. It represents the public interest in facilities for efficiency in government. Thirty new public schools will be the equal of those of any country.

Highways and Streets are being paved to meet the needs of motor traffic in the cities and between them. Asphalt or concrete are used depending on location and necessity. This familiar looking paver is only a part of the modern equipment seen in Peru.

The New Water Supply System—including underground collecting galleries high in the hills, concrete reservoirs, and conduits of concrete or iron—will soon supplant the well constructed, but entirely inadequate, vitrified clay pipes of the ancients. Sewers and Disposal Plants will guarantee the health of the people.

The modernizing of Peru is a typical construction project of this organization.

THE FOUNDATION COMPANY

CITY OF NEW YORK

Office Buildings · Industrial Plants · Warehouses · Railroads and Terminals · Foundations
Underpinning · Filtration and Sewage Plants · Hydro-Electric Developments · Power Houses
Highways · River and Harbor Developments · Bridges and Bridge Piers · Mine Shafts and Tunnels

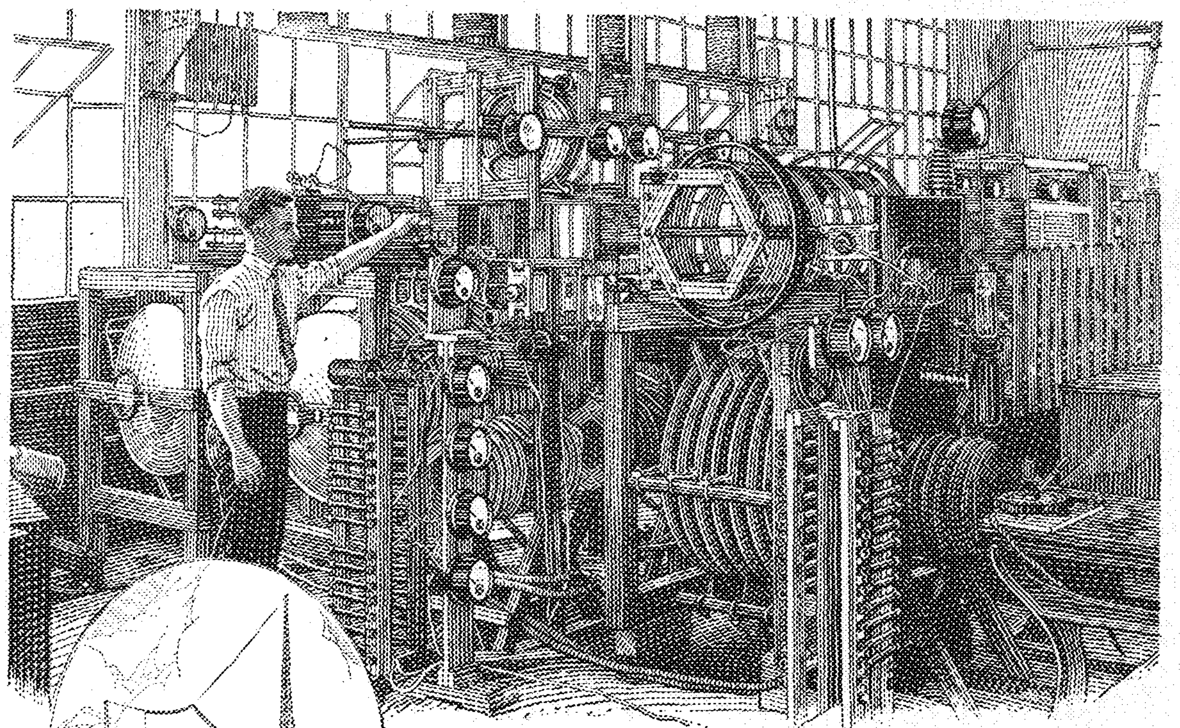
ATLANTA
PITTSBURGH
CHICAGO

SAN FRANCISCO
LOS ANGELES
MONTREAL, CANADA

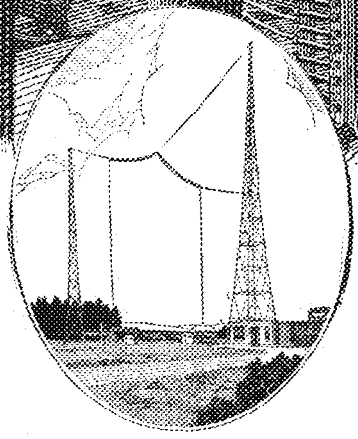
MEXICO CITY
LIMA, PERU
CARTAGENA, COLOMBIA

LONDON, ENGLAND
BRUSSELS, BELGIUM
TOKYO, JAPAN

BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES



One of the power amplifier stages of the world's first super-power transmitter



Antenna of super-power transmitter

The World's Loudest Voice

On the rolling plains of South Schenectady, in several scattered buildings, is a vast laboratory for studying radio broadcasting problems. Gathered here are many kinds and sizes of transmitters, from the short-wave and low-power sets to the giant super-power unit with a 50- to 250-kilowatt voice.

Super-power and simultaneous broadcasting on several wave lengths from the same station are among the startling later-day developments in radio. And even with hundreds of broadcasting stations daily on the air throughout the land, these latest developments stand for still better service to millions of listeners.

Only five years old, yet radio broadcasting has developed from a laboratory experiment into a mighty industry. And alert, keen young men have reaped the rewards.

But history repeats itself. Other electrical developments will continue to appear. And it will be the college man, with broad vision and trained mind, who will be ready to serve and succeed.

From the studio of WGY in Schenectady, six miles from the developmental station, there may be controlled a great number of transmitters, one of which is the first super-power transmitter in the world.

WGY, together with its associates, KOA of Denver and KGO of Oakland, is the General Electric Company's assurance to the American public that radio broadcasting shall be maintained upon the highest standards.

A new series of G-E advertisements showing what electricity is doing in many fields will be sent on request. Ask for booklet GEK-1.

95-190DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

VOLUME VI. MINNEAPOLIS, MINN., MARCH, 1926 NUMBER 6

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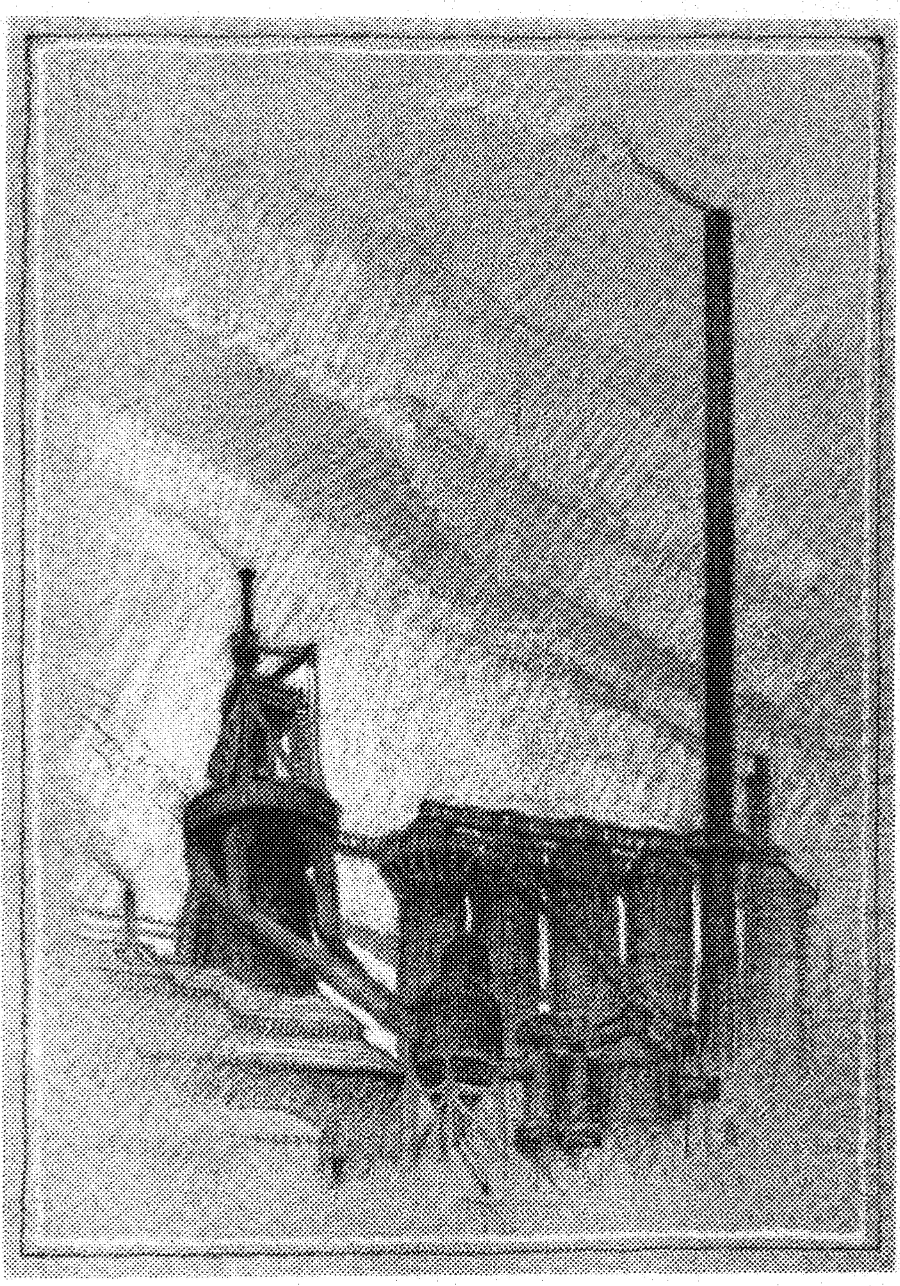


From the mighty and towering furnace flows the thread of steel to weave the web of industry.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI | MARCH 1926 | Number 6

The Graduate in Industry

Training course with large company gives opportunity for young engineer to select field of endeavor for which he is best fitted

By EMERSON B. ROBERTS
Educational Department, Westinghouse Electric and Manufacture Company

THE decision to go to college and pursue an engineering course is an exceedingly important one in the life of any young man making it. Recent investigations of engineering education show that it is generally contemplated throughout at least the latter years of high-school training. The writer, out of some years of intimate contact with a considerable number of college graduates, and with the records of interviews with over a thousand young Americans approaching the end of their senior year's work in our colleges before him, believes that more important is the decision as to *what to do with an engineering education* after it has been gotten. He has frequently told engineering classes before which he has been invited to talk that it is his opinion that that man in a particular class who stands middle or thereabouts in his group, but who carefully studies the field to be entered and elects work the requirements of which are consistent with his tastes and aptitudes, will go further in accomplishments and attain greater happiness than the honor man of the class who fails to make a decision as to type of work on the basis of a careful self-analysis.

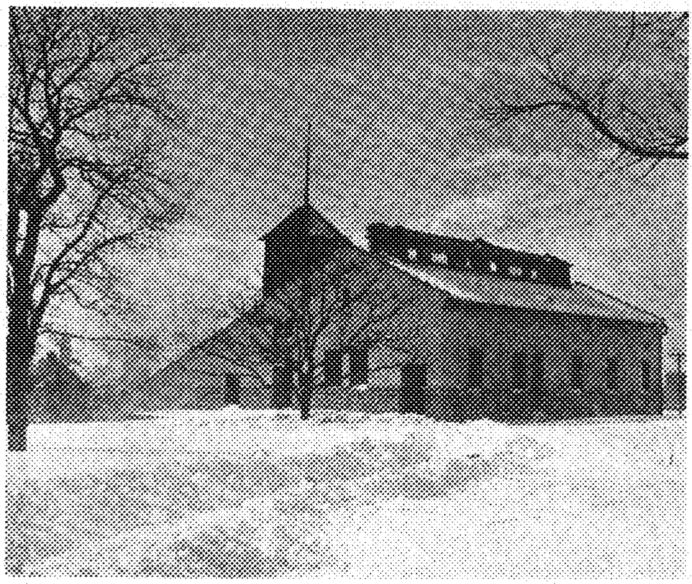
It is highly important that those representatives of industry who annually visit colleges with a view to interesting seniors in this or that work have a clear conception of their opportunities and responsibilities. The same investigation referred to above shows that a surprisingly large number of graduates have secured their first jobs on the basis of these interviews and contacts. The men to whom this work is entrusted should be of broad gauge and with a conception of engineering and industry transcending the particular company with which they are associated. A great damage may be done in urging a certain action on the individual. Often a great service is to be done in urging an applicant toward another line of endeavor than that which the interviewer, perhaps, represents. Engineering deans, and other prominent educational executives with whom the writer has had contact, seem to feel that a great improvement is to be noted in respect to the way this work has developed during the last few years. It is not now at all uncommon to find industries sending out to the colleges to interview students high-calibered men — chief engineers, directors of engineering, sales managers, district superintendents, directors of personnel, educational managers, etc.

> *"What is the problem confronting the college man which makes his decision as to how to use his engineering education so important? Not to go with this company or that company, this railroad or that one, this public utility or that utility, but how to get into that field where his usefulness will be the greatest, and where, by virtue of his own tastes, inherent or acquired, nature intended him to be."*
>
> *This is the answer to the obvious question that is uppermost in every senior's mind this part of the year. We are very glad to present this extremely vital as well as interesting story written by one who knows college graduates from A to Z. It is the fifth of a series of articles dealing with opportunities in the various fields of endeavor.* —THE EDITOR.

Essential as a point of contact with the student is a spirit of helpfulness on the part of the interviewer. Notwithstanding all that has been said to the contrary, the attitude of the great majority of college seniors is good. A few exceptions coming before those of not too broad a contact have tended to condemn the whole group. The writer, during the spring, visited approximately forty American colleges, pretty well distributed geographically, and at each he was privileged to talk with not less than 90 per cent of the individual members of the senior classes in electrical and in mechanical engineering. The great majority of these young men recognize their need of experience, of contact with men, and the necessity of beginning their lifework at the bottom and building slowly from a solid foundation. He has not found money to be the uppermost thought in their minds. What they ask is an opportunity to come into an industry and learn the business; to get their feet on solid ground; to gain contacts with the various fields of activity embraced in the industry they enter before making a decision as to where they fit best and where they will permanently go. "Is there a fair chance to gain promotion as it is earned, and is there an opportunity to take on additional responsibilities as I become able to carry them?" is an almost universal inquiry. The representatives of industry must meet the sincerity of the engineering college senior with the tender of a real service of helpfulness.

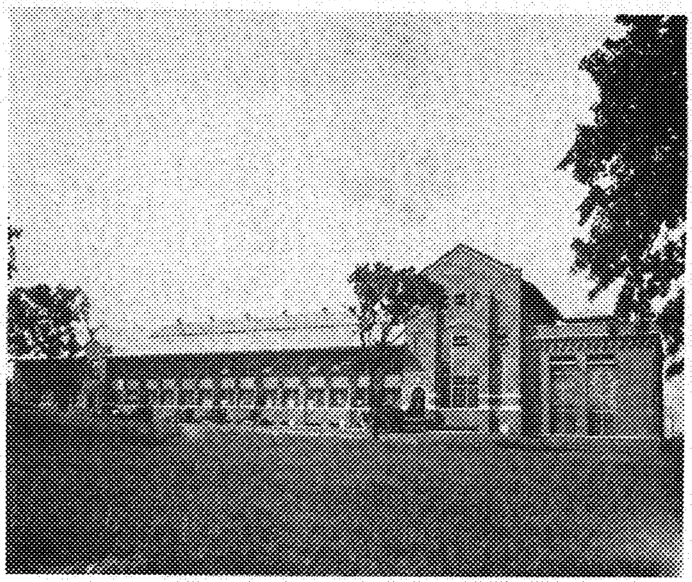
What is the problem confronting the college man which makes his decision as to how to use his engineering education so important? Not to go with this company or that company, this railroad or that one, this public utility or that utility, but how to get into that field where his usefulness will be the greatest, and where, by virtue of his own tastes, inherent or acquired, nature intended him to be. It is no longer enough for a college man to say he is going to follow mechanical engineering, civil engineering, or electrical engineering. Every day industry is coming more and more to disregard this subject-matter classification of its engineering work and substitute for it an occupational or a functional classification. Recent reports before the societies of engineering teachers show that this same viewpoint is beginning to be reflected in the schools themselves. About two years ago a report was presented to the Society for the Promotion of Engineering Education presenting courses based on a functional arrangement of engineering work. One course was designed to prepare men for research and designing, another for manufacturing, and another for the commercial aspects of engineering work. It is right here on this problem that the college has the right to look to industry for help. If industry cannot make it clear to the college just what the human

(*Continued on page 194*)



OLD MINES EXPERIMENT BUILDING

Small brick structure, constructed in the fall of 1911 and located on the banks of the Mississippi river at northwest end of University campus.



NEW EXPERIMENT STATION

Completed in 1922, this laboratory, occupied in part by the U. S. Bureau of Mines, is said by experts to be the finest of its kind in existence.

Minnesota Mines Experiment Station

Built for promotion and development of the mineral resources of the state, this laboratory is the largest of its kind in existence

By William R. Appleby
Dean of the Minnesota School of Mines, and Director of the Mines Experiment Station

THE Minnesota School of Mines Experiment Station was established in the fall of 1911 for the purpose of promoting the development and conservation of the mineral resources of the state. The activities of the station are confined largely to mining and metallurgical investigations, as the general geological work of the state is conducted by the Minnesota Geological Survey. The station formerly occupied a small wood and brick building located on the banks of the Mississippi river at the northwest end of the university campus. It was not long before this building and its equipment failed to meet successfully the object for which the experiment station was established.

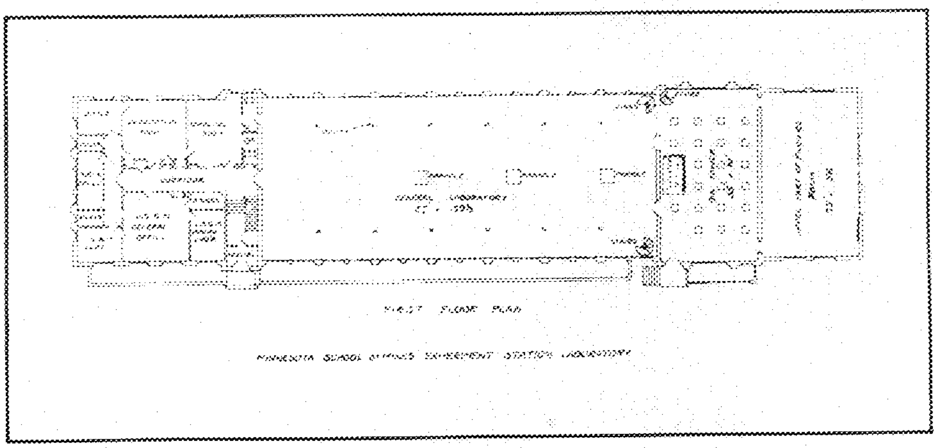
In 1916 the University of Minnesota and the United States Bureau of Mines entered into a co-operative agreement whereby the federal bureau would establish and support one of its experimental stations on the university campus provided the university would furnish and equip a suitable building to replace the old one. Delays were encountered during the war period, and it was not until 1922 that the structure was completed. The new building is located practically on the same site on which the old one stood, and is occupied jointly by the U. S. Bureau of Mines and the School of Mines Experiment Station. It is pronounced by leading experts to be the most unique and well equipped building of its kind in the United States, if not in the world.

From the first floor plans of the building it will be seen that its total length is 280 ft., that it is 60 ft. wide, rectangular in form and is divided into four general sections.

The first section, as shown on the extreme left of the plans, provides for general office space on the first floor and office and laboratories in the basement.

The second section is the general laboratory. It is 139 ft. long, two stores high and is equipped with a ten-ton travelling crane. In the basement below are located the assay laboratory, sampling room and shops.

A mezzanine floor surrounds three sides of the laboratory. Two sides of this floor are used for storing apparatus when not in use, so as to make the greatest possible space available for operation. At the end of the laboratory nearest the bin tower the mezzanine floor is used for setting up machines which may be used in the various tests. Through the wall just above this floor, can be seen two openings, through which is fed the ore from the next section or bin tower down to the machines located directly below them. The ore fed from these feeders to the machines on the mezzanine floor passes down to the machines on the floor of the main laboratory. In the middle of the main laboratory floor are three large manholes through which the ore can again be passed down to machines set in the basement. This arrangement offers three levels on which machines can be placed



FIRST FLOOR PLAN

Offices are on extreme left while the main laboratory which is 139 ft. long comprises the center section. The bin tower and furnace room are on the right.

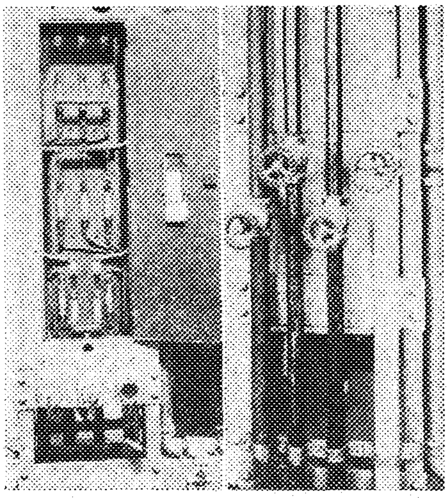
and permits gravity feed. The ore, therefore, can pass through three stories of machines without rehandling.

There are twelve posts, six on each side, supporting the mezzanine floor. In each one of these posts are electrical outlets furnishing three phase, 220 volt, 60 cycle; single phase, 110 volt, 60 cycle; single phase, 220 volt, 60 cycle and 110 volt direct current electric service. On the back of each of these posts are pipes furnishing high pressure steam, low pressure steam, high pressure air, low pressure air, high vacuum, low vacuum, city water and illuminating gas. Each piece of apparatus is equipped with its own motor so that the equipment on these twelve posts makes it possible to set up various machines in any part of the laboratory.

When a test has been completed, the ten-ton crane picks up the machines used in the test and places them on the storage sides of the mezzanine floor.

The third section is 35 ft. long, five stories in height—three above ground—and contains steel ore bins. The sampling, grinding and crushing equipment is located on the main floor. A ten-ton electric elevator connects all floors.

In addition to the twelve posts previously mentioned as being in the main laboratory and carrying the various service outlets, these same service stations containing outlets for electricity, gas, steam, air, etc., are located at convenient places about the building and in many of the smaller laboratories. Electric current connected to these service stations is secured primarily from the Minneapolis General Electric company through a 4,000 volt, 3-phase transmission line. These cables enter the building in conduits placed underground and are connected to the main switchboard and transformers in a transformer room located in the sub-basement. Here, the high voltage is changed to 220 volt, 3 phase, 60 cycles for general motor operation, 110 volt for general lighting and 220 volt, single phase for small motor operation. Large cables carry this electricity to the main switchboard located in the basement. At this point various switches are arranged to connect these various electrical supplies to the service stations over the building.



Front Back

DETAILS OF POSTS

Various voltages a. c. and d. c. and also steam gas, air and vacuum supply are available.

In the sub-basement, just below the main switchboard room, is located the machinery room. This room is equipped with a 500 cu. ft. capacity, 100 lb. pressure air compressor; a 500 cu. ft. capacity, 30 lb. air compressor; an 800 cu. ft. capacity, low-pressure blower; a 200 cu. ft. capacity wet vacuum pump; and a 15 kw. motor generator set for changing the 200 volt, 3 phase current to 110 volt direct current.

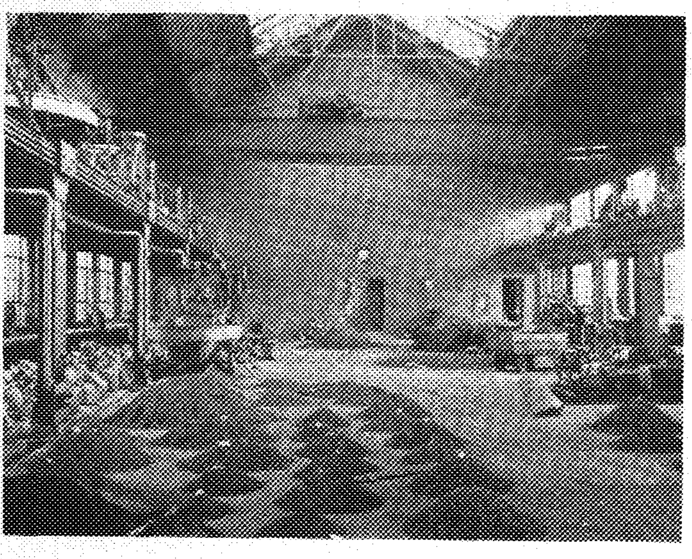
All of this equipment is piped and wired in the various service stations over the building, and in addition to these, gas is secured from the city mains, water from the city water mains and steam from the university heating plant. The compressors, blowers, etc., in this machinery room are all operated by remote control, push button stations located at various convenient points over the building. When necessary, the compressors can be connected for automatic operation, thus maintaining the proper pressures on the various pipe lines.

In the main laboratory, a guage board is located which indicates the pressure on the various air, water, gas and steam pipes and also the direct and alternating points and indicates the equipment in operation.

In the basement, a low pressure exhaust fan is located which removes the fumes from the hoods in the chemical laboratory and also the gases from some of the furnaces. This fan is also opererated by remote control buttons.

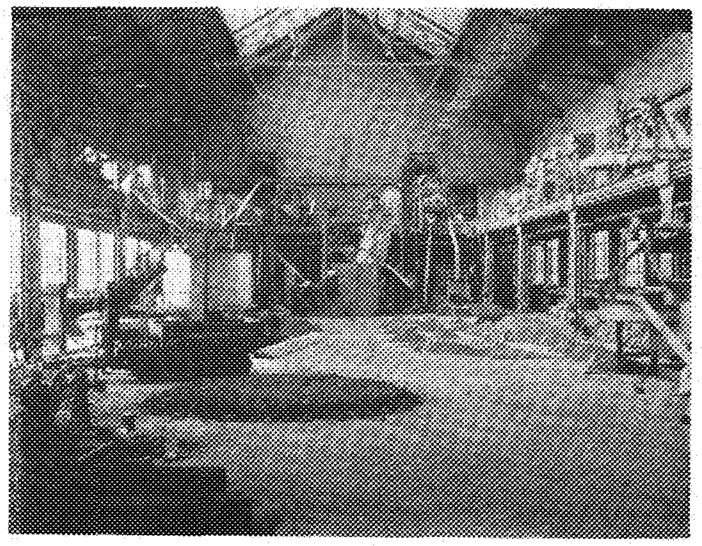
In the upper floor of the office section of the building, a large steam still is located. This still is so arranged that a large storage tank is constantly kept filled with distilled water. This distilled water is piped to various points over the building and into all the laboratories through block tin pipes.

A considerable amount of water is used in the treatment of iron ores and much of the waste from this treatment process is in the form of sand which is carried away by the water. On both sides of the main laboratory and at various other places in the building, large launders or gutters are located. The drains from these launders are 6 in. steel pipes which drop vertically into the sub-basement are still larger concrete launders into which these vertical steel pipes discharge. These launders collect the water and sand discharged from the pipes into a large central drain which passes at a steep angle out of the building and into the Mississippi river. It is therefore impossible for the sand to accumulate at any point within the building or drain system except in the large launders in the sub-basement. Occasionally it is necessary to wash these out by means of a high-pressure fire hose.



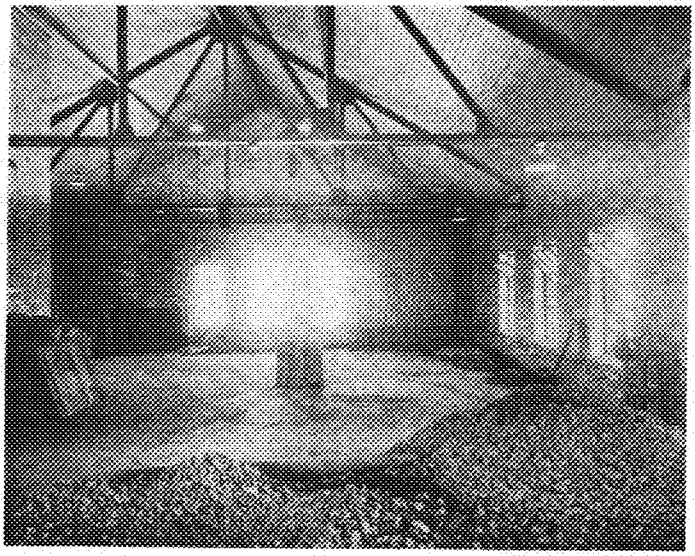
GENERAL LABORATORY (VIEW NO. 1)

Samples of ore under test are shown in foreground. Apparatus not in use is stored on the mezzanine floor. Note the large traveling crane.



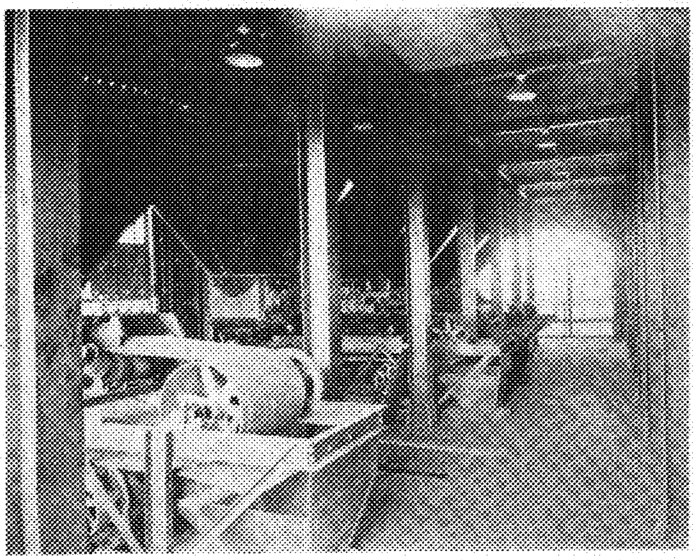
GENERAL LABORATORY (VIEW NO. 2)

Ore comes through the two openings in farther wall from storage bins and is fed to the various machines for such treatment as is desired.



TOP FLOOR OF BIN TOWER
If the ore is wet or frozen, it is dried by steam. Then it is shoveled through the manholes and starts on its downward journey.

The ore arriving in carload lots is placed in an electric truck and carried by the elevator to the top of the bin tower. If wet or frozen it is first dried on driers, shown in the corner of the upper room. When dry, the ore is shoveled through a manhole and falls into storage bins. There are six of these bins, and below each of them is a belt feeder which is operated from the floor below. Its speed and direction is controlled from a box on the floor where the crushers, rolls and screens are located. The operator on this floor, therefore, can feed the ore in one direction to the crusher or in the opposite direction into the rolls, or the ore can be fed from another bin by means of another feeder to a set of trommels or vibrating screens for sizing. The products from the machines on the crushing and sizing floor drop through the floor into other bins. When the ore has been worked into the desired size and condition for the test proper, it is taken up by the elevator and discharged into two large bins. From these bins the belt feeders convey it through the wall into the main laboratory to the machines for such treatment as has been determined.



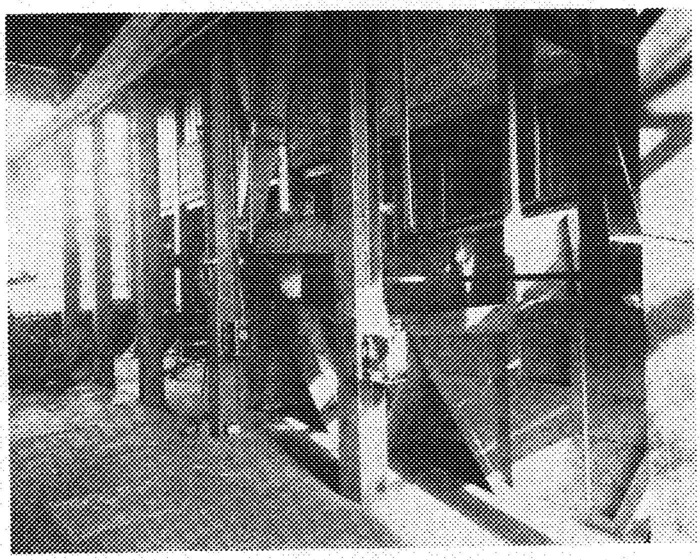
ORE BINS AND FEEDERS
The ore falls into any of these six bins and by means of the belt feeders can be sent to either the rolls, crushers or screens.

At the extreme right of the plan is the furnace room which is 35 ft. wide and contains a blast furnace 30 ft. high. The furnace has a hearth 3 ft. in diameter and is equipped with stoves for preheating the air as carried on in actual practice. It has in fact all the essential features of a large furnace. Its daily capacity of from five to six tons of metal represents about one per cent of the tonnage of a large commercial furnace. The furnace is constructed so that samples of gas and temperature readings can be taken easily at many points in the furnace. The entire floor of the furnace room is of molding sand. The furnace was designed by Mr. T. L. Joseph, superintendent of the U. S. Bureau of Mines Station at Minneapolis, and his staff. The School of Mines built the furnace, but the furnace operations were carried on under the direction of Mr. Joseph, to whom we are indebted for much of the information concerning the furnace and its application to the state work. At the present time the Bureau of Mines and the university control the only experimental blast furnace in the country and probably the only one in existence.

Modern industrial blast furnaces produce 600 to 700 tons of pig iron daily. The raw materials, ore, coke, and limestone required to produce this amount of pig iron are necessarily large. Much creditable work has been done in the development of the modern furnace and adapting it to changes which have taken place in raw materials. However, due to the order of magnitude of the operation and the financial hazard accompanying any departure from standard or proven procedure, the development has taken place slowly and gradually.

Although Minnesota is not a large producer of pig iron, it is richly endowed with iron ore deposits, some of which contain manganese, a metal indispensible in the modern art of steel production. The development of the iron ore resources depends somewhat upon the trend in furnace development, and the proven performance of various types of ore in the blast furnace. Due to the close relation existing between the manufacture of pig iron and the production of iron ore, interest in the former as well as in the latter is obviously important to the development of state resources.

In 1919, the Bureau of Mines in co-operation with the Minnesota School of Mines Experiment Station undertook to develop an experimental blast furnace in order to investigate, at much smaller cost than if full-sized equipment were used, various problems of vital interest to the iron industry. Blast furnace operators, accustomed to use of methods based on lone experience, are reluctant to use new or untried methods or materials, the peculiarities of which have not been disclosed by practical tests. Progress has been made by increasing output rather than determining accurately what happens within a furnace and applying



SCREEN AND CRUSHER FLOOR
When the sample has been crushed, or rolled, or screened, it is carried by elevator to bins and then conveyed to the main laboratory for treatment.

this knowledge in the design and operation of furnaces.

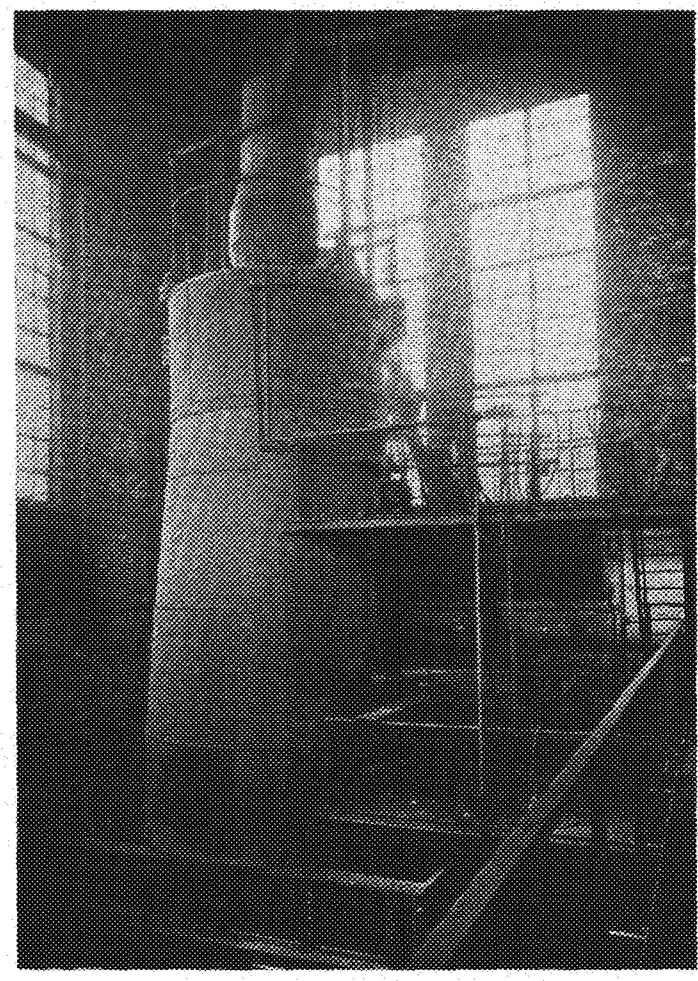
The utilization of manganiferous iron ores was the first problem undertaken with this experimental furnace. Such ores occur in several districts of the United States, but Minnesota contains the most extensive deposits which have an added advantage of cheap transportation by way of the Great Lakes. At present, these ores are finding an increasing market because they aid desulphurization in the blast furnace and produce high manganese pig iron which benefits the steel making process in a number of ways. Some furnace men claim that a better quality of steel can be made from high manganese pig iron, and there is considerable evidence to support the conclusion that the amount of expensive ferromanganese needed in steel making can be decreased if high manganese pig iron is used. There seems to be little doubt that actual benefits are derived from the use of manganiferous iron ore. However, because of a very limited supply of domestic manganese reserves, the Bureau of Mines and the Minnesota School of Mines Experiment Station undertook a joint research, looking toward the most efficient utilization of these ores.

As a part of the problem, the experimental furnace was operated 34 days during which period about 136 tons of metal were made. This material is now available for further investigating methods of obtaining a product that can be used in the manufacture of ferromanganese. This would open a new outlet for the ores, and would make this country less dependent upon imported ores and alloys which are specially important in times of war.

As a background for this experimental work, the Bureau has men in the field conducting plant research. This affords an opportunity to keep in close touch with the industry and the problems of vital interest to its development.

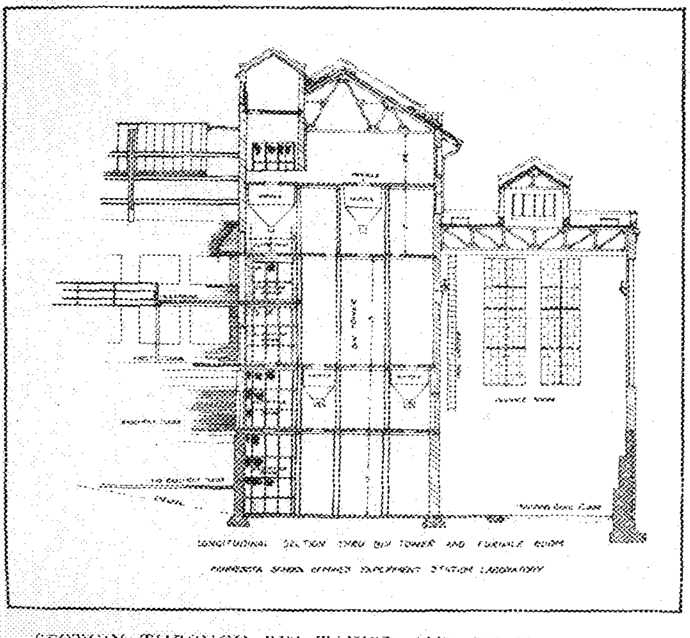
The general construction of the building is brick with concrete walls and steel and slate roofs. It is located near the Northern Pacific tracks, and a spur runs to the building. The building is of factory type construction, which offers the best possible lighting in the large laboratory.

The building was built and paid for by the State of Minnesota, and with its equipment represents an investment of $450,000. The building is not in the least ornate or elaborate, but is designed for the purpose of furnishing a suitable laboratory that will not become antiquated as science advances. Simplicity is the keynote of design.



EXPERIMENTAL IRON BLAST FURNACE
Though small sized, this furnace has all characteristics of the large ones. Note openings in upper part for taking gas samples and temperature.

From a study of the plans it will appear evident that the School of Mines Experiment Station is equipped to investigate all metallurgical processes and to test all minerals found within the state. It determines the possibilities of ore concentration, the grade of concentrate that can be produced and the extraction to be expected. It also presents a general review of the treatment recommended. Information is gladly given concerning standard metallurgical practice and also the application of the information to the use of special machinery and apparatus. Detailed costs of construction of plants and their operation depend on so many variables and are often so involved, that they cannot be satisfactorily presented by the station. These questions naturally fall to the private consulting engineer for solution. General cost data, however, are furnished when desired. Operators within the state may have tests made free of charge by the station.



SECTION THROUGH BIN TOWER AND FURNACE ROOM
Construction of bin tower, furnace room, hoppers, elevators, and their position in relation to central part of building are shown.

In addition to the regular routine testing work, the station carries on research work and special investigations in metallurgy and ore testing. It is constantly endeavoring to develop methods of treatment that will result in better practice and greater conservation of the state's mineral resources.

Some conception of the value of this station to the state can be had by looking at the annual statistics covering the production of merchantable ore. In 1924 nearly one-quarter of all the material shipped from Minnesota to be smelted was produced from ores that in the original state were too low to ship and smelt, but after proper testing and treatment yielded a product equal in value to the standard merchantable shipping ores.

The station with its laboratory is a reliable public service station. No question is too large or too small, too general or too personal to receive consideration.

The Mercury Turbine

New prime mover employing binary vapor system with steam as working substance will improve efficiency of power generation

By Burt L. Newkirk, B. A. '97
Research Laboratories, General Electric Company

THE demand for increased economy in the development of power is very urgent. This applies especially to central station operation. In the year 1924, thirty-seven and a half million short tons of coal, over sixteen million barrels of oil and over forty-eight billion cubic ft. of gas[1] were burned in central stations for the development of power. An improvement in fuel economy of a few percent only would save millions of dollars to the power companies and would help to conserve the world's supply of fuel. So preponderant is the fuel bill in the cost of central station operation that a turbine of exceptionally high economy earns a big dividend for its owner, and a turbine having exceptionally poor economy would not be acceptable to a power company as a gift, if they were under obligation to operate it for any considerable proportion of the time.

The Binary Vapor Process

Among the proposals for improvement of efficiency in power generation is one to use mercury vapor in combination with steam as a working substance. The mercury is evaporated at high temperature but comparatively low pressure. The mercury vapor passes through a turbine, doing useful work; and from there into a condenser-boiler where it becomes liquid, and then returns by gravity to the mercury boiler. In condensing, the mercury gives up its latent heat to water, forming steam at a pressure suitable for use in a steam turbine of ordinary design. The steam is superheated and then passes through the steam turbine where it does useful work, and then to its condenser; from which it is returned to the condenser boiler. This completes the binary vapor cycle which is repeated indefinitely.

Hartford Installation

Two years ago last September, an installation for the realization of this process began operation at Hartford. It ran for about a year, and demonstrated the fundamental soundness of the theory upon which its design was based, showing in particular the fuel economy expected of it. During this period a total of about two and a half million kilowatt hours was developed by the mercury turbine, and the condensing mercury produced enough steam to develop over four million kilowatt hours additional power. Some trouble was experienced with small leaks in the boiler, due to cracking of the welds, and a change in boiler design was decided upon. At the same time the working pressure in the mercury cycle has been increased from 20 lbs. gage to 60 lbs. gage, and the single stage mercury turbine has been replaced with one of three stages. The new boiler and turbine have been run successfully at rated load but are shut down at the present writing for minor repairs in the boiler and to install apparatus for burning pulverized coal.

Fig. 1 shows the entire system, including the generator and condenser boiler. However, since this drawing was made the capacity of the boiler units has been increased so that only four units are now used in place of the six units shown in the figure at the right. The liquid mercury in its return from the condenser boiler at 400 deg. F. enters a "liquid heater" in which its temperature is raised to that of the boiler. The flue gases pass through this liquid heater immediately after leaving the boiler. Leaving the liquid heater the flue gases pass through a steam superheater and then through an economizer where they give up heat to the feed-water, which is returning from the steam turbine condenser, and on its way to the mercury turbine condenser boiler.

Water boils in the dead end tubes which hang down into the condenser space and are surrounded by the condensing mercury vapor. The mercury vapor condenses in the 29 in. vacuum at 420 deg. F. and the steam is made at 200 lbs. pressure. The water enters this condenser boiler from the economizer, and after leaving, the steam passes through the superheater. Fig. 2 shows the new boiler units. There are four units, each composed of 160 dead end tubes with a vapor dome, and vapor pipe connections for each unit.

Economies

As to the economies to be obtained from this binary process, tests of the former Hartford installation showed a production of power at the rate of 1 kw.-hr. from slightly over 12,000 B. t. u. of heat developed in combustion of the fuel. This includes the power actually generated in the mercury turbine-generator, and a fair credit of power for the steam produced in the condenser boiler, allowance being made for power to run the auxiliaries of a good modern steam turbine. This figure of 12,000 B. t. u. per kw.-hr. is to be compared with 19,267 B. t. u. per kw.-hr., an average figure for three large central stations during the month of January, 1924. However, in making this comparison it should be noted that the mercury turbine unit was of small size (1100 kw. developed by the mercury turbine generator), had a single stage mercury turbine (about 60 per cent efficient) and ran at a mercury pressure

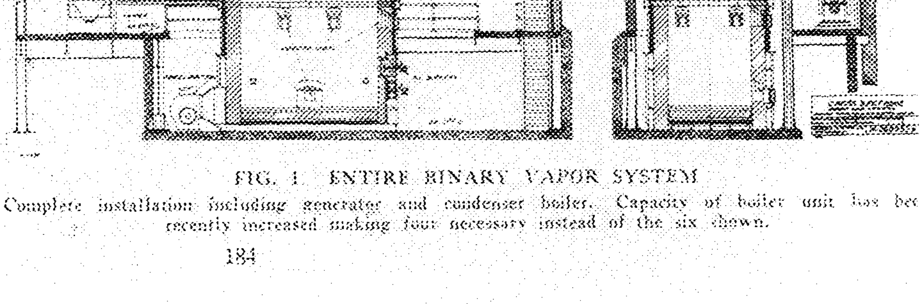


FIG. 1. ENTIRE BINARY VAPOR SYSTEM
Complete installation including generator and condenser boiler. Capacity of boiler unit has bee[n] recently increased making four necessary instead of the six shown.

[1]Commerce Year Book.

of only 24 lbs. gage at the turbine. A short test made recently with the new boiler and three stage turbine showed still better economy; and this in spite of the fact that the boiler was forced so

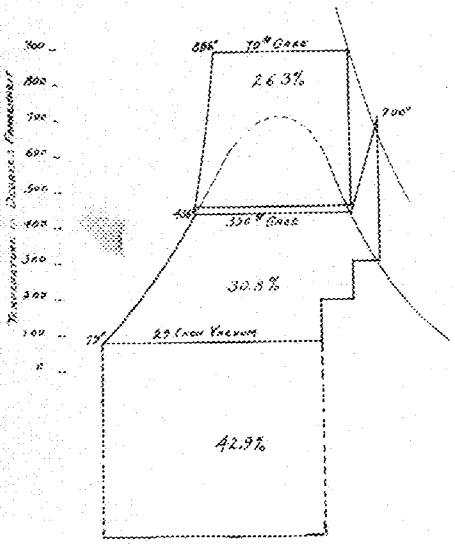


FIG. 3. ADVANTAGE OF PROCESS
Theoretical possibility of system applied to existing power plant.

that the flue gases entered the stack at 500 deg. F.

In making these comparisons, it is only fair to say that within the past year the Philo station, of the Ohio Power Company, operating two General Electric 40,000 kw. turbines with the latest refinements for economy claims the very remarkable record of 13,715 B. t. u. per kw.-hr. of net station output. This may seem to approach the efficiency attainable with the mercury turbine, however, any refinement which improves steam turbine practice is applicable to the steam end of the binary vapor process and the additional economies due to the use of mercury are still available for the binary process. With the latest refinements in the steam cycle, this process should give a kilowatt-hour at the switch board for 10,000 B. t. u. or less in the fuel.

Problems

The unquestioned advantages of the mercury vapor process for generation of power are opposed by certain difficulties. Mercury is costly, it is poisonous and it must be confined so there are no leaks.

Mercury now costs one dollar and fifteen cents per lb. in seventy-five lb. flasks. The mercury boiler as designed at present must be supplied with about seven lbs. of mercury per kw. of total steam and mercury output. Of course, this mercury is not used up and, barring accidents, is should last indefinitely. An extensive application of the mercury vapor process would require perhaps five million lbs. per year, which would necessitate increasing by 70 per cent the present world production of mercury.[2] It is believed that the required amount of mercury will be forthcoming, at a somewhat incresed price. It is not likely, therefore, that any scarcity of mercury will prevent application of the process for power generation. However, the scarcity of mercury renders it essential that there should be no considerable day to day loss of mercury in the operation of the plant, that is that there should be no leaks in the boiler or pipes carrying the liquid or vapor.

The poisonous nature of the mercury will probably not prove a serious obstacle. In operation the mercury moves from boiler to turbine and condenser and back again to the boiler, in a series of steel passages that are completely sealed by welding except at one shaft packing and at one point in the liquid return line which is carefully guarded by a gasketed joint, against any escape of vapor to the air. Precaution is taken against the possibility of leaks in these passages by enclosing the passages either in the flue or in a housing from which air is drawn for draft to the fire, so that if a leak should occur the mercury would discharge into the flue and be carried out of the building. If proper precautions are observed in handling the cold mercury, the hazard is slight. In the twelve years during which experiments have been in progress on this process no person engaged in the work has suffered anything worse than temporary illness from exposure to mercury.

Reliability

Unquestionably the degree of reliability and dependability for continuous operation is the foremost consideration in central station equipment.[3] If the mercury vapor process should fail in this respect no increase in efficiency could entitle it to a place in a power station. However, the outlook in this direction is decidedly favorable. It is true that the temperatures to be dealt with are high, and expansion strains and lowered elastic limits of materials must be considered carefully in the design. These difficulties are offset to some extent by low vapor pressures and low running speeds. The pressure of mercury vapor at 884 deg. F. is only 70 lbs. gage, and the nozzle velocity of the mercury vapor is so low that the rotational velocity of the rotor is very moderate. This makes for freedom from vibration troubles and troubles due to shaft packing. All of the fundamental simplicity of design which has made the turbine preeminent for central station power development is inherited by the mercury turbine. It is proposed also for other reasons than those of reliability, to make the mercury vapor turbines in small units, one for each boiler, consequently any shutdown of one unit would not deprive the system of any considerable proportion of its generating capacity. Altogether it would seem that the mercury vapor process shows a favorable prospect on the score of reliability.

Thermodynamics

Briefly stated, the theoretical maximum amount of power that can be obtained from a given amount of heat energy depends upon the working range

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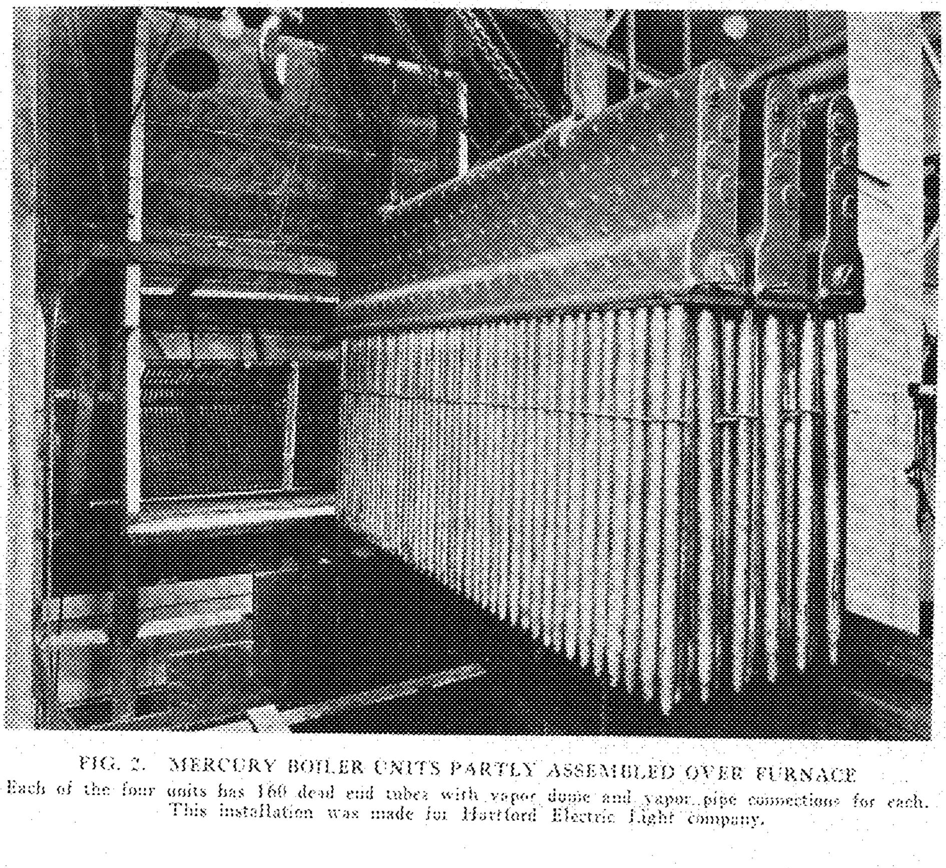

FIG. 2. MERCURY BOILER UNITS PARTLY ASSEMBLED OVER FURNACE
Each of the four units has 160 dead end tubes with vapor dome and vapor pipe connections for each. This installation was made for Hartford Electric Light company.

[2] U. S. Geol. Survey. Quicksilver in 1923.
[3] This is accomplished by welding all joints that are exposed to liquid or vapor pressure.

Volcanoes—Mountains a *Mile* High in *Minnesota!* That is *Only* a Part of

Our Geologic Past

By John W. Gruner.

Assistant Professor of Geology and Mineralogy, University of Minnesota

COLUMNAR JOINTING IN KEWEENAWAN BASALT HARBOR.

A GEOLOGIST would make a poor press agent for California if asked which portion of our continent he considered most stable, for the would have to admit that the Golden West is still far from having attained the stability which Minnesota has enjoyed for many million years.

To find the reason for our state's solid foundation, we must go back to the most distant past, almost to the time when the earth was torn loose from our sun by the attraction of some other passing solar system. Such an event, astronomers tell us, may happen once in a thousand billion years. How many hundred or thousand million years it took for the molten earth to cool sufficiently for a solid core and shell to form will never be known. But radiation finally reduced the heat enough for a solid crust to form in places, only to be fused again by some sudden release of heat from the earth's interior. No record remains of this foundering of pieces of the crust,—stupendous events in comparison with which even great volcanic eruptions would be as insignificant as the striking of a match compared to the firing of a 16-in. gun.

And when the smoke had cleared away there had finally formed a solid foundation, a geologic "basement complex" which though often ruptured during the succeeding epochs, was firm enough so that nature could begin to build and sculpture on it her geologic formations. The tools at her disposal for this work are the still very considerable internal heat of the globe, the radiation from the sun, the atmosphere, and the water which condensed from the latter.

Our oldest rocks are greenstones. Some of them may be seen today around Tower and Ely on the Vermillion Range. They are ancient lava flows which were poured out on the newly formed crust of the earth.

Of course, like most of the other rocks found in Minnesota, the greenstones are not confined to our state, but cover many regions of the world. In our discussion, let us limit ourselves, however, mostly to Minnesota, which, on account of its very large iron deposits, has become one of the areas most thoroughly studied by geologists.

Though the greenstones are volcanic rocks, there is plenty of evidence that at their formation large bodies of water—the oceans—began to take shape. Where there is water there is also an atmosphere, wind, rain, and other forces which do their destructive work on the rocks exposed on land. But in their very eagerness to break up the rocks and reduce all elevations to a common level, they carry the debris to the ocean and form new rocks, the sedimentary ones. In this eroded material there are all the food constituents necessary for the growth of plants. Is it, therefore, any wonder that life of the very lowest form could and did begin to exist as soon as erosion of the greenstones carried plant food in the form of iron, silicon, potassium, phosphorus, etc., to the ocean? Carbon dioxide, so necessary to plants, was already in the water, having been absorbed from the atmosphere. There formed, then, with the aid of plants which could take iron and silica out of the sea water, one of the most peculiar rock formations. It is called the Soudan Iron Formation by geologists because it contains a relatively large percentage of iron and can be studied especially well near the Soudan mine at Tower, on the Vermilion Range. It is made up of black, white, gray, and red (jasper) bands which present a very striking appearance, especially since these bands now are bent, folded and buckled in the most intricate fashion. Yet they were straight and horizontal when they were deposited in the water. The low plants which extracted a large portion of the iron and silica from the water were algae and bacteria; they exist today in almost identical species, as the lowest biological forms. Some of these ancient fossilized algae have withstood the attack of almost every imaginable sort of geologic process so well that they can be seen under the microscope today. (Fig. 1.)

Some people might be skeptical about

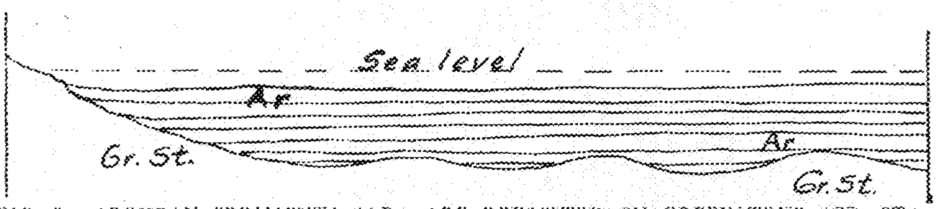

FIG. 2. ARCHEAN SEDIMENTS (AR.) ARE DEPOSITED ON GREENSTONE (GR. ST.)

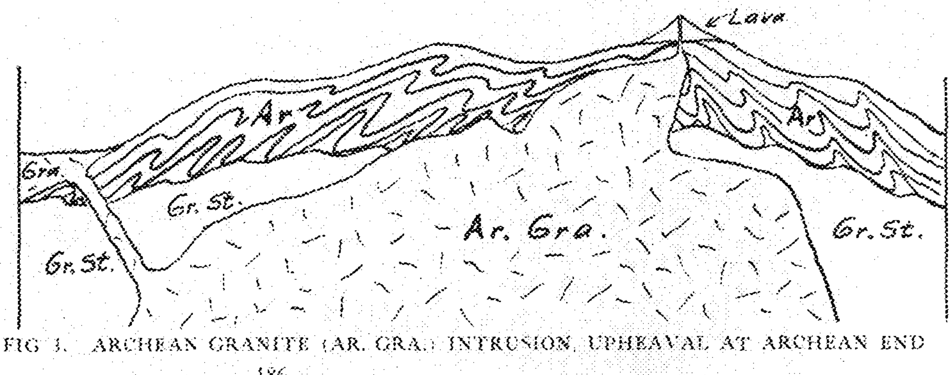

FIG 3. ARCHEAN GRANITE (AR. GRA.) INTRUSION, UPHEAVAL AT ARCHEAN END

the statement that the minutest organisms can build large geologic formations. There is, however, abundant proof. Are not many of our very large limestone formations built almost entirely of fossil remains? What about the Great Australian Reef which fringes the Australian continent for more than a thousand miles, or the enormous diatomaceous and infusorial earth formations? Quite recently we have also read of unmistakable evidence of the important work of bacteria in connection with the oil-bearing strata of the world.

But let us return to our oldest or Archean epoch in which life began as soon as conditions permitted. The sediments then laid down by the primeval waters, with the addition of a great deal of volcanic dust from contemporaneous volcanoes, accumulated to great thickness. In fact they became so heavy that they caused a slow sinking of the earth's crust on which they were deposited. (See Fig. 2.) According to the wise laws of nature, when the crust subsides in one area it must rise somewhere else. This process the geologist calls isostatic adjustment. The iron formation as it sank, came into a zone in the earth where, due to great pressure and heat, the layers were twisted and buckled into the shapes in which we see them today. But the iron formation did not remain at such depth very long, geologically speaking. Plutonic forces of enormous power lifted these sediments slowly compressing them still more, while at the same time enormous volumes of molten rock invaded the sediments. Incidentally some of these intrusions of the melt were powerful enough to break through entirely with explosive violence, to issue at the earth's surface as lavas accompanied by great quantities of volcanic dust. The total effect at the end of such a period of upheaval might be represented by figure 3.

We now had highlands and mountains which in Minnesota may easily have reached the heights of the loftiest peaks existing on this continent today. There began a new cycle of erosion and sedimentation which we call the Huronian epoch in the countries bordering on the Great Lakes. In magnitude the sediments deposited during this time were just as enormous—probably more so—as in the preceding epoch. Tremendous thicknesses of gravel (which are called conglomerates when cemented in the course of time) and slates were the results. Simultaneously the mountains from which the sediments were derived were reduced to almost the level of the seas existing at that time. In Michigan, the Marquette iron formation was deposited contemporaneously. The periodic oscillation of the earth's crust again carried these new sediment-

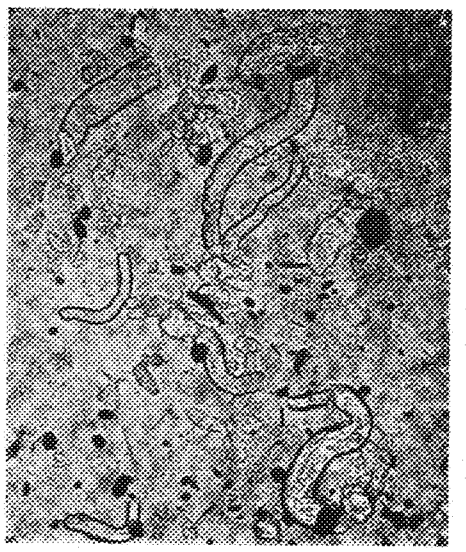

FIG. 1. ARCHEAN FOSSIL ALGAE
View of ancient fungus magnified 200 times. Some specimens are outlined.

ary rocks to great depth where they were thoroughly compressed, and, as the geologist terms it, metamorphosed. Figure 4 shows a cross-section of the earth's crust as we may imagine that it appeared at the end of the period of deposition.

The next move carried the rocks upward, partly floating on vast volumes of molten granite intrusions—some of them hundreds of miles in diameter. The granite just north of the Mesabi Range towns is a product of that period. Numerous volcanoes at the same time provided outlets for the excess pressures in the molten reservoirs below the crust. (See Fig. 5.) None of these movements of the rocks were very rapid or violent, volcanoes excepted. Each erosion cycle followed by upheaval and mountain making lasted for many millions of years.

It is impossible in this paper to show how geologists arrive at such apparently extravagant figures, but it is estimated that it takes from 10,000 to 20,000 years for the accumulation of enough vegetable matter to form one ft. of coal. In many coal fields we have over a hundred ft. of coal. Yet this period of formation of coal is just an incident—a day—in the life of our planet. In Figure 8, an attempt is made to convey to the reader a picture of the sequence of the geologic epochs and of the duration of each. These estimates are based on the investigations of a number of men and are little better than guesses. There is hope, however, that we will soon possess a fairly accurate geologic time table based on the rate of decomposition of radio-active elements.

The mountains raised at the end of the Huronian epoch were leveled during the so-called Upper Huronian that followed. The sea once more invaded portions of Minnesota and in its were deposited the largest iron accumulations known. The Mesabi and Cuyuna iron ores had their start here. A whole book could be written on this interesting geologic incident, but suffice it to point out that the sea of this epoch carried enormous quantities of iron and silica in solution. Minute algae and bacteria precipitated these two constituents in the ratio of about 40 per cent iron oxide and 60 per cent silica. The iron formation in this way attained a thickness of 400 to 800 ft. and probably covered 10,000 square miles. Thousands of feet of slate were deposited on top of the iron formation. (See Fig. 6.)

Vast indeed must have been the span of time necessary for such immense accumulations to form. Once more a tremendous effort of the forces imprisoned under these sediments lifted these rocks to mountain heights. Thousands of cubic miles of molten rock accompanied these upheavals and congealed into the

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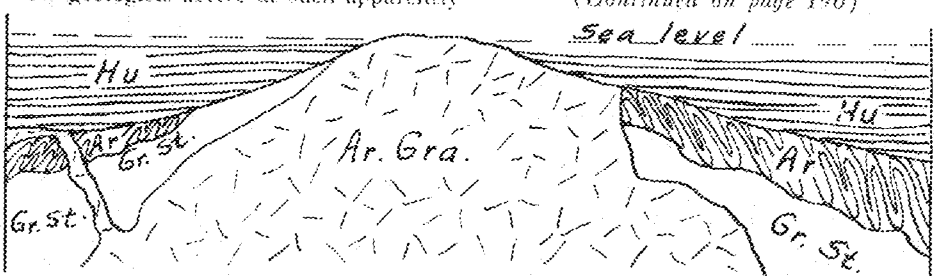


FIG. 4. HURONIAN SEDIMENT (HU) DEPOSITS ON SUBSIDING EARTH'S CRUST.

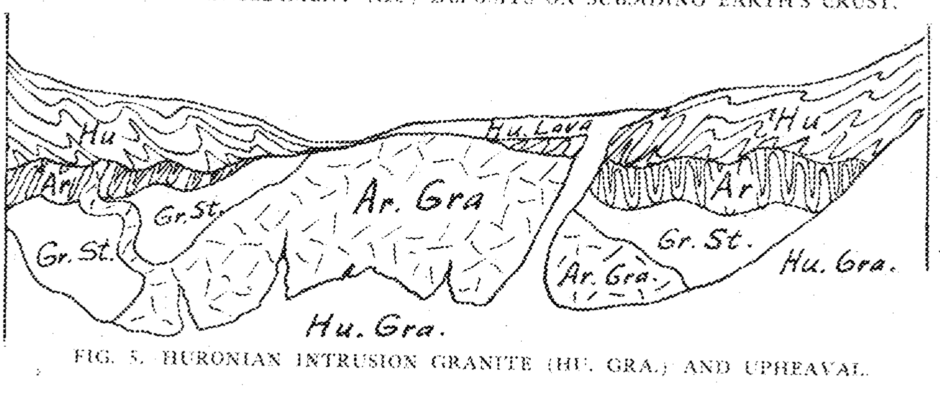


FIG. 5. HURONIAN INTRUSION GRANITE (HU. GRA.) AND UPHEAVAL.

NEWS FROM THE TECHNICAL CAMPUS

1905 Graduate Addresses School of Mines Society

Erick J. Schrader, graduate mining engineer of '05, recently addressed the School of Mines Society and members of the faculty concerning the conditions of the mining industry in the western states. Mr. Schrader is consulting engineer for several of the larger companies in the Nevada region.

In general the trend of the talk dealt with the re-opening of the abandoned mines which were put in operation at the time of the war. These mines, with a few exceptions, produced an ore which was much leaner than the present market value would permit for profitable operations. To resume work on an abandoned mine would require an expenditure beyond reason because the mines as a whole, are flooded and caved in. This would require a large repair and maintenance crew, Mr. Schrader brought out. However, Mr. Schrader expressed optimism concerning the future conditions of the mining industry in the lead and silver mines of the Nevada region.

'U' Radio Station Near Completion: Excellent Programs Arranged

The broadcasting studio of the U of M radio station, 9XI-WLB, located on the third floor of the Electrical Engineering building will be completed in the near future. Construction began last December and has progressed rapidly since.

The floor is covered with a heavy well-padded rug, and asbestos felt with perforated oilcloth covering is fastened to the ceiling to reduce the reflection of sound and increase the acoustic properties of the studio. Heavy curtains will be hung on the walls to further facilitate good reproduction.

The studio is connected by private wire to the Gold Medal station, WCCO. This will enable the programs to be broadcast from either studio or from either station.

Excellent programs have been arranged by Mr. Lee Seymour, the program director. One hour each week from WCCO is devoted to a University program, which includes popular music and lectures that are informational and educational. The material for all of the programs is furnished by the faculty, students, and employees. A series of lectures is being given which are arranged by various departments such as Chemistry, Geology, and Health.

The west room adjacent to the studio may be converted later into a reception room. There is also some possibility in the future of the construction of a similar studio on the farm campus.

Prominent Scientists Speak At School of Chemistry

Professor W. K. Lewis of the Massachusetts Institute of Technology, spoke on "The Amorphous State of Matter" at the chemistry auditorium, February 16, 1926. He stressed that chemists need a clear physical conception of natural phenomena in order to be able to apply the science. Dr. Lewis is one of the foremost chemical engineers of this country. He was in charge of research on offensive chemical warfare of the Chemical Warfare Service during the war. The lecture was sponsored by the School of Chemistry.

On Thursday, March 5, Dr. E. H. Volweiler, chief chemist of the Abbott Laboratories, Chicago, gave an address on "The Applications of Chemistry to Medicine" before the Minnesota section of the American Chemical Society. Dr. Volweiler's work on medicine is internationally known, as he is one of the most brilliant men of his profession.

Plans Near Completion for Engineers' Day Celebration

The campus will be subject to many surprises on April 23 when the technical colleges stage their annual celebration, Engineers Day.

Richard Trexler, a junior mechanical, was elected chairman for the day. He will have charge of all administrative detail for the celebration. The executive group whom Mr. Trexler has chosen to help him consist of the following committee heads: parade, Chas. Burmeister; the "Brawl," Stewart Bailey; open house, Paul Bliven; the "Green Tea," Margaret Bradbury; decorations, Joel Carlson; music, Roger Wheeler; parents and alumni, Joe Brenner; knighting, Joe Wald; publicity, Paul Giessel; posters, Robert Dunning; Sunlite, Louis Schaller; finances, John Hoving. Norman Ronning is secretary.

The senior engineers met on March 12 and chose by unanimous vote, Ray Kelly, to represent St. Pat. Mr. Kelly's first official act was to knight thirteen seniors who graduated in March. Those knighted were R. C. Bolstad, J. R. Breeden, R. C. Cooper, C. S. Johnson, S. W. Lewin, P. G. Lindstedt, A. A. Lipchick, C. E. Meyerdick, U. G. Ohman, G. E. Peterson, C. H. Sandberg, Edward Winkanwarder, T. P. Young.

A contest has been opened to all students in the College of Engineering and Architecture, and in the School of Chemistry, for a button designed to be used for this event. The design should show originality and cleverness as well as being symbolical of St. Pat's Day. There will be three prizes: first prize, $5.00; second $3.00; and third prize, $2.00. The designs are to be judged by George C. Priester, Donald C. Heath and Richard Trexler. All designs must be turned in at the Techno-Log office not later than five o'clock Wednesday, April 7th.

Architectural Engineers Hold Annual Banquet

Wednesday night, March 10, the architectural engineers held their second annual banquet in the Viking Room of the Hotel Radisson. Cyril Pesek, '25, was the toastmaster and introduced the following speakers: Professors Mann, Maney and R. T. Jones.

There was a very good representation from all classes in the department and especially a good delegation of freshmen.

Entertainment was furnished by some "home talent" when Kilpatrick and Pearson took the floor for a short time.

The committee in charge consisted of Robert Kranzfelder, chairman; Neal Nelson, Don Gilfillan, Glenn Youatt, Alvah S. Bull, and Howard Colvin.

Numerous Representatives Here Interview Graduating Engineers

"Have you a job for next year yet? What do you think of Westinghouse or the G. E.?" Everywhere these days we hear seniors asking such questions.

The representatives of several firms have been here already interviewing the senior electricals regarding employment for next year. Most of these firms offer a training course where the student is paid a nominal salary and has a chance to learn details about the business of the firm and its products.

The first man to interview seniors this year was Mr. E. W. Seeger of the Cutler Hammer Company, who was here at the close of the fall quarter. This company plans on taking two or three men from Minnesota. Mr. White of the Century Motor Company visited here in January to arrange for the employment of seniors mainly in the field of sales engineering. The visit of Mr. Roberts of the Westinghouse Company caused considerable excitement as it was intimated that his firm would take about ten men. The representative of the Fort Wayne Works of the G. E., Mr. Hockett, also interviewed the seniors in January and four more have ceased to worry about jobs. The Northern States Power Company sent their representative here to impart the cheering news that this company would be willing to take about a dozen men this year.

Minnesota engineers hold a status equalled by few schools, believes E. B. Roberts, head of the Educational Department of the Westinghouse Electric and Manufacturing company, who was here recently interviewing members of the senior class relative to employment with his concern.

"When I came here I intended offering only four positions, but the excellence of the men with whom I had interviews, led me to increase that number several times," he continued.

Charles Reif, Patent Attorney, Speaks at A. S. M. E. Meeting

Charles Reif, practicing Minneapolis attorney and engineering graduate of Ohio State University, gave an interesting discussion on patents in a recent student A. S. M. E. meeting.

Mr. Reif, in the brief time allowed, brought out many of the important items concerned in patent law. He distinguished between a trademark and a copyright, and told just what things may be patented. Mr. Reif brought out the important point that it is the date of exposure of an idea, and not the date of invention, that is recognized in priority cases. He said that an invention should be explained to a friend when conceived, and that the date of the exposure should be written and signed by both parties. This, Mr. Reif stated, is an important item to remember, as many inventors make the mistake of of keeping their invention secret too long, and so lose priority rights.

The importance of writing the claim of a patent was also brought out; in connection with this Mr. Reif told of the many difficulties experienced in obtaining a patent through the government office. He explained how skeptical patent office employees are as to the value of any patent and told how a patent examiner was offered a half interest in the telephone for $50.00 and refused.

"Synchronous Machines" Topic of Speaker at A. I. E. E. Meeting

"The Application of Synchronous Machines" was the subject discussed by Mr. Place of the Chicago office of the General Electric Company, at the meeting of the A. I. E. E. on Tuesday evening, March 9. Ray Christen, chairman of the student branch of the A. I. E. E., introduced the speaker.

In his talk, Mr. Place emphasized the part played by economics in the engineering profession. Machines can be built to comply with very high requirements if the customer is willing to pay for them. It is up to the customer to decide whether the benefits derived from these high specifications will balance the increased cost of the machines.

The synchronous machine has many such difficulties to overcome but is gradually displacing induction and other types of motors in many kinds of service. For low speed work the synchronous machine has the advantage over the induction motor and the fact that a synchronous motor can be operated at unity power factor means a saving to the power company and consequently better rates to the users of synchronous machines for power.

Scarabs, an Architectural Fraternity, Installed Here

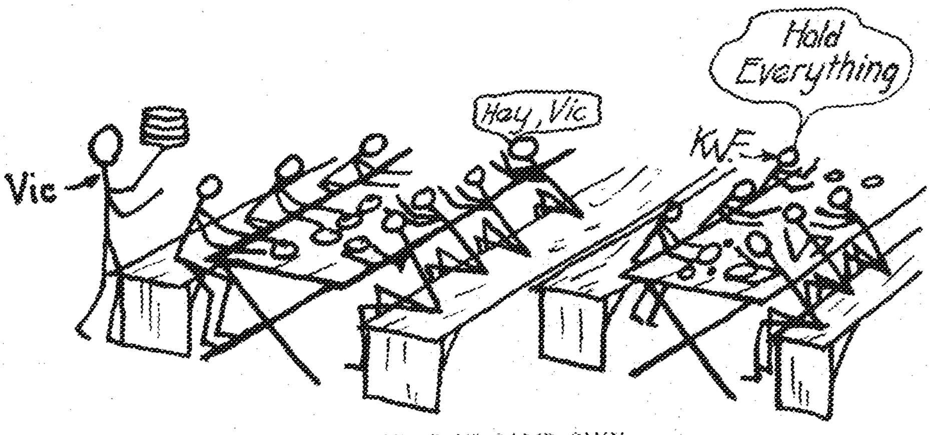
On February 26, Scarabs, national professional architectural fraternity, installed a chapter at the University of Minnesota. The installation ceremonies took place at the new Nicollet Hotel where Scarab members from other schools, but now out in the profession, assembled for the occasion. Following the installation, a banquet was held during which speeches were given by prominent architects who are Scarab members.

SCARAB PIN

Scarabs fraternity was founded at the University of Illinois in the year 1909. It was the first architectural fraternity to come into existence and has grown until it now has eight chapters including the newly installed chapter at Minnesota. The school where Scarabs have chapters are Illinois, Kansas, Armour Tech, Penn State, Carnegie Tech, Washington U, and George Washington U.

Two years ago the members of the Dodeca club, which at that time was composed of twelve members from the department of architecture but strictly a local organization, felt the need of the professional contact with other institutions and as a result they applied for a charter in the fraternity of Scarabs.

To install the Minnesota chapter, E. E. Valentine, national president of the brotherhood, came from Muskegon, Michigan. He was assisted by Professor R. T. Jones, faculty member of the department of architecture and a Scarab member from Illinois. Two other members of the faculty—Professors R. R. Robertson and R. C. Jones—were made honorary members. One alumnus, Cyril Pesek, and the following undergraduates were initiated: Neal Nelson, Stanley Bull, Donald Gilfillan, Lawrence B. Anderson, Paul F. Eaton, Lester Cameron, Clyde Lighter, Raymond Rasey, Winston Close, Lawrence Hovik, Gordon Jones and Walter Huchthausen.



DINNERTIME IN CAMP CIVIL

The rusty saw gong sounded the call and husky civils forgot all civilities at the annual summer camp banquet held recently on the shores of Lake Main Engineering Auditorium.

Civils Do Last Gesundheit As Summer Camp Reunion Is Held

"Anderson,—Balkin,—Bolstad," began Mr. Cutler, just as he did morning after morning at 6:10 in front of the dining tent at Civil Summer Camp. It sounded natural to hear that roll call again, but even at that it was not quite right. Ray Kelly was there with his boots laced.

"Young, E. F.—, T. P.," he finished and Mr. Boon dove through the entrance of the tent set at the door of the engineering auditorium just as he had done at camp. But the seniors varied the usual occurrence by doing a Gesundheit march in and around the tables, led by "Railroad" Kelly. It brought back old memories of the triumphal march in to supper that Saturday night after the Totem Pole had been raised and the dedication ceremony performed.

The march broke up and all assembled at the rough board tables in the places taken at camp. When every one was seated the cry began. "Please pass the meat, please," sent high stacked platters moving up and down the tables. Every one forgot formality, talked as they ate, helped themselves and their neighbor, and laughed as the conversation took on the usual trend of work done in camp or supposedly to be done on the morrow.

Everything was as near like it was at camp as it could have been. The boys in working clothes, breeches and boots, but without neckties, appetites, as big as they ever had been after a day's work afield: Balkin after the potatoes, Foster calling for the meat, and Robinson after the pie. Zelner and Cooper swapped the usual jokes and kept the table laughing.

After the eats came the smokes, and then the stunts in which they lived over in a few hours the days spent in camp. Tent 10 did a full day's work in plane table topography in a few minutes; Foster and Gould read triangulation; Kaercher as construction superintendent rebuilt a well known part of camp structure while Ed Young read Whitcomb Riley's poem on a similar structure; T. P. Young went sounding; and Mayerdick gathered wood for the camp stove.

With the conclusion of the stunts the meeting turned to serious business. The matter of organization of the class and publication of a class news letter after graduation was considered from several angles. Different plans were proposed but finally discarded in favor of the single secretary plan. In a ballot, Sam Balkin was elected to the office of secretary. Considering Sam's ability as a humorist, the news letter promises to be a mighty interesting sheet—something to look forward to receiving when all are out on the job a few years hence.

Among the guests of the evening was Truman Rickard, author of "Minnesota, Hail to Thee." When the business was concluded, he took charge of the song fest that followed. Each man carried home with him that night a peculiarly pleasant memory in a carefree mind, for that evening he had forgotten his troubles, his problems, examination, and had lived again those days spent on the shores of Cass Lake.

Shepardson, Touring World, Is Now in Calcutta, India

Professor G. W. Shepardson, head of the department of electrical engineering, is spending a years sabbatical leave by making a complete tour of the world. According to letters received by faculty members of that department, he is at present in Calcutta.

After spending the summer in writing several books and also in designing a new generator while at Benton Harbor, Michigan, Professor Shepardson sailed from New York on the Belgenland, going direct to Cuba. From there he visited Mexico, Southern California, and the Hawaiian Islands. He then took passage to Japan and spent several weeks visiting there and in China, Java and other points of interest in the orient.

From Calcutta, he will go up the Persian gulf, tour the Mediterranean countries and then spend some months visiting in Europe before returning home.

He is visiting Minnesota alumni in all parts of his itinerary. While in Bombay he intends to see Hiram Shellenberger and Glen Cerney, mechanical engineering graduates of 1920.

Professor Shepardson is adding to his large collection of antiques of science and hopes to procure a large number of the oil lamps used by oriental peoples, to add to his collection of primitive lighting equipment of peoples of the world.

A. S. M. E. Club Room Shows Great Improvement

The A. S. M. E. Club Room in the shop building is fast becoming popular with the mechanical engineering students. When its doors first opened little attention was paid to it and, in fact, the majority of the students did not know what it was and made no effort to find out. The A. S. M. E. symbol on the door meant nothing in itself and evoked no particular interest.

AROUND THE WORLD WITH OUR ALUMNI

Architects

'17—George F. Poulsen is with the Steenberg Construction company of St. Paul.

'18—Seeman Kaplan was married to Miss Sada Sharp on January 14 of this year in Minneapolis. After spending a month's honeymoon in sunny California, they returned to Minneapolis and are now at home to their friends at 2400 Harriet avenue.

'22—Howard N. Haines writes that he is teaching this year in the Technical High School in Omaha, Neb. He has all of the mechanical drawing classes and enjoys this sort of work much more than when teaching formerly in Iowa. "Now I have a chance to push a pencil once in a while myself," he concludes.

'23—Otto C. Person, former business manager of the Techno-Log is now working for the Schuett-Meier company in St Paul. He writes that he enjoys the Techno-Log very much especially the news items as he is so busy that he never has time to look up the old friends around the campus. Person was married last Christmas.

'24—Paul E. Nystrom, former staff member of this magazine, recently returned from an extended trip to Florida. Members of Alpha Rho Chi fraternity were surprised to find a mud spattered car, carrying a Florida license, parked outside of their house the other noon, and upon entering, found the genial Paul, none the worse for his healthy coat of tan.

'25—Alvin Rigg, the man with many keys, has accepted a position with the North Dakota Architectural College as assistant instructor of architectural design. He left recently to take up his duties and will be located at Fargo.

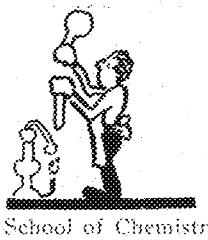
'25—George Freeberg, who last spring won the Moorman Traveling Prize recently returned from his trip, which included the most important architectural centers of the east and incidentally the best shows and football games. He spent several hours the other day entertaining the department with an account of his travels.

'25—The latest dope from Edward Molander is that he is "arkitecting" in that "sylvan retreat" of Cedar Rapids, Iowa. We expect to hear of Molander stepping off one of these days.

Chemists

'06—Ch. E. '07—J. C. Halverson is research chemist with the State Department of Agriculture at Raleigh, North Carolina. He is a co-author of several papers which were delivered before the meeting of the American Chemical Society at Baltimore. While in attendance at this meet, he reports seeing Russell McBride ('08) of Washington, D. C., as well as Dr. Gortner of the University of Minnesota.

'07—Walter L. Badger, who is professor of chemistry at the University of Michigan, finished his text-book on "Evaporation and Heat Transfer" last spring during a leave of absence. He completed his work in his office, directing several graduate students at the same time as well as giving a seminar course evenings. One of the men working with him in investigations was Mr. George H. Montillon, assistant professor of chemical engineering at Minnesota, who completed his thesis for a Ph. D. degree with Mr. Badger. During last summer, Mr. Badger attended the meeting of the American Institute of chemical Engineers and in company with his wife visited many eastern cities. During September, he was called as a consultant with the American Trona Corporation to their plant at Trona, Cal. He returned to Michigan shortly before the starting of school.



'19—The marriage of Arthur C. Beckel to Miss Francis Hollenbeck ('20) occurred on last December 1. Both Mr. Beckel and his wife are well known in musical circles. He was a former member of the faculty of the School of Chemistry and has recently accepted a position with the Mayo Clinic at Rochester where he and his bride will make their home.

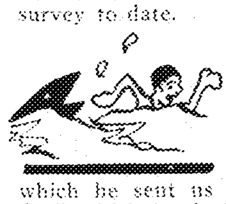
'21—M. W. Seymour, who received his Ph. D. in chemistry from Princeton last year, has been working in research in the color photography at the Eastman Research laboratory at the Eastman Kodak company at Rochester, N. Y.

'24—Karl F. Paul and Juanita Day, daughter of Mr. and Mrs. Charles P. Day of Depue, Ill., were married Tuesday, February 2, at the home of the bride's parents. They will make their home at Kenvil, N. J. Mrs. Paul is a graduate of Bradley Polytechnic Institute.

Civils

'91—Walter A. Chowen is manager of the California Inspection Rating Bureau and is located at 216 Pine street, San Francisco.

'15—Warren Withee, assistant engineer for the United States Geological survey, is a co-author of a report on the water resource of Tennessee, a complete compilation of all records of stream flow for that territory prior to September 30, 1924. He states that the government is now engaged in making a very comprehensive survey of the Tennessee river basin for the purpose of determining the power possibilities of that great river. Aerial photography was made use of for the first time on a large scale. Over a half million dollars have been expended on the survey to date.



'22—Ellsworth Johnson, who is wintering at Miami Beach, Fla., has been doing some remarkable fishing lately as evidenced from the photograph which he sent us showing a large "sail fish" which he had caught while fishing for kingfish. This monster of the sea was over seven feet long and made the scales groan at 56 pounds. It derives its peculiar name from the large collapsible fin which it has on its back and which can be raised or lowered at will. Johnson states that swimming is a daily occurrence with him with the result that he is as tan as a pair of Cordovan shoes.

'24—M. V. Harrington is working with Brush and Bondy, civil engineers at Brandenton, Florida. Brandenton is situated on the south side of Tampa Bay. Like all emigrants to Florida, Mr. Harrington says that he likes the climate very well.

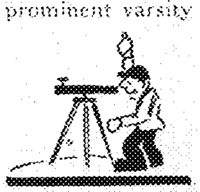
'24—S. Caryl Chapin, former advertising manager of the Techno-Log, is now city manager of Lacrosse, Kansas. He was formerly with the Illinois State Highway department.

'25—Joseph P. Lushene, who is with the U. S. Coast and Geodetic Survey, writes that they have just completed their survey of Tampa Bay, and will now take readings up and down the west coast of Florida. Wading in mud up to his hips in topography work is one of his occupations. Because of the variety of work they must do, Joe has five uniforms, two khaki, two white, and one blue. Many of his party have received orders to go to the Phillipines but Lushene intends coming back to Minnesota in the near future. His present address is Box 147, St. Petersburg, Fla.

'25—Clifford Swanberg is working in the U. S. Army engineers' office at Milwaukee, Wisconsin.

'25—E. I. Quinn is with the State Highway Commission at Owatonna, Minn., where he is working on paving construction.

'25—Harold Bird and Horace Nutting recently left for Florida where they will be employed in construction work during the winter months. Both men were very prominent varsity swimmers.



'25—Arthur J. Kroll has been spending the month of February down in New Orleans taking in the sights of the Mardi Gras. He was sent there by the Illinois Central railroad to do the necessary surveying for a new mechanical facilities plant, which will replace the one that burned down on New Year's day. Art says that the town is very much like old France with its overhanging porches, rusty shutters and oil lamps.

'25—Professor Cutler must have aroused the railroad spirit in his classes because seventeen of the class have gone into this field. The Illinois Central has seen fit to take six of the class. They are: Moris, who is in a surveying crew at Belle River, Ill.; Art Kroll, in a building department making use of Freddie's hydrology in reservoir construction; Bartholomew who is on construction work in Thompsonville; Steve Donahue who is also doing construction work but at Dublin, Ky.; Carlbom who is at Jackson, Miss.; and Baldy Eilers who is in the Maintenance Department of the Chicago Terminal.

Larson, Gobeli and Burns are with the Santa Fe. Fred is at Newton, Kansas, and Art and Dwight are at Lehman, Tex., freezing in tents which are their bunk houses. Banovetz, Waldor, Wolf and Haima are with the Northern Pacific. John is on a grade separation job in northern Minneapolis. Ted is designing in the office. K. M. Olson and "Tony" LaBonte are with the Milwaukee. Tony is in Milwaukee while "Dinty" is in Chicago as assistant architect. Moore is with the Pennsylvania in their divisional offices in Chicago.

'26—George Ohman, a March graduate, is now employed by the U. S. Engineers Office at Milwaukee, Wis., in office and field engineering work.

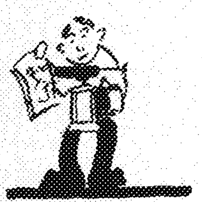
Electricals

'11—Martin J. Orbeck spent his vacation in the Reserve Officers Training Camp, Custer, Mich. Mr. Orbeck is Assistant Engineer with Holland, Ackerman and Holland and is located at Ann Arbor, Mich.

'12—Albert L. Thuras was one of the designers of the new Victor Orthophonic phonograph. He is employed in the communication research division of the Bell Telephone laboratories in New York city and was one of the designing engineers present when the device was first presented to the public at a private gathering of businessmen last November.

'14—The announcement of the engagement of Harold E. Harris of St. Paul to Miss Catherine Clayton ('24) has been recently made.

'15—Otto E. Jackson and his wife have moved to their new home at 4722 Nicollet avenue, Minneapolis, where they are at home to all of their friends.



'20—O. O. Kruse has resigned his position as sales engineer for the People's Gas, Light and Coke company of Chicago and is now working for the American Can company of that city as industrial gas engineer. His address is at 5352 Fulton street, Chicago.

'22—I. M. Ellestad is in the Maintenance Department of the N. W. Bell Telephone company at Minneapolis. His home address is 509 Beacon street S. E.

'22—Arthur C. Willard is located at 601 Philadelphia building, Pittsburgh. He is in the Engineering Department of the Duquesne Light company.

'23—Leroy A. Grettum is with the Wisconsin Railway, Light and Power company at their Winona offices.

'23—Edwin A. Friedman is in Mexico, Ky., installing electrical equipment for the LaFayette Flourspar company.

'23—Donald E. Thorne has been transferred from the Indianapolis office of the Western Union Telegraph company to the office of the vice-president of traffic at 195 Broadway, New York city. His assignment is in the cable division of the North American or westward side.

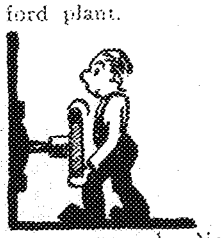
'23—William F. Helwig has left the General Electric company at their Chicago office and is now in the sunny south teaching at the University of Texas at Austin.

'23—C. R. Zimmerschied will be permanently located in New York city where he is now in the sales offices of the Electric Machinery company.

'23—Mr. and Mrs. Walter F. Kannenberg took a three week's honeymoon this summer in the form of a 2,500 mile automobile trip overland to New York city, camping enroute. Walter spent last year in graduate work at Minnesota and is now with the Bell Telephone Laboratories in New York. He can be reached at 37 West 88th street.

'24—Charles M. Burrill is back at Schenectady in the induction motor engineering department of G. E. He spent the summer months in their Pittsfield works studying transformer problems.

'24—Ivor W. Johnson remarks that most of the fellows who took the test course at G. E. in Schenectady are drifting back closer to home. Of the 24's, Joe Kater was the first to come back to Chicago. He is now working in the Sanitary District. Then there is Kenneth Ross who is with the district office of that company in Minneapolis. Johnson was the next to come and is with the Brunswick-Balke-Collender company at their Rockford plant.



'24—J. S. Mayer who was in the Engineering Department of the St. Paul Gas and electric company is now with the Northern States Power company since the taking over of gas company by Northern States. He is married and is living at 1812 4th street S. E., Minneapolis.

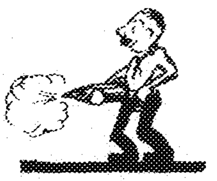
'24—Leonard Frazee was married to Miss Doris C. Jacobs in Pittsburgh, Pa., last November. Frazee is assistant superintendent of the Morgantown Public Utility company at Morgantown, W. Va.

'25—Van Meter Cousins is another of those joining the ranks of the married. He is now with the Bell Telephone Laboratories in New York city but makes his home at 545 sixth avenue, Lyndhurst, N. J.

'25—The smiling face of Arthur Christensen is seen once in a while around the of the Northern States Power company at their Minneapolis office.

'25—Harold H. Heins has been transferred to the Sharon, Pa., works of the Westinghouse Electric and Manufacturing company.

Mechanicals



'10—The kind of work that Donald McD. Westbrook is connected with takes a lot of wind judging information we have received that he is the general manager of the Chicago Pneumatic Tool company at their Canadian branch in Montreal. His address is 25 St. Antoine street, Montreal.

'10—Wallace H. Martin is professor of heat engineering at the Oregon Agricultural College location at Corvallis.

'14—James A. Colvin, who is the superintendent of generation for the Northern States Power company, was a speaker at the joint meeting of the student and northwestern branches of the A. I. E. E. which was held recently at the High Bridge station of that company.

'16—Charles W. Stone is the sales representative of Niles, Bement, Pond company and Pratt and Whitney company with offices at 507 Lincoln Bank building, Minneapolis.

'18—George H. Bierman is with the White Motor company at Cleveland in the capacity of technical assistant to the superintendent of heat treating.

'19—Milton S. Wunderlich is with the Flaxlinum insulating company of St. Paul.

'20—Everything is running smoothly in Indiana judging reports we hear from Glen C. Cerney who is a lubrication engineer for the Standard Oil company with headquarters in Bombay, India. If you write him, address it in care of the New York office of that firm.

'20—Paul W. Rhame, a former faculty member, is now the superintendent of inspection for the A. C. Spark Plug company at Flint, Michigan.

'21—Sven A. Vaule, former St. Pat. in the year 1921, is vice-president of the Grice Associated, industrial engineers with offices in 301 Metropolitan building, Minneapolis.

'22—Clarence J. Eddy is in the Mechanical Department of the Minneapolis Tribune.

'23—Chester R. Marshall is a results engineer with the Northern States Power company in the Twin Cities.

'23—Delton T. Waby is a service engineer for the Public Service company of Illinois.

'24—Robert K. Erskine is with the Minneapolis Heat Regulator company. Address him at 1780 Goodrich avenue, St. Paul.

'24—George F. Berry is a combustion engineer for the Northern States Power company at their Sioux Falls plant.

'24—Edgar M. Nelson is now in Cleveland, Ohio, working for the Ohio Bell Telephone company.

'24—William J. Darmody has left the Northern Fire Apparatus company of Minneapolis and is now working for the Bureau of Standards in Washington, D. C. Address him at 3108 18th street N. W.

'24—Donald E. Earl has also left the old home town and is now a patent examiner in the United States patent office in Washington. He writes that he likes the work exceedingly and that the patent office is over 40,000 patents behind. His address is 1736 G street.

'25—W. Oswald French and Gertrude M. Fitzgerald have chosen Wednesday, April 21, as the date of their marriage. Mr. French is working for the Mississippi Valley Public Service company at Winona. Miss Fitzgerald is a graduate of St. Catherine's college in St. Paul.

'25—Webster Pendergast is with the Northern States Power company as a boiler room engineer at their Riverside station in Minneapolis.

'25—Roland Holmes is at Wilmington, Pa., with the Westinghouse Air Brake company.

'25—R. W. Boss is with the Specialty Manufacturing company at Midway, St. Paul.

'25—Smith Eggleston is with the Standard Conveyor company at North St. Paul.

'25—Elliot L. Ludvigsen is in Cleveland, Ohio, in the engineering department of the White Motor corporation.

Miners

'06—Walter H. Wheeler has been recently awarded the contract to build an 18 story concrete structure in Denver, Col., one of the largest ever to be erected in that locality. Wheeler has in past years constructed many buildings in the west and only lately was awarded additional contracts entailing several hundred thousand dollars expenditure.

'11—William F. Jahn is the general superintendent of the Minas Pedrazzini Gold and Silver Mining company located down in Arizpe, Sonora, Mexico. This is one of the largest gold mines in Mexico. He writes that no trouble is experienced with greasers.

'16—Alvin T. Krogh is in the metallurgical research division of the Westinghouse company at their East Pittsburgh Plant.

'17—John A. Moga has deserted the pick ax for the more delicate tools of probing and is now taking a medical course at Minnesota. He can be addressed at 271 Charles street, St. Paul.

'23—All miners do not go very deep into the earth judging from Harry M. Wrbitzky who is a junior highway engineer with the Illinois Highway Department, and located at Peoria.

The
MINNESOTA TECHNO-LOG
University of Minnesota

EFFICIENCY, efficiency—that is the cry which is heard today in all branches of industry. Will this machine give more for a certain output, can our firm get more for the money if that apparatus is used? All manufacturers are expending huge sums of money for the sole purpose of raising the efficiency of their product though it is a small percentage. The test for results is the final step in any engineering job. Plans that exist on blueprint slowly took form in steel and concrete. When completed, they await the most important step of all—the test. Were the plans correct, was the mixture well proportioned, the steel of sufficient strength? In other words, is it efficient?

This principle applies in a startling sameness to ourselves as students. How efficient are we—what is the result of the labors which we expend each day that in the future we may be known as graduates of our university? First of all, we must have units by which we can measure the input and output of "Ourselves," the machine now under consideration. Let us arbitrarily select the number of hours of actual study for the larger amount in this ratio. Upon what can we base our output? The results that students attain are various. Some do not concern themselves with grades while others delight in a straight A or B average. We honestly believe that they are those who work to gain a practical knowledge and then those who work for the mark, nothing else. However, the most apparent result is the grade and this we will take as the result of the student's study.

The means of measurement decided, let us proceed. Here we have Bill, a regular fellow who works hard and plays hard. He is not a bookworm nor does he pay visits to the student work committee. Bill sits down for a couple of hours each night and digs—really works. Moments of his spare time are spent in working on an outside job or perhaps in the pursuit of worth-while extra-curricular activities. He spends on the average of two hours a day in study and has a C plus average. His efficiency would then be 75 per cent using a C plus average as the equivalent of one point and a half. Then there is Jim, more or less of a grind who is not a bit smarter than our friend Bill and is lazier. He does not concentrate when he studies and each day it takes five hours before the morrow's lesson is ready. However, his extra time tells somewhat and let us assume a B average for Jim. His efficiency is only 40 per cent.

But what have we here? Behind his thick glasses and pale complexion, we recognize Clarence whom we only see in the classroom. The prof needs only to know the first of the alphabet when it comes his turn for a grade. He studies. For our calculations, assume that his input is five hours, and in ratio with his A average, a percentage of 60 is the result. But you say, how about the fellow who studies one hour a day and has a C average, or the one who puts in a brief thirty minutes and has a D? This theoretical scheme of ours like other rules, has limitations which conditions of practice impose upon it. We have yet to see the man who can get a C average with an hour's study or a D with half that time. Thus it is through the whole rank of engineering students. What some lack in brilliancy, they make up in persistency. There is the flashy one who starts big, falls off and even is confronted with F's.

The question arises—what is the ideal student? Marks are of paramount importance and so are activities. The ideal student is the most efficient one—he who does not waste time but is on the job every second, either working or playing. He may not get the highest average but he has done his best. He may not be successful in campus politics, but he made a good run.

There is a variety of activities which offer opportunities—dramatics, music, publications all are in constant need of more and better participants. These will, perhaps, happen upon some hidden talent. It is the unhappy tendency for engineering students to become too absorbed in their work. Mix a little activity with this situation and there is a paradoxical outcome—a studious, active, all-around fellow. There are too few Bills in our college today.

By the way, let's figure up our efficiency for the last quarter.

THEORY and practice, the classroom and the shop, these are the two contra-distinctive sides of a educational system in general, applying in entirety to a technical training. We of the classroom often do not realize to the fullest extent, the existence of definite applications of things we study in school to everyday life. It is often heard that the training we are receiving is too one-sided, that theory, and that alone, is stressed. The classroom is the place for theory, fundamentals must be learned in school. This is unavailing if it cannot be made applicable when the short four year's course is finished. To more properly orientate scholars of a subject, to nearby plants, industrial systems, or in short wherever there is actual practice, inspection trips should be made.

Now as to being more definite, the civil's visit to the large water supply systems of the Twin Cities and other places, would prove instructive, it would be commendable if the electricals would organize a trip through the stations of the local power company, inspect the workings of telephone and telegraph companies, in visiting some of the large factories, foundries and shops of the city, the mechanicals might pick up many new side-lights on their profession. Thus through all of the departments, this practical side could be emphasized far more than it is at present. Even extended trips during vacation throughout the middle west and eastern states could be arranged.

Some of these must come from the department heads, others could be put into effect by the several student branches of engineering societies. Little or nothing is being done about it. It is high time that this feature was fully recognized in the engineering college.

Across the Editor's Desk

The Day of Days

A university without traditions is nothing, an engineering college without its annual Engineers' Day would be hard to imagine. Outsiders often wonder why we engineers stop work for an entire day, and with weeks of preparation, pull off a combination of a three-ring circus, including all of the side-shows, the parade and everything. Those of the School of Dentistry could have a grand and glorious tug of war if they wanted to; the medics would not meet with any stiff opposition if they wanted to present a parade or open house, but all of the various colleges with the exception of the ags, who have their annual livestock show and field day, do not make any pretenses towards showing the rest of the university the why and wherefore of their existence.

The reason is easily answered. Real ambition and enthusiasm is bound to bubble over sometime—you can't keep a college of 1000 red-blooded engineers d o w n. Thus Engineers' Day. The juniors are to be congratulated upon their selection of Richard Trexler, mechanical editor of the TECHNO-LOG, as their general arrangements chairman. No one could better represent St. Pat than Raymond R. (Railroad) Kelly, the unanimous choice of the seniors for their patron saint. The committees are representative.

Now is the time for all good engineers to come to the aid of their party. The day is fast approaching and with it comes the multitude of tasks which must necessarily be done that it be successful. Freshmen, it is up to you to make floats for the parade. Sophomores and juniors, upon you rest the burden of working on the details. Seniors, we must purchase green paper hats and emerald capes so we may fittingly march April 23 in the great parade across the campus to the knoll where we will be knighted into that royal Irish order of St. Patrick, maker of the first worm drive.

Vale

They took out the Blarney Stone the other day and a dozen of our number, after kissing this bit of Irish folk lore, forgot school and started out into the world. Our numbers are starting already to thin, these March graduates, fellows with whom we have associated for four pleasant years, leaving college, never to return. Incidentally, when he heard of the salaries these boys were starting with, we resolved that our course should have been civil, not electrical.

One of these graduates was R. Conrad (Con) Cooper, football and boxing star during his entire college career. Athlete and engineer, here's to Con Cooper, graduate of the March civil class of 1926.

FACULTY SKETCHES

WILLIAM F. HOLMAN

PROF. WILLIAM F. HOLMAN, familiarly known to the faculty and students as "Doc," hails from the state of Nebraska, land of tall corn and golden wheat. It was there he grew up and received most of his education—before the age of autos, when bicycle races were headliners at the county fairs, and shocking wheat and pitching hay furnished the bulk of the summer's entertainment.

"Doc" took his first look at the world and decided that it was good at Friend, Nebraska, March 6, 1883, but when nine months old he moved to Tobias, taking his parents with him. His early boyhood and youth was spent in this town, which was located about 60 miles southwest of Lincoln and boasted of a population of about 400, and at the age of 15 he graduated from the local high school with a record senior class comprising five boys and three girls. After one year of work in his father's store, he decided to enter the University of Nebraska and registered for a two-year course in general science. During the sophomore year at the U he was made student assistant in the physics laboratory and corrected papers during his junior year at the munificent salary of 25 cents per hour. He shifted his course at the end of the second year to electrical engineering, but continued his work in the physics department for the remainder of his stay at the University. He was initiated into the Phi Gamma Delta fraternity when a sophomore.

Directly after his graduation in February, 1904, when 20 years old, he was employed by the General Electric company at Schenectady, but after a period of two months his health failed and he returned to his home in Nebraska. It was during September of that same year that he returned to the University to renew old acquaintances on the campus that he incidentally got in touch with the Physics Department. On meeting the head of the department, he was offered a scholarship for one year and immediately registered for additional study in physics. He pursued the same line of study for another year when tendered a fellowship and received his M. A. degree in 1906. During these two years of graduate work he had charge of some laboratory work and in the spring semester of 1906 had complete charge of the course in electrical measurements. Because of his research work in physics he was elected to Sigma Xi.

Mr. Holman left for Goettingen, Germany, on the first of September, 1906, and studied there for two years, majoring in physics and minoring in mathematics. He received his Ph. D. in July, 1908. During the spring of that year he met Prof. Brooke and the two became intimate friends.

He returned to the United States in August and accepted a position as instructor in physics at Worcester Polytechnic Institute, Worcester, Massachusetts. At the end of the year Mr. Holman came to the University of Minnesota and became a member of the faculty in the department of physics. He resigned after two years to go into commercial work and entered the field of structural engineering, but on Thanksgiving in 1911 Prof. Haynes of the department of Mathematics and Mechanics in the College of Engineering of Minnesota suffered a stroke of paralysis and Mr. Holman took charge of his classes through the recommendation of Prof. Brooke, and since then has been with us constantly taking active part in student affairs. He was promoted to a full professorship in 1921.

"Doc" has been president of the Inter-fraternity Council and the chairman of the Advanced Standing Committee for the past eight years; has served for two years on the Delinquent Students Committee which is now the Student's Work Committee; is a member of Acacia, and an honorary member of the Theta Tau and Alpha Rho Chi fraternities.

An epoch in "Doc's" life occurred in 1914, when he committed matrimony. He married Miss Grace Parkhurst, of St. Paul, and has two children, John and Jane, twins, six years old. He is an enthusiast of duck and rabbit hunting, but also confessed his liking for golf, and swings a wicked mashie in the pursuit of the elusive white pill.

Spring Politics

Spring brings spring fever and campus politics. Already, aspirants for office are lining up their respective forces for the various jobs around the engineering college and hot will be the competition for some of the positions. Engineers hold a respected and prominent place in campus politics. One person said the other day, "You fellows all get out and vote." That is what puts the kick in elections. A student body with a mass vote of a thousand will swing any campaign. In the past, the outcome have hinged about the engineering college and they will in the future.

To some, politics seems like a lot of piffle. What good are outside activities anyway is sometimes asked. Politics, one kind or another, determines many jobs though the open poll is not used. Campus politics develop a political sense. The time has come when the profession must go out among leaders and demand for themselves the things that they justly deserve. About an engineer in politics, who would make a better mayor of a municipality than an engineer?

Returning to the spring elections, may the best man win.

An Addition

At last we had to do it. Cast your eye over our editorial masthead and you will see that man's domains are sacred no longer—we have one of the feminine sex on our staff. To be exact, Margaret Bradbury, junior in interior decorating, is the addition. Her presence has caused a marked change in the language about our office already. We claim to be the only member of the E. C. M. A. with such a member on its staff.

Making a Grade

We have a novel custom—that of posting the marks of every student in the college. This frank, open manner of announcing each student's grades unconsciously tends to instill competition. Part of the satisfaction of a good grade is letting the world know about it and when you get a poor one, you can have the sympathy of all of your friends automatically.

The Graduate in Industry

(*Continued from page 179*)

requirements are, the college has a poor chance to interpret these needs. Just what means are best adapted for establishing understanding between education and industry on this point are not yet fully understood. Some means, however, that some industries have found to be valuable aids in meeting such needs are the sending out of practical men for the purpose of lecturing before students on various phases of engineering work. The colleges themselves, in spite of the crowded curriculum, are well prepared to receive and utilize such a service through the medium of their student branches of the national engineering societies such as the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. Quite a number of industries see fit to afford opportunity during summer months or periods of sabbatical leave for engineering teachers to engage in practical engineering work. Three or more of the larger manufacturing companies actually plan summer conferences for engineering teachers in which, in conjunction with some engineering work, the teacher may acquire in a brief space of time quite a broad contact with many of the principal phases of industry's problems. Other industries are sending out to the schools problems of a practical nature actually drawn from their files, which, if not used in the actual instruction work, are nevertheless valuable in portraying to faculty and students the nature of the work they may be required to meet in practice. Timely messages from industry to the colleges, either in the form of letters or in the form of photographic illustrations, have been found another valuable means of contact. Many of the larger industries operate motion picture and lecture bureaus the subjects of which deal with technical problems, and which are available without cost to the colleges. It must be clearly shown the college men just what the jobs to be done are and what the requirements in each case are. *It is a tremendously bigger problem for the college man to find the right job within the industry he enters than to select the industry.*

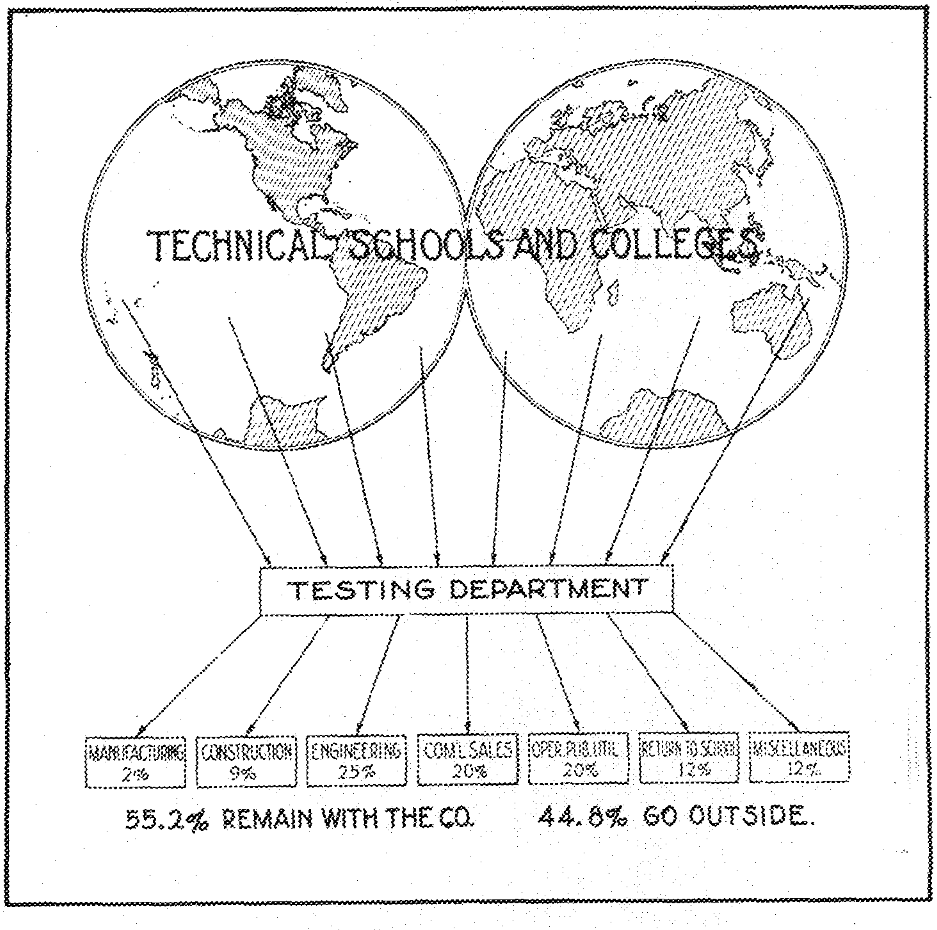
Today the young electrical or mechanical engineer may very properly find outlet for his abilities in any of the following fields:

Pure Research
Design
Manufacturing
Erection
Application
Sales

The job specifications for each of the above-named lines of work are very different. Each requires men of different tastes, personalities, interests, and type of mental abilities, but they are all fields for engineers. In general, those lines of work at the head of the list require a higher degree of scholarship, mathematical ability, and analytical prowess with less emphasis on the elements of personality, leadership, co-operativeness, etc.; while the reverse would be true with those functions at the end of the list. Men entering the middle section of the list should be pretty well balanced with physical qualities—physique, health, energy, endurance, etc. The list presents a functional classification of engineering work—a classification, as it were, laid out at right angles to the old-style academic classification referred to above. To go into detail regarding the nature of the duties of engineers in each of these fields would be out of place in a paper of this kind. Most of the larger manufacturing companies have more or less well-prepared job specifications regarding them.

In making a selection of two hundred and fifty college men a year, out of eight to ten times that number of applicants, the company with which I am connected places more emphasis on choosing groups of men of specific tastes and aptitudes in proportion to the needs of the various functional departments of the organization than on endeavoring to secure all Phi Beta Kappa or Tau Beta Pi men. Scholarship is not the sole criterion. Some college teachers have been greatly surprised at the offers which have been made at the end of a day's work of interviewing. Some men of high record have been rejected, while others of considerably lower scholastic standing have been offered appointments. As near as the system may be reduced to a record form, a scale somewhat similar to that devised by the Committee on the Classification of the Personnel of the Army used for rating officers for promotion is used. Not to go into detail, which can be gotten from a study of the blank, it will be noted that ratings are given in (1) physical qualities, (2) intelligence, (3) leadership, (4) personal qualities, and in (5) special talent. In using the scale, it is essential that the principles laid down by the Army Committee be followed and that each interviewer have established in

(*Continued on page 202*)



EMPLOYMENT CHART OF GENERAL ELECTRIC COMPANY

These figures are based on survey made over past four years of the 2000 graduates from leading technical colleges of the world, who passed through the testing departments.

Our Geologic Past

(Continued from page 187)

dark coarse-grained rock, the so-called gabbro, familiar to those who have examined the steep slopes of Duluth and their continuation for a hundred miles along the north shore of Lake Superior. (Fig. 7.)

Mill. Yrs.	*Main Divisions*	*Main Events*	*Advances in Life*
5	Cenozoic	Glaciation	Man
20	Mesozoic	Upheaval	Mammals Birds Reptiles
75	Paleozoic	Upheaval Glaciation Coal	Amphibians Fishes Land Flora Invertebrates
25	Keweenawan	Upheaval	
50	Upper Huronian		Marine Flora
100	Huronian	Upheaval	Marine Flora
100 to 300	Archean	Upheaval	First Life (Algae)

FIG. 8. GEOLOGIC TIME TABLE
Sequence in proper chronological order begins at the bottom of diagram.

This period of rock intrusion was economically extremely important for the largest nickel deposits of the world at Sudbuey, Ontario, the great silver veins of Cobalt, Ontario, the rich gold ores of Porcupine, Ontario, and the vast copper belt of Michigan had their origin in connection with contemporaneous intrusions. Basalt lava flows issued also in quantities so vast that we have difficulties in estimating their volumes. Since they are especially abundant on the Keweenawan Peninsula, this time of intrusions and extrusions is called the Keweenawan epoch. At Taylors Falls, Minnesota, we may observe a lava flow of this period at the power dam. The Keweenawan epoch left a profound geologic record the world over, as practically the same type of rocks as those in our state were erupted at that time on all continents. So vast were these changes that until about 14 years ago geologists had been unable to discover any fossil life whatsoever in the rocks as old or older than the Keweenawan. Since, however, comparatively highly developed organisms such as mollusca, crustacea, corals, sponges, etc., had been found in the rocks immediately following the Keweenawan epoch, it was logically concluded that life had existed long before that time. Dr. Walcott of the Smithsonian Institution of Washington, within the last few years has found evidence of plant life (algae and bacteria) in the older rocks including the Huronian epoch, while the present writer has recently been so fortunate as to find microscopic fossil algae (Fig. 1) in even the oldest sediments, those of the Archean.

Before we continue our history, let us digress a moment and observe what changes have taken place in the iron formation of the Mesabi Range. We left it as shown in figure 7, lifted up to practically its present position. The slate was eroded in the course of time and the iron formation, consisting of about 40 per cent of iron oxide and 60 per cent of silica, was exposed to the atmosphere. Now, according to our present definition of iron ore, the composition given above is not an ore. To come under this classification the iron oxide would have to be concentrated to about 80 per cent. The only way this could happen was by the removal of silica; and that is exactly the constituent that was removed, not all over the formation but from approximately 8 per cent of the iron formation that outcropped. The silica was dissolved in these places by the ground waters. Hundreds of millions of tons of silica were carried away in the millions of years that followed.

That it took a tremendously long period for the leaching of the silica is proved by the fact that silica is one of the most difficultly soluble oxides. We even make dishes out of it for the chemical laboratory because it is so resistant. Only iron oxide is more insoluble under natural surface conditions, and that, of course, is the reason that it remained in place. After the removal of the silica the formerly solid iron-bearing rock was like a sponge full of pores and cavities. Whenever the weight and overburden which this porous iron oxide had to support became too great, there was a slump and caving in of the surface with a consequent reduction in the volume of the iron ore. This slumping is sometimes recognizable at the surface and may lead to the discoveries of ore bodies. The latter are usually very irregular in outline and size, and their extent must be determined by diamond drilling.

In the early days of exploration the compass was an indispensable instrument for the iron prospector, for it indicated the general location of iron

(Continued on page 200)

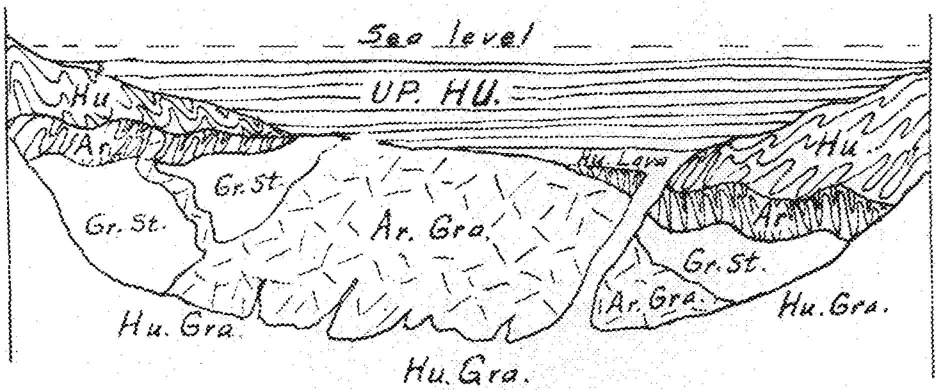


FIG. 6. UPPER HURONIAN SEDIMENTS (UP. HU.) OF IRON FORMATION AND SLATE.

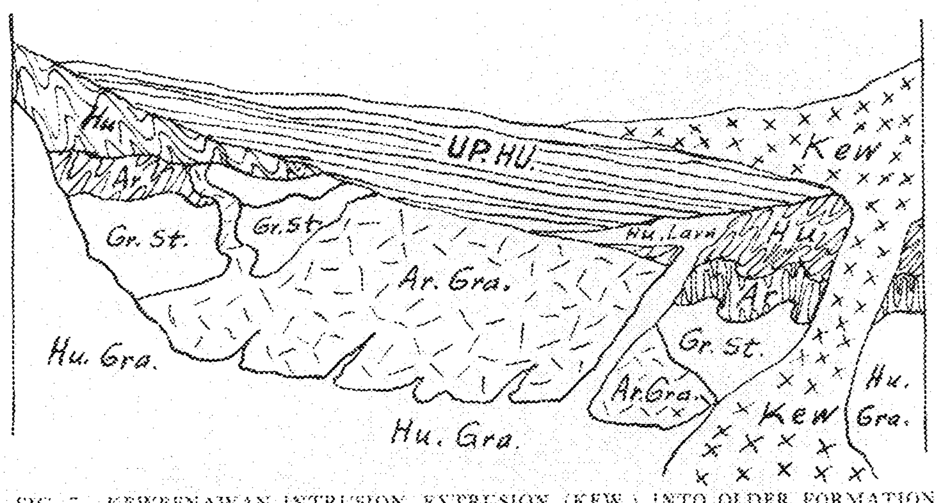


FIG. 7. KEWEENAWAN INTRUSION, EXTRUSION (KEW.) INTO OLDER FORMATION.

The Mercury Turbine

(Continued from page 185)

of temperature; that is the drop in temperature between the throttle and the condenser. The portion of this theoretical maximum which can actually be secured depends, among other things, on the properties of the working substance (steam). Now, water steam has properties favorable to its use in a temperature range from, say, 500 deg. F. to 79 deg. F., but is at a disadvantage in a higher temperature range. Mercury on the other hand has properties favorable to the range from 500 deg. F. up to perhaps 1,000 deg. F. or even higher. Consequently the combination of mercury and water in a binary vapor process makes possible an extension of the working temperature range under conditions favorable to the realization of a fair proportion of the corresponding theoretical maximum efficiency.

Figure 3 shows the theoretical advantage of the binary vapor process. The cycle for steam of lower pressure, one superheat and bleeding at two stages is clearly shown. It should be noted that the theoretical economies are just about the same in both cases.

This figure brings out the wide range of steam pressures that can be used in the binary vapor cycle. Since the range of saturation temperature of steam is small over a wide range of pressure, it is only necessary to vary the vacuum in the condenser boiler a little in order to produce steam at any desired pressure below the critical. For example, mercury condensing in a 29 in. vacuum produces steam at 200 lbs. pressure. Steam at 800 lbs. pressure could be produced by mercury condensing in a 23 in. vacuum.

The temperature entropy curve for water in these figures brings out the limitation of this substance in the higher temperature range. The dome of the curve is at about 710 deg. F. and the proportion of area representing available energy increases very slowly with increasing steam pressure, especially unless superheat and bleeding are added, the former to gain some of the advantage of increased temperature range, and the latter to recirculate some of the heat instead of dumping so large a proportion of it into the condenser. The dome of the temperature entropy curve for mercury is far above the range of temperatures now practicable for boiler operation and the area representing available energy does not narrow to any considerable extent within this range.

Bleeding to heat the feed water, and superheat have resulted in very decided increases in steam turbine efficiency within the last four years. However, as the diagram shows, the mercury cycle can be superimposed on these latest steam cycles with additional increases in efficiency. If the temperature range is to be increased above that now used in the latest steam practice (700 deg. F.), the mercury vapor cycle seems to offer the logical means for securing the corresponding efficiencies.

Editor's Note: Dr. Newkirk is a former member of our department of mathematics and mechanics and will be pleasantly remembered by his host of friends at Minnesota. He recently paid the campus a visit in his itinerary of several colleges, lecturing on the developments under way by his company on the balancing of the rotating parts of large machines. Every alumnus in Schenectady is always welcome at Newkirk's home, another example of his extreme loyalty to Minnesota, his alma mater. We are fortunate in being able to present this article by Dr. Newkirk.

Our Geologic Past

(*Continued from page 196*)

formations, which are usually magnetic. The ore itself, however, as mined in Minnesota today, shows no magnetism and cannot be traced with the compass except insofar as a magnetic iron formation surrounds non-magnetic ore bodies. In other words, if one could show that magnetic attraction is very marked around a certain area, but not in the central part, there might be a possibility for ore, provided that this non-magnetic central area were not too large. Many factors, however, enter into such considerations and only the experienced geologist can offer a reasonably definite opinion on problems of this kind. No divining rod has ever discovered an ore body anywhere. Lately, instruments for electrical prospecting and specially constructed torsion balances have been used by scientifically trained men with some success in metal and oil explorations, but these must not be confused with the numerous "doodle bugs" which unscrupulous promoters show to the public.

Let us now return to our geologic history which we left at the end of the Keeweenawan epoch. It seems that after this period, all Plutonic forces which had given rise to such extensive volcanism had been spent forever for this section of the continent. While there have been occasional slow subsidences of Minnesota below the ocean no violent upheaval has occurred since then. Our state in this respect belongs to the large geological unit surrounding Hudson Bay, which is called the Canadian Shield. This area has enjoyed this comparative quiet for probably fifty to a hundred million years. During this time the rest of America and the larger portions of the other continents have undergone profound changes and upheavals which have produced, for example, all of the now existing mountain ranges of the world.

The Paleozoic epoch which followed the Keeweenawan, is of importance in many respects, though Minnesota experienced only a couple of relatively short inundations in the seas at the beginning of this epoch. The results were the flat-lying sandstones, shales, and limestones which may be seen in the river gorges surrounding the Twin Cities. Probably the best known exposure is the rock ledge over which Minnehaha Creek has sent its waters for a good many thousand years. About the time that Minnesota rose above the waves, in the Paleozoic age, the first fishes appeared in the ocean. Somewhat later the oil-bearing rocks over Texas, Oklahoma, Illinois, and Pennsylvania got their start and the first amphibians may be found as fossils in rocks of this age. The age of coal-making (Carboniferous) began about this time and its rocks spread over the whole earth. At the end of this period the earth became arid and much salt was deposited in many lands. And quite in keeping with this change, there evolved from the amphibian an animal suited to life in these arid regions—the reptile.

The Paleozoic chapter of our history ends like all the previous ones, with a tremendous upheaval over a large portion of the earth. The Appalachian Mountains rose (probably to stupendous heights) about that time and introduced a new era—the Mesozoic or Middle Ages. These Middle Ages were, however, more progressive than the dark ages of the historian, for they produced the first birds and mammals and witnessed the rising of the Sierra Nevada of California. Minnesota, hav-

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The Graduate in Industry

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his mind persons opposite each of the scale. Since the individuals against whom a comparison is made are all recent graduates of the preceding class, and just one step in advance, it is apparent that a candidate is better or poorer than the average now doing the same work as his total is more or less than sixty.

A very careful check is made of the college records, and if personality records are not available, suitable inquiries are made of the teachers to check this point. Often the opinions of the younger instructors and of classmates are found very valuable in checking the personalities of the men and their standing among their fellows. It is pretty sound reasoning to believe that a student who has stood well in college, has worked well with his associates in laboratory, shop, and test sections, who has shown himself to be free from deceit and selfishness, and, in a word, able to co-operate with others, will display these same qualities when he enters industry.

In every engineering class of size there is some individual who is qualified for each of the several functions of engineering work mentioned above. It is at once the problem of the man and of the industry to see that the square pegs get into square holes and the round pegs into the round holes. This, of course, cannot be accomplished by a ten or fifteen minute interview, but a start can be made in that direction in that time, and the problem completed within three or four months after entering upon the first job.

In our company, this problem receives a large amount of attention. It is the endeavor to segregate or allocate the new graduate in the industry to some special line within sixty days of his arrival at the plant. It is not always possible to do this, but if the men are systematically acquainted with the work of various departments — designing, research, application, manufacturing, selling, etc.—and are put in touch with the executives in charge of these activities, it is surprising how quickly ninety per cent of the men will come to a decision and how few changes will be necessary later on. One especially valuable means of arriving at this decision is to place the young engineer for a short space of time—say from six weeks to two months—in that line of work toward which he feels some inclination, but for which he does not feel ready to make a definite decision. Two months' work in a department—say on the design of railway motors—has invariably been found to be a means of arriving at a definite decision either for or against it as an objective. Suitability for research work can also usually be determined as quickly through the same means. Application and commercial engineering are, perhaps, not quite so susceptible to this treatment. Our company has put its finger on this point as a most critical one in the development of its technical man power. The company feels that the decision made at this time spells "success" or "failure" for a great majority of its college men. Its leaders are concentrating their thought on the problem of helping the man think his problem through to a decision. Under other conditions he may flounder a half-dozen years and at the end of that time be only ready to make another start under less favorable conditions. It is surprising to note that within groups of two hundred and fifty men a year for the past three or four years, the number who desired to change subsequent to making their decision is exceedingly small.

Descriptions of the types of training courses provided for each of the various groups would be out of place in a brief article of this kind. It should be pointed out, however, that one of the great advantages to the individual in making such a decision early is the fact that it enables him to plan an intelligent schedule of training and transfers for the year which he will put in before passing on into regular engineering work. The usual type of program may be illustrated from the attached schedule of training for commercial engineering in the Company's Railway Sales Department. It will be seen that the time is divided among a variety of shop sections and special class work with special training on the commercial policies and methods of the company. Throughout the course a portion of the time each week is spent in class work under the guidance of specialists.

The product of the American colleges during the last few years relatively has contained too large a proportion of men who are interested in the technical side of engineering work as compared with the number who are interested in the commercial side. That is, too large a proportion to proportionately satisfy the requirements of industry. It is not meant that there have been too many graduates. In fact, recent findings have indicated that the demand for engineering graduates is far in excess of the supply; but what is meant is that the commercial side of engineering work has not drawn its full share. It has appeared at times as though the engineering schools of the universities were not holding their full share of men of the keen, aggressive, high personality type. While the writer has seen some figures to the contrary from one or two schools recently, it would seem that the engineering colleges have not had more than their share of athletic captains, publication managers, class officers, social leaders, and fraternity men. The writer has been inclined to believe that the country over the schools of Commerce and of Business Administration have been inclined to draw many of this type of American youth from the strictly technical subjects. This is to be regretted, for the general phases of industry, including salesmanship as a large field, are just as big a part of engineering as any other field. To write a job specification for commercial engineering would be a difficult task, and few would probably agree on it after it was written. Ability, knowledge, and personality are all required of those who would succeed in it. Which of these three characteristics is the most important it is impossible to say, but some measure of each is indispensable. The engineering salesman must know his goods, how they are manufactured, their design, the materials, and the workmanship. He must know their uses and applications, and he must know the requirements of their users. In many cases it is his opportunity to act in the capacity of a consulting engineer to the buyer. He must know the people with whom he is dealing, the language of their trade; he must have initiative and imagination. He must find new ways of finding business, of presenting his propositions, and of making friends. He must be persuasive, logical, honest, and faithful. Tact, of course, is an absolute essential. He must be able to play as well as to work. He must have real dignity which expresses itself in his play as well as in his work. It is worthy of comment, perhaps, that while a dearth of material is coming from our technical schools for commercial work, nevertheless, if anything, advancement is probably more rapid in that field than in any other. It is believed that a preponderant proportion of engineering executives has come up through the commercial end of business.

What results does a company such as ours get from its program of training technical graduates? Is the expenditure of upwards of $1,000 per man, in addition to what he produces during his year of training, justified? Do the men "stick" to the company and to engi-

(*Continued on page 206*)

SHOP LIGHTING.

In an address delivered before the members of the Western Pennsylvania Division of the National Safety Council, Pittsburg, Pa., March, 1918, by C. W. Price, the importance of good lighting in industrial establishments was discussed, and the disadvantages of poor lighting were clearly shown by some figures mentioned by Mr. Price.

A large insurance company analyzed 91,000 accident reports, for the purpose of discovering the causes of these mishaps. It was found that 10% was directly traceable to inadequate lighting and in 13.8% the same cause was a contributory factor. The British Government in a report of the investigation of causes of accidents determined a close parallel to the findings of the insurance company above quoted. The British investigators found that by comparing the four winter months with the four summer months, there were 39.5% more men injured by stumbling and falling in winter than in summer.

Mr. John Calder, a pioneer in safety work, made an investigation of accident statistics covering 80,000 industrial plants. His analysis covered 700 accidental deaths, and of these 45% more occurred during the four winter months than during the four summer months.

Mr. C. L. Eschleman, in a paper published in the proceedings of the American Institute of Electrical Engineers several years ago, reported the result of an investigation of a large number of plants in which efficient lighting had been installed. He found that in such plants as steel mills, where the work is of a coarse nature, efficient lighting increased the total output 2%; in plants, such as textile mills and shoe factories, the output was increased 10%.

In an investigation of the causes of eye fatigue, made by the Industrial Commission of Wisconsin, it was found that in a large percentage of industries, such as shoe, clothing and textile factories, the lack of proper lighting (both natural and artificial) resulted in eye fatigue and loss of efficiency. At one knitting mill, where a girl was doing close work under improper lighting conditions, her efficiency dropped 50% every day during the hours from 2:30 to 5:30 P. M.

The above mentioned incidents indicate how important a factor lighting is in the operation of the industrial plant. It has been well said, "Light is a tool, which increases the efficiency of every tool in the plant." Glare or too much light is as harmful as not enough lighting, and in no case should the eyes of the workers be exposed to direct rays, either of sun or electric light.

Windows and reflectors should always be kept clean; that is, cleaning them at least once a week, for where dust and dirt are allowed to collect, efficiency of the light is decreased as much as 25%.

Good lighting, in addition to its other marked advantages, is a strong incentive towards keeping working places clean, for it clearly exposes any place where dirt or other material has been allowed to collect. White walls and clean windows glazed with Factrolite Glass will eliminate the sun glare and increase the illumination 25 to 50 feet from the window from 58% to 72% as compared with plain glass.

Lighting is of primary importance to every employer and fully warrants a careful investigation of the subject, for there is no substitute for good lighting, and if it is not supplied the efficiency of the entire working force must suffer a serious reduction.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

St. Louis. New York. Chicago.

Our Geologic Past

(Continued from page 200)

ing been land for a very long period, began to sink slowly toward the end of the Mesozoic. A large portion, especially the western part, of the state was submerged for a while. The fossil shark teeth and oyster shells so common on the top of the iron ores of the western Mesabi Range belong in this geologic division.

The end of the Mesozoic witnessed one of the grandest spectacles of which we have record. A very large part of the continent began to appear slowly above the ocean, introducing the Cenozoic or New era. In the western Americas, enormous cracking and faulting of the earth's crust permitted the lifting of vast blocks of the crust from which the Rocky Mountains were sculptured. In Europe the Alps, Pyrenees, and Caucasus; in Asia the giant Himalayas and many other ranges, rose to snow heights. It is probable that practically all the mountains of the earth now over 8,000 ft. high had their origin or received a very material "boost" during the Cenozoic. Though it must be measured in millions of years, not enough time has elapsed for erosion to wipe out any of these uplifts. Most of the large gold, silver and copper deposits of the West originated during the Cenozoic era. As another relic of this epoch the so-called "Great Circle of Fire"—a vast chain of volcanoes—girdles the Pacific Ocean. The numerous earthquakes of the Pacific coasts from Cape Horn to Bering Strait, Japan, and New Zealand, tell a vivid tale of lack of adjustment along the newly formed mountain ranges.

Minnesota, while not affected directly by these upheavals, had another treat in store for it somewhat later. For reasons quite unknown to us, the climate had grown much colder. Enormous masses of ice had accumulated over large areas of North America, Europe and Asia. These ice sheets probably attained a thickness of over a mile, and like the mountain glaciers of today, advanced slowly southward till they had covered practically all of Minnesota, and several of the other states,—in places as far south as the Ohio River. After these sheets had melted, continental glaciers thrice more covered large sections, if not all, of our state. Each time the melting glacier left huge masses of rock debris which it had picked up many miles farther north. Many old stream valleys were filled by these glacial moraines and any hills that were not sufficiently resistant were simply leveled by the force of the advancing ice, their rocks being scattered over hundreds of miles.

When the ice at length receded for good, a topography similar to the present one was left. Only the river gorges were absent, or were just beginning to form. Large lakes appeared because the country's old river channels had been destroyed by the glaciers and because the slow retreat of the ice prevented any drainage of the country toward the north. Many of the large flat tracts of our state are old lake bottoms, which had their origin during this retreat. The largest and best known of these prehistoric shallow basins was Lake Agassiz, which covered a large part of northwestern Minnesota. Lake of the Woods and Lake Winnipeg are remains of this giant among glacial lakes. The Great Lakes with the exception of Lake Superior, also had their origin in the Ice Age—at the end of which Man was ushered in as the height of creation.

The Graduate in Industry

(Continued from page 202)

neering? Do they make good? Some facts with reference to the history of our training program may be stated. Then, the reader can draw such conclusions in answer to the questions above listed as seem to him to be justified.

1. The roll of principal executives of the company, including its vice-presidents, general managers, district managers, district superintendents, departmental managers, work managers, etc., contains a predominant proportion of men who originally entered the company's employ as students immediately from college.

2. Contrary to the usual opinion of such things, over 50 per cent of the men who come as students remain at the end of a ten-year period. Somewhat paralleling the heavy loss during the freshman year in college, the most of the loss that does occur comes early in this period.

3. The company has a heavy demand from its larger customers for men trained in the application and operation of its specialized equipment. Over 30 per cent of the men who leave the company enter the organization of railway properties, central stations, large manufacturing concerns, etc.

4. Ten per cent of the men were of foreign birth and academic training and returned to their own country to engage in engineering practice.

5. Between 5 and 6 per cent of the trained engineers are returned to the colleges in the capacity of teachers, research assistants, etc.

The question is sometimes asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents, or are they forced into narrow grooves?

This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came with the Westinghouse Company after graduation and within the past ten years.

Engineer! Arrest that Bolt

JOSEPH SLEPIAN

THE Sales Department was talking in emphatic and easily understood language. It was saying, "We want action."

At Westinghouse, action in many cases is another word for research. And research works toward selected goals. In this case the goal was for new apparatus to make unchained lightning more respectful of power plants, lines and equipment.

Today, as a consequence, the electrical industry is the beneficiary of the "Autovalve Lightning Arrester", perfected to a degree of efficiency, long service and universal utility never dreamed of before. Behind that picture you find Joseph Slepian. With two degrees from Harvard, he started training in our East Pittsburgh Shops in 1916. A year later he entered the Research Department.

This was the lightning arrester situation which Slepian took into the research camp: There were two different types of apparatus. One, called the multi-gap, was used chiefly on poles of distribution circuits. When lightning struck, it frequently caused transformer troubles and damaged equipment. For high-voltage application there was the cumbersome electrolytic arrester. Its performance was good enough. But it required constant attention; was costly of upkeep; and could not be used on poles.

When Slepian perfected the Autovalve Arrester, the demand was so great that orders could not be filled. It was entirely new. One type of apparatus solved the whole problem—no more costly care. It stands up indefinitely, whether used on poles or on the ground—sufficient reasons for yearly sales exceeding $2,000,000.

Such results may depend as much on a phase of an engineer's past training as on his immediate research. Take the radio horn which gives the natural tone to Radiola sets. It was Slepian's mastery of mathematics, in which he specialized at Harvard, which contributed toward that big advance in the early days of loud-speaker popularity.

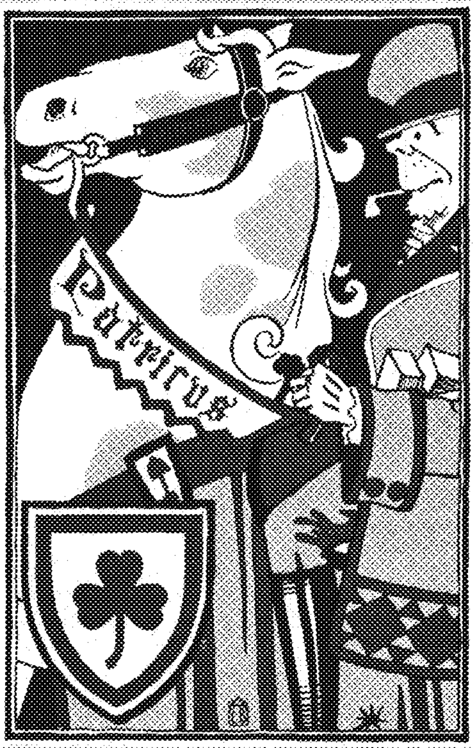
The man with "hidden reserves" is constantly finding them called upon to "climb peaks and cross mountains" in institutions like Westinghouse.

Westinghouse

THE LUND PRESS, INC., 416 EIGHTH AVE. SO., MINNEAPOLIS

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges
of the University of Minnesota



APRIL
1926

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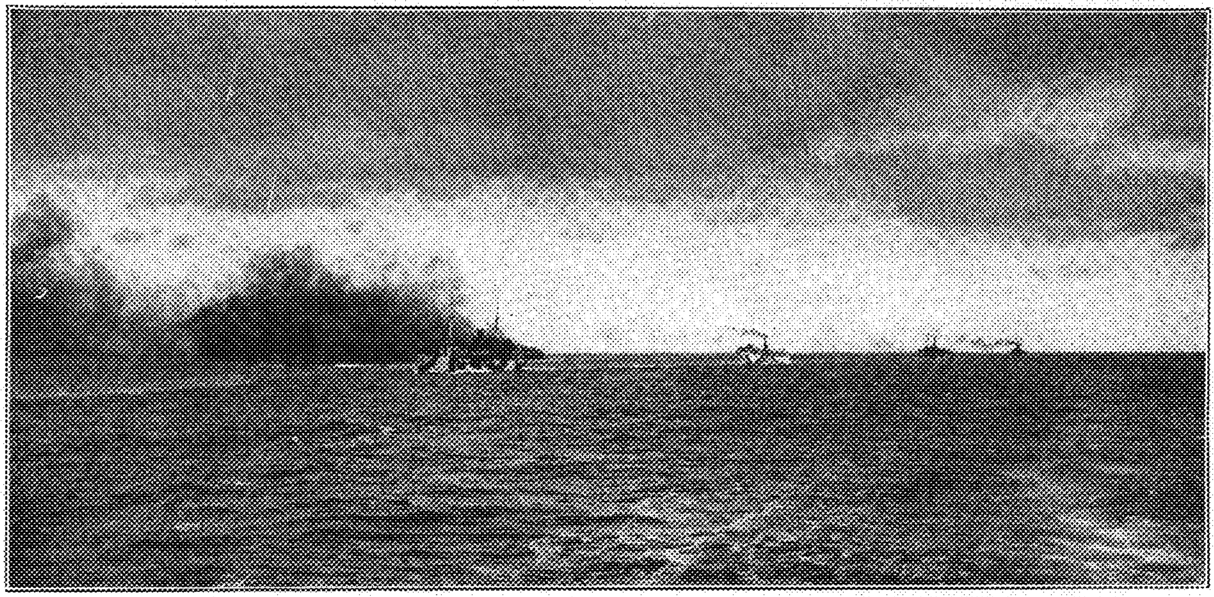


Photograph by courtesy of Captain R. R. Belknap, U. S. N.

Fighting Submarines with Elevators

When the American people answered "War" in 1917, no matter was of more importance than the readjustment of the great industries to the conditions of war, and no contribution to national defense was more exacting than that of the Otis Elevator Company.

It was a long way from the ordinary operations of business buildings throughout the country to the North Sea in war time, yet strangely enough Otis automatic leveling or micro-drive elevators proved one of the most valuable innovations in connection with naval warfare.

Up to the time the American Navy became a factor in the World War, it had been impossible to lay, in the North Sea, the contemplated mine barrage, which it was hoped could be used to prevent submarines from skirting the north end of the British Isles. This had been impossible, because the time required to get the mines overboard prevented successful results. The Otis Elevator Company cooperated with the American Navy and provided automatic leveling elevators for the delivery of the mines from the hold of the mine layers to the main deck, where they could be put overboard at such frequent intervals as to make the laying of the barrage a success.

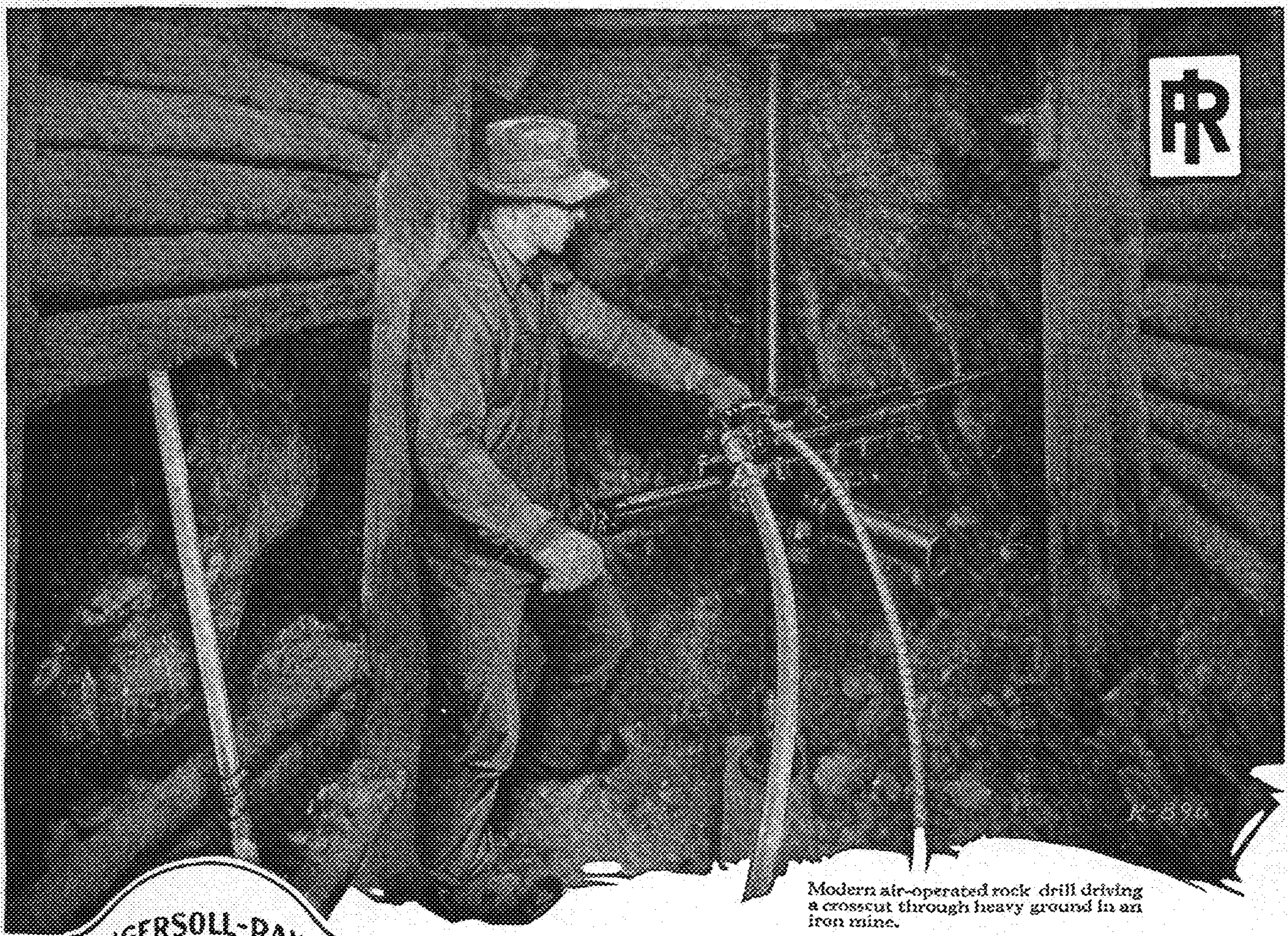
In an article published several years ago, Captain Belknap, U.S.N., who was in command of the mine laying squadron at the time, stated that in the nine months or more of operation, in which sixty thousand mines were handled in and out, as well as many more in the course of drills, there was only one occasion in which any one of the thirty-two elevators was shut down. This was the fault of the operator, not the elevator, in that it was run too far up and jammed there for a few hours, but without causing any delay in the mine laying operation.

In war as in peace, the Otis Elevator has become one of the indispensable parts of our civilization.

Otis Micro-Drive Elevators, as developed for the mine laying ships and for the great Army and Navy Bases at New York and Boston, are now in constant use throughout all parts of the country in office buildings, hotels, department stores, warehouses, terminals and factories. The automatic leveling feature eliminates "inching" at the floors, obviates the stumbling hazard in passenger elevators, as well as saving time in operation, and increasing the life of the apparatus. On freight elevators it also provides an exactly level landing to facilitate the handling of freight.

O T I S   E L E V A T O R   C O M P A N Y

Offices in all Principal Cities of the World



Modern air-operated rock drill driving a crosscut through heavy ground in an iron mine.

INGERSOLL-RAND PRODUCTS

AIR AND GAS COMPRESSORS
ROCK DRILLS
DRILL SHARPENERS
PNEUMATIC TOOLS
TIE TAMPERS
CAMERON PUMPS
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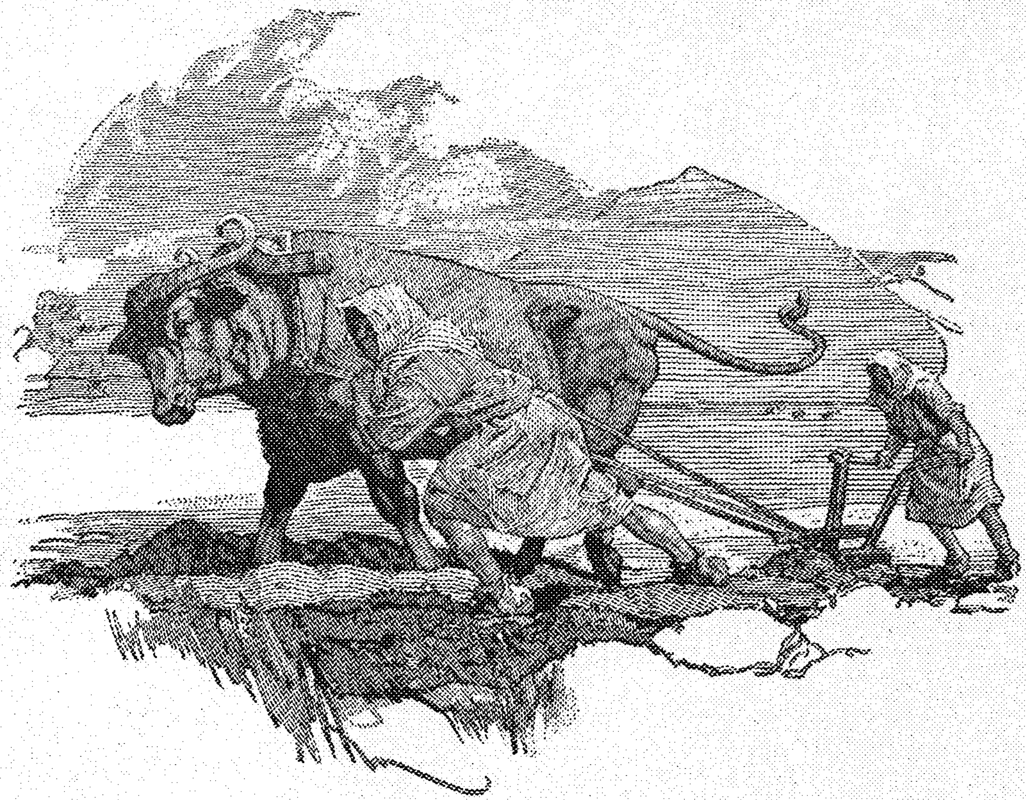

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

VOLUME VI. Minneapolis, Minn., April, 1926 NUMBER 7

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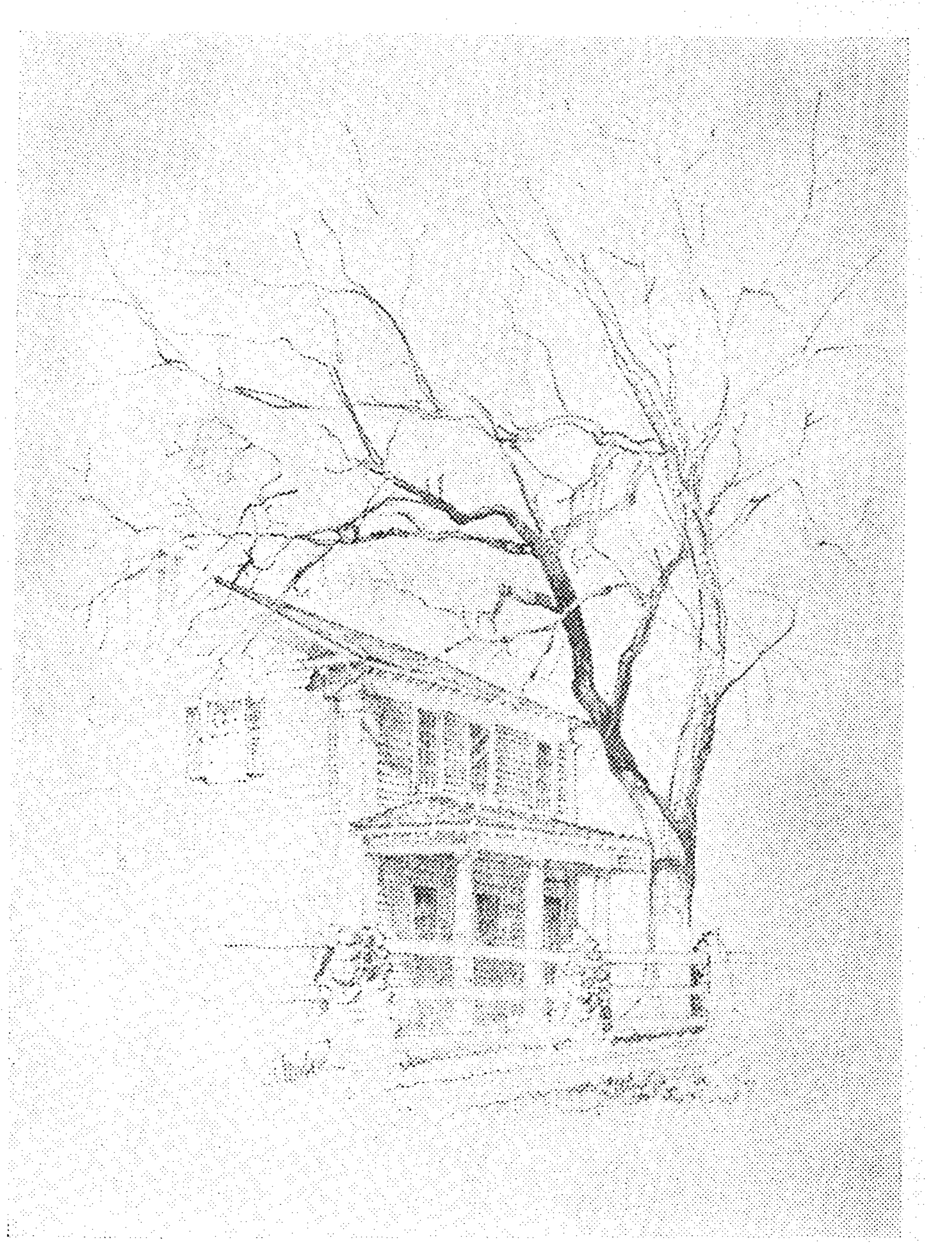

An Old Frame House

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI APRIL 1926 Number 7

Building Our Highways

Minnesota Highway Department offers much inducement to a graduate civil engineer in construction and maintenance of the State's roads

By JAY T. ELLISON, C '09

Chief Engineer, Minnesota State Highway Department.

DEVELOPMENT of the modern system of motor transport has grown from an almost imperceptible beginning approximately twenty-five years ago until today the manufacture and use of motor vehicles comprises one of the foremost industries of our nation.

Naturally, as the automobile and motor truck became more numerous and their use more common, there came the ever increasing clamor for more and better roads. So long as highway transportation was limited to horse drawn vehicles and was entirely local in character, the old township and county road system served fairly well. With the advent of the automobile by means of which a person could traverse numerous counties or even the entire width of a state in a single day, the public was no longer satisfied with roads of this character. The people as a rule were almost universally in favor of good roads but were at a loss as to the proper method of raising the tremendous amount of money which would be required for this purpose and were also largely concerned regarding the manner in which and by whom this money should be spent and the affairs administrated.

I feel that it might be advisable to relate the experience of our own State, as in size, valuation and other characteristics we are similar to many of the other central states.

The development of highways may be divided into three periods. The first from the organization of State until 1906, the second from 1906 to 1921, and the third from that time to the present.

The first period was one of development, during which most of the energies of the local authorities were confined to the building of roads from farm to market. During this period there were two methods of building roads, one by the township, whereby farmers and others could work out their road tax, and the second under control of the county. The money for this purpose was raised by a levy on all personal and real property in the county. This method worked out with good satisfaction during the earlier part of the period, but with the advent of motor traffic the public began to feel that some other more wide spread system of control and finance was desirable. This move ushered in the second period which marked the participation of the State in financing and controlling the construction of a limited mileage of the more important roads in the State. The State's share of this money was raised by a general tax on all property and this in turn was allotted to the counties, not more than three or less than one percent to any one county. All work done on the State road system had to be approved by the State Engineer, and in case the plans and work were satisfactory the County was allowed to draw a certain percentage of State Aid from the money previously allotted them.

> *Figures taken from the January issue of* ROADS AND STREETS *show that Minnesota's road building program for the season of 1926 will involve millions of dollars for new projects as well as maintenance. Four million and a half is to be spent on new concrete roads alone, one half million is to be used for gravel surfacing and a cool million will be expended for drainage and grading. Append nine million for maintenance and you will arrive at the total expenditure. Plans include over 170 miles of new concrete highway, 300 miles of gravel roads as well as considerable asphalt paving. A young highway engineer need not seek elsewhere for work, his own state offering him exceptional opportunities.*
>
> *This article is the sixth of a series setting forth the opportunities for a graduate engineer in the various fields of endeavor.*—THE EDITOR.

This period marked the first systematic attempt at maintenance by the patrol system that was attempted in the United States. Under this system a man with team was employed to devote his entire time to taking care of a certain stretch of road. This method of maintenance has proved very satisfactory and has been adopted generally where earth and gravel roads are common.

This period also marked an epoch in highway practice that is important to engineers, for it was under this State control that engineering control of highway planning and construction was developed until today the position of County highway engineer is legalized by statute and as a matter of fact every County is required to employ a County highway engineer who shall devote all of his time to this work.

Prior to this period the supervision of the work had always been in the hands of County and Township officials, who while in most cases honest, lacked the experience and training required to secure the best results. In addition they were elected by vote of the people and consequently were in many cases influenced by political expediency. These officials were at first inclined to view the highway engineer with alarm and suspicion and many years of hard work and education were necessary before some of the County officials were willing to relinquish their former authority and turn over to the engineer the control of highway affairs. The change has come gradually but we now find that in practically every County the board has turned over to the engineer the entire control of construction and maintenance within the County. Many of the Counties still have the same engineer for a period of ten years, and many of the other engineers would still be in their original counties had they not been transferred to better positions in other counties or to the central organization of the Highway Department. It is impossible to

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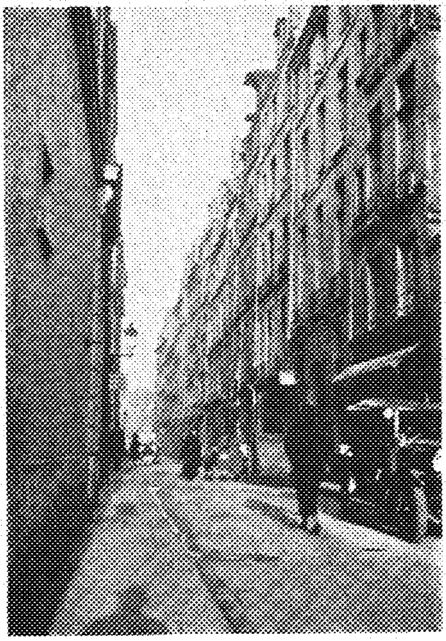
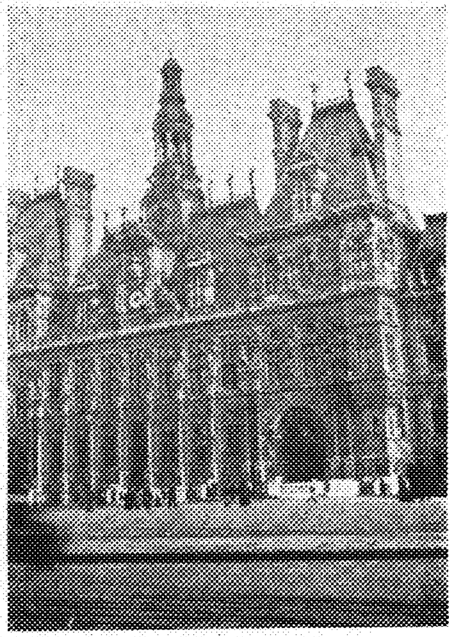


NARROW STREET IN PARIS

Something About Paris

By RODERICK W. SILER

Department of Mathematics and Mechanics, University of Minnesota.



THE HOTEL DE VILLE

THE editor of the TECHNO-LOG has asked me to write something of my last year's European experiences, tragic or otherwise. In this article I will say something of Paris, a metropolis which has already been made more or less familiar to many of us *bookworms* by the vivid descriptions in Snappy Stories. As a matter of fact I went direct from New York to England, landing at Plymouth and going on up to London by rail. I remained for some time in London, a place I had been in before, and probably would have remained there longer had it not been for the weather. When I ran into a total eclipse of the sun lasting for five or six consecutive days, during which the fog never raised except to let down more rain, I decided it was time to seek sunny France. I went to Southampton to get the cross-channel boat, and I crossed the channel on a very rough day. I finally landed in France, with my two grips, my new English overcoat, and minus a large English breakfast I had eaten at Southampton just before leaving.

To attempt anything like a complete description of Paris in so short an article as this is, of course, useless. Perhaps it is better to confine myself to the recital of a few personal experiences and reactions, which are quite likely to fall to the lot of anyone visiting this city.

My experiences in Paris really began on my first morning there, when after my voyage of the day before I set out to find something approximating an American breakfast of fruit, breakfast food, bacon and eggs, toast, coffee, with a piece of steak in addition if the rest of the food was satisfactory. It is quite a trick to find such a meal in the morning in Paris. Of course, at the hotels patronized chiefly by American such breakfasts are obtainable, but at the strictly French cafes they are not. To the average Frenchman the sight of an American devouring in the morning such a meal as I have described arouses the same emotions as an American would experience in watching a cannibal at a feast. The Frenchman's breakfast is light, very light. A cup of coffee and a roll, and very frequently without the roll. The French breakfast is, after all, like so many other French habits and customs, thoroughly sane and beneficial. However, this is a custom that many Americans can never accept cheerfully. I have met Americans in Paris who told me that the art gems of the Louvre, the historic associations of Notre Dame, the vistas of the Champs Elysees, the scene from the Eiffel Tower, all became dim when they thought of a plate of wheatcakes for breakfast.

French food and cooking is, of course, very good—if a man can forget the wheatcakes. However, one should be able to read a French bill of fare before undertaking to order a meal. Before getting to France I could read French well enough to get through a newspaper, but I found it quite another matter to get through a bill of fare. Upon the first French menu which I studied I saw "*Pommes Frites*," and as it seemed familiar, I ordered the waiter to bring me some. Pomme frite, pronounced "pum freet" in American, is, or are, fried potatoes, and I offer it as a suggestion here, for any American who can stand fried potatoes three times a day need never starve in Paris. All my guesses were not as fortunate as this one. At supper one evening during my first week in Paris I saw one phrase on the menu in which occurred the word "porc." This I judged to be the flesh of the pig, though as to just what portion I was not sure. I pointed it out to the waiter. He said something, but I insisted, and so he left. Ten minutes later he returned and again protested. I again insisted and he again departed. In fifteen minutes he came back carrying a large covered dish and placed it in front of me. He raised the cover, and there surrounded by greens was a pig's foot. This gives some idea of the very great value of being able to read and speak French when visiting Paris. Later on, when I had mastered the language and could say, "Come here, *garcon*," "*Bon jour*," "*Oui, oui, m'sieur*," I found my difficulties much lessened. Nothing in a foreigner so impresses and pleases a Frenchman as to hear the foreigner string half a dozen French words together in such a way as to be intelligible.

I lived for some time on the left bank of the Seine and not far from the University. This is by no means the most aristocratic part of Paris, but in some respects it is the most interesting. I lived in a small hotel on a very narrow street. There is a district here, lying between the Seine and the Boulevard St. Germain, where all streets are very narrow and crooked and busy. Small shops abound, in which is sold every article of merchandise known to civilized man. Judging from the smells, cheese and dried fish frequently predominate. Along the more important thoroughfares of this domain, such as St. Germain and St. Michel, there are any number of cafes in which the patrons drink as well as eat. The French evidently do not proceed on the theory that it is well to keep temptation away from university students. Certainly a very considerable part of the patronage of these cafes is furnished by students.

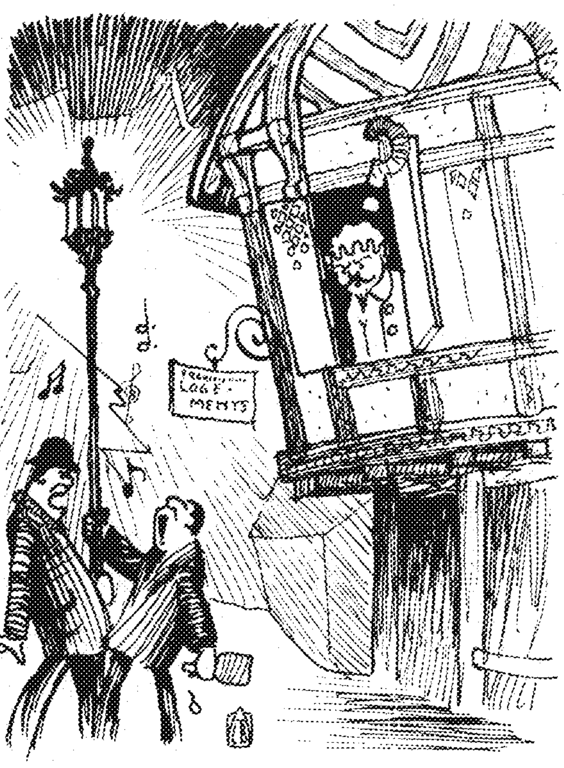
The French students always struck me as being, for their years, more sophisticated and mature than American college men. The French boys discuss politics. A good many of them drin beer and light wines in public. They frequently wear beards. It was this last feature of theirs which I admired most, thinking of the efforts of our seniors with moustaches. However, this also indicates the disinclination of the average French students for athletics. In football or wrestling, for instance, these whiskers would not do at all.

Not long ago, someone who had evidently seen "The Student Prince" asked me if the French students enjoyed singing. I am inclined to think they do, under the same stimulation as indicated in the play. On a good many nights, between the hours of midnight and dawn, I have been awakened from sound slumber by squads of these young gentlemen passing down the middle of the street and rendering the equivalent of "Dear College Days" in French.

I suppose the most distinctive feature of Paris is the Seine. The river divides the city very evenly in two parts, is enclosed and beautified by embankments throughout its entire course within the confines of the city, is bordered by fine trees, is spanned by numerous ancient and handsome bridges, and affords passage for a great deal of shipping. A walk along the Seine is always pleasant and interesting. It is a great river for fishermen, but not so good for fish. This seemed to me particularly true on Sundays, and I should say that any fish passing down the Seine on a Sabbath morning is taking a long chance. However, I do not remember ever seeing a fish caught, though I have seen a good many men out with hooks and sinkers. To anyone who has fished in a northern Minnesota lake this fishing in the Seine might look like poor sport. But it should not be forgotten that the scarcer the fish the better the fishermen who gets them. I would say that because of the competition it takes more skill to get a sardine out of the Seine than to land a muskellunge in Minnesota.

Paris offers many walks besides those along the Seine. It is astonishing to an American how attractive walking becomes under the proper conditions, and such conditions exist in many of the European cities to a far greater extent than with us. As for Paris, the climate there is favorable. Extremely cold weather, with snow and ice on the sidewalks, is rare, and while there are hot days in summer they are not such days as are met with in most American cities at the same time of year. Tall buildings such as we have are not permitted, with the result that the Parisian streets are more open to light and air, are as a rule less congested, and certainly are far more attractive to the eye. Streets seem to intersect at all angles but ninety degrees, and while this is annoying to the simple foreigner who knows he is only five minutes walk from his hotel if he only knew in which direction to walk, the improvement in all other respects is not to be doubted. A walk of ten minutes anywhere in Paris will bring one to some point where a number of streets converge, always an interesting fact and a challenge to further wandering. The remarkably numerous and healthy trees of Paris do their share in beautifying the city, forming frequent avenues where heavy urban traffic passes under a foliage that one might expect to find only on a country road. Probably the finest gathering of trees within the confines of Paris are found in the Champs Elysees, which forms part of the wonderful prospect extending from the Louvre to the Arc de Triomphe.

Right in this region between the Louvre and the Arc de Triomphe, a man with an inclination for the historical should find himself satisfied. There is the Louvre, in which is at present housed the most famous of all art collections, and formerly a palace occupied by the kings of France. Stepping from the Louvre one enters into the Jardin des Tuileries, gardens laid out in the formal style and once the site of another palace, destroyed in the last century by one of the revolutions of the period. Next comes the Place de la Concorde, in the center of which stands the Egyptian Obelisque, an object older than Paris, itself. On the Place was erected the guillotine of the first French Revolution, and according to all accounts this instrument of execution worked here with great indifference to rain or shine, or the age, sex and rank of its victims.



"—and rendering the equivalent of 'Dear College Days' in French."

Crossing the Place from the Tuileries one comes to the Champs Elysees, under the trees of which in the summer time are benches, statuary, fountains, and young couples holding hands. An extension of the Champs Elysees to the right, contains, I believe, the official residence of the French president. To the left are the Grand Palais and the Petit Palais, where are held exhibitions, and looking between these two buildings one can see across the Pont Alexander III, the finest bridge over the Seine, to the Invalides, beneath the dome of which lies the coffin of Napoleon. At the end of the Champs Elysees begins the gradual ascent of the Avenue des Champs Elysees to the Arc de Triomphe, where lies the Unknown Soldier. This is called the Place de l'Etoile, and because of its elevation and the converging here of ten or twelve great boulevards the effect is very fine and stirring.

All of this ground extending from the Louvre to the Etoile, can be covered in a brisk walk of half an hour, and I do not know of another walk in the world of the same distance which offers so much of beauty and significance.

The compression of much into a short distance is one of the things that will always impress an American visitor to Paris, at least if the visitor has had any experience with distances in great American cities. Whoever has tried to walk from the Battery to the Bronx in New York, or from Englewood to Rogers Park in Chicago, or from the river to the Ford plant in Detroit to find out what's the matter with his car, knows what a walk is. A walker in good health and wearing the right size of shoes could get across Paris in two hours or less. This compact character of the town is significant, and should be particularly so to engineers. It is due, I believe, to the fact that Paris has grown in concentric circles, always with the center somewhere in the region of Notre Dame, and always under the direction and supervision of the best technical skill of the time, and always with a thought for ultimate beauty and convenience. Thus the city has come to be the pride and boast of her citizens, the most renowned metropolis of the world in many respects, and the one place where an American may indulge in frequent taxicab rides without being bankrupted.

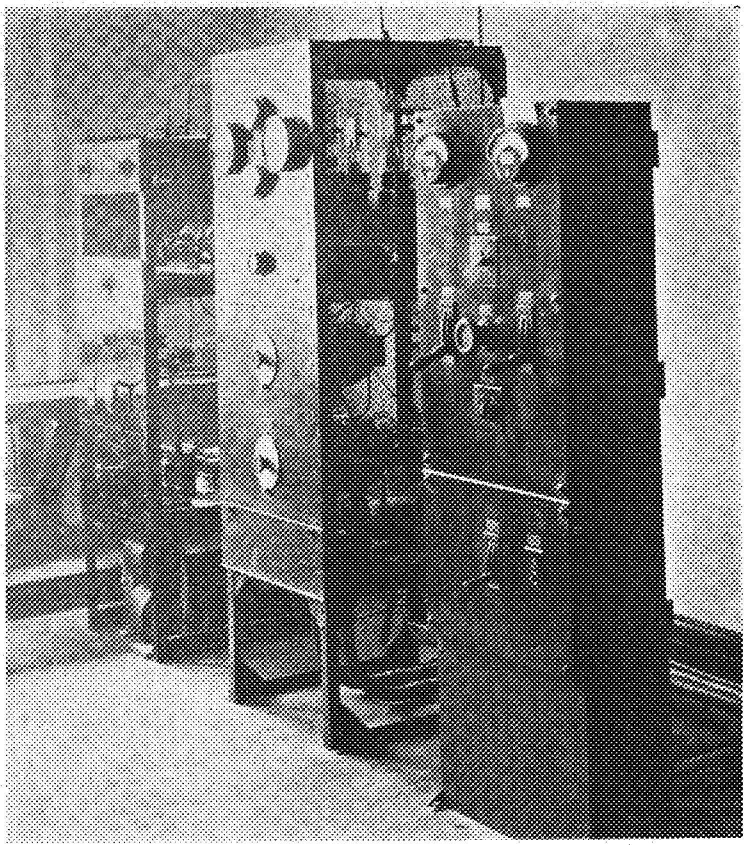
Paris impresses me, at least, as having been developed with superlative intelligence and sentiment. Technical and engineering skill has been made full use

(*Continued on page 236*)

9XI-WLB

Experimental radio and broadcasting station of the University of Minnesota

By Stuart L. Bailey, E '27



The short wave transmitter, the broadcasting set operating under call letters WLB, and power control are shown from left to right.

OPERATION of an experimental radio station at the University of Minnesota dates back to 1912. The first station was installed in the old electrical building under the direction of Professor F. W. Springer, who was then acting head of the department of electrical engineering in the absence of Dr. Shepardson. Professor Springer had recently returned from studying abroad, where, under Dr. Slaby, a German scientist, his interest in this new development was first aroused. Wireless at that time was wholly a laboratory subject. Transmission consisted in sending impulses or code for short distances. Telephone transmission without wires was practically unknown, although short distance conversations were held by impressing the voice upon an arc and transmitting the wave produced.

The experimental station begun by Professor Springer was put in charge of H. M. Turner, an instructor who had recently come to Minnesota from the University of Illinois. The first actual transmission was attempted in the fall of 1912, when the football games were broadcast by wireless from the new station. A spark transmitter was used; and, of course, the regular telegraph signals were employed. The station developed rapidly up to the time of the world war, when the government took matters in hand and shut down all amateur transmitting stations. All apparatus at the station was sealed and transmission was completely stopped.

In the fall of 1920, Professor C. M. Jansky, Jr., came to Minnesota from the University of Wisconsin, where for two years he had been developing an efficient transmitter using the electron tube as a generator of oscillations. The station at that time was using a one kilowatt spark transmitter tuned to 200 meters. Besides carrying on communication with other amateur stations, the set was used to broadcast market reports and weather reports. This set was a pioneer in the field, and is still remembered as one of the most powerful and efficient spark sets in the Northwest at that time. Under the supervision of Mr. Jansky, a continuous wave transmitter was constructed, and a series of comparative tests was begun. Under the direction of Chief Operator H. C. Forbes, the operating personnel kept accurate data on the action of the two sets, and at the end of a four month's period (January to April, 1921), this was compiled into tabular and graphical form. The results showed that, although the c. w. set was putting less than half the power into the air than was the spark, the former consistently averaged higher in miles per call. It was also noticed that the c. w. signals were more reliable than the spark during periods of excessive atmospheric disturbances, a decisive point in its favor.

A more powerful transmitter was immediately built and was adapted not only for telegraph communication, but for radio telephony as well. Thus in the spring of 1921, market and weather reports were broadcast daily by radio telephone, and the program was later enlarged to include one concert a week.

Amateur and experimental work was continued under the license of 9XI. It was always the policy of the department to leave the details of operation to a chief operator, who was chosen from the student body. These men followed closely the progress in amateur radio and the station was often altered to keep pace with the rapid development which took place from 1921 to 1925.

In the spring of 1925, it was decided that in order that operation might be studied systematically, it would be necessary to install all apparatus in a permanent form, leaving experimental investigations on apparatus to other research departments. The first move under the adoption of this policy was the construction by the staff of a one kilowatt tube transmitter designed by L. V. Berkner and J. P. Barton, student engineers. Some of the problems in design other than those usually met with were the necessity for easy variation of wavelength and power, absolute protection to operators from the high voltages involved, and simplicity in control. A Hartley oscillator circuit, modified to keep the high voltage out of all parts of the circuit except on the plates of the vacuum tubes, was decided upon as being the most adaptable to the requirements of the station. The transmitter was divided into three sections, the upper carrying the antenna circuits, the center the oscillator circuits, and the lower the power input circuits. Each section was controlled from a corresponding panel. Novel features in design were the protection of the tubes from vibration by means of spring mountings, and the symmetry of all wiring in the oscillator circuit. The construction followed standard commercial practice in insulation and wiring, all

(*Continued on page 238*)

Senior Chemist's Inspection Trip

Extended tour through large manufacturing plants enlightens '26 class concerning varied application of chemistry to industry

By Joseph H. Kugler, Ch. '26

WITH itinerary in one hand, suitcase in the other, and brains still hazy as a result of examinations only a few hours past, 16 senior chemists stormed the depot. It was 5:30 p. m., the train left at 6:20 but each of us was on time, yea, a little ahead, for who could risk missing the event of the year, the annual inspection trip? This inspection tour is required of all senior chemical engineers, its purpose being to give the student a better insight into chemistry as applied to industry.

We piled into the Pullman which had been reserved for us, and started off for Appleton, Wis. As might be expected, the first night was spent chiefly in warding off the more vicious of the tribe and in trying to learn how to sleep on the train. The only time Dr. Mann was seriously disturbed was when one of the boys at four o'clock in the morning very loudly proclaimed that he was seeing wooden oil tanks. At 8:02 we arrived at Appleton. The Kimberley Clark Paper company was our first stop. The firm makes sulphite pulp, balsam, spruce, and hemlock being used. The order of operations is as follows: debarking, chipping, digesting with sulphite liquors, "blowing off" the product, washing, bleaching, washing, screening, mixing with other pulps and sizes, coloring, and finally making the paper. The most interesting machine in the plant is the Fourdrinier paper machine which makes paper at the rate of 460 ft. a minute. This wet paper is partially dried by vacuum filtration and finally passes over about 50 drying rolls. Imagine the job of rethreading this machine when the paper breaks, without shutting down the machine. This must be done, but we were not fortunate enough to see things break. This plant turns out about 250 tons of paper per day.

In the afternoon we visited the Fox River Paper company which is a rag paper plant and employs the soda process. The rags are first sorted and foreign material is removed. They are then cut into one inch squares, dusted, and digested with the caustic liquor. Washing, bleaching, and sizing proceeds in the usual order, the screening being done by means of screens of .008 in. openings. A Fourdrinier machine is used to make the paper. All the finer grades of writing paper are rag paper. Book paper is mostly sulphite paper and newsprint consists almost entirely of mechanical pulp.

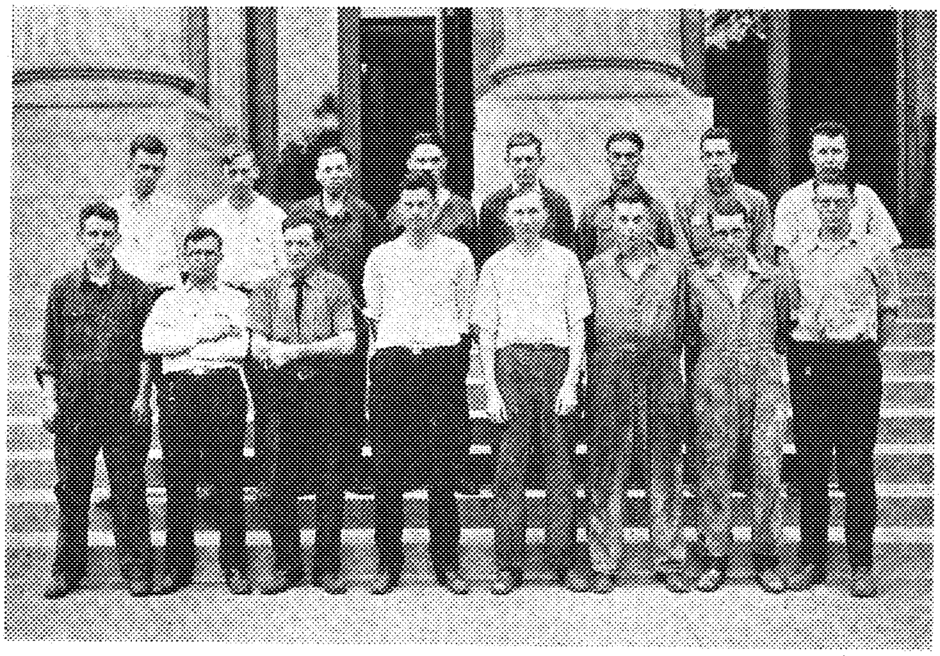
And next we wandered to Milwaukee, where we stayed at the Wisconsin Hotel. Milwaukee is quite as German as it is said to be, and we feel quite certain that a Swede wouldn't have a chance there. Friday morning we went to the Pfister Vogee Leather company where the hide house convinced us that there are odors which are almost too strong for even a chemist. Pfister Vogee uses chrome tanning entirely in this plant. They treat all suspected skins with bichloride of mercury which kills the deadly anthrox germs. It is amazing to observe the large number of operations through which a hide must pass in order to become finished leather. Almost all stages of the process require chemical control; consequently Pfister Vogee has a large and well equipped chemical laboratory.

In the afternoon we went to the U. S. Glue company. Glue is made by extracting calf and pig skin scraps (after the hair and grease have been removed) with water and evaporating the extract. The concentrated liquid is cooled which causes it to congeal. It is then dried with air currents. To make one pound of glue requires ten pounds of coal, and this company uses as much water as a town of 75,000 population. Gelatin for confections and photographic films is very much the same as glue, only it is made from better grade material and is more carefully refined.

Saturday found most of us still going strong, sometimes it seemed almost ten miles an hour. This time we were at the Pittsburg Plate Glass company, which happened to be a paint factory. Varnishes, enamels, paints, lacquers, and insecticides are made there. Varnish is made by thinning molten resins with turpentine; some dryers such as letharge and manganese dioxide are also added. High grade varnishes are always aged. The pigments chrome yellow, chrome green, Prussian blue, and Para red were also being made. For enamels the pigments are ground exceedingly fine; the other constituents are varnish and linseed oil. Arsenate of lead was being made in the insecticide division. In order to protect the workmen, all packages are filled and sealed by machines. The Pittsburg Plate Glass company, as all other paint companies, is very much interested in proxylin lacquers, and they are doing considerable work with them. The laboratories of this firm were the most complete of all of those we had seen on the trip.

We also saw the Milwaukee Coke and Gas company. They had fifty Kopper's type ovens and about an equal number of Solvay ovens. The recovery system used by this firm is very complete; practically everything which can be recovered is recovered. Saturday afternoon found us at the Wm. O. Goodrich company, a linseed oil plant. Linseed oil is made as follows: the seed is screened to remove foreign impurities, and then crushed through five rolls which cracks the seed but doesn't pulverize it. The crushed product is carefully steamed, and then pressed in a

(*Continued on page 230*)



THE 1926 CHEMICAL ENGINEERING CLASS

Men in the back row are Moffat, Merrill, Smith, Kugler, Sverdrup, Johnson, Gerlicher, Montonna. In the front row are Rogers, Lewenstein, Vaubel, Damp, Kobe, Schlafge, Leahy, Tronson.

This Business o'

BEIN' A SAINT

By Raymond R. Kelly, C '26

St. Pat. Elect, 1926 Engineer's Day

Kelly as St. Patrick

IT is a blessin' for me that Oi'm used to bein' good. Shure and if Oi wasn't, Oi'd be a sorry sight of a saint. Oi thot all Oi had to do in bein' a saint was to be good and kind and generous; but Oi've learned a bit more in the last few weeks. It seems to be generally expected that Oi'll say things, do things, and write things, and during all this it is me job to go 'round actin' like Oi knew what it was all about. In spite of all that, Oi'm indeed a lucky Irishman to hev the honer of bein' the official representative of the patron saint of all engineers on the 17th Ingineer's Day at the University of Minnysoty.

Oi've a plenty to be thankful for, and most of that is that Oi've a quane to share me honer and help me do me dooty on this greatest of festivil days. When Oi started takin' ingineering a few years back, Oi thot it was a terribly hard life, and Oi oft' wondered if Oi'd iver amount to anything. Shure 'nuf it is a hard life, but it's a life full of pleasure for the b'ys who do their work well. Shure and Oi did amount to something; in less than four years Oi hav become a saint.

Me first dooty as Saint Patrick was to knight the b'ys of the March class. Shure and what a sight Oi am dressed in me full attire. A divil a bit that should worry me, for who'll be a takin' any note o' me when Oi hav me quane by me side? Well do Oi know, they'll all be a lookin' at me quane, and payin' no attenshun to me.

As Oi was sayin', we had a little cirimony for the b'ys who left us in March. Some of the l'yal juniors dragged out the Blarney Shtone and laid it in front of a grane chair which was to be me throne. Faith and what an ordinary lookin' rock the Blarney Shtone turned out to be. It's not a very large affair for the importance of it, an' with all of the careful guardin' it has, an' right in the top of it is a big iron ring. But its power to beshtowe the sacrid gift of Blarney has nivir bin dooted.

Miny a sober, steadfast, and dimure ingineer has kissed this very same shtone and they are shtill talkin' about it and iverything else till this very day. Shure an' the shtone is piece out o' the famous Blarney Castle over in dear old Oirland. An' about the cirimony. The President of the Technical Association said a few things, an' Oi kissed the good shtone, an' then he gave me some p o w e r s an' a s'ord to Knight the b'ys with. Faith, did ye iver hear o' St. Patrick havin' a s'ord? Shure an' Oi could hev knighted the b'ys better if he 'ad given me a good old Oirish shella'ie. All o' the cirimony was completed without even a quane to help us.

Shure an' after that Oi spent a few weeks "quanin'." Quanin' is a noo indoor sport, an' it manes lookin' for a quane. Most of the game is played in the Post Office. Oi mean that big place with all the boxes where we get our Dailies an' notices an' the loike. The game is highly seasoned with adventure, romance, an' the thrill o' gamblin'. That explains why ye've bin seein' me in the P. O. so much lately. Oi suppose there was about four hundred sanurr co-eds who were iligible to be chosen for me quane. Faith, an' what a job it is for an ordinary Saint to pick one co-ed out of some four hundred more or less.

Nivertheless "quanin'" is a game which will rival any o' the better indoor sports. While lookin' over the co-eds, Oi was much pleased to see all the eyes and *other things* which were well worthy o' the gaze of a Saint. And miny a time did I see a quanly co-ed only to learn that she was not one o' the four hundred. Thin one day a *most* quanly co-ed from the northern Minnysoty city happen'd to cross me path. Shure an' she was one o' the iligible ones an' ye'll see her by me side on the day whin all good ingineers cilibrate.

No sooner had Oi finished playin' me game an' selectin' a quane, whin the committee of the Day comes along an' tells me that in two days Oi'm goin' to give one o' these speech things as part o' a radio program. An' bein' a Saint Oi ses, "Yes, Oi'll be glad to do it," nice an' sweetly just loike Oi thot it would be a lot o' fun. Aven a Saint don't hev me pleasure in gettin' up before one o' thos little round radio things an' readin' a long paper that is supposed to sound loike a speech. No doubt Oi come near messin' up the whole affair. An' now that that is off me mind, Oi can look forward with great pleasure to Friday, April the twinty-thoid, when Oi'll hev the honir o' bein' knighted by me quane an' then Oi shall knight the rest o' the sanur b'ys and gurrls into the order o' the Knights o' St. Patrick.

Shure an' it's goin' to be a great day. In the afthernoon, Oi'll be there with me quane drinkin' tae, an' dancin', an' enj'yin' oursilves with all the b'ys an' gurrls from the whole University. Faith, an' in the avenin' is goin' to be the best part of it all. The famous Ingineer's brawl will be held with all its usual splindor and lavish intertainment. An' the quane and oursilf will hev the honir o' struttin' our stuff at the head o' the grand march.

Shure an' the quane and meself will be afthur seein' that a good time is had by all who come. It'll indeed be a pleasure for us to be there all o' the afthernoon, receivin' the guests an' enjoyin' the grane tae an' the dancin' as much as any o' them. Faith, an' the tae will really be grane. Shure an' I know the good Saint Patrick will be more than glad to see all the joy that we'll be afther havin' in payin' honir to his own blessed self. No doubt he'll be a wishin' he could be here himself to cilibrate the day with us.

Faith, an' all o' the preliminaries to Ingineer's Day hev been a heap o' fun, but Oi'm waitin' patiently for the big day o' the cilibratin' the same as all the rest o' the b'ys and gurrls. May the good patron Saint kape us all well and fit for the cirimonies on April twinty-thoid.

Athletics for Every Engineer

Newly organized Technical College Athletic Board sponsors complete program of activities; Bookstore provides rewards as an incentive

KENNETH W. FOSTER, C. '26

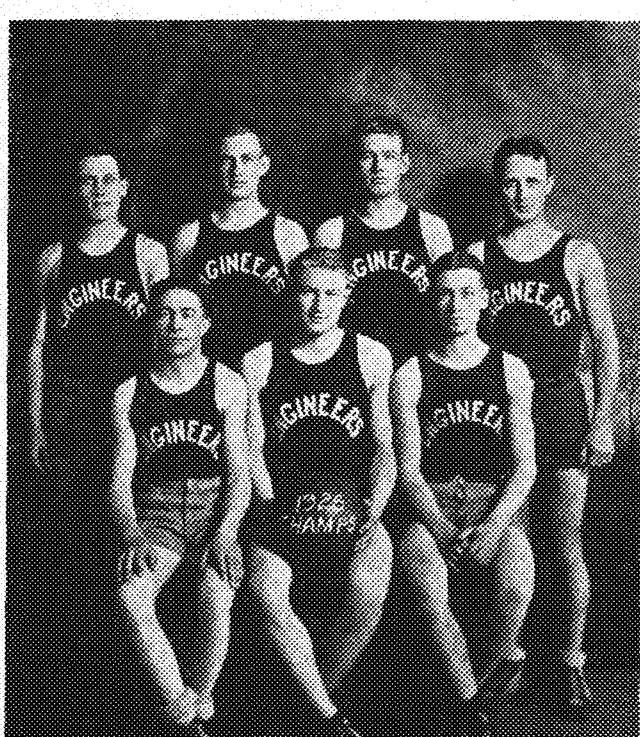
ON Thursday, April 15, the first officers of the newly recognized Technical College Athletic Board were elected, marking what appears to be the most conspicuous mile post in the history of engineering athletics. Last year, through the efforts of the college manager and the class managers, the board was first organized. Several meetings were held and much good was done, as any who were in school last year must admit. However, the board did not receive official recognition in time for public announcement so that the men composing the board were compelled to labor in obscurity and the powers behind the athletic throne were comparatively hidden.

Now the board is in a position to demand its proper position among the organizations on the technical campus and to receive due recognition from the campus at large for the successful work that it has completed and will complete in time to come. The past year has been its test period. How well it has withstood and equalled demands is easily shown by its accomplishments. The Technical College Athletic Board, through its precedent, has been responsible for the organizing of two tennis and two golf tournaments, one touch ball league, a diamond ball league, a basketball league, swimming instruction classes and a baseball team that won the I. M. championship. Certainly any organization whose purpose it is to promote and encourage athletics must be proclaimed successful after the completion of such a program. The test period is complete. We are now fully prepared to continue to give the men of the College of Engineering and Architecture and the School of Chemistry more and better athletic recreation.

A bit of history would not be amiss. The Technical College Athletic Board was organized last spring. It was one of the boom in athletics that was experienced by the Engineers and Chemists and is the necessary governing implement by which athletics in the College of Engineering and Architecture and in the School of Chemistry will be controlled. Under the former system in the College of Engineering and Architecture, a class athletic manager was elected by the members of the respective classes. The senior class manager was then declared the college manager. This system worked quite successfully for a number of years, but of late the position of college manager, when properly conducted, has taken so much time that the need of a change in organization became apparent. Then, too, the fact that the present policy of the Intra-mural Department is to conduct athletics practically among the fraternities alone, has been an important factor.

A constitution was drawn up and submitted to Professor Zelner for approval and criticism. It might be well to state that Professor Zelner at one time was the director of I. M. athletics for the entire University, acting from the position of chairman of the I. M. Athletic Committee. After the constitution was put into its final form, it was submitted to the Dean of Student Affairs and to the Technical Commission. Favorable action was taken by both and by the end of the spring quarter in 1925 at least officially recognized.

During this formation period, a full athletic program was maintained. The first touch ball was very successfully played during the fall quarter of this school year. Incidentally the touch ball rules drawn up by men of this college as the results of their play here, are due to receive wide-spread distribution next fall. For those who do not know, touch ball is played somwhat similarly to football, the main difference being that a student can play it for a half hour and, after spending five minutes washing up, report to his next class none the worse as far as bruises and torn clothing are concerned. During the winter quarter we played off a basketball league which provided a very close race, three teams being in the running right up to the finish.



1926 TECHNICAL COLLEGE CHAMPIONS
In the back row are Joesting, Johnson, J. R., Kreger, and Bolstad, while seated in the front are Deegan, Manson, and Foster.

A word concerning this spring's list of events. There are 70 entries in the Technical College Tennis tournament which number almost exceeds that of the All-U tournament. The pairing for the golf tournament will be made as soon as the chemists have signed up. Mr. W. R. Smith, head of the I. M. athletics, has promised to have the grounds keeper put in a horse-shoe court in the immediate vicinity, which will enable our "barn yard golfers" to get busy. The biggest thing of the quarter will be the diamond ball league. We expect to have fifteen teams comprising engineers, architects and chemists competing for the Technical College championship. The winning team will play off for the All-U title with the agricultural and fraternity champions. Last year, the freshmen engineers won the college championship and then defeated the Ag champs and Theta Chi, the fraternity champs, thereby bringing the second All-U title to the technical college. This team is practically intact again this year.

It may be a good thing to explain the eligibility rules. The ruling now enforced by the I. M. Department prohibits any man from playing on two teams in the same sport leading to an I. M. championship. If this ruling was adopted most of the men who now play with fraternities would be lost. In many instances the fact that one or two fraternity men have been able to play has enabled a class or section to enter and hold together a team where otherwise they would not have had the initiative or, occasionally, the athletic ability to do it. Fraternity men are used as the ex-

(Continued on page 232)


The Making of an Engineer
After you have spent 4 yrs. dreaming of air castles,
Don't slam the door
and tried numerous railroad offices etc. in search for a job, and they all turn you down -
Plug
5
You will take a job chaining. After spending 14 yrs. at this position the chief Engineer-
Calls for you, and asks what you did at the U. You tell him not much except that you kissed the Blarney Stone and was a firm follower of St. Pat.
And the "chief" decides you should be a full fledged Engineer because of your unfailing faith.
You'll be glad you kissed the "Brick".

Order of Events

FORENOON

9:00-11:00

Every department holds open house at which souvenirs are distributed to parents and alumni.

11:00-12:00

Gigantic parade, depicting humorous and serio-comic phases of life as seen through the eyes of an engineer, wends across campus.

12:00-12:45

Knighting ceremonies on the campus knoll when St. Patrick and his lady queen will duly dub each graduating engineer a true son of the ould sod.

ELIZABETH DIXON, *Queen*

Order of Events

AFTERNOON

1:00-3:00

Open house in all of the buildings at which details that couldn't be seen in the morning can be given the once over in thorough manner.

3:00-5:30

Dansant in the laboratory of the electrical building as well as the main engineering auditorium commences. Green tea will be served to all.

9:00-12:30

Grand "Brawl" in the Minnesota Union starts. The grand march comes off at 9:15 led by none other than St. Pat. and his queen.

Committees In Charge of the Day

Brawl

STUART BAILEY, *Chairman*
RUSSELL SORENSON
CARL BARTHELMY

Decorations

JOEL CARLSON, *Chairman*
ROBERT GUSTAFSON
FLOYD BORNE

Green Tea

MARGARET BRADBURY, *Chairman*
LOUISE BELDEN
ALICE CUDWORTH
RUTH DANIELSON
MURIEL EHRENBERG
ELIZABETH FLATHER
GLADNESS WILKINSON

Finance

JOHN HOVING, *Chairman*
KENNETH JOHNSON

Parade

CHARLES BURMEISTER, *Chairman*
DONALD ROSING
ALBERT SCHULTZ
EDWARD BOTTEMILLER

Knighting

JOSEPH WALD, *Chairman*
CLIFFORD BRANDT
ALBERT LEE
FRANK LUNDSTEN

Open House

PAUL BLIVEN, *Chairman*
PAUL SPEER
ROY THORSHOV
SIDNEY CROWELL
LOREN POHL
WILBUR CHAPMAN
CURTISS CEDARSTROM
EDWIN COATES

Posters

ROBERT DUNNING, *Chairman*
GLENN THOMPSON
LEONARD KLIENFELD

Sunlite

LOUIS SCHALLER, *Chairman*
LLOYD BERKNER
JOSEPH ARMSTRONG
JAMES HARTIGAN

Publicity

PAUL GIESSEL, *Chairman*
ROBERT EDGAR

Alumni

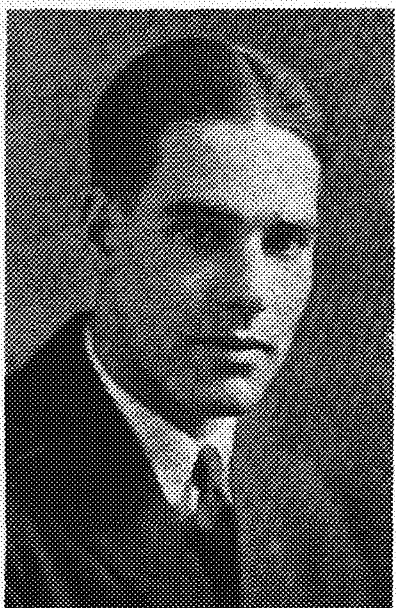
JOHN BRENNER

Music

ROGER WHEELER

Secretary

NORMAN RONNING



RICHARD R. TREXLER, *Chairman*

Personalia

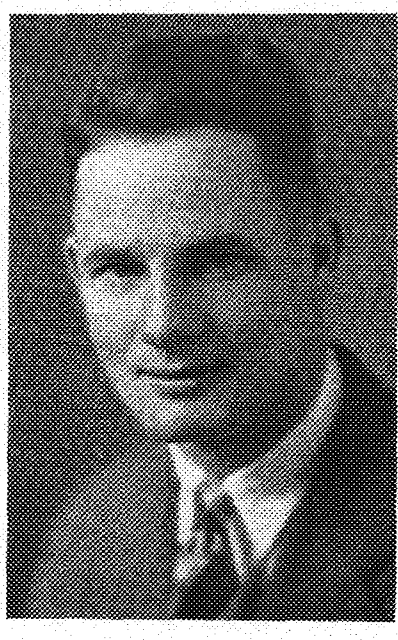
ELIZABETH DIXON, who with royal grace will act as St. Pat's queen, is a senior in the College of Education and is prominent in student affairs. She was album editor of the 1926 Gopher, is a committee member of the Senior Prom, has been active in the Y. W. C. A. and W. S. G. A., and is a member of Pi Beta Phi sorority.

*

RICHARD R. TREXLER, junior mechanical, as general arrangements chairman, has had the responsibility of putting the day across and much of the credit for the success depends upon him. He is the mechanical editor of the TECHNO-LOG, and belongs to Triangle fraternity as well as Pi Tau Sigma, honorary mechanical engineering fraternity.

*

RAYMOND R. KELLY, known also by his nickname of 'Railroad,' derived from his initials, is the originator of the Gesundheit march, lockstep made famous by the civils on scrap day. He has been a loyal worker in all engineering activities during his college career and justly deserves the highest honor that can come to an engineer—that of being St. Patrick. He is a member of Phi Sigma Kappa fraternity and Chi Epsilon, honorary civil engineering fraternity.



RAYMOND R. KELLY, *St. Pat.*

NEWS FROM THE TECHNICAL CAMPUS

Novel Concrete Construction On Yeates Building, Minneapolis

An interesting bit of reinforced concrete construction is being done by the James Leck Co. on the Yeates Building, Minneapolis. The concrete work itself is perfectly normal, but the novel feature about the job is the fact that four stories are being added to the six-story building in the heart of the Nicollet shopping district with no inconvenience to tennants in the original structure.

The tunnel-like protection built around a temporary wooden sidewalk, with all its attending annoyance to pedestrians, that is usual in downtown construction jobs, is entirely lacking. Instead, a solid wall of sheathing was started about six feet out from the top of the original building on the Nicollet and 9th street sides, and was extended up story by story as the construction progressed. A platform reaching from this wall to the building protects passersby below from any falling materials. A layer of tar paper on the inside closes all cracks and helps to protect the green concrete from cold weather.

All building materials are hoisted in a tower that was erected in a small loading court directly behind the building, and scaffolding was constructed between the tower and the building, with runways extending from the tower to each slab. Materials are delivered as used, and Nicollet avenue and 9th street are therefore free from all stock piles.

No difficulty was experienced in preparing the roof slab for the four additional stories, for the building had originally been designed for ten stories, and all plumbing and electric fittings had been carried through the slab and blanked off.

Greater Efficiency in New Gopher Row Boat Motor

The "Gopher Motor," a Minnesota home product, is growing better year by year. Just a few years ago when the motor was more or less in its infancy, it was cantankerous and balky like an irritable mule. After a few hours of superhuman effort on the part of the operator, the engine might condescend to run for a short time till a bearing burned out or a connecting rod came through the crank case.

The engineers at Minnesota, however, were not the type to be dismayed or discouraged by mere trifles. They persevered in this task and one by one the faults in design were corrected. After a time the engine reached a stage in its development where it started easily and ran rather consistently. The problem of vibration still seemed a difficult one but by carefully balancing the reciprocating parts the vibration was cut down as much as is possible with a single cylinder engine.

In the spring of 1925, a radical change was made. The crankshaft had formerly been vertical and the propeller was driven through mitre gears at the lower end of the crankshaft. There was considerable failure of the gears and difficulty in keeping the motor support firmly fastened to the boat. The new motor has an axial drive which eliminates the mitre gears and has less tendency to shake the support loose from the boat.

The claims for the new design are said to be greater ease of handling less complication of the parts, smoother running and higher efficiency.

Dr. Shepardson, Touring World, To Spend Summer In Europe

DR. GEORGE D. SHEPARDSON

Dr. George D. Shepardson, who is on a sabbatical leave this year from the university, reports having a most profitable time on his trip around the world, which he is now taking. One of his main interests on the trip is the collecting of old relics relating to lighting and communication for the electrical museum at Minnesota, which is among the best of any in the world in the completeness as well as diversity of subject matter. To date, Dr. Shepardson has collected many articles for the museum, among which are an old Chinese compass, Chinese glass chimney lamp, candles, a square coolie lantern, and some Japanese straw symbols.

He is expecting to spend most of the summer in Europe, and plans to be back about September 15. He took a special trip across India, and is planning to leave the cruise in Cairo, spending two additional weeks in Egypt and Palestine, then making Naples a center for some time, from which he will work up into France and Switzerland.

Mail sent in care of the American Express Company, 11 Rue Scribe, Paris, will reach him until about June 1.

Great Lakes Division of A. I. E. E. Offers Prizes to Student Members

The Great Lakes division of the American Institute of Electrical Engineers is this year offering as an incentive to student members of this district, a sum of money in prizes of $50 and $25 for the best paper written on some field of the electrical industry. The manuscripts are to be handed in to a local committee of faculty members and then submitted to the chairman of the committee on awards. Prof. C. M. Jansky of the University of Wisconsin is chairman of this committee. Prof. W. T. Ryan is in charge of the local section and papers must be turned in not later than the first of June of this year.

1911 Mines Graduate Designs New Santa Fe Terminal

Lloyd R. Whitson, a graduate of the School of Mines in 1911, now a prominent architect of Dallas, Texas, is the chief designer of the Santa Fe terminal, only eclipsed in size by the Bush terminal in New York City. Prof. G. A. Maney of the University of Minnesota was engaged as consulting engineer on the project.

The terminal consists of four parts covering an area of 840 by 240 feet. The first section consists of two parts, a 20 story office building facing on the street and a 10 story stock display house in the rear. The second unit is a ten story warehouse while the third is an eight story cold storage plant. Unit four which is eight stories high, is a warehouse.

All shipping is done on underground tracks which connect all parts of the terminal. A "Thermos bottle" locomotive which will work eight hours once charged with steam at 200 pounds pressure, is used on all switching work as the cinders and smoke of a steam engine would make working conditions impossible.

In addition, a two story University Club house is now being built on top of the second unit. Access to this will be an elevator to the tenth floor of the office building, and thence across a bridge over to Jackson street to the top of this second unit.

Junior Mechanical Engineer Designs New Pneumatic Hammer

Wilbur Chapman, Junior Mechanical, has just added to his already large group of mechanical contrivances a new type of pneumatic riveting hammer. The design, although patterned after existing standards, is essentially original.

The hammer works under a pressure of 100 lbs. per square inch or higher and is capable of driving rivets up to about three-quarters inch diameter. Mr. Chapman expects that with a few improvements and a slight change in design, which he is contemplating at present, the gun will be much more efficient and powerful.

The remarkable freedom from vibration which characterizes the performance of this gun in directly responsible for its ease of handling, which facilitates operation and improves the efficiency of the workman. These desirable qualities are due to certain radical departures from standard practice which the designer has not as yet made public.

Mr. Chapman has also, during the last year, designed and constructed a small twin cylinder steam engine which operates satisfactorily under steam pressure up to 600 lbs. per square inch.

Jansky, Home From East, Speaks Before the S. P. E. E.

"Collegiate Training for the Radio Engineering Field" was the subject of an address given by Prof. C. M. Jansky, Jr., before the Minnesota chapter of the Society for the Promotion of Engineering Education on April 19. Prof. Jansky recently returned from the east where he was in attendance at the convention of the American Radio Relay League held at Hartford, Connecticut. He also visited several large eastern manufacturing concerns and was successful in obtaining several crystals for use in oscillators for standard wave calibration.

Electrical Engineering Students Conduct Original Research

Students in the Electrical Engineering Department are being encouraged to do research work along lines that are new and apparently untouched. As a result, there is now a considerable number of men, graduates and under-graduates, who are working on different original phases in the electric research field.

Two seniors, Welton and Clarence Johnson, are experimenting on the electrical welding of copper. It is a known fact that copper is a metal which is very difficult to weld. The Johnsons noticed that after the metal was apparently securely welded, an explosion took place, the weld was ruined, and the molten metal was scattered away from the weld. They believed that this failure was due to a phenomena that is known as the pinch effect, and they are now doing work to determine the effect of pressure and electric current on the pinching off of the copper.

The transformer used is operated from the 110 volt a. c. line, giving 4,000 to 6,000 amperes at 12 volts.

Among others doing research work is Mr. George F. Corcoran, a graduate, who is developing an analysis of squirrel cage currents. The tests enable him to graphically follow the alternating current through the motor for over two seconds after the switch is closed.

Mr. Schnell is doing research work in the radio field. He is studying the problems of crystal control oscillators.

Mr. James F. Barton, '27, is working on the design and construction of a radio short wave meter.

Mr. Lloyd V. Berkner, '27, is doing research work, investigating the operation of radio stations. He is also investigating the factors governing the 40-meter short wave, with low power transmission.

Mr. Tighe and Mr. Joesting are studying the problems and principles of "B" battery eliminators.

Mr. Karl Albrecht, a graduate, is making a general study of the cathode ray oscillograph, with its application to radio.

Mr. John Hilliard, also a graduate, is doing considerable research in the determination of the voltage gain in power amplifiers. He is using Western Electric and Bell equipment, and is also developing equipment of his own.

Mr. Hart and Mr. Sjoberg are conducting an experiment to find the output of storage batteries at different temperatures, in reference to automobile starting in sub-zero weather.

Mr. Beveridge has been doing considerable experimental work with lamps and other household appliances. His work has been along the line of determining the general overall efficiency of electrical apparatus that will be of value in his thesis on "The Efficiency of Electrical Power Equipment."

Mr. Fiene and Mr. Williams are doing research work in the field of electrical resistances. The main object of their work is to find some resistance or system of resistance units that would be the best suitable for laboratory work. Several different types of resistances are being tried and their relative merits found.

Senior Mechanicals Assist Freshmen In Various Shops

The increasingly large classes enrolled in the freshman shop courses have made it necessary to employ more assistants for these various groups. In the Mechanical Engineering Department a novel system has been inaugurated whereby senior mechanicals are used as assistants in charge of each branch of the shop. This gives the senior valuable experience and a closer contact between upper and lower classmen is accomplished. Lawrence O'Donnell is now an assistant in the foundry classes and in the forge shop Carl Fornfeist is in charge. Lawrence Erskine, who graduated last spring and is now taking graduate work in the department, is the helper in the pattern shop.

Permission Given Engineers To Carry Special Canes

Engineers are showing their originality this spring by deviating from carrying the orthodox canes of the rabble and are brandishing walking sticks of their own creation. Civils during summer camp this year fashioned out of small trees found in the neighborhood of Cass Lake a peculiar cane formed of knotted wood, and are startling the campus in general by calmly displaying these works of nature.

Ray Kelly, St. Pat. elect, has been seen about the campus with a large Irish walking piece, reputed to have really seen the Emerald Isle. It is an heirloom of the Kelly family and has been handed down from generation to generation.

There has been some agitation as to whether or not men of the engineering college would be allowed to use canes of their own invention, but the following letter from Charles Morris, president of the senior commission alleviates any doubt:

"The Senior Commission hereby grants permission for the senior class of the College of Engineering to use such weapons as they deem fit, in lieu of the regular canes as prescribed by the committee in charge. The walking sticks as specified are standard and simple, but that originality, a valuable trait may be cultivated, this special request has been granted."

Electrical Department Equips New Photographic Laboratory

A special photographic laboratory which will be used in connection with oscillograph pictures is being equipped by the department of electrical engineering on the main floor of the electrical engineering building. An intense study of similar dark room laboratories in several of the leading schools of the United States has been made and the results obtained in this investigation are used to advantage in this new layout.

The department owns several oscillograph machines which pictorially show the wave forms of electric current and potentials and are used to show the characteristic current flow in various machines. These are the only instruments of their kind in the Twin Cities and are used as standard reference by large firms when tests of this kind are used.

A large washing sink and drying rack as well as printers for these special films are being installed and other equipment will soon be put in permanently. Much time can be saved by the use of this new laboratory, as the small sized film can be taken immediately to the dark room and developed so that the results of the test can be determined before the apparatus is taken down.

Highway Laboratory to Be Ready For Classes By Fall

Construction is being rushed on the highway materials testing laboratory which is being built as an addition to the experimental engineering building with the hope that it will be ready for interior finishing by June 15. It is planned to conduct some classes in it during summer session and the regular schedule of classes will be held there starting the fall quarter.

The addition consists of a basement very near the level of the ground, and two floors. In the basement will be located testing machines. The first and second floors are divided in halves, each containing practically duplicate apparatus for the use of student and for the State Highway Department. The second floor will contain in addition several rooms for private research. In the center of the building runs a light shaft which also connects with the main structure through an archway.

The new structure is the same width as the main building and extends 78 ft. towards Washington avenue. It is finished in the standard style, rough red brick exterior and Bedford stone trimming being used throughout. Asbestos shingles are used for roofing.

The plans were drawn up by Professors Rowley and Lang in conjunction with Professor F. M. Mann, head of the School of Architecture, and C. H. Johnston, the state's architect.

"Engineers' Religion" is Title of New Book by Prof. Shepardson

"The Engineers' Religion" is the title of a book recently written by Professor Shepardson, head of the department of electrical engineering. The book has been under preparation for some time and was completed late this summer while Professor Shepardson was spending his vacation at Benton Harbor, Michigan. The exact date of its appearance in printed form will not be known till Professor Shepardson returns from his trip around the world.

Dr. Eli Burton, Canadian Scientist, Is Lecturer Here

The fourth of a series of scientific lectures sponsored by the Graduate School was given by Dr. Eli Franklin Burton in the auditorium of the School of Chemistry on April 16. Dr. Burton, who is professor of physics at the University of Toronto, had as a subject "The Physics of the Ultramicroscope." He explained in detail the use and properties of suspended particles and colloidal cells and also described some of his discoveries in this field.

Cash Prize to Be Awarded For Best Engineering Themes

Many prizes are awarded annually to engineering students for papers on technical subjects. These awards are made for the purpose of stimulating interest along certain lines and at the same time giving the participants training and experience in technical writing.

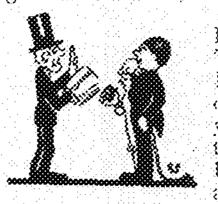
O. P. Briggs of Minneapolis has for several years offered a prize of $75 for the best paper on foundry practice. Only sophomores are eligible for this prize and the papers should be submitted to the rhetoric department before May 1. Last year none of the papers submitted were adjudged of sufficient merit to warrant the awarding of the prize.

AROUND THE WORLD WITH OUR ALUMNI

Architects

'23—Clarence H. Luedeman is traveling out of Kansas City, Mo., for the General Fireproofing company.

'24—Charles R. Barnum is an instructor at Bradley Institute, Peoria, Ill. He was married last spring to Miss Mabel Glasgow of St. Paul, Minn.



'24—The marriage of Frank R. Root to Miss Teresa E. Sm?re of Minneapolis occurred on January 2nd of this year. Immediately after their wedding, they left for a short trip and will be at home after February 1 at Wheeling, W. Va.

'24—Lawrence A. Tvedt was married on November 5, 1925, to Miss Mary Slocumb ('25). Mrs. Tvedt is a graduate of the department of interior decoration. They are making their home in Memphis, Tennessee, where Mr. Tvedt is the chief estimator for the Gauger Korsmo Construction company.

'24—I. Woodner Silverman has been awarded a fellowship in architecture of $1200 by Harvard University. Mr. Silverman graduated from Minnesota with honors last spring, and at present plans to continue his studies in Europe.

Chemists

'22—Ruben Ellstad, an assistant in the quantitative laboratory of the School of Chemistry left recently for Harvard where he will be research assistant for Professor Baxter. Mr. Ellstad completed several important research problems while working under Dr. Brenton here at Minnesota.

'25—Homer Hamm has accepted a position with the Bureau of Standards at Washington.

'25—Marjore Howe was a recent visitor to the campus. She now holds the position of chemist of the Duluth branch for the Russell-Miller Milling company.

'25—A. M. Edmunds is now a combustion and efficiency engineer for the United Alloy Corporation of Canton, Ohio.

'23—Walter E. Katz, who was with the Great Northern Railway company, is now with the Minnesota State Highway Department.

'26—Loren Shirk has accepted a position with Procter and Gamble and will go to Ivorydale, Ohio, to work for them soon after graduating in June.

Civils

'91—Noah Johnson, now a valuation engineer for the Wabash railroad and located at St. Louis, motored through northern Minnesota this summer in company with friends of that city. They spent several days at Lake Vermillion and also visited the University campus.

'09—N. W. Elsberg, the city engineer of the city of Minneapolis, appeared before the student branch of the American Society of Civil Engineers at their March meeting. He spoke on the proposed river harbor for Minneapolis and showed how it would lower the freight rates between Minneapolis and all points on the lower Mississippi.

'10—Alfred C. Godward, park and municipal planning engineer for the city of Minneapolis, left recently for an extended tour through Bermuda, Cuba and other points south. He plans to study municipal development in these localities and take several pleasure trips on the side. He is accompanied by his wife.

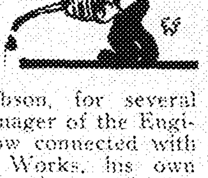
'14—Leonard E. Ott has left the Arthur Mining company, Marble, Minnesota, and is now working for the Guthrie Construction company as superintendent on a tunnel being put through the Ozark hills. Mr. Ott was married last August to Annabel Earl of Grand Forks, North Dakota.

'18—George W. Putnam has lately been appointed director of the division of dairy products of the Chicago Department of Health. Since graduation, Mr. Putnam has done some notable work. In 1922 he took the position of chief sanitary engineer, State Board of Health of Missouri, and resigned this position to accept the one offered by Chicago's Commissioner of Health. During his service in Missouri he organized the water, milk and sanitation work of that state, and was also executive secretary of the Missouri Conference on water purification. He served as assistant sanitary engineer with Minnesota State Board of Health in 1917-1919, and with the California State Board of Health, in 1921. During the World War he served as Lieutenant, Sanitary Corps, U. S. Army.

At present Mr. Putnam is chairman of the Committee on Sanitary Protection of Ground Water Supplies of the Conference of State Sanitary Engineers.

He is a Fellow of the American Public Healt Association, a member of the American Water Works Association, and an Associate Member of the American Society of Civil Engineers.

We feel assured that the city of Chicago has placed the handling of its m... supply in compentent hands.



'21—James H. Werdenhoff is engaged in refinery construction, recently completing a large plant at Okmulgee, Okla. He plans on visiting Minnesota in the near future.

'21—Howard C. Jacobson, for several years the successful manager of the Engineers' Bookstore, is now connected with the Jacobson Machine Works, his own enterprise. His brother Frank (E. '24) is associated with him.

'21—George M. Christilaw is now a resident highway engineer at Red Wing, Minnesota. Other civils with the highway department who have just entered the field are Frank Christlieb, '23, who has gone to Sandstone, Loring Slade, '22, who is now at Moose Lake, Arthur Tews, '24, who is at Shakopee, and Carl Odquist, '23, who was recently sent to International Falls on a road building project.

'21—Everett J. McCubrey is a resident engineer for the Minnesota Highway Department with headquarters at New Ulm, Minnesota. He is married to Palma E. Deringer (A'19) and they have one daughter, Betty Jane.

'22—Walter E. Cook is now with the United States Gypsum company in their Chicago office. He was formerly with the Joliet and Eastern railroad. The job with which he is connected at present is the design of an addition to the company's hydrated lime plant at Genoa, Ohio.

'22—Edward L. Espenett of Minneapolis recently announced his engagement to Dorothy Dalrymple of St. Louis, Missouri, at a tea given on New Year's Day. Mr. Espenett is connected with the Missouri State Highway Commission. Miss Dalrymple is very well known in St. Louis. They will be married early in the spring and will spend their honeymoon in the Twin Cities.

'22—E. M. Silverman is resident engineer for the Illinois Highway Department and is at present in the State Highway Office, Dixon, Ill. He was married last June to Molly M. Isaacs of Minneapolis. Mr. and Mrs. Silverman drove up to Minneapolis in December for a three week's visit with friends and relatives and expected to drive back to Dixon if the roads were in good condition.

'22—Arthur E. Horstkotte, editor of the Techno-Log '21-'22, is now in the contracting business in Oregon with headquarters at 430 Northwestern Bank Building. His branch is the building of sawmills and boiler installations. He predicts a very prosperous summer.

'22—Dewey Mattson is in the guard rail engineering department of the State Highway Department. He was formerly an office engineer on Highway No. 1 at Two Harbors, Minn.

'23—Rolf E. Bergford, who has been engineer of inspection of state highways, has left the department and is now working for the Standard Oil company.

'23—Just to show that the electrical men cannot get along without the civils, Henry J. Manger is conducting hydraulic investigation and development work for the Northern States Power company. He is located at Bruce, Wisconsin. Worse than that, he was married last year to Miss Anna Gjesdahl, a graduate from our own College of Education in 1923.

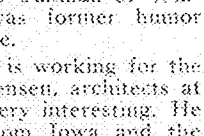
'23—Walter M. Maiser is on construction work with the J. W. Snyder company, contractors, in Chicago. At present they are engaged in erecting several new buildings for the Commonwealth Edison company at Chicago. Mr. Maiser says that he ran into H. E. Messer ('23) at the Fisk Street station.

'23—Robert H. Ridgway is a surveyor with the U. S. Engineers' office at the Municipal building located at Chattanooga, Tennessee.

'24—Away up in Alaska is the hangout of Stanley G. Olson. He is with the U. S. Steel company and letters addressed to Kennecott will reach him.

'24—Announcement has recently been made of the engagement of Frank T. Roos to Miss Gertrude Tallman of Willmar, Minn. "Bill" was former humor editor of this magazine.

'24—C. Milton Olson is working for the firm of Mundie and Jensen, architects at Chicago, and finds it very interesting. He rooms with a man from Iowa and the results of the Iowa Homecoming game which he came to Minneapolis to see, pleased him exceedingly.



'24—Roy J. Blair is living at Highland Park, Michigan. He is junior engineer in the United States Lake Survey and is working in the Survey Office, Old Custom House, Detroit, Michigan.

'25—M. D. Judd is living at 311 Fifth St. NW., Mason City, Iowa, where he is working as salesman for the North Iowa Brick & Tile Co. He was married recently to Blanche Anderson of St. James, Minn.

'25—Dwight Burns, Arthur Gobeli, and Carl Gerdes, all graduates of March, '25 are now working for the Santa Fe railroad and are located near Lubbock, Texas

'25—Hamilton Craig has been employed in the erection of new blast furnaces and mill buildings in Boston for the Illinois Steel company but he is now in the Chicago office where he expects to remain.

'25—C. R. Peterson is now with the Engineering Department of the Chicago, Milwaukee and St. Paul railroad and is working out of the Minneapolis office.

'25—Another alumnus has assumed the responsibilities of married life. Arthur J. Kroll was married to Dorothy Erickson of Chicago on November 23, 1925. They are living at 1503 E. 64th St., Chicago, Ill. Mr. Kroll is working in the engineering department of the Illinois Central.

'26—Our graduate of March, 1926, are all out testing their wings in the stormy winds of life. C. H. Sandberg is in the Bridge Department of the Santa Fe railroad and is working in the Chicago office.

T. P. Young is in Richmond, Virginia, working for the Chesapeake and Ohio railroad in their Bridge Department.

C. E. Meyerdick is in the engineering department of the Elgin, Joliet and Eastern railroad working in Joliet, Illinois.

George U. Olman is in the United States Army engineers' office at Milwaukee, Wisconsin.

P. G. Lindstedt and R. C. Bolstad are both in Chicago working on the Chicago Terminal Improvement for the Illinois Central railroad.

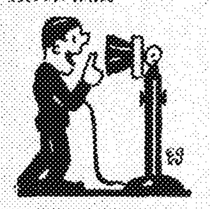
R. Conrad Cooper is working with the Universal Portland Cement company. He is engaged in sales and promotion and is working out of the Minneapolis office.

C. S. Johnson is with the Engineering Department of the M. and St. L. railroad and is located at Minneapolis.

J. R. Breeden is working with the Illinois Central railroad. He was sent to Jackson, Mississippi, but was later recalled to Chicago to work in the Bridge Department.

Alex Lipchick is in Chicago working for the American Bridge company.

Electricals



'20—Norman W. Kingsley was recently appointed the general plant employment supervisor of the Northwestern Bell Telephone company at Omaha, Nebraska. He will be in charge of all employment at headquarters plant. Kingsley started with the telephone company after finishing school, as a member of their construction crew in Minneapolis and has steadily pushed his way to the top. Norm will be remembered for his many activities while at school. He won seven letters and the Conference Medal and in addition was captain of the varsity football team, center on the basketball team and was also a crack sprinter on the track squad.

'22—Martin P. Wichman, who is division interference engineer for the Northwestern Bell Telephone company, was recently interviewing senior engineers relative to employment with this company.

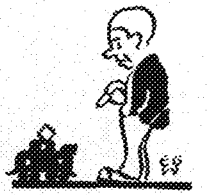
'23—Leroy A. Grettum was one of the speakers at a joint meeting of several southern Minnesota power companies recently. His topic was "Safety." Grettum is with the Wisconsin Railway, Light and Power company and is located at Winona.

'24—Theodore F. Schilling has severed his connections with the Minneapolis branch of the Standard Oil company and is now affiliated with the Noble Electric company, contractors for electric power installations.

'24—L. W. Morton married Helen Perkins of Minneapolis on December 31, 1925. They are now living in Schenectady, N. Y., where Mr. Morton is with the General Electric company.

'24—Gaylord Gilman is building bridges out in Pittsburg, Pennsylvania, which goes to show that a man doesn't always follow the line of work that he studied for in school. His address is 6334 Marchand St., Pittsburg, Pa.

'25—Kenefick Robertson, managing editor of the Techno-Log last year, has been transferred to the Sioux Falls division of the Northern States Power Co.



'25—Geo. J. Shavor was one of the speakers at the regular meeting of the Northwest branch of the American Institute of Electrical Engineers held March 29 at the electrical engineering auditorium of the University of Minnesota. His topic was "Automatic Starters for Synchronous Motors." The meeting was staged by the Electric Machinery company of Minneapolis.

'25—Hugo H. Hanft visited the U of M recently as advisory aid to the interviewer from Westinghouse. Hugo is very interested with his work and expects to be in the east for several years.

Mechanicals

'98—James Garvey was here recently, representing the Western Electric company, to secure graduates from the class of '26 for placement with the company.

'17—F. W. Hvoslef is now chief engineer for the Timkin-Detroit Company.

'20—J. H. Czock is practicing his profession way out in Somerville, Massachusetts. He is mechanical engineer, working on Diesel engines.

'21—Ralph W. Liddle was recently in the Twin Cities, called there by the illness of his wife. Liddle is editor of the Edison Roundtable, official organ of the Edison Club of the Commonwealth Edison company of Chicago.

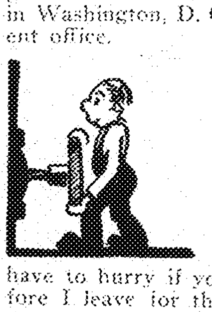
'24—J. A. Anderson is surely plugging along. He is working for the A. C. Spark Plug company in their Efficiency Department and is located in Flint, Michigan.

'24—C. R. Blodgett is engaged in scheduling of electrical equipment and press room work for the Federal Electric company of Chicago.

'24—Paul M. Boyd received his Masters degree at the Massachusetts Institute of Technology last year and has since been with the Curtis Airplane and Motor company, working as project engineer, at Garden City, Long Island.

'24—If you want to write to Lyle Borst, address him 321 West 6th street, Davenport, Illinois. He is down there working for the Donovan Construction company of Saint Paul as superintendent of construction.

'24—Donald E. Earl got his Masters degree at Minnesota last year and is now in Washington, D. C., working in the patent office.



'24—Roderick M. Cross is in Florence, Alabama, doing work on the Wilson Dam at Muscle Shoals. He writes, "Every one visits the dam but my friends. I haven't seen one familiar face in 18 months, but you'll have to hurry if you want to see me before I leave for the north in the spring. I've been doing everything from architecture to plumbing, and testing machines down here.

"Florence, Alabama, died about 60 years ago and is only now beginning to show signs of life. Don't let anyone sell you any of this land unless you know a bigger sucker someplace else."

'24—"Red" Langman is with the Proctor and Gamble Manufacturing company at Kansas City. He writes that he is getting along very well and that his job is a good one.

'25—Tom Caswell has deserted the mechanicals and fallen under the spell of electrical engineering. Apparently he has made a good start, for he recently visited Minnesota to make advance arangements for the interviewer from the General Electric company. He is with that company located at Schenectady.

'25—Lloyd Peck is living at 535 Gooding Street, La Salle, Illinois. He is a mechanical engineer for the National Laundryowners Association.

Miners

'05—Erich J. Schrader, consulting mining engineer of Reno, Nevada, spent the winter in Minneapolis visiting with his old friends and looking around the school. He spoke before the student body of the School of Mines on the reopening of the mines in the southwest that were closed during the war.

'05—Chauncey Cadewell died on February 11th at Anaconda, Montana, of pneumonia. Burial took place in the Masonic plot at that city. He leaves three sons and one daughter besides his wife. Cadewell had been in the employ of the Anaconda Copper Mining company as superintendent of their Surface Department and was located at Washoe Smelter.

'11—Harold J. Rahilly was married to Miss Grace Gardner of Minneapolis on March 4. He is assistant general superintendent in charge of the Original, Steward, and Colorado mines of the Anaconda Copper mining company.

'07—C. F. Jackson is engaged in private consulting work, having left the employ of the Cypress Mines Corporation. Mr. Jackson, while in Minneapolis, gave an address before the School of Mines Society.

'18—Lenden L. Foley, who has been doing geological work independently at Tulsa, Oklahoma, is now in the employ of a large oil company in that city.

'20—J. D. Wheeler is at Barranguilla, Columbia, S. A. He is with the Geological Department of the Richmond Petroleum company of Columbia. It is his hope to return to the Twin Cities next fall to see our championship football team in action.

'23—James Stewart has been appointed assistant geologist for the Northern Pacific railroad at Billings, Montana. Since graduating he has been with the N. P. as instrument man mapping the lignite fields of North Dakota.

'23—Garfield Siverson has recently accepted a position on the staff of the Purol company and is located at Tulsa, Oklahoma.

'23—Chen Ping Chang is teaching in Southeastern University at Nanking, China.

'25—H. P. Sherman was a visitor at the School of Mines on April 19. Sherman is engaged in metallurgical work at Biwabik, Minnesota.

The
MINNESOTA TECHNO-LOG
University of Minnesota

THE emerald country of Ireland was overrun with snakes. Many an old toper was continually having delerium tremens and it seemed that the slimy reptiles were everywhere. What could be done? In one part of the island lived a good saint, Patrick by name, who had gained fame for his acts of kindness. Thither went all of the O'Briens, Mulligans and Flannigans beseeching the good Saint Pat. to rid the land of reptiles, which he did. This was one of the first jobs of engineering on record, but we hesitate whether in the making of this first worm drive, the mechanical or sanitary sides should be stressed.

Why do collegians of America today *revere* St. Patrick and on one day celebrate in his honor? The answer is simple. He was a true engineer, doing something which people thought impossible and something which benefitted the human race. Many have been the engineers whose deeds are worthy of remembrance, but we find none so colorful as he. Perhaps he didn't have a transit, use a voltmeter or a steam gage. When he was called on to perform a task others had found unsurmountable, he went ahead with the tools he had. His service to his fellowmen has earned for him a place in the hearts of the world. To render service is the task of the engineer. His tools may be different and his problems, too, but he does his work just as surely as that old saint did. Though he never saw a slide rule, St. Patrick nevertheless was an engineer, and a good one.

Festivities in the various technical schools of the country differ in form, but all have the same purpose in mind, to demonstrate to the public the exact nature of their collegiate work. Some places, the celebration lasts an entire week with exhibits, parades, vaudeville shows presented by home talent. At others, a single day has been designated on which pandemonium reigns with its open houses, parades, knighting ceremonies and brawls. The movement apparently started in the middle west but has now spread to both coasts. The time of celebration depends upon the climate. In the milder parts of the United States it occurs on March 17, while in the northern climes, it has been postponed until the more balmy days.

Every engineer regards the day as the climax of the year's activities. To the freshmen and sophomores it is the gala day of the year, a day when they find free expression for that spirit which is peculiar to the engineering college. They are called on to tap the unfailing supply of Irish humor which makes the parade a success. The juniors are masters of the ceremonies, and feel justly proud of their efforts to make the celebration better than ever before. After weeks of hard work and preparation, they are in a position to appreciate it most. To the seniors it is a more solemn occasion. Attired in their green hats and capes, they are the guests of honor and are mindful of the approaching close of their college life.

Only an engineer can appreciate the full significance of the day, and only the good St. Patrick can embody the spirit that makes engineers.

A GERMAN newspaper has said that the general American public is in sympathy with the Fascist movement in Italy. All of Mussolini's deeds do not draw praise, but the fact that he has created a rule of law and order does. It is this rule that attracts the interest of the so-called intellectual class, since they are themselves sticklers for law enforcement to the letter.

Judging by this last criteria it would seem that the auto driving few on our campus do not come from this intellectual class. At least a great number of them show no signs of being thinkers. Yellow curbs and narrow streets where there is danger of having fenders clipped, are used in preference to the large parking spaces provided, where the car is relatively safe.

Dashing through these narrowed streets come the speeder, apparently in a mighty hurry to get where he is going, but in reality going nowhere fast, merely bent on attracting attention to the almighty me. Coupled with this ego is the desire to show an ability to drive or handle the car. Corners must necessarily be taken on the prosaic two wheels, or the engine is raced into a roaring getaway. This really shows an ignorance of the proper methods to use in driving or an utter disregard for the motor. A good driver makes a smooth, quiet start without strain on the car. But then, these rah-rah boys should worry, the "old man" pays for the car and their accidents—they don't care.

A very convenient inability to read comes to the rescue if a no-parking sign blocks the way. One street, especially placarded because of its narrowness, is continually filled with cars sandwiched in carefully between signs that cry, "No Parking On This Street."

It would seem, then, that our campus needs a Mussolini or else a good efficient traffic cop.

SOME members of the senior class have proposed the idea that the class of '26 should leave a memorial when it graduates. It has been suggested that a flagpole be erected for this purpose in the engineering group.

For four years these seniors have played their part in campus activities, and it is not without reluctance that they pass the reigns of leadership to other hands. A memorial such as proposed, forms a tangible expression of their appreciation of those four years and their desire to have future classes carry on. And when a few years later these same seniors, carrying the responsibilities of industry as blithely as they now carry their lordly canes, return to the campus and find the old landmarks gone, they will be glad indeed to have some reminder of their undergraduate days.

Across the Editor's Desk

Bookstores for All

The university populace will soon have the opportunity of voting upon the plan of a campus wide co-operative bookstore. Engineers have had such an establishment for six years and it has proven very successful. However, it was a pioneer in its line and had to undergo severe trials before certain hard-headed merchants could accede to the idea, which meant financial loss to them. The salient point about student bookstores is that actual dollars and cents are saved to the purchaser and a better all-around service is maintained. It is a logical means of doing business, the student's money is handled by students themselves, there is no excuse for the exhorbitant prices—books cost enough at any rate. The neat dividends declared each year create a feeling of co-operation between the establishment and its members.

Engineers feel proud that the business which they founded is proposed as a campus system and are pleased to offer their scheme for the use of all. This investigation shows the foresight of the All-University Council and they should be commended. In all probability, the plan will be adopted universally, there being branches in several parts of the campus. The Engineers' Bookstore will remain in the main engineering building, the progenitator of the most progressive and economical student activity ever enacted.

Bring Your Lunch

It probably never occurred to the architect who designed the main engineering building that any engineer would be ingenious enough to bring his lunch to school. The fifth hour each day finds groups of students in the classrooms and around the lockers working problems or discussing questions of mutual interest while munching a sandwich brought from home. Many students from the Twin Cities find that bringing lunch from home cuts down expenses. Why not set aside a room in the building for this use? The room could serve also as a clubroom for all students. The miners and mechanicals have student club rooms which are much used and greatly appreciated. A main engineering clubroom would serve very well for all who use that building.

The freshmen especially have no common meeting place. Classrooms are poor places to get acquainted. It is only in the laboratory and through conversations that close friendships are formed. The change of the Extension Division headquarters to the new administration building has made several more rooms available as classrooms. One of these rooms could very easily be turned over to the students for a clubroom.

FACULTY SKETCHES

William T. Ryan

THE Knights of St. Patrick had a capable and fitting leader in the spring of 1923, who was none other than William T. Ryan, our congenial friend from the Electrical Engineering Department—a full-fledged Irishman, graduate of Minnesota, and a popular member of the present faculty.

Professor Ryan first saw daylight on a farm near Joice, Iowa, in 1882. The usual routine of farm life was followed up through the grade school education at the public institution in Joice. There were no regular high schools in the immediate vicinity at that time, so young William entered an equivalent school in the North Springs Seminary, at North Springs, Iowa. He participated in debating, forensics being the only regular activity scheduled.

After his graduation from this school in 1900, he tried his hand at teaching in a country school near Joice.

Mr. Ryan entered the University of Minnesota in 1901 and graduated from the College of Engineering in 1905. He became a member of the Students' Engineering Society, the only technical organization at that time. The year after graduation Prof. Ryan was connected with the Westinghouse Electric and Manufacturing company at East Pittsburgh, Pa., devoting his time in their shops and testing department. His second year with the Westinghouse company was spent as a sales engineer at Salt Lake City, Utah. In 1907 he returned to the Electrical Engineering Department of the University as instructor, and has been with us constantly since. It was in this same year that Prof. Ryan succumbed to the unfailing accuracy of Cupid's arrow, when he met Ellen I. Ryan. The nuptial ceremony was performed in June of that year.

In 1909, Mr. Ryan was appointed assistant professor, and in 1919 was promoted to associate professor. He was given his full professorship in June, 1923. Now he has charge of classes in alternating currents, central stations, electric power transmission, valuation of public utility properties, and assists graduate students on special central station and power transmission problems.

By taking part in civic and public activities, Mr. Ryan has earned an enviable reputation as an authority on valuation of public utilities. Through the College of Engineering and Architecture he has supervised the valuation of public property for the Minnesota Tax Commission since December, 1921. His investigations have extended to municipalities in Minnesota and South Dakota on special problems that have been given to the University for solution.

Mr. Ryan has conducted an extensive research on special types of interconnections for high voltage lines. His prediction as to certain types to be used commercially have been fulfilled. Several of his articles on this subject have been published in the Electrical World.

Two graduate students in 1917 and 1918 under the direction of Prof. Ryan, made a comprehensive study of the characteristics of iron wire for high voltage transmission. He published certain graphs as a result of this research, for which there has been a constant demand from central stations all over the country. His paper on iron wire transmission was presented at the first meeting of the South Dakota Electric Power association and also at the annual meeting of the Minnesota Electrical association.

Other valuable data and information obtained by research has been published from time to time in the numerous magazine articles and several books Mr. Ryan has sent to the press.

Mr. Ryan is a member of Theta Xi, Tau Beta Pi, Kappa Eta Kappa, Sigma Xi, Eta Kappa Nu, Society for Promotion of Engineering Education, Better Minneapolis committee of Civic and Commerce Association, Engineers' Club of Minneapolis, Class C member of the National Electric Light Association, and a full member of the American Institute of Electrical Engineers. He was president of the Minneapolis Engineers' Club in 1923, and president of the Minnesota Federation of Architectural and Engineering Societies in 1925.

Zoning

Smoke, grime, soot, noise, rumbling and thunderous, the earth quakes, not disastrously, but perceptably. The train rushes on, and on the same wind that blows towards us full of cinders, comes the various odors of industrial regions. This is not a description of a factory district but in brief, the condition existing in the neighborhood of our campus.

It is unfortunate that the University of Minnesota is hemmed in on all sides by railroads and industrial districts. A three minutes walk and you are among towering elevators or greasy oil tanks and through the center of otherwise peaceful grounds, runs a busy thoroughfare with its clattering trucks full of livestock bound for South St. Paul.

Our university is the biggest business that the Twin Cities has. Its constant growth indicates that the time is not far distant when expansion will come. Which way will it move? Are a few paltry factories more important to our common welfare than additional campus buildings? No! Tracks can be moved, the cheap factory buildings torn down, and the perilous oil tanks moved. It is essential that the University expand uniformly, and be centralized. To do this, space must be provided, and only by zoning can this be done. The factories must go.

Honor or Cash

An honor fraternity recently refused membership to a student with a good average because he was unable to pay the initiation fee. The purpose of an honor fraternity is to encourage and recognize scholastic achievement. The honor thus held forth undoubtedly ably encourages students to work harder. It seems unfair that once such an honor is earned, anything should keep a student out of the fraternity. What a howl of protest would be raised if the captain of the football team were refused a letter because he couldn't pay for it! Admittedly an honor fraternity must have funds to keep going, but it cannot expect to maintain its prestige if it passes up men solely for financial reasons.

Building Our Highways

(Continued from page 213)

give too much credit to the men who formed the first group of highway engineers in the State, and with inadequate salaries, and under unfavorable conditions demonstrated to the public the far-reaching benefits of proper principles of highway administration.

As stated before, this County and State Aid system developed and proved satisfactory for many years, but as traffic became heavier, Counties, particularly those adjacent to the large centers of population, began to experience considerable difficulty in the maintenance of their roads. In many cases it was a financial impossibility for them to raise sufficient money to adequately construct and maintain the main arteries of traffic.

After considering the matter carefully from all angles the Highway Department officials came to the conclusion that the best solution to the problem was a system of highways connecting every County seat and all of the more important cities and villages, which would adequately serve every portion of the State. This system was tentatively laid out, but on account of the fact that our constitution prohibited the expenditure of funds for internal improvements by the State, it was necessary to amend the constitution. This amendment was drawn up, approved and submitted to vote by the legislature of 1919. It was approved at the election in 1920 and the legislation required to make it operative was passed by the 1921 legislature so that the new system actually became effective in the spring of 1921.

Briefly stated, this comprised a system of 7,000 miles of highway which were to be forever located, constructed and maintained by the State. The money for this purpose was to be derived from the proceeds of motor vehicle license fees and aid received from the Federal Government.

The Highway Department was therefore confronted with the problem of immediately taking over the entire responsibility of this system. The old department organization formed the nucleus for the new, and additional men were recruited from the ranks of the County Highway engineers.

The entire control of the organization was in the hands of one man, the Commissioner of Highways, and all the engineering features under the charge of the Chief Engineer. There were the general divisions of administration, construction, maintenance, and bridges.

For the purpose of keeping the proper control of the work, the State was divided into eight districts with one engineer in charge of all construction and maintenance. Each of these districts was in turn divided into two maintenance districts, with an engineer in charge as Maintenance Superintendent.

In thirty days the organization had been effected, the maintenance taken over and the first advertisement for construction started. The system put into effect at that time has been kept without change and has been satisfactory in every way.

During the past few years the gasoline tax has become one of the common means of securing revenue for highway purposes. Again in our State it was necessary to amend the constitution before the money received from this source could be made available for highway purposes. The necessary changes were made and this tax became effective May 1, 1925. The estimated total revenue of the Highway Department for this year is, Motor Vehicle license fees, $9,000,000, Gas Tax, $5,000,000, and Federal Aid, $2,100,000. This money will be expended as follows:

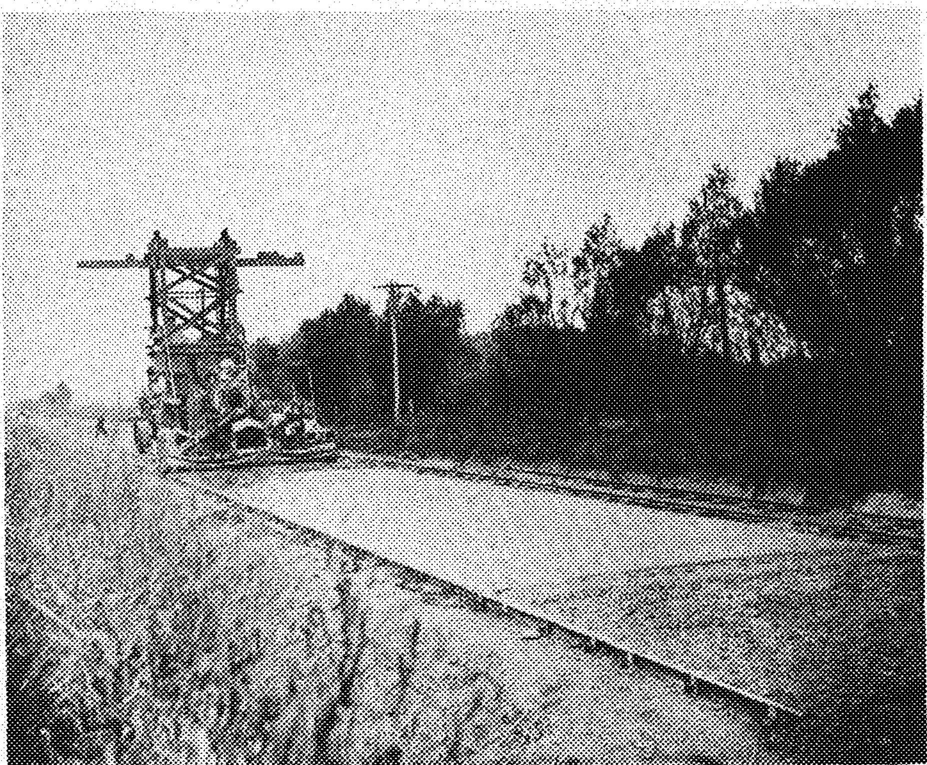
Interest and Sinking Fund to take care of bonds issued by the Counties and turned over to the State with the Trunk Highway System, $3,800,000, Administration, $150,000, Maintenance, $4,200,000, and the balance available for construction.

There is also spent by the Counties on the County and State Aid System the sum of $11,600,000. Therefore, we have in this State alone, the approximate sum of $20,000,000 spent under engineering supervision.

This is for Minnesota alone, and many of the other States are progressing even more rapidly. Foremost among these are Illinois, who have just completed spending a $60,000,000 bond issue and are just starting on one of $100,000,000.

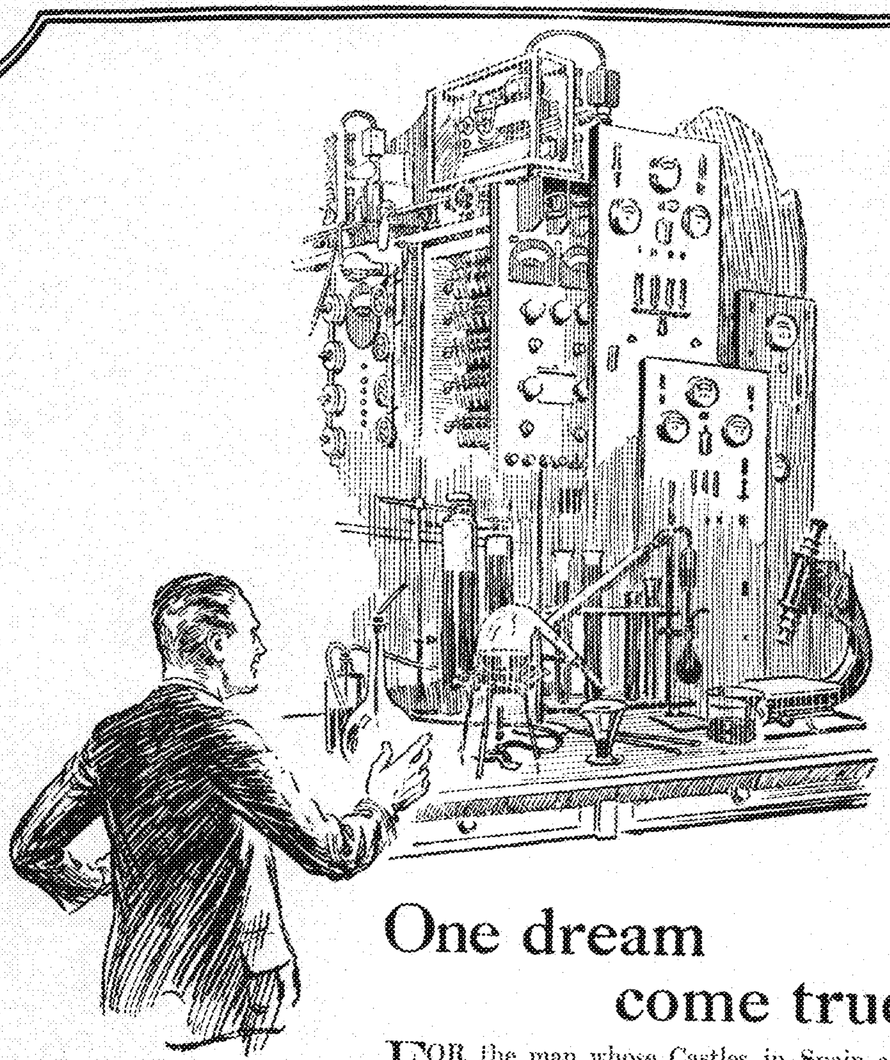
Naturally, in the spending of these vast sums of money under engineering supervision there is good opportunity for advancement. This is especially true owing to the fact that in nearly every State Highway Department promotion has been based on individual effort and capability rather than on political influence. In our own department practically every department head and engineering executive has come up from the ranks. This policy has been rigidly adhered to and promotions made from time to time as vacancies occur or new positions are created. A beginner is usually sent out in the field in a minor position or as an inspector until he has had an opportunity to show his ability. If his work is satisfactory he is promoted as occasion warrants, and in the course of time becomes a Resident Engineer in charge of a construction project.

(Continued on page 234)



THE START OF A CONCRETE HIGHWAY

A moving aggregate bin and proportioning plant followed by a mixer and screed finishing machine has just begun to lay this stretch of pavement. Material comes forward on the industrial track.



Senior Chemist's Inspection Trip

(*Continued from page 217*)

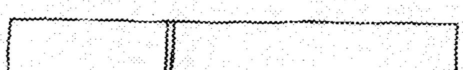
camels' hair cloth in hydraulic presses, the oil oozing out. When it is sold as such, it is called "run" linseed oil. Blown linseed oil is made by blowing air through raw linseed oil, and boiled linseed oil is raw linseed oil heated to 300 deg. F. and to which dryers have been added. The "cake" is sold as cattle food.

Finally Sunday, the day of rest, arrived, but we didn't rest. It seemed too much of a fascination to try to "see it all." Yet, I can hardly say that Chicago impressed the chemists very favorably. Monday morning four of the boys were missing—they forgot to get up. The rest of us went to the Sherwin Williams company, where we were fortunate in having a Minnesota graduate as a guide, a Mr. Owens who showed us the interesting method of making old Dutch white lead, red lead, beta napthol, lithopone and azo dyes which were also made at this plant.

Next came out most pleasant surprise, the Universal Portland Cement company. A company bus took us from the car line to the plant restaurant, where we were told, "Boys, eat, remember, the company pays." In addition we were also given light coats to protect our clothes and a complete printed outline of the plant! How's that? The Chemists say, "Hats off to the Universal Portland Cement company." Cement, as you know, is made by heating dry limestone and finely ground dry slag (from blast furnaces) in the proper proportions almost to the melting point (2800 deg. F.) by means of a powdered coal flame. This is done in rotary kilns about 10 ft. in diameter and 100 ft. long. As the mass becomes pasty, clinkers form; these really are cement, except that peculiarly enough they have no setting properties until they are finely ground. Obviously this is only a meager outline of the process.

Tuesday, our first destination was the Corn Products Refining company. As a raw product only shelled corn is used. It is first steeped with sulphurous acid and then sent through attrition mills. The germ which has been loosened can now be floated off because of the oil it contains. The hulls containing the starch and gluten are reground in Buhr mills following which the starch and gluten are washed through a silk bolting cloth, the hulls remaining behind. The starch and gluten are separated by slowly passing the water in which they are suspended through long troughs. The starch, because it is heavier, settles to the bottom. The gluten flows off and is settled out in tanks being used as a cattle food. The starch is sold as such or hydrolysed to make syrup and the trade sugar cerelose, which is glucose. Gloss starch is in reality more expensive to make than edible starch, but it sells for less in order to fulfill the expectations of the public.

At noon we had another company dinner, this time with the Western Electric company. The hospitality of some of these firms certainly made a lasting impression. Western Electric employs



WHEN THE ROLL IS CALLED UP YONDER

25,000 people, 5,000 of whom are technically trained. Their standard of workers is very high and the firm seems to make every effort to provide an enjoyable factory atmosphere. The buildings are modern, well kept and occupy a ground space of 200 acres.

We enjoyed very much seeing how Copper wire was made. Pieces of electrolytic copper 4 in. square and 4 ft. long are hot rolled to 4 in. wire and then cold drawn. The hot rolling is very impressive. It seems as though dozens of red hot snakes go shooting over the iron floor. One of the electrolytic bars of copper yields about 1,500 miles of 40 gage wire. We also saw how the 2424 strand cables were made and witnessed the forming of those interesting electrolytic iron cores used so extensively because of their desirable hysteretic properties. Two metallic finishes seemed worth noting, the Sherardized surface produced by subliming zinc on the iron surface, and the magnetic oxide finish produced by permitting steam to come in contact with the metal heated to 1,450 deg. F. in a muffle furnace from which the arc had been excluded. And at dozens of interesting products such as hard rubber, bakelite, insulated wire, we took but a parting glance—the Western Electric can't be seen in one day.

Wednesday, we went to the Standard Oil company of Indiana at Whiting, a plant of a 55,000 bbl. daily capacity, and occupying a ground space of 750 acres. Crude oil is received through 8 in. pipe lines from Texas, Oklahoma, and Kansas. Every type of still from the obsolete to the newest was used, from atmospheric pressure distillation to 325 lb. pressure distillation. Cracked gasoline, straight run gasoline, gas oil, lubricating oils, wax candles, grease, stanlax, and asphalts, these all are products of the refinery. In the fire stills petroleum coke forms to the thickness of 1 to 1.5 ft. and this must be chipped out before another distillation is made. Consequently, men who must have constitutions of iron, go into these stills and clean them out. The devil isn't the only one who has a hot job, it's 350 deg. F. in these stills.

The U. S. Lead refining was next on our program. Their chief products are lead, gold, and silver. The daily output of silver is 20,000 oz. We saw several 80 lb. bars in the stock room and, tired as we really were, we would not have objected to carrying one along. A d. c. voltage of 100 is across the 56 electrolytic cells in series. The amperage is 5,500.

In order to make a good job of the day, we gave the Grasselli Chemical company our official "once over" and found that they had a maze of different operations. Sodium sulphate nitric acid, hydrochloric acid, sulphuric acid (by chamber and by contact), sodium sulphide, hypo, lead arsenate, acetic acid, sodium silicate and litharge, all are their products and it would require a volume to describe the methods of manufacture. It is interesting to note that the Grasselli firm uses the sulphur dioxide they obtain by roasting zinc sulphide in the making of sulphuric acid by the chamber method.

Thursday morning's stop was at the Illinois Steel company. Steel mills always will be the most fascinating of sights. Those reddened shadows through the smoke, the roar of the furnaces, the clang of the gongs, those shrill terrifying whistles and then the dazzling brightness of the metal as it is poured.

(*Continued on page 240*)

Athletics for Every Engineer

(Continued from page 219)

ample because in practically all cases this controversy concerns them. Of course, when a team is entered into regular I. M. championship play, the line-up is composed according to I. M. rulings, substitutes taking the place of the men who are eligible for technical college but not for I. M. play.

Some may wonder where the equipment and awards come from. The I. M. Department furnishes equipment for games. The Engineer's Bookstore has extended a very helping hand and bought many diamond balls and bats during the times of need. The league was saved last spring by an appropriation from the Bookstore and they have supplied enough equipment this spring to assure that there will be no shortage. The men are allowed to check equipment in and out of the Bookstore which solves what might easily be quite a problem.

The system of awards which the board adopted last spring makes provision for the awarding of college letters with sweaters to the winners of any technical college championship sponsored by the T. C. A. B. Technical college teams competing in I. M. sports are expected to be good enough to win I. M. awards. The selection of the outstanding team of the year is left to the board and is recommended to the Bookstore Board for the special award of keys. This special award is given by them each year to the outstanding team, or man, in I. M. athletic achievement. Its purpose is to create interest and to suitably reward the best of those competing. Last year that award was made to the technical college baseball team which won the All-U championship. The necessary finances for the letters and sweaters are provided by the T. C. A. B., the money being raised by giving a dance. The first affair given last spring was relatively successful and the second one, which is to be given about May 15, should be much more so. If as many attend the dance as play diamond ball, golf, tennis and pitch horse-shoes, the Union will be comparable to the proverbial container of sardines.

All activities are under the direction of one manager and his assistant, both appointed by an Advisory Committee which is in turn made up of faculty members appointed by the dean. Additional help in carrying on the work is gained by the election of a class manager from each of the four classes.

The technical athletic manager, by virtue of his appointment, becomes president of the board. The other offices are filled by vote of the board members, and from their number.

The acting board is headed by Kenneth W. Foster, as president, Clarence C. Lande, vice-president, Raymond C. Deegan, secretary, and Lloyd Hoover, treasurer.

Building Our Highways

(Continued from page 228)

Highway systems in general may be divided into three parts, first, the primary roads which in Minnesota are the truck highways of the state system, second, the secondary or state aid roads which are sometimes called county roads, and third, the small feeders or township roads. In Minnesota the trunk highways make up 7,000 miles of the total mileage of the state. The secondary roads total about 86,000 miles and the small feeders complete the total of 100,000 miles of roadways.

In the event of the subdivision of a county or a change in the location of a county seat, the legislature has the power by virtue of amendment to establish a trunk highway to it, but other than that, no change in the routes can be made. Their termini are fixed and they must pass through certain specified towns. However, when 75 per cent of the present mileage of the system has been improved, and funds are available for the improvement of the rest, the legislature can then begin making additions to the system.

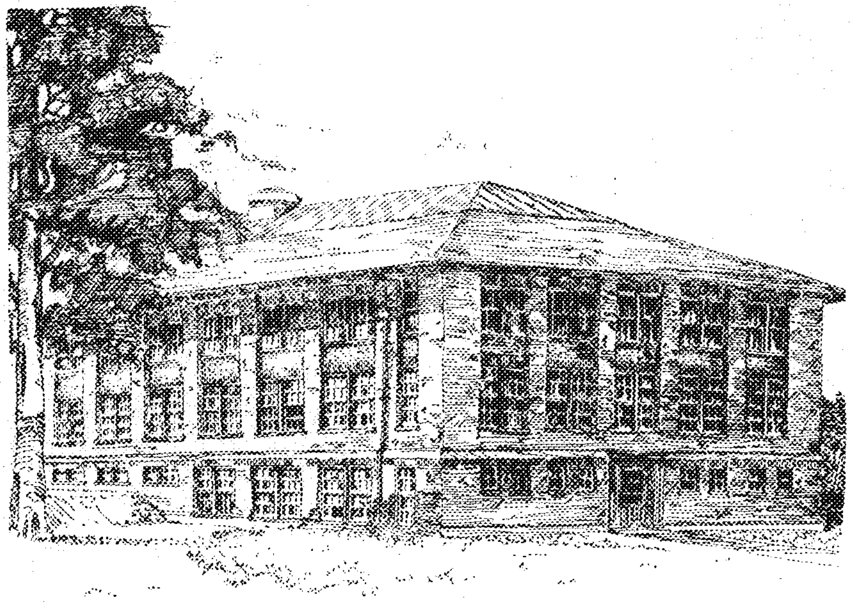
Bonds, interest and sinking funds must be provided for before any money can be used for improvement and of the moneys available, not more than a stipulated percentage can be used for paving. Minnesota has never issued bonds to date, but has taken over county bonds to the extent of 30 millions of dollars to reimburse the counties, cities and villages who had previously paved their roads in anticipation of the trunk highway. The original basis for taxation or rather the purpose of it was merely for the police powers which it gave. Because of this, a flat rate was charged in most states. Then as the volume of traffic increased, there was an attempt to tax them according to the amount of their use of the highways. Then again as the vehicles became more elaborate and expensive, there was a similar attempt to tax them on the basis of the value or indirectly on the ability of the owner to pay. Minnesota's present plan is a combination of the two in that the amount of the wear on the road is directly proportional to the gasoline consumption and is hence paid for in the gasoline tax, the license fee being based on the value of the car.

The highway commissioner is appointed by the governor. The commissioner in turn appoints a chief engineer who selects two deputies and places one in charge of the construction program and the other in charge of maintenance. The state is farther divided into eight districts, each under the supervision of a district engineer. Sixteen maintenance districts are placed in charge of a maintenance superintendent who is responsible to the division engineer of his district. All of the large construction jobs have a resident engineer on the grounds.

Often a resident engineer is transferred to the position of Highway Engineer for one of the Counties. During the past spring we have placed several men in these positions and in every case to the advantage of the person transferred.

The usual line of promotion from Resident Engineer or County Engineer is to the position of Maintenance Superintendent, and from there to Division Engineer.

This work together with its allied fields of investigation, research and testing, is one which is worthy of consideration by every young civil engineer.



Something About Paris

(Continued from page 215)

of, but the spiritual and sentimental side of the problem has never been lost sight of. Historical monuments of Paris have been preserved, and furthermore each monument has been given a setting adding to its dignity and significance while serving in efficient manner the utilitarian ends desired. Place a modern skyscraper beside Notre Dame, and Notre Dame would no doubt suffer enourmously; and so would every human being who is capable of drawing inspiration from such a monument as Notre Dame, but not from a twenty-story building.

To my mind, the great lesson offered by Paris to American visitors is the wholly efficient way in which economic interests may be combined with the artistic and sentimental to make a city of universal interest and appeal. When a young man has finished his college career in this country, feels the urge to round out his education with a year of travel, and has finally arranged for passage to Europe on a cattle boat, he need not hesitate to include Paris in his European itinerary. Whether he has been the type of student who has ruined his eyes studying or the sort who has sprung his knees conquering the Charleston, he will find his heart's desire in Paris.

There are great libraries, galleries, and museums in Paris. And there are quite a number of places where they dance.

GOOD LIGHTING OF INDUSTRIAL PLANTS SECURES SAFETY AND EFFICIENCY.

The Code of Lighting for factories, mills and other work places of the State of New Jersey makes excellent recommendations of daylight for the proper lighting of industrial buildings.

Adequate daylight facilities through large window areas, together with light, cheerful surroundings, are highly desirable and necessary features in every work place, and they should be supplied through the necessary channels, not only from the humane standpoint, but also from the viewpoint of maximum plant efficiency.

Importance of Daylight.

The unusual attention to gas and electric lighting in factories, mills and other work places during the past few years: the perfection of various lamps and auxiliaries, by means of which an improved quality and quantity of lighting effects are obtained; and the care which has been devoted to increasing the efficiency in various industrial apparatus—all go to emphasize the many advantages and economies that result from vital and adequate window space, as a means for daylight in the proper quantities, and in the right direction during those portions of the day when it is available.

Three Considerations.

Three important considerations of any lighting method are sufficiency, continuity and diffusion, with respect to the daylight illumination of interiors. Sufficiency demands adequate window area; continuity requires (a) large enough window area for use on reasonably dark days, (b) means for reducing the illumination when excessive, due to direct sunshine, and supplementing lighting equipment for use on particularly dark days, and especially towards the close of winter days, (c) diffusion demands interior decorations that are as light in color as practicable for ceilings and upper portions of walls, and of a dull or matt finish, in order that the light which enters the windows or that which is produced by lamps may not be absorbed and lost on the first object that it strikes; but that it may be returned by reflection and thus be used over and over again.

Diffusion also requires that the various sources of light, whether windows, skylights or lamps, be well distributed about the space to be lighted. Light colored surroundings as here suggested result in marked economy, but their main object is perhaps not so much economy as to obtain results that will be satisfactory to the human eye.

Requirements for natural lighting:

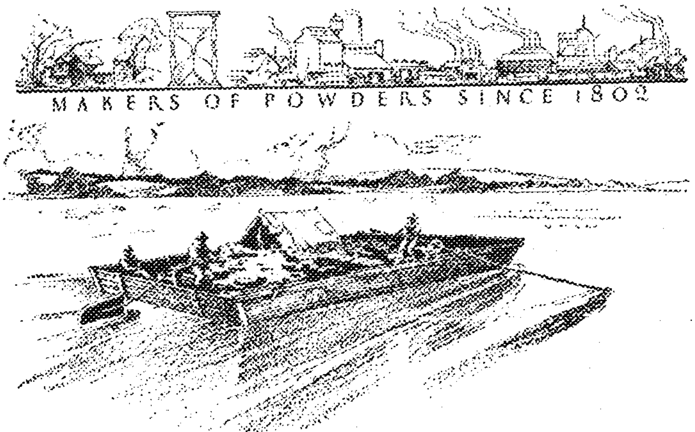
1. The light should be adequate for each employe.
2. The windows should be so spaced and located that daylight is fairly uniform over the working area.
3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.
4. The windows should provide a quality of daylight which will avoid a glare, due to the sun's rays, and light from the sky shining directly into the eye, or where this does not prove to be the case at all parts of the day, window shades or other means should be available to make this end possible.

As will be noticed in the above recommendations, large windows and proper diffusion of daylight are urged, in order to meet the demands of daylight lighting.

Shades may be eliminated and most efficient lighting obtained by the use of Factrolite Glass.

If interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.



In 1802, the flatboat carried du Pont powder to settlers along the Ohio

CONTROL

Chemical control is superseding rule-of-thumb methods in industry. When the first du Pont powder was made nearly a century and a quarter ago—chemistry was not an exact science.

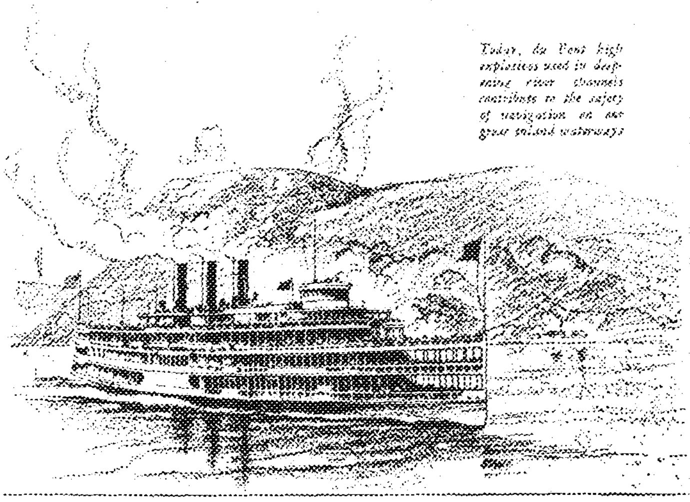
Today, the chemical engineer with the vast resources of modern science at his disposal controls production from raw material to finished product.

To chemical control, through research and experiment, is due that unvarying quality which makes the "Du Pont Oval" a symbol of excellence everywhere.

Under the du Pont name is published a practical and authoritative work—the "Blasters' Handbook." It is being used by instructors and students in many of our leading technical institutions throughout the country. A copy of the "Blasters' Handbook" will be sent free upon request.

E. I. DU PONT DE NEMOURS & CO., INC.
Explosives Department
Wilmington, Delaware

DU PONT



Today, du Pont high explosives used in deepening river channels contribute to the safety of navigation on our great inland waterways

123 YEARS OF LEADERSHIP
IN THE SERVICE OF INDUSTRY

9XI-WLB

(Continued from page 216)

leads being of heavy copper tubing or braided copper ribbon.

The transmitter was installed in the station in such a manner that it can be completely controlled by relays operated by switches and keys on the operator's table. On this table is also placed the receiving set. The output of the transmitter is fed to a vertical antenna supported by two 90 ft. steel towers mounted on the roof of the electrical building. Because of the demands placed on the antenna by the broadcasting station, the fundamental of this system is 185 meters. In order to use waves shorter than this fundamental, the antenna is made to oscillate in parts. It is loaded in such a manner that the third, fifth, and ninth harmonics are used for transmission on the eighty, forty, and twenty meter bands, respectively.

By the end of the fall quarter of 1925, the program of permanent construction had so far advanced as to warrant more systematic study of operation than had previously been possible. Heretofore, operation had been of an irregular character. Opening on the winter quarter of 1926, a schedule of continuous night operation was established. This was accomplished by a staff of 17 operators. All data was recorded on a series of specially arranged log sheets in order that it might be readily analyzed. Incidental to the operations of the station necessary to obtain this data, much excellent work has been accomplished which has attracted considerable attention. In a report submitted to Mr. C. M. Jansky by L. V. Berkner, Chief of the Staff, a summary of this work is found.

"During this period (winter quarter, 1926) 9XI worked a distance of 984,000 miles at night and a distance totaling over 1,100,000 miles including daylight operation. Two way communication was established with 422 stations at night and 222 stations in daylight or a grand total of 644 stations worked. This includes communication with 94 foreign stations representing 19 countries on the six continents as well as numerous islands. This international communication has been practically world-wide. A total of 518 hours was spent on the night watches, or an average of seven hours per night. During this time 425 free messages were handled, many of which were with foreign countries. Several schedules have been maintained with fair regularity, the most notable of which was probably the press schedule with KFUH at New Zealand." A few of the most distant countries worked during this period include Africa, Argentine, Australia, Brazil, Chile, England, Hawaii, Italy, Japan, Tasmania, and Uruguay. Hundreds of cards and letters have been received reporting reception of the station's signals. Among these reports are found many of particular interest. One from Delhi, India, tells of the reception of 9XI's signals at noon, a very exceptional record, while another from a ship of the United States Navy in port in Esthonia reports the station's signals as having remarkable strength.

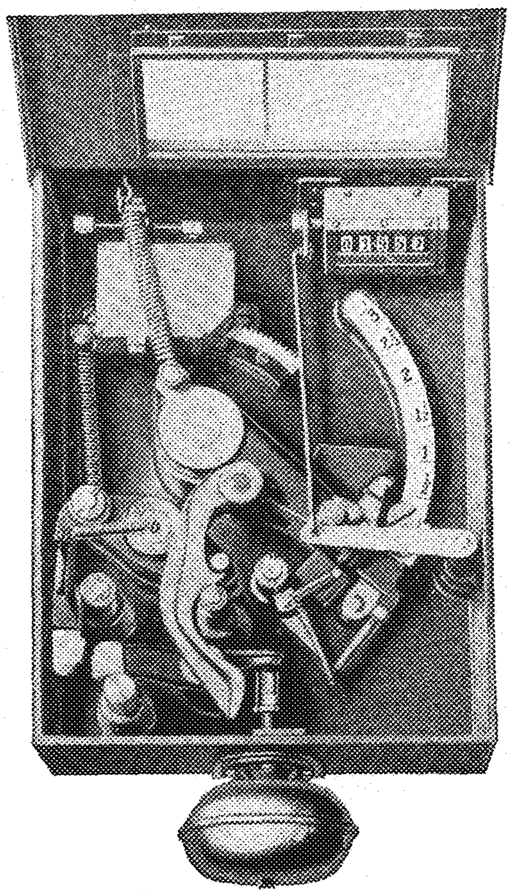
Some interesting experiments have been carried out at 9XI on low power. On March 12, and again on April 19, communication was established with a station in Tasmania, a distance of 9,800 miles. Transmitting equipment of the Tasmanian station consisted of an ordinary receiving tube supplied by 400 volts battery to the plate—an input of approximately eight watts. It is almost impossible to conceive of reliable com-

(Continued on page 242)

Standardized Concrete

This illustration of the Koehring escapement type batch meter shows the method by which the discharge chute is automatically locked as soon as the charge enters the drum. The discharge chute cannot be moved until the regulated mixing time has elapsed, when it automatically releases the discharge lever and signals the fact with a bell. The meter also registers each batch that enters the drum.

Patent Nos.
1,321,460; 1,282,558, 1,338,761.



THE Koehring Company long ago foresaw the *value* of standardizing concrete,—foresaw and provided for it before the tremendous volume used in constructing roads and permanent structures made standardized concrete a vital *necessity.*

One of the most important means of insuring a uniform strength and quality of concrete is the Koehring Batch Meter,—a positive means for timing each batch and measuring the thoroughness of mix. This device, upon being set for the specified mixing period, automatically locks the discharge chute as soon as the drum receives the materials; the discharge chute cannot then be operated until the full specified mixing time has elapsed.

Every state highway department requires, in its specifications for concrete highway construction, the use of batch meters. This Koehring development is an integral unit on practically every paving mixer today,—a Koehring contribution to the industry.

The Koehring mixer, with the Koehring batch meter, Koehring five action re-mixing principle, and the Koehring automatic water measuring tank, provides the most positive mechanical means yet developed for producing standardized concrete of unvarying uniformity.

KOEHRING COMPANY
PAVERS, MIXERS—GASOLINE SHOVELS, CRANES, DRAGLINES
MILWAUKEE, WISCONSIN

KOEHRING

Senior Chemist's Inspection Trip

(*Continued from page 230*)

all are awe-inspiring. Yet, mere man, even though he edges away from the heat, calmly controls the very energy which could destroy him in a fraction of a second, if he should lose that control. Bessemer furnaces all were producing the metal which really has done much more for civilization than gold will ever do. The ingots from the Bessemers went to the roll mills, where steel is handled as though is were as plastic as soft wax. The final rolling of the metal in the plate mill gave us a surprise; the scale on the plate is blown off with salt, and the explosion was startling.

In the afternoon, we went to the American Wire company at Joliet. The wire for fence purposes is made from Bessemer Steel and is galvanized with zinc. The machine which makes the ornamental fence wire for lawns is very ingenious, it seems barely possible that a machine can be made to perform so many operations.

On Friday, the last day of the trip we visited the American Bottle company at Ottawa, Illinois. One of our party cheated a few pop bottles out of their existence when he bumped into the delivery end of a hopper, and consequently was showered with sand, soda ash, potash and lime, much to his own discomfort. And the bottle machine—it is much too human to be called a machine. It dips into the molten bath, takes out enough glass for a bottle, blows it in a mold, transfers it to a conveyor which takes the bottle to an annealing oven and finally lo and behold, there they are! Pop bottles, thousands of them.

The National Plate Glass company is equally interesting. Large pots full of molten sand, soda ash, and lime are lifted out of the ovens by cranes and the glass is poured onto a water-cooled iron table where it is rolled to the desired thickness. Sheets of plate glass about 20 ft. by 30 ft. are thus produced. Section cup lifting devices transfer sections of the large pieces to annealing ovens after which they are cut and polished.

The last concern was the Western Clock company at LaSalle, Illinois, a splendid plant-ful of girls who refused to let us do the inspecting, but insisted on reversing the procedure. Consequently we couldn't really appreciate all those little wheels which the guides insisted on showing us—well, who cared for wheels then anyhow? But these girls apparently also know how to work. The plant turns out 26,000 big, little, and intermediate sized Bens each day and about 10,000 of them must be ringing all the time. This concern also makes some of its own clock springs which are tempered when wound in a ring, and then rewound in the opposite direction. This produces resilience. The technical staff made every effort to give us all the information desired and we thank them for it.

The students who made the trip were Parmalee Haugsrud, Henry Jerabek, Wallace Johnson, Kenneth Kobe, Joseph Kugler, Abraham Lewenstein, Grant Merrill, Harold Moffat, Robert Murray, Theodore Rauen, Marvin Rogers, William Schlafge, Allen Smith, Edward Sverdrup, and John Tronson. Professor C. A. Mann and G. H. Montillon of the faculty supervised the tour.

And so it ended. The trip was a very pleasant one and will be remembered long. We had seen a cross section of industry and it, in passing before our eyes, had presented to each senior chemical engineer, a challenge to go and also do.

9XI-WLB

(*Continued from page 238*)

munication being carried on with this power over such an enormous distance, when it is considered that eight watts is barely sufficient to light an ordinary flashlight battery. The possibilities of low power were again illustrated on February 25, while working with an army station in Honolulu. At this time the input of 9XI's transmitter was reduced to nine watts without impairing the reliability of communication. These examples, with many others, serve to illustrate the vast possibilities for radio development which are open to a station such as that which the university is maintaining.

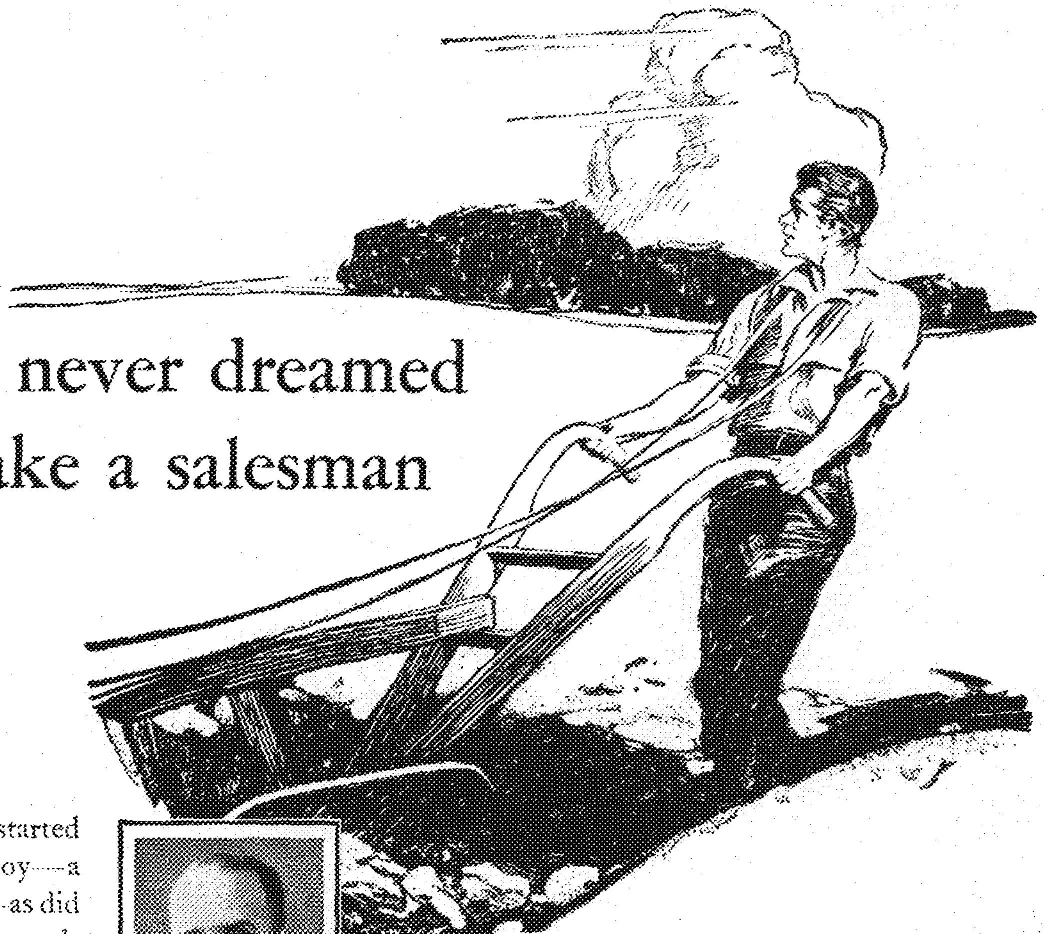
In the analysis of the quarter's operation, some very interesting facts were brought to light. Contrary to the general belief, the weather as it varies from day to day has little effect on transmission at the shorter waves. The exception to this is in the case of storms, which are usually accompanied by heavy atmospheric disturbances, making reception difficult. The local barometric pressure also has little effect on the ease with which signals are exchanged, though there seems to be some evidence that signals travel most readily along isobaric lines. It was noticed that periods of best transmission occurred during the dark of the moon, but it has not yet been possible to determine whether or not this fact can be attributed to this cause.

Much of the success of this work must be credited to the fact that a standard wave (39.00 +/— .05 meters) has been adopted for all ordinary work. The use of a fixed frequency for ordinary transmission serves several purposes. It helps to standardize frequency at other stations, thus assisting the government in keeping these stations within the allotted bands. It also makes it possible for stations to locate 9XI at any time on this definite wavelength, a factor which is particularly valuable in stimulating international communication. This is most forcefully illustrated by the statement of an amateur in Sydney, Australia, to the effect that after sending a general inquiry call, he tunes first to 9XI's wave, where he knows that an answer will be forthcoming if his signals have been heard.

Such reliability depends not only upon the apparatus at the station but also upon the operators, whose duty it is to keep the station operating at maximum efficiency. The staff of operators consists of the following students: L. V. Berkner, chief operator, Leonard H. Weeks, Edmund H. Scholz, Gus Haedecke, Clifford A. Brandt, Gordon W. Volkenant, William J. Zeidlik, J. C. Barnes, Win C. Hilgedick, Everett M. Van Duzee, Gordon M. Larson, Henry L. Tholstrup, Harold J. Boyce, James P. Barton, John K. Hilliard, Stuart L. Bailey, Paul B. Nelson. This staff is under the supervision of Prof. C. M. Jansky, Jr. Most of the staff have had wide experience in radio operation before coming to the University of Minnesota, many of them having served as commercial operators in the United States Army, Navy, or Merchant Marine. Two of these men were internationally recognized during the McMillan polar expedition a year ago, where radio played such an important part. The broad experience of the staff has placed it in a position to suggest various improvements in operating procedure. Many of these have come into national usage, and some have been officially adopted by the American Radio Relay League.

There can be little doubt in the mind of anyone who is at all conversant with the work of the University of Minnesota's Experimental Radio Station that such a station is a valuable asset to an institution of this kind. It keeps the university in direct contact with the important nations of the world. It serves to keep the department of electrical engineering in close touch with the rapid development of the applications of radio communication. It gives its operators valuable training not only in station operation, but in working into an organization whose existence depends upon the willing co-operation of all its members. It furnishes the basis for many important research problems which aid in the development of radio engineering. It is with this background that the station will continue operation in the future.

Loomis never dreamed he'd make a salesman



E. W. LOOMIS

The question is sometimes asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents? Or are they forced into narrow grooves? This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came with the Westinghouse Company within the last ten years or so, after graduation.

E. W. Loomis started life as a farmer boy—a real "dirt" farmer—as did his parents and grandparents before him.

Across the corn furrows, however, he would catch sight on the road of the only kind of engineer a farmer boy of that day saw—a civil engineer—and a civil engineer Loomis determined he would be.

At Delaware University, however, he got a job in the electrical laboratory—he also waited table, played football, wrestled, was commissary of the Commons, ran the battalion and did a number of other things, besides studying electrical engineering. One day a kindly professor said to him—"You understand men even better than you do electricity and engineering, why not go in for the sale of electrical apparatus?" Loomis liked the idea—came to Westinghouse—took the student course—then off to the New York Office as a "cub" salesman.

He worked—he always had—both on the farm and in college. In three years he was head of a section of the industrial sales department. By 1922 he was manager of the Industrial Division of the New York Office—charged with responsibility for the sale of Westinghouse apparatus to all industrial customers in New York State and in the northern half of New Jersey.

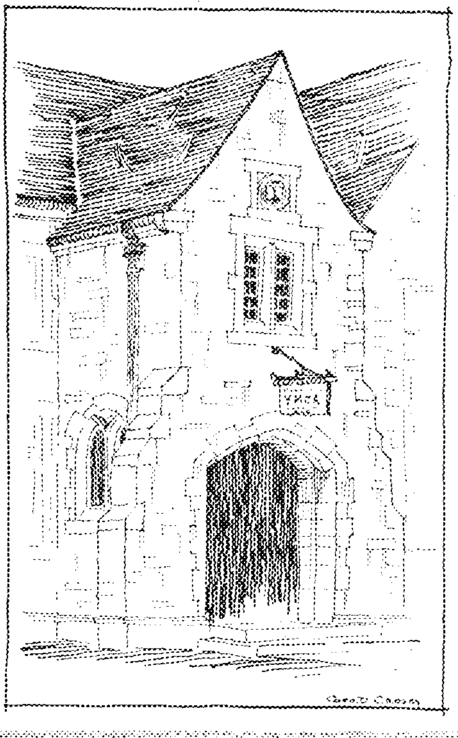
Loomis has fifty-two men working under his direction. It is barely eleven years since the wise old professor remarked to him—"Consider selling; it's a promising field."

Westinghouse

The Lund Press, Inc., 416 Eighth Ave. So., Minneapolis

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges of the University of Minnesota



MAY
1926

VOL. VI. MINNEAPOLIS, MINN. NO. 8.

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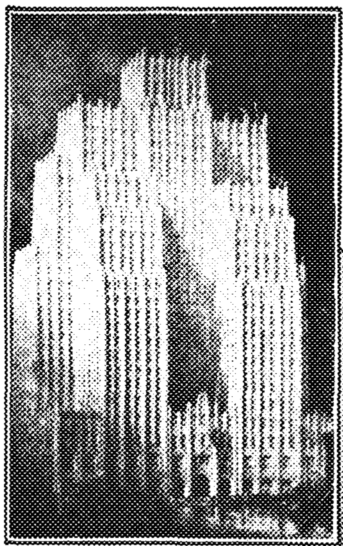
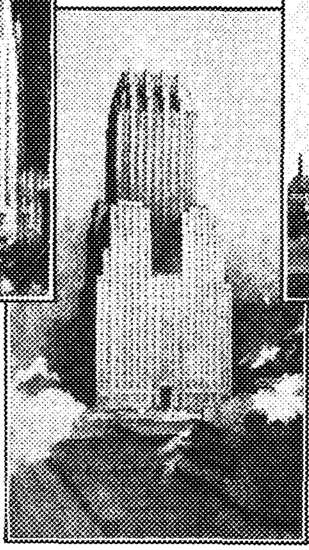
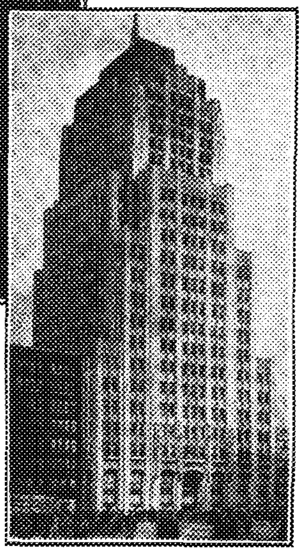


Southwestern Bell Telephone Company, St. Louis, Mo.
Mauran, Russell & Crowell, *Architects*
I. R. Timlin, *Associate Architect*

Pacific Telephone & Telegraph Company, San Francisco, Cal.
J. R. Miller, T. L. Pflueger & A. A. Cantin, *Associate Architects*



Barclay-Vesey Building, New York Telephone Company, New York
McKenzie, Voorhees & Gmelin, *Architects*



Ohio Bell Telephone Company, Cleveland, Ohio.
Hubbell & Benes Co., *Architects*

FOR many years, thinkers who watch mechanical progress with a friendly eye have asserted that the goal of machinery is to set mankind free from routine tasks, to give him time and opportunity for those tasks of the mind for which evolution has particularly fitted him.

In two of our most important industries there have been recent developments which may be truthfully said to have ushered in a new epoch. The dial telephone system, after years of experiment, has proved itself a practical and efficient servant of man. And the Otis Signal Control Elevator, also a product of untiring effort and experiment, marks a revolutionary step forward.

The transportation system of a modern building requires fewer elevators of this new type, than were heretofore required of other types. Control is entirely automatic, the car being operated by the pressing of car or hall button.

This type of control automatically brings the elevator to a stop within an exactness of level which eliminates the delays of readjustment experienced under the old system, and also automatically opens the doors as the car stops. This accuracy of landing greatly eliminates the possibility of accident.

In view of these epoch-making developments in the telephone and elevator industries, it is most appropriate that the four new monumental telephone buildings stretching across the country, and located in New York, Cleveland, St. Louis and San Francisco, should be equipped with the latest type of Otis Signal Control Elevators.

OTIS ELEVATOR COMPANY

Offices in all Principal Cities of the World

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

VOLUME VI. MINNEAPOLIS, MINN., MAY, 1926 NUMBER 8

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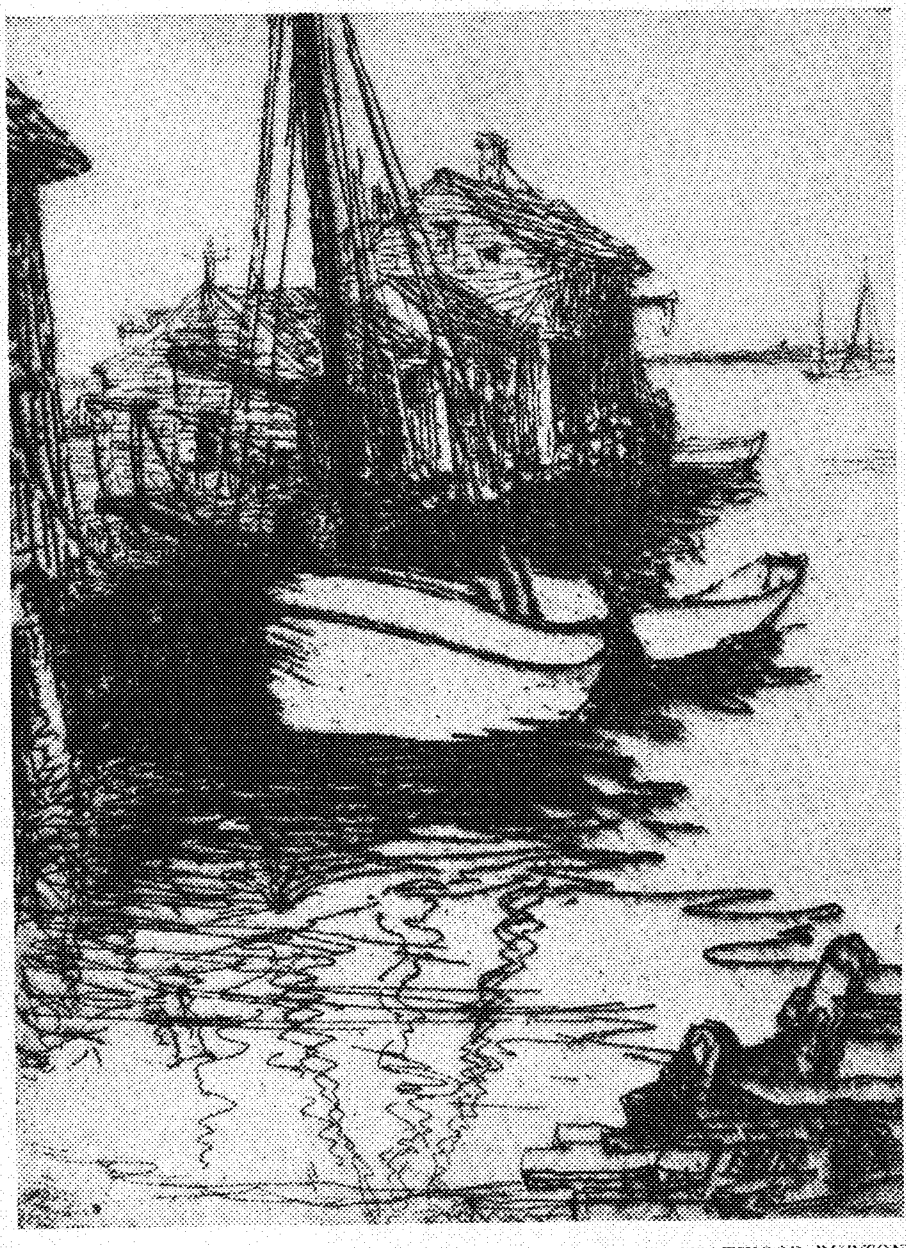

S. CHATWOOD BURTON

Along the Sea Front

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI | MAY 1926 | Number 8

Extra-curricular Activities

Investigations conducted by committee on educational research reveal the value of participation in student affairs.

By F. STUART CHAPIN

Professor and Chairman, Department of Sociology, University of Minnesota

TWO years ago, because of the wide-spread interest among faculty and students in the problem of how far student extra-curricular activities had social and educational value, a sub-committee on The Educational Value of Extra-Curricular Activities was appointed by the University Committee on Educational Research.

University students will remember that a year ago they were requested to answer certain questions on the number of student activities in which they were engaged, together with an estimate of the time so spent. Owing to the co-operation of the All-University Council and the student body in general, a very satisfactory return was obtained from these questionnaires. In fact, considered in the light of the usual experience in the return of questionnaires, our students responded in a very cooperative manner. The following table summarizes the return by colleges:

TABLE 1.

College.	*No. sent*	*No. rec'd.*	*% rec'd.*
Education	1051	723	68.7
Dentistry	360	254	70.5
Engineering	892	733	82.1
Chemistry	139	134	97.8
Business	215	188	87.4
Agriculture	571	301	53.0
Medicine	389	179	46.0
School of Mines	68	36	54.0
Law School	258	97	37.5
Coll. of Pharmacy	145	119	82.0
S. L. & A Freshmen	1356	1039	76.6
S. L. & A Soph.	1188	534	44.9
S. L. & A Juniors	320	233	72.8
S. L. & A Seniors	178	67	37.6
Total	7130	4637	65.1

Table 2 summarizes groups to which questionnaires were sent. It will be observed that the study was conducted to supplement the returns from students by collecting facts from campus organizations and from alumni who as students had been active in campus activities.

TABLE 2.

	No. sent	*No. rec'd.*	*% rec'd.*
Student Questionnaires	7130	4637	65.1
Alumni Questionnaire	1000	407	40.7
Organizations on campus	308	161	52.5

The task of analyzing and interpreting the mass of data contained in these 5,000 returns is a considerable one and the present article is, therefore, merely a brief summary of the preliminary findings.

A number of general impressions of student activities are borne out by the facts, e. g. senior college students engage in more campus activities concurrently than do junior college students. The period of greatest concentration of activity in student affairs seems to be in the senior year, although the most frequent number of activities for both senior and junior year, taking all students, is but one.

Participation in the many activities offered to the student form a distinctive part of his collegiate life. Yet, because of the nature of these, to some these activities may require so much time as to prove detrimental. The sorts of affairs, the number each student took part in, the effect upon scholarship, men and women participating, and other data were unknown until this investigation was carried out lately by a special committee. There is a tendency among those not in the run of college affairs to believe that all is pleasure and work is the least considered. This will definitely point out their fallacy.

The results show that activities are beneficial and that the traits developed make themselves evident in later life. There is a close correlation between the student prominent in campus affairs and the alumnus active in social work in his community. We are very glad to be the first to present the result of this research.—THE EDITOR.

When junior and senior classes throughout the university are considered, the typical number of activities, including campus, off campus, and general activities, is four for the men and three for the women students. In general, senior college students show from one-fifth to one-third of their total number engaged in seven or more activities concurrently, and relatively speaking, women students engage in more activities than men students in spite of the fact that the typical number of activities for women is lower than for men. This is so because a larger percentage of women are found in five or more activities.

The foregoing statements apply to all activities, that is, the total of on campus, off campus, and general activities. Perhaps it should be stated in explanation that the questionnaires which the students were asked to answer classified student activities as *On Campus* (with ten subordinate headings here), *Off Campus* (with four headings), and *General Activities* (with seven headings).

Turning now from statistics of the entire student body to data relating to student activities of 379 prominent students, the following conclusions are suggested by the data. The typical number of activities for the prominent men and women students is six, and this conclusion is based upon a classification of all activities—on campus, off campus, and general. It is also noted that when it comes to eight, nine or ten activities prominent women students show a larger proportion than do prominent men students. As regards campus activities, prominent men maintain a slightly higher average of activities than do prominent women, although a larger proportion of prominent women students are engaged in four or more activities than are prominent men. In general, it seems that prominent women students are more likely than prominent men students to be engaged in many activities at the same time. These data are drawn from returns made to a special appeal sent to 770 prominent students. The names of this group of prominent students were obtained from the returns

(*Continued on page 278*)

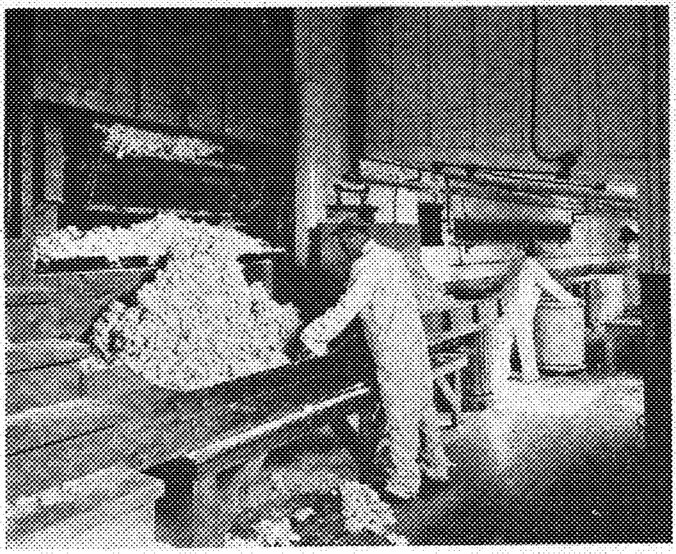

FIG. 1. A HUGE COTTON DRYER

In preparing film base, cotton, after washed with caustic soda, is dried and treated with nitric and sulfuric acids in a nitration process.

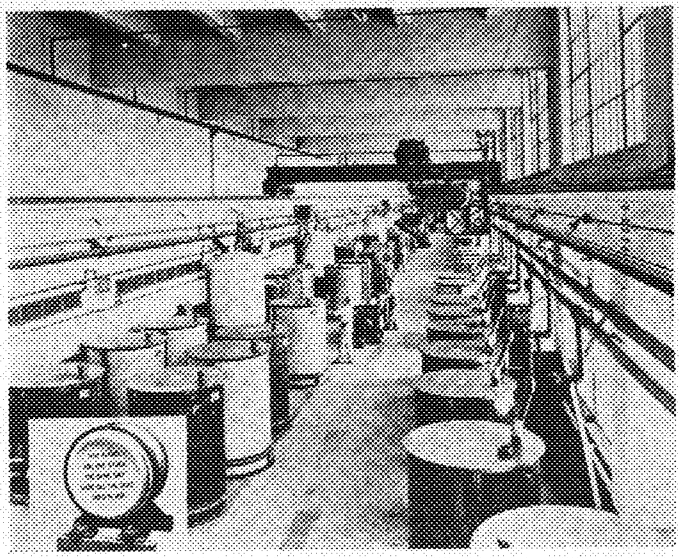

FIG. 2. DOPE STORAGE TANKS

Nitrated cotton is dissolved in organic solvents. The viscous liquid "dope" is then piped to these air-tight tanks ready for coating.

Chemistry in the Motion Picture Industry

Accurate control of processes of film manufacture based on careful investigation make for uniformity in product and allow prediction of results

By GLENN E. MATTHEWS, Ch. '20
Research Chemist, Eastman Kodak Company, Kodak Park, Rochester, New York

THE part that chemistry has played in the development of photography is aptly illustrated by a comparison of the crude, cumbersome apparatus which was necessary to make pictures years ago, with the simple, compact cameras and the stable and highly sensitive films available today. When a wet plate photographer started out for a day's picture-making with his pack of chemicals, plates, and dark tent on his back he resembled a prospector more than a camera man. Of necessity he was his own manufacturing plant. He chemically sensitized his own plates just before using, exposed them while wet, and developed them at once. Prints were made later on paper which he sensitized himself.

With the introduction of the dry plate and later the film, the crude methods of wet photography disappeared, the preparation of the materials became a commercial operation, and photographers now purchase almost all the materials that they use from firms who manufacture them in large quantities. This centralization has resulted in a far greater improvement in quality than would ever have been possible by individual effort.

Motion picture film was first sold in America in 1889 when George Eastman supplied narrow film "ribbon" to Thomas Edison. As now manufactured, it consists of a transparent, flexible base or support on which is coated a very thin layer of gelatin in which are suspended microscopic particles of a light sensitive silver salt. This upper sensitive layer is called the emulsion. To turn out millions of feet of film a year maintaining an unvarying uniformity of thickness, sensitiveness and quality requires a highly skilled organization backed by trained chemical research. In view of these conditions it would be quite impossible for an individual to prepare his own motion picture film.

Experimentation must also be always in progress to improve the film and to find new methods of manufacture. In all this work, chemistry plays an important part, not only in the manufacture and treatment, but later in the processing, after treatment, tinting, toning, and renovating of the film. On the care with which these chemical operations are conducted depends the wearing quality or life of the film.

Manufacture of Motion Picture Film

In the manufacture of motion picture films and other sensitized photographic materials, absolute cleanliness is very necessary at every stage of the process. All operations must be conducted in dust-free rooms and only pure, clean, chemical substances are used.

Eastman motion picture film is manufactured at Kodak Park, at Rochester, New York. The plant consists of about 230 acres situated in the northwest section of the city. The output of this plant is, roughly, 150,000 miles per year. To make this quantity, over 5 million pounds of cotton are used yearly, several millions of pounds of gelatin, and over 12 tons of solid silver per month.

The water necessary to take care of the needs in manufacture is pumped through a private pipe line into large reservoirs from Lake Ontario, 4 miles away. The reservoirs have constantly on hand sufficient water to supply a city of 150,000 people. The temperature of the workrooms is rigidly controlled at all times by refrigerating machinery, having a cooling capacity equivalent to the melting of 4,000 tons of ice every 24 hours.

In the preparation of film base or support, cotton is thoroughly washed in circular rotary vats with caustic soda solution to remove vegetable gums and other impurities. After carefully drying in huge dryers to eliminate all moisture (Fig. 1), it is treated with two acids, nitric and sulphuric, a process known as nitration. Nitrating centrifugals, made of perforated baskets rotating inside a vat, are used for this process. The cleansed cotton is fed into the basket and the acids run in until the cotton is immersed. The fibrous structure of the cotton is not destroyed by nitrating but the treatment makes it possible to dissolve the cotton later in a solvent. When nitrating is completed the acids are drawn off and the basket rotated at high speed for draining. Nitrated cotton is known as cellulose nitrate. The excess acid is removed by placing the nitrated cotton in centrifugal washers. After washing in these machines, it is placed in large tanks of water where it is drained and rinsed repeatedly for several weeks. Centrifugal wringers operated at high speed next remove all the water. All these elaborate precautions are necessary in order that the cotton be freed from every trace of acid.

Washing and drying completed, the nitrated cotton is ready for dissolving in the organic solvents. These are usually compounds such as methyl alcohol to which certain other higher boiling liquids may be added. The solvents are contained in large paddle mixers and the nitrated cotton is fed into them through chutes. When thoroughly mixed, the solution is a viscous liquid of the consistency of honey and is usually referred to as "dope." It is then piped to large air-tight tanks until ready for coating (Fig. 2). To remove any undissolved specks and fibres, the dope is filtered under great pressure. It is then coated on the surface of large polished wheels in a thin layer and as the wheels slowly rotate, the solvents evaporate, the film dries, and is peeled off. The thin sheets of transparent base 2,000 ft. long, 3½ ft. wide, and approximately .005 in. in thickness are wound up temporarily

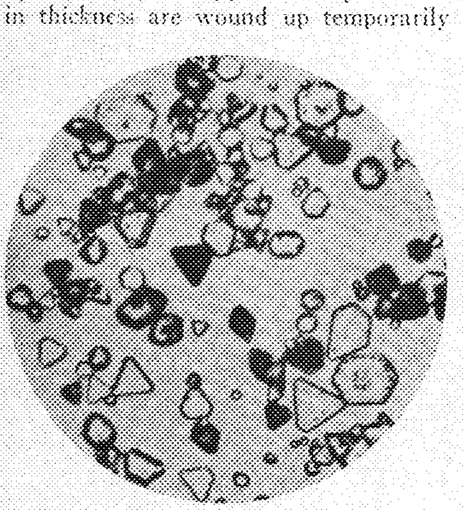

FIG. 3. UNDEVELOPED EMULSION
Crystals from original grains vary in shape from spherical to triangular and hexagonal.

until ready to be coated with the emulsion.

For more pleasing presentation on the screen, motion pictures are often tinted by bathing the film in dye solutions which stain the gelatin. To save the finisher the time and trouble of this operation, Eastman positive film is supplied in several different colors of tinted base. In this product the color is impregnated in the film base.

For use in portable projectors which require a non-inflammable film, a special safety base called cellulose acetate is manufactured. It is made in much the same way as the nitrate except that acetic anhydride is used instead of nitric acid for treating the cotton so as to render it soluble in the organic solvents.

Preparation and Coating Emulsion

We now turn to the making of the emulsion or the light sensitive layer that holds the photographic image. It is made in two grades, negative emulsion which is very sensitive to light and is used in the camera, and positive emulsion which is much less light sensitive and is used for printing the pictures afterwards viewed on the screen. All emulsion making is conducted in rooms lighted with safelights which have been specially prepared for this purpose.

In negative emulsions the silver particles are about .00008 to .00012 in. in size whereas in positive emulsions they are less than one-tenth as large.

Silver, as used in making motion picture films, comes in bars each weighing about 42 pounds. The bars are dissolved in nitric acid in porcelain dishes and after recrystalization pure crystals of silver nitrate are obtained. Other ingredients of the emulsion are potassium iodide, potassium bromide and gelatin. If these bromide and iodide salts are dissolved in water and to the solution thus prepared silver nitrate solution is added, an insoluble yellow salt is precipitated which is very sensitive to sunlight, turning black after a few minutes exposure.

If this solution is coated on the base, the film would have very little sensitiveness and for all practical purposes it would be worthless. For this and other reasons the precipitation must be conducted in the presence of some material that will avoid these difficulties.

The material commonly employed is gelatin, a substance analagous to glue in composition, and like glue in that it is extracted from the hoofs and hides of cattle. Photographic gelatin is usually prepared from calf skin by soaking the skins in lime water, and subsequently extracting with hot water. The gelatin is dissolved in water and the bromide and iodide solution carefully mixed with it. To this mixture, heated to the correct temperature, is added the silver nitrate solution. The precipitate of the sensitive silver salt is held in suspension throughout the solution by the gelatin and because of this it receives the term, "emulsion."

These actual operations are conducted in silver lined steam jacketed vessels provided with suitable agitators. Soluble salts formed during the reaction must be washed out of the emulsion. This is accomplished by chilling it to a jelly, shredding it by pressing the mass through a chamber with a perforated bottom and sides, and washing the spaghetti-like strands many times with cold water. The shredded emulsion is then melted and coated.

For coating the emulsion on the base, special and delicate machinery is necessary in order to carefully control the thickness. The film base is handled in such a way that only one side comes in contact with the heated emulsion. After the film is coated, it is carried in large loops through chilling rooms to set and harden or become "conditioned." When thoroughly dried, it is automatically cut into strips 1⅜ in. wide and wound into rolls varying from 100 to 1,000 ft. in length.

Perforating the film is carried on in a special department and the greatest care is required to have the work done accurately, for unless the perforations are correct in spacing, the film will not run smoothly in cameras, printers, or projectors and the picture will be unsteady on the screen. The rolls of perforated films are then taken to the packing room to be wrapped in selected pure black paper and packed in tin cans which are sealed to keep the contents air and light tight. The cans are stamped with the emulsion number, the footage, and are then placed in strawboard containers ready for shipment.

To make films of the high average quality demanded, inspection tests are necessary at every step in the manufacture. These include the actual making of pictures which are projected to show the photographic quality and to test the strength and wearing properties of the

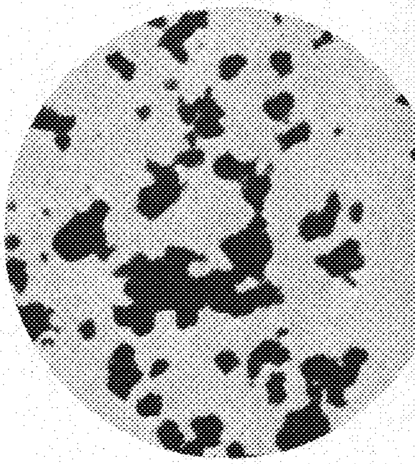

FIG. 4. DEVELOPED EMULSION
Microscopic view showing minute grains of metallic silver resembling tiny masses of coke.

base. Thousands of feet of film are used up weekly in this way in a critical inspection of the manufactured product. No stock is permitted to reach the consumer which does not come up to the standard requirements.

Research on Chemistry of Emulsions

In the manufacture of photographic emulsions, the art has preceded the science. Great refinements have been introduced in manufacture on a large scale, but the real chemical causes and the factors controlling the reactions have until recently remained as much a mystery as in the early years when all emulsions were coated by hand. As a result of a large program of intensive research that has been in progress now for many years in the Eastman Research Laboratory and other laboratories, some of the uncertainty has been removed but much additional work remains to be done.

To gain a better understanding of this research work, something should be known of the actual characteristics of

(*Continued on page 264*)

Insulating Materials Testing

Determination of laws governing flow of heat aids in the analysis of value of present day building materials and methods.

By Frank B. Rowley

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

ONE of the big problems in the engineering field has always been that of determining the correct laws and the application of the laws governing the flow of heat. Heat is the fundamental source of all mechanical power. Every steam engine, steam turbine, gas engine or any other prime mover depends upon it. Even water and wind power in their last analysis are obtained from the heat of the sun and it is difficult to conceive of any power problem which does not have this element. Heat may be considered a form of energy and it has the property of flowing from one body to another just as water will flow in a pipe or electricity on a conductor. As water requires a drop in head or level to make it flow, and electricity requires a drop in voltage or potential, the heat also requires a drop in temperature or intensity. It will always flow through a body from points of high to points of lower temperature. The rate of this flow will depend upon the material and its structure. Some material such as copper, silver and many of the metals will transmit heat very rapidly. They have a low resistance or a high conductivity. Other materials, such as cork, wool, etc., transmit heat very slowly. They have a high resistance or a low conductivity. Sometimes the problem is to get the heat to flow from one point to another as rapidly and with as little resistance as possible, while in other cases the problem is to retain the heat and to prevent its flow.

Those materials which are designed to fulfill the second requirement are known as insulating materials, and it is with them that this article is primarily concerned.

When we consider that in Minnesota alone at least 30 millions of dollars per year are spent to furnish comfortable living temperatures throughout the winter months, we realize that there is a fundamental problem in the conservation of this heat. If heat could be supplied to the buildings and all escape prevented, the solution would be comparatively simple; but since it can not, the next best thing is to construct walls, windows and the entire building to prevent, as far as possible, the losses of heat without undue expense. With this fundamental problem in mind, apparatus has been constructed and experiments are now in progress at the Engineering Experiment Station to determine what types of building construction best fulfill the requirements. This work was started about eight years ago at which time a single walled test box was constructed and used for testing built up wall sections. Due to the difficulties which were experienced in getting accurate calibrations, and reliable results from this apparatus, an improved type of double wall box was devised and constructed and is now in use. In addition to this a hot plate and auxiliary apparatus has been built, all of which will be described later.

In order to make the problem clear, it might be well to first discuss briefly the methods of testing insulating materials, and the constants used for comparisons.

The unit of measurement for the heat transmitted through any material is the number of British thermal units transmitted through each square foot per hour per degree difference in temperature between the two sides of the material. If these temperatures are taken as the surface temperatures, the constant is known as the hot plate constant and usually denoted by the letter "C", if the temperatures are those of the air on each side, the constant is known as the hot box constant and usually denoted by the letter "K". The resistance of any material to the flow of heat is made up of the surface resistances and its internal resistance. Since the hot box constant is calculated from air to air temperatures, it will include these surface resistances and the hot plate constant being calculated from surface temperatures will exclude them. The resistance, therefore, will be greater in the first case than in the second and since the conductivity of a material is inversely proportional to its resistance, the conductivity as reported by the hot box constant will be lower than that reported by the hot plate constant. This should be borne in mind when rating or when interpreting the rating of insulating materials.

The question naturally arises as to why these should be two different constants or standards. The principal reason is that materials are used under both conditions. Take window glass, for instance, the surface resistances are a major part of the total resistance and to rate it by the hot plate constant would be entirely misleading. On the other hand, the hot box gives very close to practical conditions. In the case of many insulating materials applied to wall construction, hot plate constants more nearly represents working conditions. As built up walls become thicker and the internal resistance assumes a greater portion of the total resistance, the two constants become more nearly equal.

The hot box, as now in use, can best be explained by reference to the illustration shown herewith (Fig. 1). The two open faces of the double box are

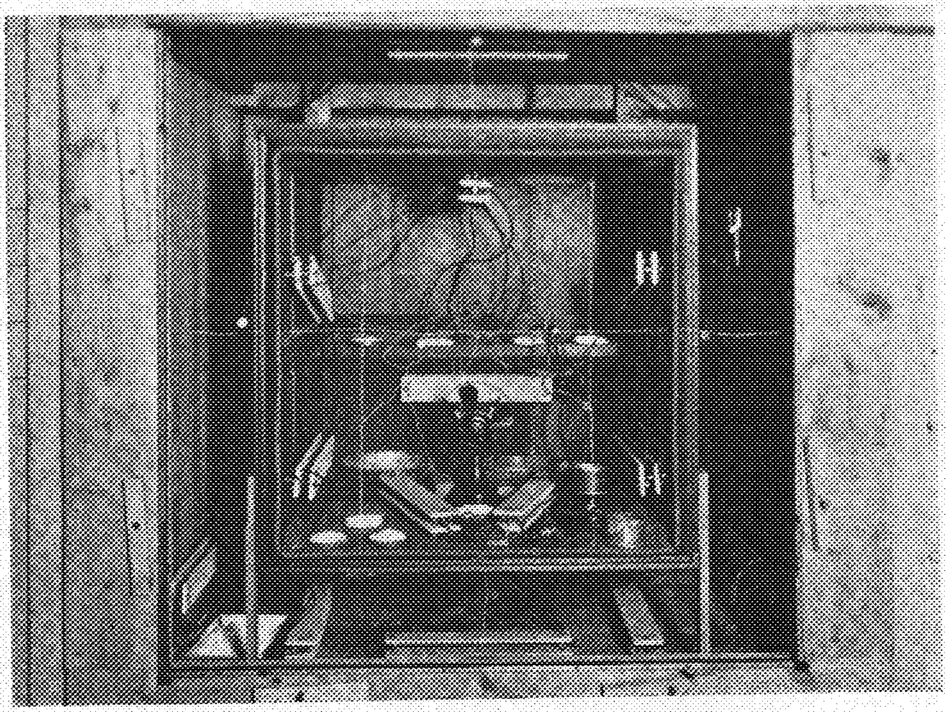

FIG. 1. THE HOTBOX APPARATUS INSTALLATION

Complete view showing the arrangement of heating elements, circulating fan, and dehydrating chemical pans. The fine white insulated wires in foreground are thermocouples.

in the same plane. The wall or material to be tested is placed over this open face, thus giving a temperature on one side of 75 deg. F. or whatever may be selected and maintained in the double box and a temperature on the other side equal to the cold storage room. The hot box temperatures are maintained with low temperature electric heating elements and regulated by thermostatic control. The temperatures in the cold room which constitute the outside air around the wall are maintained by 1500 ft. of 1½ in pipe which is supplied by ammonia from a 7½ ton ammonia compression refrigerating machine. The temperatures in the hot box are measured with copper constantan thermocouples, and those of the outer or cold room are measured with Leeds-Northrup resistance thermometers. All temperatures are read with instruments placed outside of the boxes. Referring to figure 1, we can see within the box the small dishes which contain calcium chloride, used to absorb the moisture and to prevent its condensation on the inner surface of the material.

The hot plate which is being used may be best explained by referring to figure 2. This apparatus consists of a central or heating plate and two cooling plates, one on each side of the hot plate. The temperatures of the heating plate are maintained and controlled by coils of electric resistance wire placed between the two surfaces. There is an outer or guard heating ring extending around the outer edge of the plate, the temperatures of which may be raised a sufficient amount above the inner heating section to prevent heat from flowing along the surface and thus escaping at the edges of the plate. The cooling plates are hollow and the low temperature is maintained by circulating water through the same. In using this apparatus, two pieces of the material to be tested are cut 25 in. square, one piece is placed on each side of the hot plate and the cooling plates moved up and clamped against the material. The temperatures of the surfaces of the material are measured by copper constantan thermocouples soldered directly to the surfaces of the plates. If the apparatus is adjusted and heated up to a uniform test temperature, the rate of electric flow into the heating elements is measured by a wattmeter and the temperatures of the material surfaces are taken with a potentiometer. From this data together with the thickness of the material, the conductivity "C" may be determined. It will be noted that with this apparatus, the internal resistance only of the material is measured, the surface resistance being eliminated by the contact of the metal plates with the test specimen. Whereas in the hot box apparatus the temperatures are taken from air to air, both the

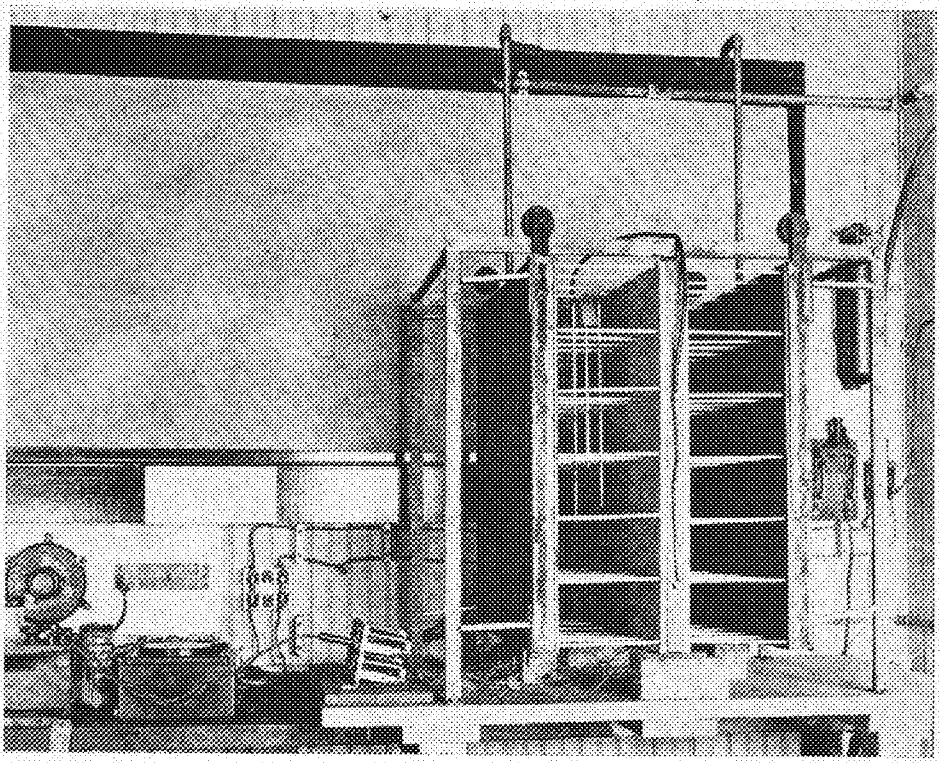

FIG. 2. APPARATUS FOR DETERMINING HOT PLATE CONSTANT

Heating elements are in the center plate and the cooling units on either side. The potentiometer equipment for reading surface temperatures in on the left.

internal and surface resistance are included.

The hot plate method has the advantage over the hot box method in that accurate results are much more easily obtained. It is extremely difficult with the hot box to obtain uniform temperatures over the entire surface. For this reason one of the problems has been to obtain equivalent hot box constants from the hot plate apparatus. In order to do this, supports were built up for holding the test materials against the hot plate without bringing the cold plate in contact with the outer surface and without interfering with the air contact on the outer surface of the test material. Figure 2 shows this apparatus very clearly. In obtaining equivalent results the hot plate constant is first determined, which gives the internal resistance of the material. A second test is then run to determine the transmission constant with one surface resistance included which is also shown in figure 2. If both surface constants are assumed to be the same, the equivalent hot box constant may be calculated from the well-known formula:

$$K = \frac{1}{\frac{1}{k_1} + \frac{x}{C} + \frac{1}{k_2}}$$

where: K = hot box constant.

k_1 and k_2 = surface constant.

x = thickness of the material.

C = conductivity.

In this method, there is probably some error introduced by assuming that both surface resistances are the same. It is, however, simple and sufficiently accurate for practical purposes. A series of tests run on insulite, the results of which are shown in table No. 1, and in curve of figure 3, show results which check very closely with those obtained with the hot box. It, therefore, appears that this method has a great deal of merit and may be used with a fair degree of accuracy. In figure 3, the hot plate constants only are plotted, and it will be noted that they vary directly with the mean temperature. This is a property of all insulating materials, although the rate of increase is different for different materials. It shows clearly that in order to properly specify the results of a test, the temperatures at which the test is made should be stated.

In building construction the air space often does or is supposed to play a very important part. Air in itself is a very poor conductor of heat and therefore a good insulator so long as it remains quiet, but unfortunately for insulating purposes, as soon as the air becomes heated, it expands and eddy or convection currents are set up which carry the heat from one point to another much faster than would be possible by conduction. The insulating value of an air space is, therefore, not directly proportional to its thickness. For vertical spaces the ratio of resistance decreases until a point is reached where the resistance seems to remain constant re-

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The Use of Iodides in Water Supplies

Iodization of drinking waters assures adequate and proper supervision at all times of this suitable means of combating simple goiter

By Arthur F. Mellen
Filtration Engineer, Minneapolis Water Works Department

MANY valuable studies have been made in recent years of a disease which is one of the most common in our state and which, because of the loss of life and of employment and the need for medical care, costs large sums of money each year. This discussion is not written from the standpoint of a physician but that of a chemist-engineer who has studied the subject closely during the past four years. It is one of general interest to all citizens of Minnesota, and especially to those responsible for or interested in public health and particularly water supplies.

The history of the art of water purification is a story of attempts to solve the difficulties incident to the production of a satisfactory water supply. Among the accomplishments are the removal of disease-producing organisms, turbidity, odors and tastes, the reduction of color, hardness, carbon dioxide, iron and manganese. About five years ago, however, our attention was called to a new problem, namely that many waters are deficient in iodides and that this is the cause of simple or endemic goiter.

This disease has been known for many centuries. The Hindu literature of 2000 B. C. gives religious formulae for combatting it, and the Chinese, as early as 1600 B. C., recorded methods for its treatment, using burnt sponges and seaweed ashes mixed in food. It was also well known to the ancient Greeks and Romans.

The ravages of this disease have long been recognized, but it was not until recently that definite hopes for its ultimate eradication have been possible.

Prevention is Possible

In this discussion we are interested only in the public health problem of the prevention of simple goiter. It is as definite a public health problem as is the prevention of typhoid fever or tuberculosis. The cure of the disease is, however, in the province of the physician and surgeon.

Goiter is an enlargement of the thyroid gland, which lies at the base of the throat. There are two principal types: simple or endemic goiter, with which we will deal, and exophthalmic goiter, with which the former has no necessary relationship.

The thyroid gland may be compared to the governor of an engine, because it controls the metabolism of the body, which governs normal growth and development.

The physical evidence of simple goiter is the throat enlargement, although in many cases impairment of health may result without an enlargement noticeable to the layman. This disease causes disfigurement and usually results in retarded physical and mental development, causing loss of time from work and retardation in school, and may result in certain forms of physical and mental degeneration such as cretinism, mutism and idiocy. The disease is especially common in adolescent girls and boys in the ages from 11 to 17 years, being from 2 to 3 times as prevalent in girls as in boys. It is, however, often in evidence at birth and may develop in expectant mothers and at the menopause period.

Since the advent of the science of bacteriology, which is only about 40 years old, scientists have tried to find a specific bacterium for each disease, but during recent years we have learned that certain diseases are caused by a lack of something such as a mineral element or a vitamin, instead of the presence of something such as certain bacteria.

Fish Used in Research

Very spectacular work on the prevention of simple goiter was done by Dr. David Marine in 1909, in co-operation with the Pennsylvania State Fish Commission, on brook trout. It was found that while adult trout brought from certain localities did not have simple goiter, still the young developed it in large percentages. Dr. Marine showed that successive generations from the same fish would not have simple goiter if adequate amounts of tincture of iodine were added to the water and that the next generation from the same fish would have this disease if the iodine was withheld.

He proved that simple goiter is a deficiency disease, an ample supply of iodine being necessary to prevent it. Dr. Marine's statement that "simple goiter is the easiest of all known diseases to prevent, and it may be excluded for all practical purposes from the list of human diseases as soon as society determines to make the effort; and it will require but a feeble effort," has been repeatedly quoted and its truth verified by the research work carried out since it was made.

The normal thyroid gland contains about 10 milligrams of iodine. This is such a small amount that more than 45,000 such glands would be required to produce 1 lb. of iodine. It is of interest to notice that while iron has heretofore been regarded as the element occurring in the smallest measureable amount which is needed in order that the human mechanism may function properly, still it has been found that the body needs only about 1/100 as much iodine as it does iron. Second, because of the statement, "Endemic (simple) goiter is the result of a deficient supply of iodine in the drinking water." While water supplies for centuries have been suspected of having some mysterious connection with simple goiter, its true relationship was but just beginning to be accepted as a demonstrated fact by the most careful students of the subject at the time this paper was given.

When water works men learned that the prevalence of simple goiter might be due to the lack of iodides in water supplies their interest was naturally aroused, and the question arose as to whether they could be of service in correcting this condition.

Following the World War studies were made by the U. S. Public Health Service of the results of the draft records, from which it became evident that simple goiter is peculiarly localized in this country. Sharp lines of definition cannot be drawn, but most of the coast regions seem to be practically free from simple goiter, while there is an increase toward the center of the country, particularly in the Great Lakes Basin.

It is commonly known that all mineral matter used in the body is derived from the soil. Iodides are readily soluble in water and have been leached out of the soil by constant rains until a deficiency exists. The logical result is the high concentration of iodides found in the ocean.

Those living near the coasts have a great advantage over those in other sections of the country because sea foods which contain large quantities of iodides are commonly eaten and, too, iodides in sea spray are brought considerable distances inland by the winds, supplying iodine to the soil and hence to the foods grown on it.

Iodine Salts Necessary

It has been known for many years that chlorine is brought in from the ocean in this way, but it has not been generally realized until recently that iodides are similarly carried. The inhabitants of these regions are therefore unconsciously protected from simple goiter.

The question was then naturally raised as to why all do not have simple goiter who live in zones where the disease is prevalent. The answer is: first, because of an ample supply of iodides at birth, which means that the thyroid gland of the mother was well supplied

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Electric Refrigeration

Quiet, simple, dependable units, automatic in operation, provide a "cold" degree of temperature at a cost lower than that of ice.

By CARL M. GLIDDEN, EX '20
Servel Corporation, Minneapolis

PROBABLY one of the earliest methods of food preservation of which most of us have read is described in stories of early American lives wherein the heroine, the picture of domestic charm, is in the spring house. There the milk and eggs are kept cool by running water and the evaporation of moisture from the walls. Methods had to be evolved for the protection of food of the city dweller and merchant and food in transportation.

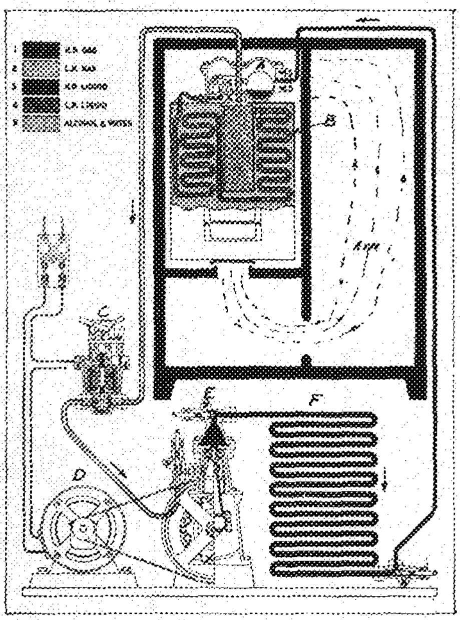
Refrigeration was a luxury limited to the very rich until the early part of the nineteenth century. It was in 1802 that the first delivery of ice was made in the United States, but ice was not available to city users in dependable quantities until 1895. This was brought about by the advent of mechanical refrigeration in a commercial way for ice making.

The most important consideration of refrigeration is the maintenance of temperature for proper food preservation. When this is accomplished food spoilage is eliminated and the health of the family protected from food poisonings. Spoiling and decay comes about by the growth of microbes which are commonly known as molds, yeasts and bacteria. At 50 deg. F. these multiply at a very rapid rate causing the decomposition of the food on which they feed. Electrical refrigerators will maintain temperatures from 40 deg. to 45 deg. F. which will practically stop the growth of these organisms.

A study of house temperatures revealed that not one cellar or room was below 55 deg. F. in the summer months. Likewise it was found that less than 35 per cent of the ice refrigerators in use would maintain temperatures below 50 deg. F. This means that there is a big field for electric refrigeration with its ideal temperature of 40 deg. to 45 deg. F.

The average refrigerator is but poorly insulated as shown by the above figures. The walls and doors should be insulated with 2 in. of solid cork board or its equivalent in heat resisting material. It is only with such insulations that electric equipment can effect efficient operation. A refrigerator designed to insure positive air circulation throughout, insures protection at all points. A recent report before the American Medical Society states that the majority of boxes in use are probably 15 per cent efficient, or 85 out of a 100 lbs. of ice is used to neutralize the heat which percolates through the walls.

Electrical refrigeration is based on the natural law that a liquid in changing into a gas absorbs heat. All liquids require heat to change them into vapor. The boiling point of different liquids varies greatly. Under atmospheric pressure water boils at 212 deg. F., alcohol at 173 deg. F., sulphur dioxide at 14 deg. F. and methyl chloride at —11 deg. F.



REFRIGERATION SYSTEM

This electric refrigerator which is described below, makes use of the heat absorbing quality and low boiling point of methyl chloride. Methyl in a gaseous state or in a liquified form is non-poisonous, non-corrosive, nor does it form injurious compounds with air or water. It was discovered by Dumas and Peligot in 1835 and has been in use as a refrigerant in France since then. Prior to the war the cost to import to this country was about $30 per lb. which made it prohibitive. But the Roessler and Hasslacher company has produced it in the United States from natural gas and chlorine at a nominal cost. About two and one-half pounds are used in a domestic machine.

When a liquid boils it must receive heat from a body of higher temperature. To boil water a source of heat with a temperature greater than 212 deg. F. must exist and a fire is necessary. To boil methyl the source need only be slightly higher than —11 deg. F. Under atmospheric pressure methyl can be liquified under moderate pressure.

In this refrigerator, the liquid methyl under pressure is admitted through the float valve (A) (see diagram of operation) to the expansion coils (B) which is placed in the ice compartment of the refrigerator. The coils in turn are immersed in an alcohol solution. As the liquid methyl changes to a gas inside these coils, heat is absorbed from the alcohol solution surrounding them, lowering its temperature and in turn the box temperature. As the heat is absorbed by the methyl the pressure becomes greater and the boiling point rises. When the pressure reaches a predetermined point, the piston of the pressure control switch (C) is raised, cutting in the switch and starting the 1/4 h. p. motor (D) and at the same time allows the gas to pass through the parts in the base of the piston to the compressor (E). As the machine runs it draws this heat-laden gas out of the coils thereby reducing the pressure with a corresponding drop in temperature. When the pressure is reduced to the proper point the piston falls and the machine stops. The average running time is 6 to 7 hours. The gas coming from the refrigerator is condensed and sent on to the condenser coils (F) where the latent heat becomes apparent heat and is removed through the copper condenser coils by means of a fan and the methyl becomes a liquid again. This passes on up to the float chamber where it is admitted to the cooling coils through the needle valve, and the cycle is complete.

The machine is built to handle all requirements up to 80 cu. ft. of space. A larger water cooled machine operated by a 3/4 h. p. motor is rated at 750 lbs. ice melting capacity (from and at 32 deg. F.) in 24 hours.

This and the other sizes will effect large economies over ice, which will cover interest and depreciation on the machine. On the larger machine the following figures show what may be expected.

Ice melted in 24 hrs.	*Ice at 40 cts. cwt.*	*Hrs. of machine operation*	*Energy cost at 4c per kwh.*	*Saving each month over ice*
250 lbs.	$1.00	8	0.32	$20.40
300	1.20	9.5	0.38	24.60
350	1.40	11	0.44	28.80
400	1.60	13	0.52	32.40
450	1.80	14.5	0.58	36.60
500	2.00	16	0.64	40.80
550	2.20	17.5	0.70	45.00
600	2.40	19	0.76	49.20

Servicing is an item that should be carefully considered. The larger companies maintain service departments with regular inspection calls. This

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NEWS FROM THE TECHNICAL CAMPUS

Dean O. M. Leland Speaks At University of North Dakota

Dean Leland was a speaker at a recent convocation at the University of North Dakota. We reprint the following announcement from our neighbor publication, the North Dakota Engineer:

On Thursday, May 13, the College of Engineering will present to the University at the regular weekly convocation, a speaker whose work has become known throughout all the United States. Dean Ora M. Leland, Dean of Engineering at the University of Minnesota, will be our guest at this time and we sincerely hope that he may be able to remain for our festivities on the following day.

Dean Leland has had a wealth of experience in the practical as well as the educational side of civil engineering. He graduated from the College of Civil Engineering of the University of Michigan in 1900 and since that time has held many important commissions. His first work was done with the General Land Office Engineers and with the U. S. Coast and Geodetic Survey in Alaska and Porto Rico. In 1903 he became a member of the faculty at Cornell and maintained his connection with the school until 1920, when he accepted a position with the U. of Minnesota.

His connections with educational institutions have been broken by numerous periods of service with large engineering concerns and by his three years of military service with the 303rd Engineers in the Army. He left the Army with the rank of Lieutenant-Colonel of Engineers after much active work in France and Germany. He has worked at various times with the J. G. White company, one of the largest firms of engineers in the country. In 1904 and 1911 Dean Leland helped in the settlement of the boundary location between Alaska and Canada; and in 1912 served on the commission which settled the Costa Rica-Panama boundary.

We are certainly fortunate in having such a distinguished visitor and we know that Dean Leland will have an important message for every student on the campus.

Three Seniors Investigate the Loss of Head in Pipes

Three senior electrical engineers, Lowell J. Hartley, William A. Hargrave and Carl A. Hummel, have just completed a series of experiments in hydraulics dealing with the loss of head in expanding tubes.

The material used was several lengths of galvanized pipe with diameters of 4 in., 3 in., 2½ in., 2 in., and 1½ in. The pipes were in series and connected to a source of water at constant pressure. Two lengths of pipe were treated at a time. A four-tube differential gage connected by four piezometer tubes to the pipes, measured the loss in head. From the measurement of the quantity of water, the diameter of the pipes and the loss of head being known, calculation of the coefficient of friction was possible. Ten minute runs were made with velocities varying from approximately one to 12 ft. per sec.

The work was done under the direction of Mr. J. O. Jones, associate professor of hydraulics. The results and data obtained with the different velocities and diameters of pipe proved very consistent. Although their work is necessarily a preliminary investigation, if continued next year, will prove to explain some of the questions relating to loss of head in pipes.

Prof. J. J. Flather, Mechanical Department Head, Dies May 14

THE LATE PROF. J. J. FLATHER

All engineers were excused from classes, Monday, May 17, in honor of Professor John Joseph Flather, head of the Mechanical Engineering Department of the University of Minnesota, who died Friday evening. The funeral was held Monday morning at 10:15 at the Lakewood chapel.

Professor Flather has been head of the Mechanical Engineering Department at the university since his coming in 1898, and has in that time seen and assisted in the development of the department from a small branch of the College of Engineering to a department having an enrollment of 200 students and a faculty of 25. He was born at Philadelphia, June 9, 1862. As a boy he attended schools in Scotland, and high school at Bridgeport, Conn. In 1885 he graduated from the Sheffield Scientific School of Yale. At Cornell University he obtained the degree of Master of Mechanical Engineering in 1890, and also studied at the University of Edinburgh. He is a member of Tau Beta Pi, and Sigma Xi, honorary fraternities.

Following his school work, he obtained several years of practical experience in European and American machine shops as superintendent, and mechanical engineer. He began his teaching work as an instructor of mechanical engineering at Lehigh University in 1888. In 1891 he left to become a professor of mechanical engineering at Purdue University, where he stayed until 1898 when he left to come to the University of Minnesota. While here, beside numerous other things, he designed the heating plants used both on the main campus and on the University Farm.

He was a member of many societies, holding a fellowship in the American Association for the Advancement of Science of which he was vice-president in 1901-1902, a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Society for the Promotion of Engineering Education, of which he has been past vice-president and treasurer, associate member of the United States Naval Advisory Board, the Newcomer Society of London, the History of Science Society and the Authors Club of London.

As an author he has published a treatise on "Steam Boilers," in 1889, and books on "Rope Driving," 1892; "Dynamometers," and the "Measurement of Power," 1900; "Kinematics," 1904; "Transmission of Power," 1908; and was a joint author of "Engineering Thermodynamics," 1915.

"Architects In Fableland" Ball Occurs on May 21

May 21 was chosen this year as the date of the Architect's Jubilee, annual celebration of the students of the school of Architecture. The theme for the traditional event this year is termed, "Architex in Fableland" and all guests are asked to come adorned in the costume of their favorite fairyland character. The decorations, which will be very elaborate, are in keeping with the theme and will be something shown for the first time on the campus.

A tea and exhibition of typical work of the department will occupy the afternoon. The grand ball at night will be the feature of the festivities and a one-act play tops the list of entertainment planned.

The chairman of the general arrangements committee is Clyde Lighter. Lawrence B. Anderson, art editor of the Techno-Log, is in charge of the decorations. All alumni are being sent invitations and are expected in large numbers. The theme last year was "Cannibal-land" with African and South Sea Isle decorations predominating.

Students Receive Commissions As Ensigns In Naval Reserve

Several men in the engineering college have recently received commissions as Ensign in the Fleet Naval Reserve of the United States Navy with designations of naval aviators. They are G. A. MacDonald, Douglas Campbell, Carl F. Luethi, Douglas Mesker, and Leon Dahlem. The commissions are received upon the satisfactory completion of the course in aviation given to college students. The course provides for the training of the student for one year in ground school. This is carried on while the student is going to school, one night a week. During the summer the student pilot is sent to the Great Lakes naval training station near Chicago. If successful, he remains there for 45 days, and is then transferred to the Hampton Roads training station located on the Atlantic Coast. Here, flight training is given on the big flying boats. When this course is completed the student is given his examination for the commission of ensign.

The commission carries with it a retainers pay, and full pay of ensign while on active duty; in fact, is the same as the commission in the regular navy, except it carries the privileges of the reserve.

Graduates of last year have also received commissions. Joseph E. Meagher, who is now working in Chicago, Wesley Saunders, who is in Milwaukee, and Harry J. Flatequal who is in Washington, D. C., hold commissions. Saunders received his a year ago, while Meagher and Flatequal received their commission more recently. Several other men from the university took up the course, but were later refused a commission because of trouble with eyesight. Clarence V. Lund completed the whole course, while Clement Tuttell completed half of the course. The examination for flight is most strict and thorough. Last fall when the men were enrolled for this year, out of the more than 40 who signed up only 10 passed all the tests.

The men who are now enrolled in the course and are expecting to go to the training stations this summer are Ross Mahachek, Donald Stevens, Edward Clark, John Diffley, Keith Krieger, Lawrence Clousing, Lloyd Berkner, Albert Cooper, Richard Hansen, and Jay Carpentier.

Inter-Honorary Banquet Held at Nicollet Hotel

On Friday, May 7, the honorary scholastic fraternities, Chi Epsilon, civil engineering, Eta Kappa Nu, electrical engineering, and Pi Tau Sigma, mechanical engineering, held their annual inter-honorary fraternity initiation banquet at the Nicollet Hotel. This dinner is held yearly in honor of the new initiates. The new members this spring are Kenneth M. Clark, Frank R. Lundsten, John C. Marcroft, Joseph B. Paulson, all initiates to Chi Epsilon; Eta Kappa Nu the initiates are Lloyd V. Berkner, Edward L. Bottemiller, Charles H. Burmeister, Robert F. Edgar, Albert C. Lee, Barrett H. Rogers; new members of Pi Tau Sigma are Ralph B. Evans, Harold J. Lamon, Dimon A. Roberts.

Following the banquet there was a program of which Professor Shipley was toastmaster. Introduction of the new members was taken care of by George Mork who also outlined the purposes of the organization. John Marcroft responded for the new members. The main speaker of the evening was Colonel John T. Stewart, who spoke on "Experiences in the Western Desert Country." His speech was illustrated by lantern slides. Colonel Stewart spent several years in Arizona, working with the U. S. Geological Survey, and in his talk told of the many novel happenings that befall an engineer in those climes.

60 Foot Flagpole Given By Seniors As Memorial

The senior engineering class will leave to the university as a memorial, a flag pole which will be dedicated at a ceremony to be held the latter part of May. This pole will be placed in the intervening space between the main engineering and experimental buildings, exactly in line with the nameplate on the electrical building and the center of the Elliot Memorial Hospital.

The idea was originated by the senior class of civil engineers who this year at summer camp erected the highest "Totem" pole yet set by any civil class. The matter was proposed at the civil banquet this year and action immediately started. Kenneth Foster was appointed chairman and the plan was given unanimous approval at the next class meeting. Committees consisting of Robert Kranzfelder and Clyde Lighter, architects, Maurice Hart, electrical, and Harold Rollin, mechanical, were assigned to collect $1.50 for each senior. The civil class had previously subscribed 100 per cent.

The pole has an ornamental iron base and a large gold ball will top its 60 foot height. The flag will be presented by the faculty and Dean Leland will officiate at the dedication ceremonies.

Waterproofing of Concrete Tested by Research Fellows

Donald O. Nelson, C '20, and Frank E. Nichol, C '25, have just completed a complete test of 14 different kinds of waterproofing compounds as applied to samples of concrete.

Nelson and Nichols are research fellows in the department of civil engineering and have conducted their experiments under the direction of Professor M. B. Lagaard, assistant professor of structural engineering. 60 different samples of concrete were tested. These different samples were made by varying the amount of water and strength of the mixture. Specimens were made in the form of a disc and three specimens of the same sample were tested simultaneously so that an average result from the test of each sample could be taken. Distilled water under 40 lbs. pressure was applied to each sample and the amount of water coming through was measured. Absorption tests were conducted along with the regular tests.

The tests were started in December, 1925, and have been one of the most complete investigations ever attempted along that line. A complete report and results of the experiment will appear soon in a bulletin published by the Experimental Engineering Department.

Success Marks Annual Engineer's Day Festivities

A post-mortem of the big event shows that Engineer's Day this year was most successful in every respect. The features which crowded the day's festivities were of the highest order and visitors to the campus went away, laden with souvenirs, and reflective upon the many things which they had witnessed.

With sidewalks painted in green letters and with shamrocks pasted up on doors and windows, the campus looked more like the land of St. Patrick than does Ireland itself. Open house was the feature of the morning and the green balloons, ash trays in the form of miniature stadiums, wooden pipes, paper weights and various other samples of shop work were distributed to visitors. Following this was the parade, traditional in its full complement of wise cracks and novel floats. Although it looked as there would be the customary rain, this failed to come even though the signs had been painted in water-proof colors. St. Pat, alias Ray Kelly, and the queen, Elizabeth Dixon, headed the procession riding in a real Irish phaeton. The anti-aircraft gun raised such a racket that the burglar alarm in the vaults of the administration building was jarred, thus starting a siren going on the outside of the building which added to the din of the affair.

The miners, though unseen, contributed to the day and effectively tore down decorations as soon as placed. The huge model clay pipe, hung over the main entrance to the campus was stolen and taken to their banquet held the night before the day in a St. Paul restaurant. Indignant engineers arrived at the banquet halls too late to recapture the pipe and its whereabouts is still a mystery.

Two airplanes flew above the campus and scattered handbills, some of which entitled the finders to free admission to the "Brawl." These were both piloted by students of the engineering college.

At the close of the parade, knighting ceremonies for the 200 graduates were held on the campus knoll. Clyde Lighter, president of the Technical Association, presented the sword to the queen who in turn knighted St. Pat. Patrick then duly dubbed each senior, giving him a resounding whack on the back.

The green tea and dansant in the afternoon again proved to be immensely popular. The electrical engineering laboratory was crowded and the overflow was taken care of in the main engineering auditorium where the same music was broadcast by means of loud speakers connected with the electrical building by wire.

Over 300 couples attended the dance in the evening, this large turnout assuring the financial success of the day. At the final check-up at the conclusion of the sale of buttons, clay pipes and tickets, the committee found that it was not in the hole as sometimes was the case formerly, but that a surplus of $100 was in the coffers.

Professor Bass Recommends Change In Expert Testimony

At a recent meeting of the Minneapolis Professional Men's Club, Professor Frederic E. Bass, head of the Civil Engineering Department, and president of the Northwest Section of the American Society of Civil Engineers, was placed on a committee to prepare legislation which will eliminate the present unsatisfactory practices governing the use of expert testimony before courts and juries.

In speaking before a meeting of the committee Mr. Bass said, that "legislation might well be in force to permit the court to ask the expert for advice, rather than have experts testify on either side. It is impossible to eliminate bias, even when intending to be honest, so long as a man is paid by one side or the other.

"The preparation of all expert testimony by experts employed by the court, however, might have some defects. Litigants would be forced to make early application to the court for such experts as might be necessary to secure data on which testimony to be given later must be based. This would impose a tremendous additional burden on the court, and probably would require a long list of rules and regulations that might be fatal to the case through restrictions that might be imposed.

"The complications and expense of such a plan might prevent its use, even if the experts, provided by the court, were underpaid, as judges themselves now are. Underpayment of important public officials is a vice in American institutions, and this plan would extend this viciousness. In my opinion, the employment of independent experts by the court must be supplementary rather than substitutive. If the court can have the right to employ experts to whom authority can be delegated to obtain and study such evidence as is necessary for information of the court and for presentation at the trial, it would appear that a substantial gain would be made in checking extravagant claims by either party."

Resolutions prepared at this meeting will be sent to the State Bar Association, and also will be presented to the State Medical Association. Other professional organizations in the state have been asked to join in the support of this movement.

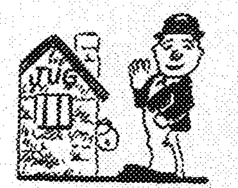
Two Senior Electricals Conduct Novel Research

Roy Sjoberg and Maurice Hart, two senior electricals, during the winter quarter have conducted some novel research into the effects of cold weather upon storage batteries with their particular application to automobile use. Often the layman will attempt starting his car in the winter time and notice how stiff the starting motor is as it labors to turn the engine over. This is many times blamed upon the oil or on the fact that the gasoline and engine were cold.

These investigations were carried out in the electrical and experimental laboratories and care was taken that the work was thoroughly done. The cold weather was made to order in the cold room of the experimental building and the temperatures varied from 75 deg. F. above to 22 deg. F. below. The conclusions arrived at after the tests were many but the salient point was that a decrease in temperature materially lowered the battery output, especially when the cells were not fully charged. This effect, together with the high starting torque required by the engine, rendered stiff by the viscosity of the oil at these low temperatures, easily explains the failure of an engine to start when cold.

AROUND THE WORLD WITH OUR ALUMNI

Architects



'19—Ralph Hammett, who has been traveling and studying in Europe under a Harvard scholarship has returned to the United States and is at present with Hall, Lawrence, and Ratcliffe at Chicago. He has lately been designing the new Cook County jail and County Courts building. His address is 154 Superior St.

'24—Mr. and Mrs. Charles Hinman left the first of May for Cleveland and the east planning to visit at various places in the east before sailing for Europe on May 26. They expect to spend six months traveling through England, France and Italy.

'25—Paul E. Wicklund is in Chicago and can be addressed at 5152 North Clark street.

'25—Walter Kendall and Alvin Jansma are still in Milwaukee and write that they are still able to keep sober in spite of the reputation of that city.

Chemists

'19, '20—Roy F. Korfhage has accepted a position as assistant in the chemistry department at the University of Wisconsin. He attended the last summer session at Minnesota last year.

'24—John Pagnucco, after finishing his research and obtaining his master's degree will go with Proctor and Gamble at Ivorydale, Ohio, in their research department. He was recently elected to Sigma Xi, honorary scientific research fraternity.

'24—Norman Bekkedahl is now with the Bureau of Standards at Washington, D. C.

'26—Marvin C. Rogers has recently received the appointment as an assistant on the staff of the engineering experiment station of the Michigan State college at East Lansing, Michigan. This is for the duration of the year 1926-27.

'26—Kenneth A. Kohe and Joseph H. Kugler have accepted positions as assistant instructors in the School of Chemistry at Minnesota.

Civils

'19—Byron K. Curry was in town last month on his way out to Lewiston, Idaho, where he will be engaged in hydro-electric work.

'20—Henry M. Lende who has been in the employ of the Minneapolis Park Board, as well as the Dayton company of the same city, for several years, has entered the automobile sales business and is now located at Granite Falls, Minnesota. He is in partnership with his father.

For the past year he has been secretary of the Columbia Golf Club in Minneapolis and is known as an expert at that ancient Scotch game.

'20—Francis A. Dever is with the Pennsylvania Railroad company in charge of the construction of yard and locomotive facilities near Weirton, West Virginia, on the Ohio river.

'21—Leif J. Sverdrup got lonesome for Minnesota so he came up and paid us a visit about three weeks ago. Mr. Sverdrup is the assistant chief engineer of the Missouri Highway Commission and has charge of the Bridge Department.

'23—A. C. Zimmerman has become a member of the firm G. O. Reed, Inc., engineers and contractors of Miamo Beach, Florida. He is at present engaged in construction work and has several bridge jobs under way. He was formerly with the army engineers at Duluth.

'24—E. R. Grant is down in southern Missouri "showing" the people down there how things should be done. He is project engineer with the State Highway Department and, at present, he has charge of the erection of a large steel bridge.

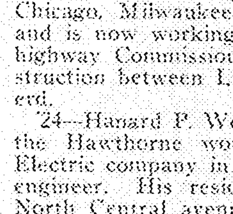
'24—Clarence J. Velz, who has been down in Florida for the winter, is now in New York in charge of development on the banks of the Hudson. He says that he expects to return to Florida in the fall when things open up again. His present address is: 436 Eastern Parkway, Brooklyn, N. Y.

'24—Norman R. Moore was married last fall and is now living at 6507 Stewart Avenue, Chicago. Mr. Moore is working on the Chicago Terminal.

'24—Anton E. LaBonte has resigned his position in the bridge department of the Chicago, Milwaukee and St. Paul R. R. and is now working with the Minnesota highway Commission on the paving construction between Little Falls and Brainerd.

'24—Hanard F. Weber is employed with the Hawthorne works of the Western Electric company in Chicago as electrical engineer. His residence address is 501 North Central avenue.

'24—K. M. Olson is in the office of the chief architect of the Chicago, Milwaukee and St. Paul railroad and has his headquarters at Chicago.



'24—Lewis H. Powell is taking graduate work in geology at the University of Minnesota. Since his graduation, he has wandered all over the world, including a hike across Europe. He was with the Philadelphia Evening Ledger as re-write man for a while and he is now working on the staff of the Minneapolis Tribune besides doing his graduate work.

'25—Harold E. Bird has been engaged in subdivision work in Fort Lauderdale, Florida, and in Myrtle Beach, South Carolina, but he has left that work to come back to Minnesota where he is now working for the Highway Department.

'25—Horace W. Nutting has been working as chief of party on subdivision work in Fort Lauderdale, Florida, and Myrtle Beach, South Carolina.

'25—Harold Jones' address is 417 Fourth street north, Brainerd, Minnesota. He is working for the Northern Pacific R. R. as engineer on maintenance.

'25—Thorsten Berg, who has been employed by the Marion Steam Shovel company of Marion, Ohio, in the sales division, is not making his headquarters at Minneapolis where he is their representative for the territory comprising Minnesota, North Dakota, Wisconsin, and upper Michigan. He came here direct from the New York territory in which district he has been working since last November.

'25—William C. Brose, who is with the Marion Steam Shovel company at Marion, Ohio, writes that he likes his work very much and that he has "hitched his wagon to the right star." He has been in the sales department since the first of the year and says that he has more than enough reason to be in a good frame of mind as he is now the proud father of a baby girl.

'25—Dwight T. Burns writes, "I expect to be here about a year and a half according to present plans." "Here" refers to Pawhuska, Oklahoma, for Mr. Burns is working as bridge inspector on a new main line cut-off the Santa Fe railroad company is building between that town and Fairfax, Oklahoma.

'26—C. E. Meyerdick is in Joliet, Ill., working for the E. J. & E. R. R. He writes that he is pleased with the variety of work that he is getting and says that that is why he likes his job. He writes also, "I like this town, too. In fact, I have confidence enough in the place so that I felt safe in buying a lot here."

'27—James B. Ringwood has been out of school this quarter because of bad health. He left on May 10 for Long Island, New York, where he has a position on the engineers and contractors of Miama Beach, Development Corporation.

Electricals

'14, '15 EE—H. S. Loeffler, assistant engineer for the Great Northern railroad, had charge of the unusual job of reinforcing an old railway bridge. The bridge, a steel through truss type with a span of 416.5 ft., was designed to take a load equivalent to Cooper's E-35. To eliminate "slow orders," it was reinforced to take a load equivalent to Cooper's E-70, just two times the load. He did the job by building another truss around the existing one.

'18—Clayton T. Gibbs is an electrical engineer for the firm of Holmes and Sanborn, located at 912 Black building, Los Angeles, California.

'18—T. F. Talbot and C. P. Benham ('13) are with the Great Western Power company. Mr. Talbot is located in San Francisco and Mr. Benham is in Alameda, California.

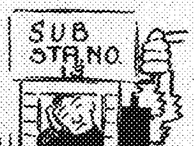
'19—David Grimes, vice-president of the Grimes Radio engineerng corporation of New York City and the inventor of the inverse duplex radio circuit as well as several other improvements in radio was in Minneapolis last week on business. While here, he was initiated into Theta Xi fraternity, he being one of the members of Alpha Kappa Sigma, a local fraternity, the predecessor of Theta Xi here. Grimes is now working on a method of eliminating static completely by use of horizontal waves.

'19—The marriage of Albert E. Peterson to Miss Mary Louise Osgood of Chicago occurred on April 17. They will be at home to their friends at 5601 West End avenue after the first of May.

'19—Harold S. Langland and H. C. Stanley, a graduate of the Armour Institute of Chicago, have organized the Stanley Iron Works. During the past year they have been manufacturing fire escapes, steel stairways, railings, residential ornamental iron, and other products of the same and different lines. Their shop is in Minneapolis and at present employs 11 men.

'20—Several Minnesota men are with the ideal Electric and Manufacturing company at Mansfield, Ohio. Harold R. Goss has risen from the ranks and is now manager of the synchronous motor department. Orney E. Dunnum, '22, is sales engineer and Clay W. Noel, '20, is the divisional manager. George Galaas, '26, plans on going with this company in their student training course.

'21—Another grad who has felt the call of sunny California is Percival E. Loye, who is assistant engineer with the Pacific Gas and Electric company, 445 Sutter street, San Francisco.



'21—We are glad to present the following excerpts taken from a letter written by C. Phillip Carlson to Sanford Bordeau, E '25, telling of his experiences in South America:

A request for information about South America puts me in a position of some responsibility. I suppose I could place myself on the safe side by recommending you not to come down here, but there are so many angles to the situation that I must explain myself more fully. In the first place, this is not the only electrical development in South America, although it probably is the largest employing so many Americans. But it probably is the only place where a young fellow with little practical experience and no knowledge of the language can get a start, so I think my remarks about Chuquicamata will just about cover the field for electrical engineers in S. A.

The work here falls into two classes: maintenance work and operating in the sub-station. For a fellow with any ambition there is not enough of a variety in either of those two kinds of work to make it worth while spending three years at it. At the time I came here it was said that less than five per cent of the electricians stayed out their contracts, so you can see how attractive they found the work and the place. Aside from mining engineers, most men are attracted to foreign countries because of the wages offered, and while the pay is good there is a reason for it. No employer ever pays any more for his labor than he has to; and with reference to foreign work, no employee wants to go out and bury himself unless he is amply paid for it. Which brings me to the point that a man should be able to save lots of money on a job like this,—not because living is any cheaper but because of the larger salary he gets.

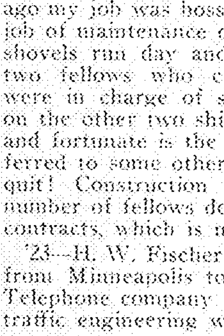
I should also take into account the spirit of wanderlust, which in my case was more of a factor than the money question. So, taking everything into consideration I can't say that my time has been entirely wasted,—I have learned a little of trouble shooting, saved a little money, and seen a bit of the world. The chief grief of a college man after he has been here for a few months is the thought that he could have advanced a lot further in his profession if he had stayed in the States, but after a year or so he sort of becomes reconciled to his lot, and in the case of the three of us who came down together it is possible that we may stay out our contracts.

Living conditions here are much better than the average mining camp in South America, so we have no kick coming there. We are at an altitude of 9,200 feet, on the slope of a range of mountains in a rainless, treeless, sand-blown, wind-swept desert. How does that appeal to you? However, it's not as bad as it sounds; we get a few drops of rain about once a year, and looking off to the East we can see snow on the distant mountains all the year around. We had a heavy rain here one day last February which raised havoc with our electrical equipment; none of which is protected from the weather.

Another factor in making me more contented with my lot is the fact that I have been put on radio work. The company has attempted transmission on 50 watts between here and the coast without any success, so now a fellow from the Western Electric company has come down here with a 500 watt set and some very sensitive testing apparatus for making a field strength survey of this part of the country. Scanlon, an ex-navy operator, is working the transmitter, and I am making the field strength measurements and observations. We aim to test on various wavelengths between 50 and 2,000 meters, and the result of these tests will determine the power necessary for satisfactory communication day and night. Static is a difficulty here on account of the high, dry and windy condition of the atmosphere. Fading of signals is tremendous after sunset. For these reasons, radio receiving is not a popular indoor sport in this camp.

A little more about the electrical work here: The power comes from an oil-burning plant at Tocopilla on the coast, 95 miles away. The capacity is 60,000 kw. It is generated at 5,000 volts, stepped up to 110,000 for transmission, and stepped down to 5,000 again here at Chuquicamata. Most of the load is the electrolysis of the copper and the remainder is used to operate the electric shovels at the mine. There are 20 shovels, Marion and Busyrus, of various types and sizes. Until a month ago my job was bossing 18 natives on the job of maintenance of these shovels. The shovels run day and night, so the other two fellows who came down with me were in charge of similar gangs of men on the other two shifts. It's a tough job, and fortunate is the man who gets transferred to some other work. They usually quit! Construction work has brought a number of fellows down here on one year contracts, which is not so bad.

'23—H. W. Fischer has been transferred from Minneapolis to Omaha by the Bell Telephone company for whom he is doing traffic engineering work.



'24—Edmond S. McConnell has won high honors in having been appointed to the Strathcona Memorial Scholarship in Transportation at Yale University for the year 1926-27. This scholarship was established by the late Lord Strathcona of Canada and is warded to a graduate student who is fitting himself for work in the field of construction, equipment, or operation of transportation, preference being given to such persons or to sons of such persons as shall have been, for at least two years, creditably connected with the railways of the northwest.

Mr. McConnell has been special apprentice in the Mechanical Department of the C., M. and St. Paul R. R. since his graduation, working under the direction of the general superintendent of motive power with headquarters at Milwaukee, Wisconsin. He is the second Minnesota graduate who received this appointment in recent years. In 1922, Francis A. Dever, '20, was awarded the scholarship and since the completion of his work at Yale has been in the Engineering Department of the Pennsylvania Railroad.

'25—Clarence W. Thyberg is taking a two-year training course with the Western Union Telegraph company in Minneapolis.

'25—Enan C. Johnson is with the Northwestern Bell Telephone company in Minneapolis.

The Minnesota alumni at Schenectady, N. Y., had a most delightful dinner and hour of reminiscencing with E. B. Pierce, general field secretary of the University of Minnesota, on Monday evening, March 22. Dinner was served in one of the dining rooms of the Mohawk club. The following Minnesota men were present: Earl M. Bill, '12; A. H. Mittag, '11; A. E. Beardmore, '21; L. P. Grobel, '24; J. M. Downie, '22; L. C. Warren, '24; R. O. Dunham, '15; Burt L. Newkirk, '97.

In the hour following the dinner, Mr. Pierce covered all the interesting high spots of University history, old and new, answering all the questions hurled at him by the news hungry Minnesotans. Earl Bill was the master of ceremonies and Burt Newkirk was in charge of dinner arrangements.

'25—Joseph E. Meagher is spending a week in Minneapolis before going to the Great Lakes Naval Reserve station for flying duty. Meagher is an ensign and pilot in the naval reserve, having completed his pilot's course last October at Hampton Roads, Virginia. Joe will be remembered for his many activities while at school, chief among which was his officiating last Engineer's Day at St. Pat.

Mechanicals

'09—Edwin M. Lambert has been quite ill for the past few months but we are glad to report that he is improving.

'20—Lewis E. Merrill is now back in Minneapolis in the employ of the Texas company. He has lately been with that firm in Sioux City, Iowa, for several months.

'21—Mr. and Mrs. H. F. Wharton of Minneapolis announce the engagement of their daughter, Gladness Irene, to Alexander W. Luce of Omaha, Nebraska. The marriage is to take place early in the summer.

'22—Ernest Carlson is plant engineer for the Northern States Power company and is stationed at the High Bridge plant in St. Paul.

'23—Sidney Acker is working on the "dynamometer car" doing locomotive test work for the Northern Pacific railroad. He is also working for his master's degree by correspondence.

'24—Floyd Olmstead has recently been appointed the manager of the American Oil Burners Association of New York City.

'24—John W. Wagner and Orpha Saxon of Worthington, Minnesota, were married recently. They are living in Flint, Michigan, where Mr. Wagner is foreman of the final Inspection Department of the speedometer division of the A. C. Spark Plug company.

'25—Vern Lindquist is in Minneapolis working for the Northern Pump company as testing and research engineer.

Miners

'05—The following item, concerning the death of W. C. Cadwell, was taken from The Anode, the official organ of the Anaconda Copper Mining company:

"W. C. Cadwell, prominent resident of Anaconda for the past 20 years, died at St. Ann's hospital on Thursday, February 11, following a brief illness of bronchial pneumonia.

"Mr. Calwell was born at LeSueur, Minnesota, in 1879. He attended the schools of that city and later, the University of Minnesota. He entered the service of the Anaconda Copper Mining company in the Engineering Department in 1905. Through his efficient and faithful services he was promoted to the rank of superintendent of the Surface Department in 1911, which position he held at the time of his death.

"He was held in the highest esteem by all of his associates, and his loss is mourned by friends in all walks of life."

'24—Donald Brunner, a former member of the varsity swimming squad, has been spending a short vacation in the Twin Cities. For the past three years he has been doing mining work in Idaho.

HOW many of us have a misconception of the true meaning of art, how mistaken are we when we associate this seemingly effiminate word with things relegated to the institute or conservatory. Last week, the editor spent a most pleasant two hours with a well-known artist, incidentally a member of the university teaching staff. He wore no flowing tie, gone was the customary smock and unclipped hair. Sensibly attired and still more sensibly minded, he took off his coat, rolled up his sleeves, I following his example as the afternoon was warm. Thus he spoke:

"Art is the moving spirit of everything, the desire to create that which is beautiful. In the innermost being of everyone, this spirit exists and it is an essential movement in the welfare of the world. If all was art, there would be no wars, for is not art the power to erect, to build, to make something of beauty, and are not these things the opposite of strife? In simpler words, art is a paid up insurance policy. Greece, the Gothic countries, France—all once in splendor, though now in ruins, give to the world a message of the former highlights of civilization, a thing which the tourist now travels across oceans to see. Art is an investment in the welfare of a nation, the returns of which come later. It is a guarantee from war and the mark of a happy and successful people."

I had never heard these practical views expressed before and new thoughts went surging through my mind. At that instant we were looking out upon the great industrial district of southeast Minneapolis with its maze of trackage, factories and puffing trains.

"Stolid elevators of cold concrete," he continued, "seem to the ordinary person only lifeless masses of mortar—but yet they are useful, they store food for man, and because they are utilitarian, they are artistic. Art is not art unless it is constructive and used to further the progress of the race. There is something symbolic in these towering heights of concrete, in their rows of rotund shapes lies an evident message of security. In the midst of teeming industry exist things of beauty, industry is an art in itself.

"Everyone can become an artist. The bricklayer if he has studied the profession in all its details and by daily observance adds skill until he is doing his best, then becomes an artist. A janitor can so master the elements of his calling that he can be an artistic servant. Not only in luxurious conservatories, hung with purple, do exist those known by the cognomen 'artist.' All the world's a studio and its habitants, rich or poor, in every walk of life, can help in painting the great human picture in an artistic fashion."

The janitor was cleaning up the studio outside. I had never noticed the painstaking care with which he wielded his mop. Outside an ordinary painter was working. How carefully did his three inch brush glide over the weather-stained woodwork. Yes, he too, was an artist.

"Art can be made a recreation. A business man, coming home tired from office, does not realize that if he will turn his mind to that different from the affairs of the day, something which will require such concentration that all will be forgotten in the pursuit of this new study—art—then will he have complete recreation, an equilibrium having been established. The placing of these two different factors in opposition brings a balance—a condition essential to all.

"To paint or sculpture requires extreme concentration and at the end of the long hours necessary before the project is finished, the artist is so fatigued that he must play hard to make up for the time of work. That he may do this, he must play hard. Folks of the outside world never see artists except when at play and erroneously form their opinions. The life of an artist is hard, perhaps that is how he found the secret of happy existence, the introduction of strenuous recreation.

"Art is practical, on every side of us it exists, the spirit that moves humanity. It is religion itself and best of all commonplace and useful."

One embryo journalist had many thoughts for reflection as he betook his way earthward at the conclusion of that little chat with an artist, a practical one.

THERE has been apparent for a long time in the technical colleges the need of a senior society whose purposes were the furthering of student interests and the general welfare of the college. This was realized simultaneously by many students at various times and the long dreamed of organization recently became a reality with the establishment of Plumb Bob.

Plumb Bob is composed of senior men. Its purpose is to promulgate the closest cooperation between faculty and student in every question, to sponsor such activities that are for the betterment of the school and to create such a spirit of loyalty within the technical colleges as will be reflected in the advancement of the university at large. It does not seek publicity for itself. Members of Plumb Bob are not made known until the end of their senior year. Working unseen, yet firmly in touch with every movement for good, future wearers of the silver emblem silently do their bit for a better college.

The symbol of membership itself is significant. A plumb bob is one of the earliest instruments used in engineering.

There are many honors that come to a student—scholastic, athletic and otherwise. However, there is not one that carries more significance than the election to this fraternity. Being chosen implies besides the qualifications of scholarship and moral integrity, an association with the college itself. When all other honors and memories become trivial, the society of Plumb Bob will yet remain.

The new members are to be commended. To those who assume the responsibilities of carrying the society forward go our words of encouragement. There is much to be done and we know that Plumb Bob, honor fraternity of men in the technical colleges, will do it.

Across the Editor's Desk

Cap and Gown Day

Originally, Cap and Gown Day was looked forward to with much expectation and conjecture, for then the names of the students elected to membership in the various honor societies were announced. Prior to this convocation, nothing was known outside of the circle of the organization as to whom the honors had been bestowed upon. As a result, the chapel was crowded and the campus agog with interest.

Today, the same announcements are made and with the exception of Phi Beta Kappa, the awards have long since been known to the student body. Scholarship does not today carry the meaning when the first day came into being. The student body now looks to the honor man or woman as the inevitable result of having been built that way. There is little striving among students for these honors. When they do not draw recognition for being exceptional, they justify themselves by assuming that they were not made for it and could not help it if they tried.

Academic costume is not worn as it used to be. Seniors donned the garb daily after the exercises of the day and wore it continually until graduation. Now it is put on for a short hour or two, grudgingly, then dropped. Maybe if it were looked upon as then, the underclassman would consider the time when he, too, could rightfully flout before the world his robes of learning and in anticipation, incidentally better his scholastic standing.

A Flagpole

The engineering quadrangle is fast being enclosed. The electrical building is in place and the new highway testing laboratory is nearing completion. Soon it will become necessary to provide quarters for the department of mechanical engineering, for the auditorium will occupy the position of the present structure.

The seniors this year in anticipation of the need of a center for this rectangle have provided a fund for the purchase and erection of a steel flag pole with a decorative base which will grace the engineering lawns in the future. This will indeed be a center around which to build, a point from which will radiate engineering spirit. The flag which it will fly represents union and strength, a worthy symbol of the united efforts of the seniors who raised it.

In the future it will be as a representative of the class of '26, a tangible object left behind by those who have gone out to parts unknown, a something to substantiate memories that grow dim.

For the Frosh

Next fall, a new institution will begin to function on this campus. The incoming freshman is to be given a week of intensified orientation—an introduction to the university in a well arranged manner and its way of doing things, as well as an insight into the scope of the various courses offered. The program for the week will include inspection trips, lectures by men of note on and off the campus and talks by members of the upper classes. Would not this also be a good time to instill a little of college traditions and incidentally create a few new ones? As it is, the freshman is put on his own. No one pays much attention to him except to smile at his half scared actions. He acquires from this treatment a peculiar sense of propriety and the rights of others and the results are far from satisfactory to all who are affected.

Some universities have sophomore rule, where the frosh wears a little green cap the year around and is administered to with a paddle when his actions are not satisfactory to the upperclassmen. Let's not go to that extreme, but above all things teach him to be considerate of others.

Another Triumph

No one can deny the fact that this year's Engineer's Day was the most successful one ever held. We who last year labored, do now take off our hats to the juniors. Though a late start was made, all of the plans worked out well, the parade was good, so was the open house, the Green tea and also the "Brawl." After the splurge of activity, the college and the committees have settled down again to routine. Springing forth from an otherwise studious body, engineers came forth and startled the campus. The many evidences of talent shown in the preparation and execution is indicative of the versatile ability lying unseen in Minnesota's engineering student body. Had the Arabs again presented their annual production, then the spring would have been complete.

FACULTY SKETCHES

William R. Appleby

THE subject of this sketch, William R. Appleby, dean of the School of Mines and director of the Mines Experiment Station at the University of Minnesota, believes in personal contact with his students. There is not a graduate who does not boast an intimate friendship with his dean, perhaps it is this bit of good fellowship that has helped to make successful men, for Minnesota's School of Mines has a reputation, bounded only by the limits of the earth.

William R. Appleby, the son of J. Charles and Julia M. (Curtis) Appleby, was born in Hoboken, New Jersey, on February 11, 1865. After receiving his preparatory education, young William set forth into the world and very appropriately entered Williams College, from which he received his B. A. degree in 1886. He then attended the Columbia School of Mines as a graduate student during the years 1886-1887. Appleby later received his master's degree from Williams in 1893. Two years after graduation from Columbia he was married to Elizabeth Y. Waller, said happy event occurring on November 21, 1889.

His first employment was with Picketts and Banks of New York as an analytical chemist. Continuing his work in this branch of science, he was next an assistant analytical and pharmaceutical chemist at the New York College of Pharmacy. The superintendency of the New York Milling and Testing works marked the year of 1890, while the next advancement was the affiliation with the Frazer and Chalmers Mining Machinery company. It was in 1891 that Appleby came to the University of Minnesota, a professor of mining and metallurgy and in 1890 was made the dean of the school.

Appleby's subsequent life has been so closely related with the developments of this school and experiment station that when mention is made of them, it is but a list of his achievements.

Beginning in 1892 with one empty room and two students, the School of Mines has continually prospered until it now occupies two fully equipped buildings on the main campus. These achievements may be summarized as follows:

The building and equipping of the original ore works located on the river bank, which site is now partly occupied by the new experiment station. The starting of practical field work classes. For many years, this was the only department where practical field work, conducted at commercially operated plants, was required in order to complete courses leading to a degree. The building of the first School of Mines on the site where the University High School is now located. The establishment of the Mines Experiment Station in 1911 for the purpose of assisting the development of mining interests in the state. Arrangement of a cooperative agreement between the University of Minnesota and the State Tax Commission whereby the School acts as consulting engineer for the commission. This work started in 1909. Building of the present School of Mines, located on Pleasant avenue, which replaced the old building destroyed by fire in 1913. Adding courses in metallurgy in 1915, which are also of value to the engineering student and the practical metal worker. Locating of the northwest branch of the U. S. Bureau of Mines at Minnesota and establishing a cooperative agreement referring to technical work and problems in mining.

Dean Appleby's professional and social affiliations are many. He is a member of Kappa Alpha fraternity. Among the honorary and technical societies of which he is a member, are American Institute of Mining and Metallurgical Engineers, American Chemical Society, Society of Chemical Industry, Institute of Mining and Metallurgy, London, Mining and Metallurgical Society of America, North of England Institute of Mining and Mechanical Engineers, New Castle-upon-Tyne, England. He was a juror of Awards in the division of mining and metallurgy at the Panama-Pacific Exposition in 1915. Last but not least, his name is found on the rolls of the Minneapolis Club, The Minneapolis Auto, Athletic and Golf Clubs and the Kitchi Gammi Club of Duluth.

Honor

Many technical students are included in the annual announcement of prizes, awards and elections to scholastic fraternities.

THE annual announcement on Cap and Gown Day of the scholars who have been honored for scholastic achievement brings from the student body many diverse opinions on the value of such honors, especially as to how accurately they predict the future success in life of the ones so honored.

There is the one viewpoint which pessimistically predicts that they will find their college honors a handicap, and points with a great deal of satisfaction to the failure of a man with a key or the success of a consistent flunker.

Another maintains that success in life necessarily follows from success in college.

Unquestionably the problems of life are vastly different from the problems of mathematics. And although college is only a means to an end, only a preparation for the serious conflicts of life, we may justly applaud those who have done better than average even in the temporary college atmosphere.

And having applauded, we are moved to work harder ourselves, either in college if we are freshmen, or in the larger material world if we are seniors.

Of the 1100 odd students in the technical schools the following have received recognition this year for meritorious achievement in both curricular and extra-curricular activities.

Architectural Awards

The Moorman prize has been awarded to Gus Naslund.

The Minnesota chapter of the American Institute of Architects' annual awards have been given to Oswald Stageberg and Robert Kranzfelder.

The prizes offered by the School of Architecture faculty have been given to Lawrence B. Anderson and Kenneth A. Backstrom.

The Magney and Tusler prizes have been awarded to Gus Naslund and Lawrence B. Anderson.

The Scarab medal was awarded to Lester Cameron.

The American Institute of Architects' medal has been awarded to Gerald Kronick.

Chi Epsilon

New members of Chi Epsilon, honorary civil engineering fraternity are: Kenneth M. Clark, Frank R. Lundsten, John C. Marcroft, and Joseph B. Paulson.

Dupont Fellowship

The Dupont Fellowship in Chemistry has been given to Irvine Lavine.

Eta Kappa Nu

Spring elections to Eta Kappa Nu, honorary electrical engineering fraternity, include these men: Lloyd V. Berkner, Edward L. Bottemiller, Charles H. Burmeister, Robert F. Edgar, Albert C. Lee, and Barrett H. Rogers.

Grey Friars

Grey Friars, senior men's organization, includes in its membership George Bohannon.

Iota Sigma Pi

Iota Sigma Pi, honorary chemical sorority has elected: Gertrude Humphrey, Myrtle Hundley, Lucile Horton, Alice Rupp.

Iron Wedge

New members of Iron Wedge, senior men's organization are: Clifford Anderson, Conrad Cooper, Percy Flaaten, George Mork, and Harry Doran.

Plumb Bob

Plumb Bob, an honorary fraternity in the College of Engineering and Architecture and the School of Chemistry, recently announced the selection of 15 men from the senior class. Election to this fraternity is based upon service to the university at large with particular reference to the technical colleges. Leadership, initiative, personality as well as scholarship were considered in the choosing of these representative seniors. Plumb Bob has as its motto the betterment of student interests and spirit and is noncompetitive with other organizations of similar nature, but of a campus-wide scope.

A large plumb bob swinging in the main engineering building announced the election and a plaque on the wall carried the following names:

Clifford H. Anderson, George W. Bohannon, Ray L. Christen, Percy H. Flaaten, Paul C. Fenton, Kenneth W. Foster, Franklin J. Halbkat, Barton Juell, Raymond R. Kelly, Carl R. Liese, Clyde W. Lighter, Geo. W. Mork, Paul B. Nelson, Raymond F. Rasey, Edward F. Young.

Phi Lambda Upsilon

New members of Phil Lambda Upsilon, honorary chemical society, are: Ralph E. Montonna, M. Cannon Sneed, Harry N. Stephens, Ralph E. Beard, A. G. Mulder, Conrad Sunde, Irving Levine, Waldo Johnson, Lew W. Cornell, Kurt W. Franke, Anton Hogstad, Carl G. Vinson, George Dysterheft, Robert Light, J. Howard Arnold, and Stephen Easter.

The Phi Lambda Upsilon sophomore prize was awarded to Clifford Thor.

Silver Spur

Silver Spur, honorary junior men's society, announces the following members: Stuart L. Bailey, John E. Hoving, and Roger B. Wheeler.

Pi Tau Sigma

Pi Tau Sigma, honorary fraternity in mechanical engineering, elected the following men: Ralph B. Evans, Harold J. Lamon, and Dimon A. Roberts.

Sigma Xi

Sigma Xi, honorary research fraternity, announces awards to the following men: Donald O. Nelson, F. E. Nichol, Loren H. Shirk, Lloyd E. Swearingen, George F. Corcoran, Walter P. Covell, and John W. Pagnucco.

Studebaker Scholarship

Lawrence O'Donnell, a senior mechanical, was awarded the scholarship given by the University of California through the generosity of the Studebaker Corporation. It is of two years duration and deals with problems of transportation.

Student Society Prizes

No prizes were given out this year by the A. S. M. E. or the A. S. C. E. as the required number of papers were not turned in. Barton Juell and Edward Gould received honorable mention.

Tau Beta Pi

Members elected to Tau Beta Pi, honorary technical scholastic fraternity are: J. H. Arnold, Stuart L. Bailey, Kenneth A. Backstrom, Alvah S. Bull, Albert A. Cooper, Bertram K. Hovey, Theophil E. Jerabek, Carl F. Luethi, Loren F. Pohl, Fred C. Teske, Jr., Richard R. Trexler, and Hugh L. Turritin.

Architects

Tau Sigma Delta

Tau Sigma Delta, honorary architectural fraternity, has two new members: A. S. Bull and Kenneth A. Backstrom.

All University Council

Russel Sorenson was elected All-University Council representative of the technical campus for the coming year.

A. S. C. E.

Officers of the student branch of the A. S. C. E. are E. O. Pearson, president, C. K. Prens, vice-president, John Hoving, secretary, and Kenneth Johnson, treasurer.

A. S. M. E.

The last get-together of the year for the mechanical students was held in the Minnesota Union May 20. New officers of the student branch of the A. S. M. E. were elected at that time. George Vye was chosen president. Other officers are Harold Lamon, vice president; Norman Boyce, secretary, and Boyd Spencer, treasurer. Entertainment was provided by an orchestra composed of students of the department. Prof. C. F. Shoop gave an exhibition of card tricks and black magic.

Bookstore Board

The new Board of Directors of the Engineers' bookstore is composed of Kenneth Backstrom, John Hoving, Edgar G. Anderson, Clyde Webber, Albert A. Cooper.

Publications Board

Stanley Bull will represent the technical schools on the Board in control of student publications. He has also been elected president of the board.

Chemistry in the Motion Picture Industry

(Continued from page 251)

the emulsion. If a piece of exposed and developed motion picture film is examined under a high power microscope, the image will be found to be composed of minute grains or clumps of metallic silver, resembling tiny masses of coke. These grains are derived from the original grains of the emulsion, which under the microscope are found to be crystals varying in shape from spheres to triangular or hexagonal plates in the larger grains (Figures 3 and 4). They are of all sizes from very small grains to quite large ones and the properties of the photographic emulsion depend largely upon the various sizes which are present.

One part of this comprehensive plan of research has been the determination of the systematic relations which exist between the methods employed in the preparation of the emulsion and the photographic properties of the material obtained. That such relationships exist is now definitely established and before many years have passed a fairly complete understanding of these will have been arrived at.

One phase of this investigation has been the direct microscopic study of the grains in thousands of different samples of emulsions. This type of research is exceedingly tedious and progresses very slowly, but it has proven one of the best lines of attack on the problem. It will not be possible to fully describe the method, but some idea of its complexity may be gained from the following statement. The emulsion sample is coated as a layer only one tiny grain in thickness by a scheme requiring a high degree of skill. A minute area of this layer is then photographed so as to enlarge it 10,000 diameters. The grains are next measured, classified according to size and from the results of hundreds of thousands of such measurements, a tentative conclusion may be drawn. This is essentially a statistical method of attacking the problem.

The chemistry of gelatin has also come in for a thorough study. That this is well worth while was forcibly proven by the recent discovery of a group of chemical substances which must be present in samples of gelatin even though in very small amounts in order that the gelatin be useful for making photographic emulsions.

These great problems of the chemistry of the preparation of the sensitive materials are only one part of the entire problem; the other is the use of the photographic materials. The faithfulness with which the final print reproduces the different tone gradations of the subject under various light conditions is known as the problem of tone reproduction. It may be reasonably said that this problem is fully solved and a statement of the accuracy of the reproduction of the tone gradations of any subject is now possible on any photographic material under any given condition of illumination.

Color Sensitivity of Movie Films

When a beam of white light (usually sunlight) is passed through a prism it spreads out into a multi-colored band called the visible spectrum. The normal eye can distinguish several prominent hues in this spectrum, violet at one end, then blue, green, yellow, orange, and red. If this colored spectrum is photographed upon ordinary film, only the violet and blue would be completely recorded and the green very slightly while the yellow and red would have scarcely any effect at all. A red object, therefore, which appears relatively bright to the eye photographs as black, whereas blue and violet objects photograph as white. The result is a false reproduction of almost the entire range of color tones. The chemist was responsible for making photographic emulsions sensitive to colors. It was found that on adding certain dyes called sensitizing dyes the sensitiveness of the emulsion to green and yellow was increased. Such emulsions are called orthochromatic emulsions. Negative motion picture film is of this type but is relatively insensitive to red light and may be handled safely in darkrooms lighted with red safelights. It is manufactured in two speeds, par-speed and super-speed film; the latter being about twice as sensitive as the former. Within the past 20 years other sensitizing dyes have been discovered which on incorporation in emulsions made them sensitive to the entire spectrum. An emulsion of this type is known as a panchromatic emulsion. Natural color photography has been made possible by the chemist's discovery of these dye substances and their use in the manufacture of panchromatic film. Such pictures as Douglas Fairbank's "Black Pirate" could never have been produced without panchromatic film.

Although panchromatic motion picture film is strongly sensitive to red, yellow and green, it remains more sensitive to blue and violet especially when photographing by daylight. To correct for this extra sensitiveness to the blue and violet, color filters are used before the lens. These filters consist of thin sheets of dyed gelatin cemented between two pieces of optical glass. The dyes are carefully selected with reference to the portions of the spectrum which they transmit and absorb. For example, a yellow filter is most commonly used with panchromatic film since this filter absorbs a definite portion of the violet and blue light to which the emulsion is most sensitive, thereby equalizing the exposure for all the colors. The result is a more accurate rendering of the tones of the subject.

When exposed to daylight or arc lamps, Eastman Panchromatic Negative Film is about equal in speed to Eastman Negative Film, regular speed. With tungsten lamps, it is considerably faster than standard speed negative film. Because of its excellent keeping qualities and its accurate rendering of tone values, panchromatic film is now being used extensively for both portraiture and landscape work.

Panchromatic film can be supersensitized by bathing for 1½ minutes in 4 per cent ammonia at 50 deg. F., and drying as rapidly as possible. When given this treatment, the film is known as hypersensitized film and is about as fast as super-speed negative film for daylight work. It should be used as soon as possible after hypersensitizing, but it necessary to store for a week or so, it should be kept dry and at a temperature not higher than 50 deg. F. The red and green sensitiveness of the film is increased three or four times by this hypersensitizing treatment which is a great advantage if exposures through red filters are to be made.

By the use of appropriate filters and treatment with certain sensitizing dye solutions, panchromatic film finds important applications for making "night scenes" in the daytime, and for making distant shots through haze. It may also be used for making duplicate negatives from positives on tinted base when no other print is available. Colored spots and stains can be eliminated by duplicating in this way.

More complete information regarding panchromatic film is given in the booklet, "Eastman Panchromatic Negative Film for Motion Pictures," supplied on application to the Motion Picture Film Department, Eastman Kodak Company, Rochester, N. Y.

Chemistry of Processing Film

After manufacture, motion picture film has little contact with chemistry until it has been exposed and is ready to be processed. The various treatments which it then receives, such as development, rinsing, fixation, washing, and drying are all chemical and determine in large measure the future permanency of the film. Besides the action of the different solutions in processing the film, there is considerable chemistry involved

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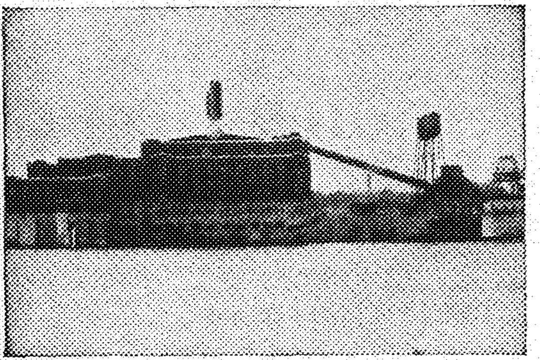
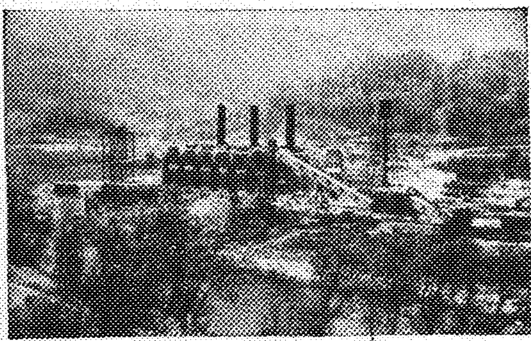
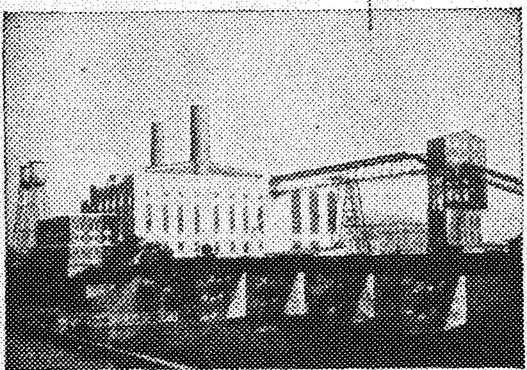
Three Unusual Public Servants







Sargent and Lundy Engineers of these Power Stations

These public utility power stations, constructed by The Foundation Company, are now contributing to the welfare of the communities they serve.

The Power Station of the Columbia Power Company, near Cincinnati, Ohio, contains the latest developments in steam and electrical generation. It has a present capacity of 120,000 H.P. which will be ultimately increased to 480,000 H.P. Ground was broken February 14, 1924, and power was generated December 10, 1925,—such the record for construction.

In the heart of the Kentucky coal fields a steam power plant has been constructed, designed to utilize fuel near its source and transmit electrical energy to nearby industrial centers, including the mines from which the fuel is taken. This $3,500,000 station of the Kentucky Utilities Company, near Pineville, Kentucky, is a link in a chain of super-power stations in this region.

At Philo, on the Muskingum River in Ohio, is situated a power plant of the Ohio Power Company which has become noted for its economical operation. Located where a navigation dam makes a considerable difference in level in the river, water for condensing is taken above and discharged below the dam without pumping. Unusual efficiency is obtained with the most modern fuel handling machinery in both wet and dry storage.

Power plant construction is a specialty of this organization.

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ATLANTA	SAN FRANCISCO	MEXICO CITY	LONDON, ENGLAND
PITTSBURGH	LOS ANGELES	LIMA, PERU	BRUSSELS, BELGIUM
CHICAGO	MONTREAL, CANADA	CARTAGENA, COLOMBIA	TOKYO, JAPAN

BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

The Use of Iodides in Water Supplies

(*Continued from page 254*)

and able to furnish a sufficient quantity to the child. Second, that there are adequate quantities of iodides in the foods chosen by certain families or individuals. Third, the lack of excessive demands on the thyroid gland, which, if occurring at certain periods of life, may upset the balance which the iodide content in the thyroid had previously maintained.

Some have raised the question as to whether careful thyroid surveys should not be made before attempting the solution of this problem. Thyroid surveys are desirable and have been made in certain localities. This is a very slow procedure, however, demanding a skilled technique not possessed by many physicians who are not intimately familiar with the disease, and also entails a major problem of public health administration with the attendant heavy expense.

In 1924, Surgeons Olesen and Clark, of the U. S. Public Health Service, made a thyroid survey of 4,000 children in 13 localities in the state of Minnesota. They reported that 41 per cent of the boys and 71 per cent of the girls examined had some degree of thyroid enlargement and stated, "The results of the thyroid survey in Minnesota plainly indicate a considerable prevalence of endemic thyroid enlargement among the school children of the communities studied. *With so decided an amount of thyroid enlargement, there would appear to be ample incentive for the responsible authorities to institute iodine prophylaxis.*"

Successful experiments with animals naturally suggest that simple goiter might be prevented in human beings by similar methods.

There was a feeling of relief among water works men when it was found that the water supply was not wholly to blame, but there was still the question as to whether we might be able to do something to help correct the situation. Any opportunity to serve in the cause of public health could not be overlooked.

Since it is evident that an iodide deficiency exists in some localities, the question arises as to how the deficiency can be made up. Two methods may be suggested. First, let every one adopt such measures as they may think best. Second, control the amount of iodides in foods or water.

Simple goiter is a peculiar disease in that it is non-contagious and non-infectious and does not cause serious pain or inconvenience in its early stages. Since our health departments have the constant problem of trying to keep the interest of new generations of the public aroused about contagious diseases to the pitch where they will realize the danger, it seems apparent that the education of the public to care for themselves in the case of this non-contagious deficiency disease is wholly impractical.

It is evident then that the method of controlling the amount of iodides in foods or water is the only logical one.

The control of various elements entering into our diet is by no means a new proposal, in fact it is widely accepted as being necessary. Most laymen understand that scurvy and certain other diseases are caused by an unbalanced diet and that calcium phosphate is often given to children to prevent rickets, and that iron is used to combat anemia. In fact, changes in the diet suggested by a physician are usually for the purpose of adding to the individual's diet certain elements not previously obtained in their food.

Any method chosen should—

1. Reach at all times those who need it.
2. Be simple as to application.
3. Be within reasonable expense.
4. Not involve complicated problems of public health administration.
5. Be immediately available.

The use of the following have been proposed as methods to make up for iodide deficiencies:

1. Sea salt.
2. Sea foods.
3. Iodide tablets.
4. Iodized table salt.
5. Iodization of public water supplies.

Sea salt does not contain iodides, because as the sea water is evaporated the sodium chloride (commonly known as salt) crystallizes out, but the iodides remain in solution in the mother liquor. Sea foods, if used for their iodide content, must be chosen with discrimination, because many of them are relatively low in iodides as compared with vegetables, milk, etc., in zones having ample iodides. Sea foods are, moreover, expensive and not readily obtainable where simple goiter is most prevalent.

The use of iodide tablets, as for instance in public schools, is very expensive, involves a definite problem of public health administration and does not reach the child of pre-school age or the expectant mother.

Iodized table salt is now readily obtainable and costs little, if any, more than the uniodized salt. This is a very interesting method, but cannot be considered thoroughly satisfactory until certain objections are overcome. It has been found that iodine volatilizes from the salt, with the result that manufacturers add a much larger amount than would otherwise be necessary. This, of course, introduces a factor of uncertainty as to the amount of iodides which will reach the consumer. Then, too, the writer has observed that some such salts darken on standing in a glass shaker, which would operate to lessen confidence in its use by the public. It has also been reported that in their eagerness to secure the desired iodides some people use excessive quantities of salt, which may be harmful in many cases. Should it be possible to provide a suitable iodized table salt it would be necessary to have an agreement reached by all manufacturers to maintain a certain minimum quantity of iodide in it and probably municipal, state or national legislation along this line would be necessary. This, of course, would require proper checking of the product by health authorities.

Iodization of public water supplies has an apparent shortcoming because it reaches only those who use the supply in question, but in the case of any one city it meets all the requirements for a suitable method as outlined above. It assures an adequate quantity of iodides under proper supervision at all times and eliminates any special problem of public health administration. It is reasonable in cost and has the particular advantage in that it is immediately available.

It is for these reasons that it has been recommended for the city of Minneapolis by the writer. If at some future time a simpler method can be devised to reach the population of the whole state or of the nation, such a method would be superior to the one suggested and should be adopted, but there would have been everything to gain and nothing to lose by the iodization of the water supply and protection to the public would have been given in the meantime more certainly and quickly than by any other method.

Dr. F. E. Harrington, Commissioner of Public Health and Director of School Hygiene of Minneapolis, states that there are about 20 deaths per year from preventable goiter and that because of loss of time from work, decreased efficiency at work and in school, cost of medical service, disfigurement, etc., the prevention of simple goiter is a matter of vital importance to this city, and he strongly urges the use of iodides in the public water supply.

It being advisable to use iodides in the water supply, the questions then arise as to the quantity necessary to give protection and the possible danger that some may be harmed by the quantities used.

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Chemistry in the Motion Picture Industry

(Continued from page 264)

in the actual mixing of the solutions and in the action of the liquids on the vessels or tanks used for containing them.

Too little thought is usually given to the preparation of solutions used in photography. We are apt to be satisfied to dump the chemicals into the water, stir the bath casually and proceed with the more important business of processing the films. Conversely it is true that it is unnecessary to take too great precautions and waste too much time in mixing the solutions, but more care should be exercised than is usually given.

Although distilled water or rain water are to be preferred for mixing solutions, experience has shown that it is only rarely that tap water which usually contains dissolved salts cannot be used. Providing the solution is filtered through a canvas cloth or allowed to settle before drawing off for use, very little trouble need be anticipated. The important thing is, however, to use only pure chemicals, dissolve each separately before adding the next, always mix them in the order recommended, agitate the entire volume of solution thoroughly as each constituent is poured in, and finally make up the solution to a definite volume with cold water. Hydrometer measurements are best avoided in mixing solutions (unless it is impossible to keep the chemicals dry), because it takes considerable time to adjust the strength of the solution. Hydrometer readings also vary with the temperature and no idea is conveyed as to the percentage strength.

A good arrangement for mixing the solutions is to place the chemical room directly above the developing room. Wax impregnated wooden tanks, enameled vats or smoothly glazed earthenware crocks are recommended as containers connected with chemical lead piping to convey the solutions to the developing and fixing tanks in the room below.

Further details may be found by consulting the chapter on "Preparing Solutions" in the booklet "Elementary Photographic Chemistry" published by Eastman Kodak Company. See also "The Development of Motion Picture Film" by J. I. Crabtree, Trans. Soc. M. P. Eng. No. 16, p. 162 (1922).

Developers and Development

The purpose of a developing solution is to change the exposed silver salt in the emulsion to metallic silver without affecting the unexposed silver salts. The constituent of the developer which accomplishes this change is called the reducing agent. The reducing agents now generally employed are elon, hydroquinone, pyro, and glycin. These substances are ineffective as developing agents until the solutions are made alkaline, usually with sodium carbonate, which activates the reducing agent, but in the presence of the oxygen of the air the

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The Use of Iodides in Water Supplies

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The cities of Rochester, N. Y., Sault Ste. Marie, Mich., and Virginia, Minn., are the only cities known at this time to be using iodides in water supplies. It is possible that there are others who are using it but have not made the matter public. It may take several years in any given locality before definite results can be shown, and while encouraging reports have come from Rochester, N. Y., it is considered too early to draw definite conclusions.

Dr. McClendon states that a water supply typical of a region having ample iodides contains about 5.0 parts per billion of iodine. The Minneapolis water supply is taken from the Mississippi River and purified in a modern filtration plant. This water contains about 0.8 of 1 part per billion of iodine. Since the deficiency in the water supply is but an index of the deficiency in foods, it is considered advisable to bring the iodides in the water supply up to 10 parts per billion, and for this purpose it is proposed to use 1/10 of 1 pound of sodium iodide per million gallons of water. It should be said that the addition of sodium iodide to a water supply will in no way change its taste or appearance or affect its value for domestic or industrial uses. The writer has drunk water containing one thousand times the amount of sodium iodide proposed without being able to detect any slightest change in the taste of the water.

The cost involved is surprisingly small. Sodium iodide is quoted for delivery in Minneapolis at $3.75 per pound. Based on the water consumption of last year and including all possible charges for equipment, overhead, etc., the cost to the city would be about $6,500, or about 1½ cents per person per year.

It is probable that from the strictly economic viewpoint this sum would be saved many times over each year by the prevention of loss of employment, cost of medical service and added expense in our school system due to retarded pupils having to repeat courses.

It is certain that if any one of the half dozen common contagious diseases could be eliminated or even controlled for several times this amount the public would heartily approve the expenditure of the necessary money.

The question as to the possible harm to those who do not have or would not have simple goiter is one that has been given serious consideration. Records referred to previously show that there are millions of people in this country living in zones where they have in their foods and water from 5 to 10 times as much iodide as is necessary to prevent simple goiter. It has not been until recent years that scientists have proved that such minute quantities of any element could have such far-reaching results. Sufficient data is at hand to show that quantities of iodides many times in excess of that necessary to prevent simple goiter may be used without the slightest harm. Dr. McClendon reports that two public water supplies in California have 8,000 and 10,000 times as much iodides in them as is contained in the Lake Superior water at Duluth, Minnesota.

It is also evident that a person accustomed to the minimum quantities is not harmed by suddenly being given such small quantities as are proposed for Minneapolis, because people are moving constantly from one zone to another and there is no case on record where any slightest harm has been done in the case of a person moving from a low iodide zone to an extremely high one.

It is of interest to know what water works men think of this matter. It has been discussed in two of the conventions of the American Water Works Association, and a committee instructed to study this matter thoroughly has reported unanimously favorable to the iodization of public water supplies and has published its report in a chapter of the "Manual of Water Works Practice" issued during the past year.

Opposition to this or any other proposed public health measure may be expected. The Christian Scientists, who should also logically oppose all processes of water purification cannot be expected to support it. Neither can those adhering to the doctrines of such organizations as the American Medical Liberty League, whose literature asserts that the chlorination of water is unnecessary; that typhoid fever is not caused by the typhosus bacillus, and that all serums and inoculations are frauds. There are, of course, many "antis" in the realm of preventive public health just as there are in connection with social, political, religious or economic questions. It may be stated, however, that those who after careful study deliberately oppose this proposal are largely those who very logically oppose many or most of the fundamental principles now in general and accepted use in the administration of our municipal health departments, with which most of us are in hearty accord.

It is hoped that those interested will study this subject thoroughly and adopt the proposed plan as rapidly as they become convinced that the cause of public health will be benefited by the use of iodides in the water supply.

It is suggested that the interest of such as public health associations, mothers' clubs, parent-teachers associations, etc., be gained in order that they may help bring to the attention of the proper authorities the fact that there is a definite demand for the eradication of preventable simple goiter.

The contributions made by Minnesota men in clarifying this subject are particularly noteworthy. Among them have been mentioned Dr. Kendall of the Mayo Clinic; Dr. Robertson, also of the Mayo Clinic, whose paper is quoted above; and particularly Dr. McClendon, who is recognized by all students of the subject to be the leading authority of the country on the iodide content of water and foods. The writer wishes to make especial acknowledgment of the kindness of Dr. J. F. McClendon, with whom he has advised frequently on this subject during the past two years, and who has made valuable suggestions regarding this paper.

In this discussion it has not been possible to refer in detail to the large volume of particularly valuable literature on this subject. It records the story of a long and glorious quest in which many pioneers have left blazed trails. Even though the last word has not been written, the goal is surely in sight.

A list of references is here given:

Journal, American Water Works Association, Vol. 9, No. 1, Jan. 1922, p. 46.

Journal, American Water Works Association, Vol. 10, No. 4, July, 1923, Association, Vol. 12, No. 1, Sept., 1924, p. 68.

The Prevention of Simple Goiter—Marine, Lenhart, Kimball and Rogoff, Western Reserve University Bulletin.

The Prevention of Simple Goiter—Dr. O. P. Kimball, Amer. Jour. of Public Health, Vol. 13, No. 2, Feb., 1923.

Simple Goiter as a Result of Iodin Deficiency—McClendon & Williams, Jour. A. M. A., Vol. 80, Mar. 3, 1923, p. 600.

The Determination of Iodine in Food, Drink and Excreta—J. F. McClendon, Jol. Biological Chemistry, Vol. 60, No. 2, June, 1924, p. 289.

Iodine Metabolism on Normal Diet in Prevention of Goitre—McClendon & Hathaway, Proc. of the Soc. for Exp. Biology and Medicine, Vol. 21, 1923, p. 129.

Please Pass the Iodine—Dr. Woods Hutchinson, The Saturday Evening Post, Jan. 3, 1925, p. 22.

The Manual of Water Works Practice, p. 268. Williams & Wilkins Co., Baltimore, Md.

Electric Refrigeration

(*Continued from page 255*)

method has proved very valuable in that it builds up confidence and is a good guarantee to new buyers.

Electric service in the American home has made possible many conveniences of living and as a result a demand for electrical refrigeration has been felt for some time. Various machines have been developed so that today it is possible to install an electric refrigerating unit in any good refrigerator and to turn over the care of preserving foods to electric service. The last year has seen the electric refrigeration industry pass the experimental stage and it is now on a definite basis.

There are in the United States:
14,538,000 electric-lighted homes.
19,400,000 iced refrigerators.
150,000 electric refrigerators.

It may be observed that the market has just been touched. Estimates place the 1925 output at 250,000 machines, or over twice the number in use at the first of the year.

Close to 500 electric refrigerating companies have sprung up in a short period. It is probable that many cannot continue for lack of sufficient financial backing and because they are not entirely practical. At the present time nearly two-thirds of the capital invested is held by five companies. Eventually it is likely the field will be limited to 10 or 12 companies, for that is about all the competition the present field will bear. The smaller manufacturers will merge their product, or the more practical of them will be bought up and their inventions financed by the larger companies. The idea of electric refrigeration is being sold to the consumer just as their other electrical conveniences have been. The problem now is to manufacture the product in large enough quantities to fill the demand and at a low enough cost to be within reach of the moderate purse. When these points have been achieved, electrically operated refrigerators will have become a necessity.

Chemistry in the Motion Picture Industry

(*Continued from page 268*)

reducing agent is oxidized and the solution turns brown. A product somewhat like a dye is formed which stains the film and slows up the developing power of the solution. When the carbonate is added this rate of oxidation is increased, but if sodium bisulphite or sodium sulphite is added, the oxidation tendency is reduced and the solution turns brown very slowly. The sulphite, therefore, generally should be dissolved first as it acts as a preservative. Besides the reducing agent, the activitator, and the preservative, the developer contains a restraining agent or potassium bromide which assists in controlling the rate of development and preventing developer fog.

The various reducing agents differ considerably in their rate of development: elon, for example, develops the image much more rapidly than hydroquinone, but on prolonged development they produce similar images. Both these developing agents are usually added to a developer because hydroquinone, when used alone, develops too slowly, especially at low temperatures. For negative development, when softer images are desired, the proportion of elon should preponderate, while in the case of a positive developer, when more contrast is wanted, the hydroquinone should be in excess of the elon.

The difference between the density or blackness of the silver image of the lowest exposure and the highest exposure is a measure of the "density contrast" of the negative. This difference in density increases with time of development, the greatest change usually occurring in the first five to seven minutes of development. Every picture is really a series of varying tones and the particular developer used, the time and temperature of development of both the negative and the positive print all influence the range of the density value of the tones.

If development is continued too long, a chemical reduction of the unexposed grains of the emulsion takes place which is commonly spoken of as "fog." It is never advisable to develop longer than one minute less than the fogging point, and it is therefore important to know the time required to produce visible fog with the type of film being used. Occasionally substances get in the developer which fog emulsions very rapidly. A serious trouble of this nature was traced to the presence of certain bacteria or fungi which acted on the sulphite in the developer changing it to sodium sulphide which fogs film badly. Both the cause and a method of eliminating the trouble were worked out in the Eastman Research Laboratory in connection with an extensive investigation dealing with the classification of different types of chemical fog and the chemistry of developer solutions.

The properties of a developer solution are affected considerably by temperature, especially if there is much hydroquinone present. When the temperature is raised, development is faster and, with a lowering of temperature, the development rate is retarded. The fogging point also changes with temperature. In warm weather developers do not keep as well, because the higher temperature increases the rate of aerial oxidation. It is very important in view of these facts to know the temperature of the solution and to keep it fairly constant in order to duplicate results.

For handling and processing film under tropical conditions, a different technique is required. Standard methods

(*Continued on page 278*)

Insulating Materials Testing

(*Continued from page 253*)

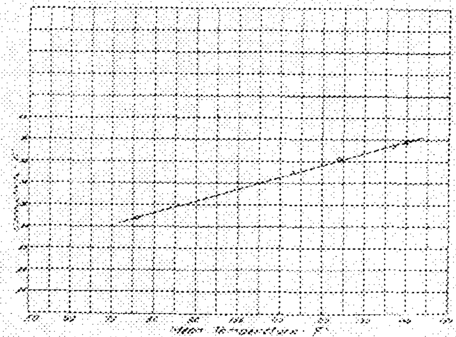


FIG. 3. HOT PLATE K VARIATION

TABLE 1.
Insulite 0.435 in. thick.
Weight 18.9 lbs. per cu. ft.

Test No.	*Mean Temp. Deg. Fahr. Surface to Surface*	*Hot Plate Constant C*	*Surface Constant k*	*Hot Box Constant K*
1	76.2	0.3052	....	....
2	113.	0.350	....	....
3	124.2	0.362	1.47	0.391
4	125.	0.362	1.52	0.398
5	137.	0.374	1.435	0.391
6	146.	0.378	1.56	0.411

NOTE: Tests Nos. 1 and 2 were made with both the hot and cold plates in contact with the material. Therefore, no hot box constant could be determined. The hot plate constant is calculated in terms of one inch thickness of material. The hot box constant is calculated in terms of material as tested.

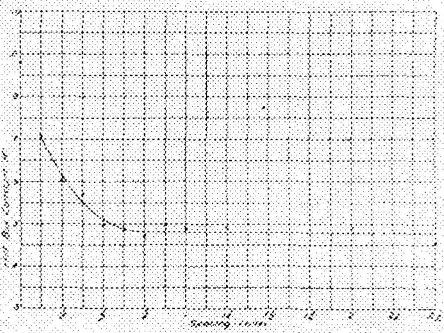


FIG. 4. INSULATING EFFECT OF SPACE

gardless of thickness. The value of a horizontal air space will depend upon whether the heat is passing upward or downward. If heat is applied at the top, the eddy currents will not be set up to the same extent that they would be if the heat was applied at the bottom, and in this case, the thickness would be more effective.

In making a study of this problem, the first point of attack would naturally be the spacing of storm windows, as double sash is common practice in Minnesota. Such a series of tests has been made on the hot box and the constants determined for single glass and for double glass varying the spacing from ⅛ in. up to 2½ in. The results of these tests are given on the curve sheet of figure 4 and show that the insulating value increases until the spacing reaches about ¾ in. after which there seems to be but little difference. These results may be explained by the fact that the resistance to conductivity increases as the space is increased, but at the same time the convection currents are increasing at about ¾ of an inch. The convection currents have attained their maximum and are carrying sufficient heat to overbalance any resistance to conduction. It is the intention to extend this investigation to include such materials as hollow tiles and building blocks.

Extra-curricular Activities

(*Continued from page 249*)

made to a questionnaire sent to student organizations in which each organization listed the names of its ten most active members.

The statistics on a group of 111 honor students, that is men and women student members of honor fraternities as listed in the *Minnesota Daily* in the spring of 1925, are interesting. Considering campus activities, the average number for honor men students is three, and for honor women students is five. Again the women students show a somewhat larger proportion engaged in more off campus activities than men. Considering all activities, the average number for both men and women honor students is six.

It should be noted here that these returns are merely rough preliminary totals. The committee is now engaged in the task of analyzing two groups of students, the first group of 102 prominent and honor students engaged in five or more activities, and the second group of students participating in no campus activities. In every case the study will consider, beside the number of activities and the time spent in them, such facts as the scholastic records, rating on psychological tests, high school standing and rating on physical condition. It is expected that as a result of these analyses some facts will be brought out relating to the question of how educationally valuable extra-curricular activities are.

Other analyses will be carried out, among them a careful study of the returns made by alumni to questionnaires sent them. A group of 500 alumni prominent in student activities were sent questionnaires, and an additional 500 chosen as a random sample were also circularized. The total of 1000 were selected from the graduates of the years 1910-1915. A number of questions were asked regarding the opinion of these alumni on a number of aspects of student activities. Facts were also gathered relating to the activities in which these alumni have been engaged since graduation. Many of these activities are roughly comparable to the kind of activities carried on as students, e. g. in athletics, literary, social and civic.

It is hoped that an analysis of these questionnaires, together with the other studies mentioned will make available to the faculty and student body facts relative to the educational value of the student extra-curricular activities.

Chemistry

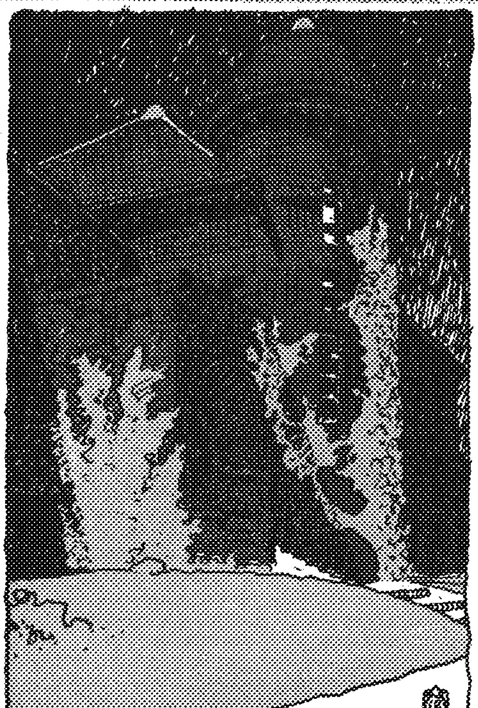
(*Continued from page 274*)

have been worked out for insuring that the sensitiveness of the emulsion shall remain unimpaired and that the latent image be retained after exposure and before development. The secret of high temperature development is to prevent excessive swelling of the gelatin. The most successful method of doing this is to add an anti-swelling chemical such as sodium sulphate, or sodium phosphate to the developer and immerse the film in a hardening bath after development and before fixation. Such a hardening solution may be prepared with potassium chrome alum in 3 per cent concentration which works very well at temperatures from 75 deg. to 85 deg. F. When higher temperature, up to 95 deg. F., are encountered, about 12 per cent sodium sulphate should be added to this bath. Fixation can be conducted in the usual way after three minutes treatment of the film in this hardeningg solution. More complete data are given in a paper on "Handling Motion Picture Film at High Temperatures," by J. I. Crabtree, in the Trans. Soc. M. P. Eng. No. 19, p. 39 (1924).

(*The second and final installment by Mr. Matthews will appear in the June number.*)

THE MINNESOTA TECHNO-LOG

Monthly Publication of the Technical Colleges
of the University of Minnesota



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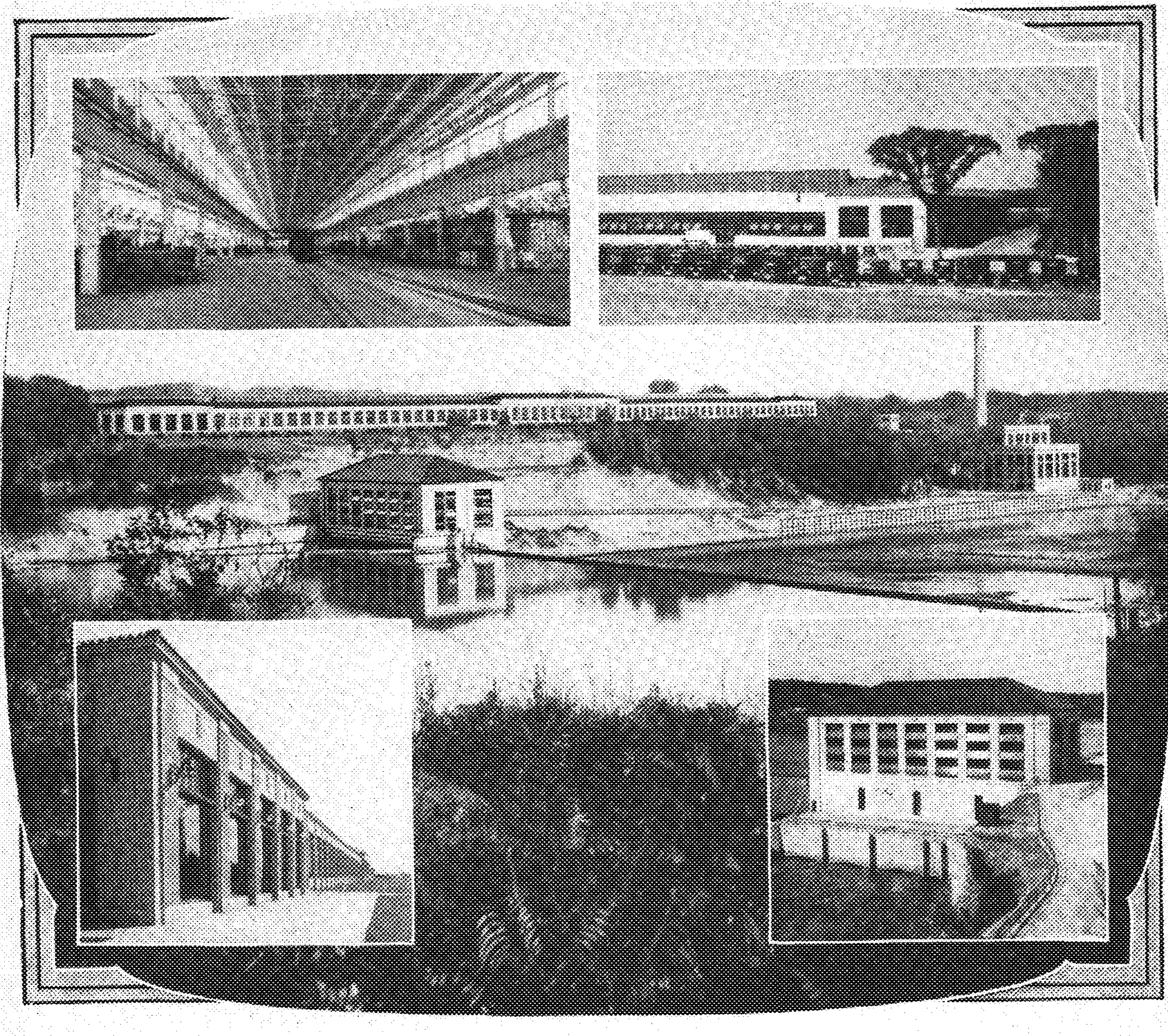

Ford Twin Cities Plant

IN this Ford manufacturing plant designed and built by Stone & Webster at St. Paul, Minnesota, the ground area of the single-story main building is nearly 20 acres* and the capacity of the power plants, one steam and one hydroelectric, on the Mississippi, is 25,000 horse power. Albert Kahn was Associate Architect on the main building.

Materials for manufacturing enter the main building and are unloaded direct from the railroad cars. It is planned to have the finished product descend by elevator 100 feet to a terminal chamber and go thence by tunnel 700 feet to a boat landing for shipment by water.

*The building is 1400 feet long by 600 feet wide

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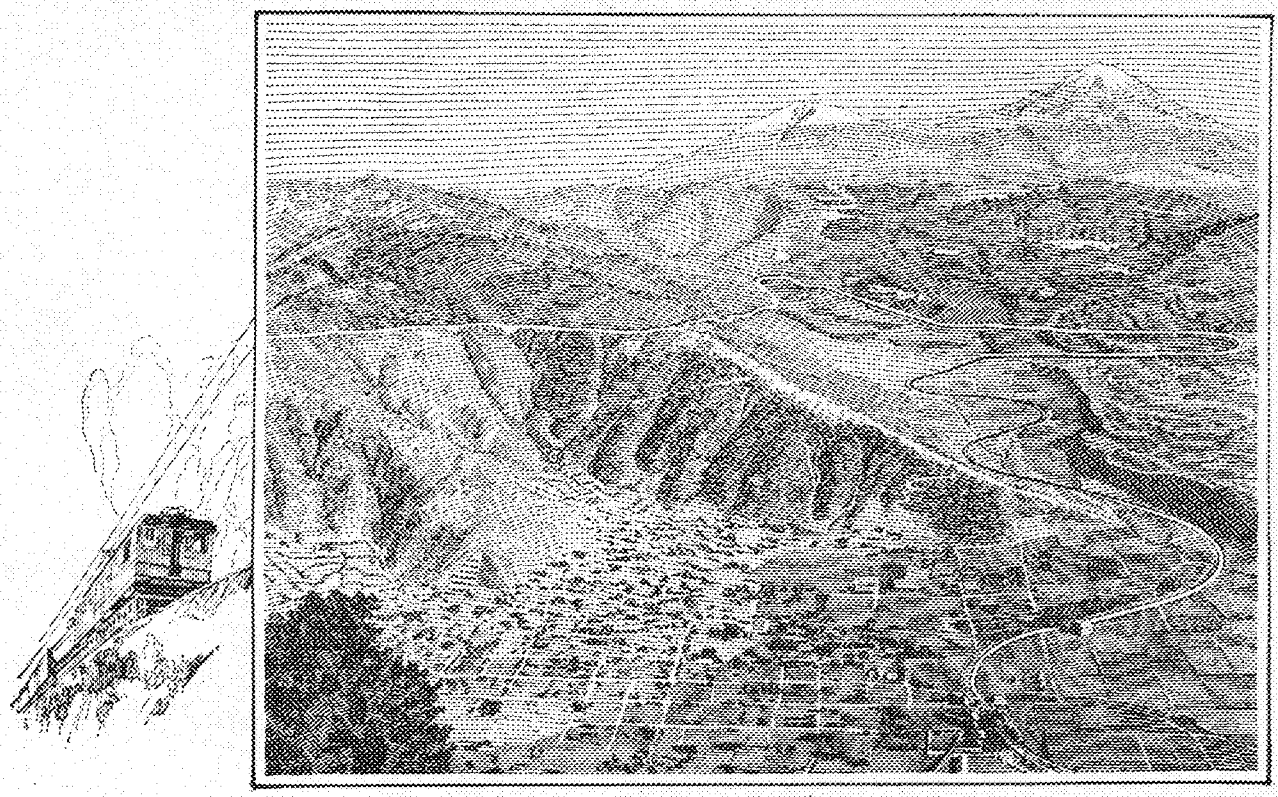

Where two steam locomotives formerly puffed and strained to pull a 360-ton freight train up the steep slope of Maltrata incline, two electric locomotives haul a 660-ton train with power to spare.

Electricity levels the Mountains

In Mexico, romantic land of pretty senoritas and languorous minstrelsy, practical American engineers have harnessed streams so that mountains may be leveled.

The winding thirty-mile Maltrata incline on the road from Vera Cruz to Mexico City is now electrified. Ten electric locomotives replace twenty-three steam engines. The electrics haul twice the tonnage of the steam locomotives—and in half the time, with obvious benefits to traveler, railroader, and shipper.

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Impressive, no doubt, but still modest when compared with the possibilities of electricity in years to come. And it remains for college-trained men, with trained capacity for initiative and leadership, to become ambassadors for further electrical conquests in foreign lands.

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A series of G-E advertisements showing what electricity is doing in many fields will be sent on request. Ask for booklet GEK-1.

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THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

VOLUME VI. MINNEAPOLIS, MINN., JUNE, 1926 NUMBER 9

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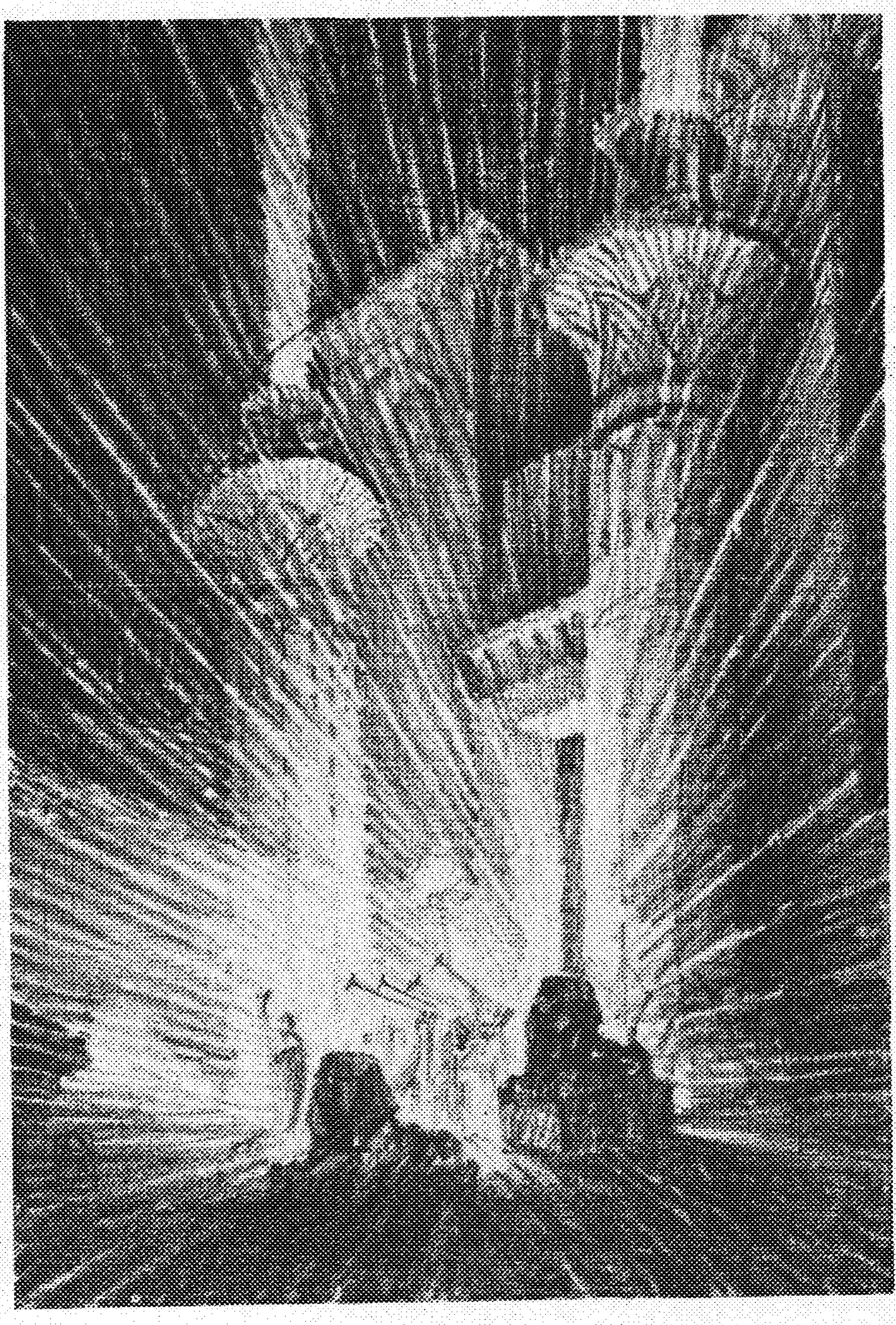


The Temple of Aida

(See page 292 for details)

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VI | JUNE 1926 | Number 9

The Mechanical Engineer in Industry

Field open to graduates in mechanical engineering much broader than ordinarily recognized by those not acquainted with its full scope

By S. CARL SHIPLEY
Professor, Machine Construction, University of Minnesota.

WHAT is a Mechanical Engineer?

The above question is often asked and rarely answered except in a vague way. The popular conception of the term mechanical engineer is, no doubt, derived from the dictionary definition of the two words, mechanical and engineer.

Webster defines mechanical as follows: (1) "pertaining to or concerning manual labor"; (2) "pertaining to or concerned with machinery." He defines engineer as (1) "one who designs or contrives"; (2) "one who manages or runs an engine." Hence we get by combining the two terms the popular idea that a mechanical engineer is one who applies manual labor to the design, construction, or operation of machinery. While in a sense the above definition is true, the field of a mechanical engineer is so broad that no short definition is adequate to cover all his activities. In fact it has been suggested that the American Society of Mechanical Engineers change their name to the American Society of Miscellaneous Engineers. Such a name might not be inappropriate.

The national society, A. S. M. E., divides mechanical engineering into six major groups, each of which contains several minor divisions. In order to show the diversity of work which a mechanical engineer may be called upon to perform, these six major groups with their content will be outlined:

I. THE ADMINISTRATIVE GROUP:

(a) Management Division. This division has grown out of the need for men trained in business methods as well as engineering in order that they might better handle the affairs of a large manufacturing concern. It includes sales, promotion, or administration and other problems connected with the economical production of commodities.

(b) National Defense Division, including aeronautics, forest products, and fuels. Problems dealing with the use and conservation of national resources are grouped under this division.

II. POWER GROUP.

(a) Fuels Division. This division deals with the production, utilization, and conservation of fuels of all kinds.

(b) Steam Power Division. This is one of the most important of the major groups and is concerned with the generation of power by the combustion of coal or other fuel under a steam boiler.

> *This is the seventh of a series of articles dealing with opportunities for engineering graduates in various lines of endeavor. It is very proper that we present this concise and clearly written story, dealing with one of the largest branches of the profession.*—THE EDITOR.

It includes the design and construction of all kinds of apparatus used for the conversion of the heat energy of steam into mechanical energy, as well as the utilization of steam for heating purposes.

(c) Oil and Gas Power Division. This division includes all forms of internal combustion apparatus, such as automobiles, tractors, stationary power units, and aeroplane engines.

The three above divisions may refer to marine as well as land operated apparatus.

III. METAL INDUSTRIES GROUP.

This is perhaps the largest of all the main groups of mechanical engineering, involving as it does, manufacturing of all kinds or at least the building of the machinery for all kinds of manufacturing. It offers perhaps the greatest field for a young engineer and often leads to a more specialized job in another field.

(a) Machine Shop Practice Division. This division includes the design and construction of all kinds of machinery for the working or handling of metal, wood, and other materials.

(b) Printing Machinery Division. Includes the design and construction of special machinery used in the printing industry.

IV. NON-METAL INDUSTRIES GROUP

(a) Forest Products Division. The production, utilization, and conservation of forest products of all kinds.

(b) Textile Division. The design and construction of machinery for the production of textiles of all kinds.

(c) Petroleum Division. The production, refining, distribution, and utilization of all kinds of petroleum products such as gasoline, oils, greases, tar, paraffin, and coke.

V. TRANSPORTATION AND HANDLING GROUP.

(a) Railroad Division. Railway Mechanical Engineering has long been recognized as a separate field for engineers and requires knowledge of the steam power division, but in a more highly specialized degree.

(b) Materials Handling Division. Consists in the handling of materials over short distances usually, both inside and outside of buildings.

(c) Aeronautic Division. While this division is closely tied in with both the national defense and gas power divisions it deals primarily with problems of commercial aviation.

VI. GENERAL GROUP.

This group embraces all activities not directly covered by the other groups. At the present time, no definite divisions have been established, yet a great deal of work is being done along the lines of heating and ventilation, refrigeration, highway research, refractory materials, paper making, insulating materials, and numerous other subjects.

From the above outline it is clearly seen that the popular definition of a mechanical engineer is not at all adequate. When one is asked, therefore, to define a mechanical engineer it is necessary to enumerate the fields of mechanical engineering in order to convey an adequate conception of the meaning of the term.

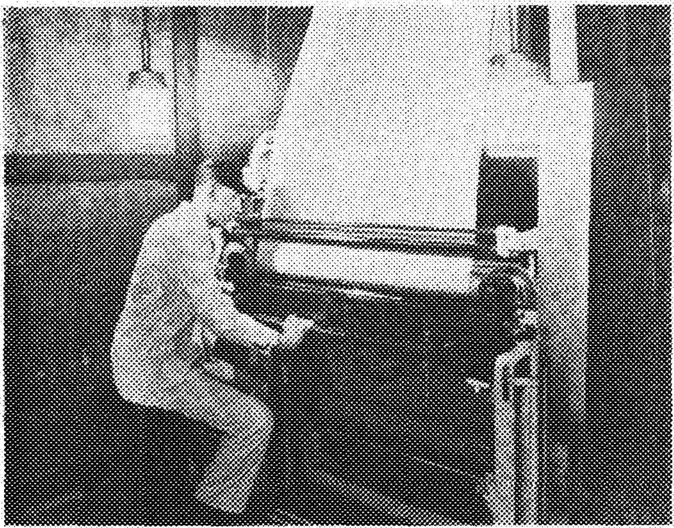


FIG. 1. COATING MACHINE
Special and delicate machinery carefully controls thickness of film base. Film is handled so only one side comes in contact with emulsion.

FIG. 2. WASHING SILVER NITRATE CRYSTALS
Bars of metallic silver dissolved in nitric acid in porcelain dishes and after recrystalization, pure silver nitrate crystals result.

Chemistry in the Motion Picture Industry

Accurate control of processes of film manufacture based on careful investigation make for uniformity in product and allow for prediction of results

EDITOR'S NOTE: *This is the second and concluding installment of this article by Mr. Matthews. Copies of the May number containing the first part may be obtained upon request.*

By GLENN E. MATTHEWS, Ch. '20
Research Chemist, Eastman Kodak Company, Kodak Park, Rochester, New York

THE life or period of usefulness of a developer depends on its particular composition and whether it receives continuous or intermittent use. As a developer is used, the solution accumulates reaction products which tend to retard the rate of development, and it is, therefore, necessary to develop for a longer time to secure a given contrast. Since reaction products slow down development, if a rack of film is allowed to remain stationary in a tank there is an accumulation of these by-products in the vicinity of the film which induces further retarding effects. Agitation of the rack and of the solution will prevent this trouble and give more uniform development.

With use a developer may become exhausted in several ways; (1) by aerial oxidation; (2) by accumulation of products resulting from the decomposition of the developing agents; and (3) by formation of sodium bromide and iodide from the reduction of these silver salts in the emulsion to metallic silver. An old developer may, therefore, have to be discarded because it develops too slowly or gives excessive stain or fog. When film is developed on a reel the solution is freely exposed to the air and if the developer does not contain an excess of preservative, chemical fog is produced. Experience has shown that the addition of about 5 per cent of old developer to a freshly mixed new developer will lower the tendency for chemical fog more than if the bromide concentration is increased above the normal quantity added. The chemical explanation of this effect is probably that the oxidized developer acts as an anti-fogging agent. Work is still in progress, however, to find the best method of reviving used developers.

For an extensive discussion of development, reference should be made to the paper, "The Development of Motion Picture Film by the Reel and Tank Systems," by J. I. Crabtree, Trans. Soc. M. P. Eng. No. 16, p. 163 (1922).

Occasionally, during processing, troubles arise caused by spots, marks, and stains appearing on the films. Methods of preventing and removing many of these difficulties have been found and published, and data on others are being assembled and investigated.

Stains may result from using old developers containing an excess of oxidation products, from particles of chemical matter in the air of the room settling on the film, or from undissolved solid chemicals in the developer. They are sometimes produced by the formation of a scum on the surface of the developer due to insoluble oxidation products rising to the surface. Spots result from similar causes and in addition may be produced by bubbles of air clinging to the film on immersing in the developer or by splashes of oil which repel development. General stain may be the result of chemical fog or a coloring of the gelatin by an oxidized developing agent such as pyro. For full discussion of stains, see paper on this subject by J. I. Crabtree, Amer. Ann. of Phot. 1921, or Brit. J. Phot. 68, 294 (1921).

When film is developed on racks in a tank, markings quite often occur at the points where the film passes over the top and bottom slats of the rack. These marks are caused by convection currents set up by the flowing away of chemical oxidation products as the development progresses (Fig. 3). They may be very much diminished by agitation of the rack, by moving the film on the rack, or by the use of a special roller rack which permits easier movement of the film on the rack at intervals during the progress of development. (See paper on "Rack Marks and Air Bells," by J. I. Crabtree and C. E. Ives published in the Trans. Soc. M. P. Eng. No. 24, p. 95 (1926).

Chemistry of Fixation

A fixing bath contains as the active chemical agent, sodium thiosulphate or hypo which dissolves the unexposed silver salts without affecting the silver image. A double salt of silver and sodium thiosulphate is formed which is very soluble in water and may be removed from the gelatin by washing. Hypo is seldom used as a plain solution but usually in conjunction with a weakly acid salt such as sodium bisulphite or with an acid hardening solution. The standard hardener contains a preservative, sodium sulphite which prevents decomposition of the hypo; an acid, usually acetic acid, to neutralize any alkali carried over in the film from the developer, thereby arresting development since an acid developer will not reduce silver salts; and a hardening agent, either potassium alum or chromium alum.

It is important to mix a fixing solution correctly. The hardener should be prepared separately by dissolving the sulphite first and when it is completely dissolved add the acetic acid. After the sulphite-acid solution has been thoroughly mixed, add the potassium alum. When the alum has dissolved make up to final volume with cold water and add the hardener solution slowly to the cold hypo while stirring the latter rapidly.

There are certain criteria used in judging the efficiency of a fixing-bath as follows:

Rate of Fixation

When film is immersed in a fixing bath, it is considered fixed when it has remained in the solution twice the time for the milkiness or opalescence of the unreduced silver salts to disappear. The rate at which this takes place depends on the strength of the hypo (30 to 40 per cent hypo fixes most rapidly), the emulsion used, that is whether negative or positive, the temperature of the solution (65 deg. F. is recommended), and the degree of exhaustion of the solution.

Hardening Properties

A certain minimum quantity of alum is required to give the necessary hardening while an excess of alum may produce too much hardening and induce brittleness. Normal fixing baths are carefully compounded to give a hardening of 130 deg. to 170 deg. F., determined by immersing a strip of the fixed and washed film in water and heating the water slowly until the gelatin flows away from the support.

Sludging Tendency

A fixing bath may become cloudy or precipitate a sludge in two different ways: (1) the hypo may break down giving a pale yellow sludge of sulphur, which is the result of the temperature of the bath rising too high or of adding too much acid to the bath; and (2) the alum may be decomposed and a white sludge of aluminum sulphite formed which is the result of too low acidity, the presence of excess developer carried into the bath, or too high a sulphite concentration.

Effect of Temperature

Changes in temperature of the fixing bath affect the rate of fixation and the life of the solution. If a film requires 95 seconds to clear at 65 deg. F., for example, it would take about 60 seconds to clear at 85 deg. F., but it is dangerous practice to allow the temperature of the bath to rise above 65 deg. F. as the solution is apt to precipitate sulphur. Under tropical conditions where high temperatures and high humidities prevail, it is obviously often impossible to keep the temperature within this limit, and the fixing bath must usually be replaced oftener. A different technique must be used for tropical processing as mentioned previously under the subject of development.

Life of Fixing Solutions

As a fixing bath is being used, the hypo becomes exhausted as a result of performing useful work in fixing out the emulsion. When the time for clearing negative film exceeds a certain point, say 10 minutes, the bath should be discarded. The acidity of the bath is being reduced by the developer carried in, although at first this tends to favor a longer sulphurization life. With continued use, however, the solution finally reaches a point where a sludge of aluminum sulphite is precipitated rendering the bath useless. On the other hand, the hardening properties of a bath usually increases slightly during the first stages of use after which they fall off rapidly until the bath is revived.

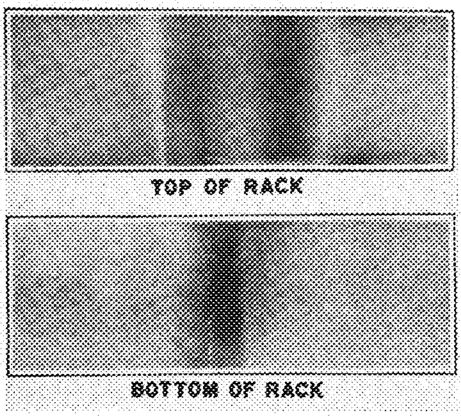


FIG. 3. "RACK MARKS" ON FILM
These are produced at points where film passes over upper and lower slots of rack.

Revival of Fixing Baths

Since the acidity of a bath and its hardening properties are depleted before the hypo is used up, it is general practice to revive the bath at intervals by the addition of a definite quantity of acetic acid. When the acidity is lowered to two-thirds of the original value, enough acid should be added to restore the initial concentration. A fairly satisfactory method is to add acid after a certain footage of film has been passed through the solution. If the bath has formed a sludge before it was revived, the solution should be discarded.

Recovery of Silver

An exhausted fixing bath contains dissolved silver salts and various methods have been tried to profitably recover the silver. The principal methods used are: (a) the sulphide method wherein sodium sulphide is added to the used bath and the silver is thrown down as a sludge of silver sulphide; (b) the hydrosulphite method in which the addition of sodium hydrosulphite precipitates a mixture of metallic silver and silver sulphide depending on the conditions of precipitation; (c) the zinc method which uses zinc in various forms, such as sheet, granulated, and dust; the silver being precipitated as metallic silver; (d) electrolytic methods which include the use of metallic units and the actual application of an electrical current. For recovery of large quantities of fixing bath, the sulphide method is most efficient; for medium quantities, the zinc dust method is satisfactory, and for small quantities, the use of an electrolytic recovery unit offers a simple and economical procedure.

Fixing Bath Troubles

When the carbonate in the developer is neutralized by the acid in the fixing bath, carbon dioxide gas is formed which produces blisters which appear on the film as tiny craters providing the gelatin is too soft to withstand the disruptive action of gas. If the bath has good hardening properties and the film is agitated on first immersion no trouble from blisters need be anticipated. If the fixing bath does not contain acid or if it is old and exhausted and contains an excess of dissolved silver, a chemical fog called dichroic fog is sometimes produced on the film. In reflected light, film fogged in this way looks yellowish green and by transmitted light it appears reddish pink. Dichroic fog never occurs in a fresh acid fixing bath or if the film is rinsed before fixing and the temperature of the bath is kept at 65 deg. to 70 deg. F. When a partially exhausted fixing bath is allowed to stand several days without use, the hydrogen sulphide gas present in small quantities in the air reacts with the silver thiosulphate in the bath and forms a metallic-appearing scum on the surface of the solution. The scum consists of silver sulphide and should be removed by drawing the edge of a sheet of blotting paper across the surface of the bath. Trouble from sludging and precipitation has been discussed previously. Several different stains such as white aluminum sulphite stain, sulphur stains, and yellow silver stains are occasionally produced. More complete discussion of fixing troubles is given in a paper on "Stains on Negatives and Prints" by J. I. Crabtree, Brit. J. Phot. 68, 294 (1921).

Chemistry of Washing Film

One might naturally think that there is little chemistry associated with washing film and this is true so far as actual chemical changes are concerned but it is a distinctly physical chemical problem to determine the conditions that will ensure complete removal of hypo and other fixing bath components and oxidized products from the film. The nature of the water supply is not of vital importance, although if dirty water or sea water have to be used, the film should be subsequently given a thorough washing in fresh water.

The problem of washing film involves two principal operations: (1) separation of the chemical substances from the film, and (2) removal of these substances from the water in the vicinity of the film. Obviously the second operation must proceed equally as rapidly as the first, or the film would still retain some chemicals when taken from the wash water and stains would appear later. The first operation is really a problem of diffusion since the chemicals are held in the swollen gelatin layer and must find their way out to the surface. It has been found that as washing progresses under favorable conditions, the hypo content of the film is halved for each equal time interval. This "half period" value can be determined for each type of film. Most thorough washing results if the water is violently agitated at the point of contact with the film. Practically the ideal washing stream can only be realized by using a spray or an excessively large flow of water. Tanks should be as small as is consistent with the film output because the smaller the volume, the more rapidly is the stale water removed. To remove surface hypo, a few seconds rinse in a separate tank, or spraying with a coarse atomizer previous to the main washing is recommended. If it can be arranged, the cascade system is excellent. In this method, film is transferred successively through about five baths in which the water is circulating in a counter direction. In continuous tube processing machines, the water should be directed into the top of the last tube, flow from the bottom into the top of the next tube, and so on. A rinsing loop previous to the large washing tubes should be installed. Compressed air admitted at the bottom of a tank or tube provides the most economical and efficient method of agitation.

If washing is incomplete as pointed out under the subject of fixation, trouble from stains and spots is often experienced. Sometimes these difficulties do not appear until several months or a year or two later but the film is usually seriously if not permanently damaged. Several theories have been advanced to explain this deterioration, but it is most probable that the sulphur liberated from small traces of retained hypo in conjunction with bacterial action are the chief causes of the fading that take place through the formation of silver sulphide. Most trouble is experienced with film that has been poorly processed and stored in hot damp climates.

If the film is properly hardened no troubles will arise from having to wash in water whose temperature is 90 deg. to 100 deg. F. When film is thoroughly fixed and washed and subsequently stored at high temperatures, it rapidly becomes brittle and in a few years is completely destroyed by its own decomposition products. *It is very important, therefore, to store film when practicable at temperatures of 50 deg. or 40 deg. F.*, when the rate of decomposition is negligible, providing, of course, that the proper care has been given the film during processing operations. The motion picture industry is comparatively young, but there are samples of film in very good condition which were processed over thirty years ago. For more detailed information on the subject of washing motion picture film, see the article by K. C. D. Hickman, Trans. Soc. M. P. Eng., No. 23, p. 62 (1926).

When moisture comes in contact with dry film previous to or after exposure, or is deposited as the result of humid

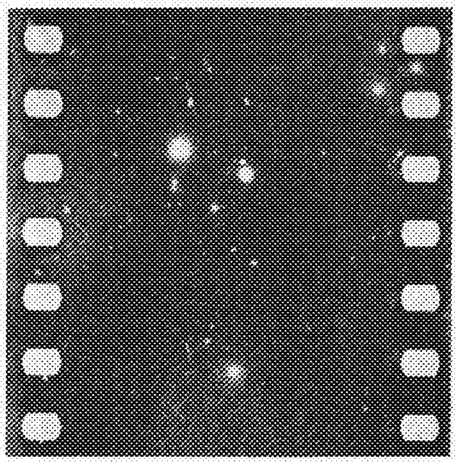


FIG. 4. MOISTURE MARKS
If washing is incomplete, spots will sometimes result after a year or two.

atmospherical conditions, or is left on the film previous to or during drying, certain characteristic markings are produced. The most common example of these is a tiny white spot. (Figure 4.) Various other types have been classified and several explanations advanced as to the causes and means of preventing such markings in a paper on the subject published in the Trans. Soc. M. P. Eng., No. 17, p. 29 (1923).

Corrosion and Relation to Apparatus

In selecting a material for the construction of photographic processing apparatus, it is important to know the probable effect, if any, of both the material on the solution and the chemical action of the solution on the material. A metal like tin, for example, which is entirely satisfactory for pipes lines carrying distilled water, is on the other hand very unsuitable for use for constructing developer tanks as it reacts with the solution giving very bad fog. An investigation of this subject was made several years ago and the results published in a series of papers to which reference should be made for complete information. (See Amer. Phot. 18, 148 (1924). A few of the conclusions may be of interest. Tin, copper, or alloys containing these metals should not come in contact with developers as serious trouble from fog will be experienced. Soldered joints in metal tanks are to be avoided. If metals must be used for apparatus to contain fixing baths, nickel, lead and Monel are the only ones recommended, and these should be electro-welded or soldered from the outside except in the case of lead which should be burned. Aluminum, zinc, or galvanized iron should not be used with either developers or fixing baths as these metals react with the solutions forming precipitates which deposit on the film and stain the gelatin.

Single metals or alloys are to be preferred to plated metals because when surface plating becomes worn or chipped they corrode very rapidly. Porous earthenware, fibrous materials, and rubber compositions should be avoided since the solutions crystalize out in the pores and subsequently disintegrate the material. Lacquered trays and japanned tanks are not suitable for containing strongly alkaline developers or acid fixing baths. Specific recommendations relative to the most suitable materials for constructing small apparatus, trays, tanks, tubes, troughs, piping, pumps, faucets, etc., are given in a paper on that subject which may be obtained on application to the Service Department, Eastman Kodak Co., Rochester, N. Y.

The After-Treatment of Film

REDUCTION AND INTENSIFICATION.

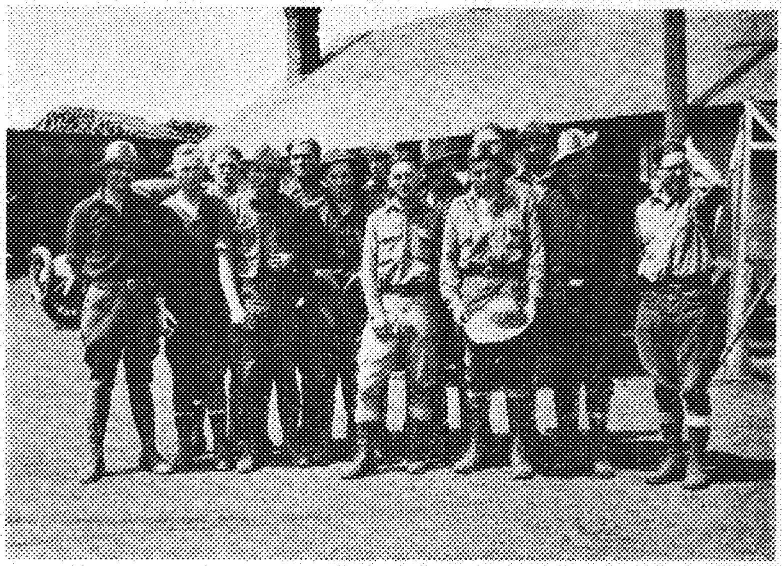
Film is occasionally overexposed in the camera and, although this can be partly compensated for in the printing, it is customary to treat the film with solutions which chemically remove some of the image. This process is photographically termed "reduction," although it is not chemical reduction but rather an oxidation since that portion of the image which is removed has been oxidized.

There are three general types of photographic reducers: (1) Cutting reducers which remove the silver nearly equally from all parts of the image; (2) Flattening reducers which attack the heavy deposits more than the lighter areas; and (3) True Scale reducers that attack both highlights and shadows proportionately. Reducers of the first type are: (a) Farmer's Reducer consisting of potassium ferricyanide and hypo; and (b) the permanganate reducer which is a slightly acid solution of potassium permanganate. With Farmer's Reducer, the silver is converted to silver ferrocyanide which the hypo dissolves. The permanganate reducer oxidizes the silver to silver sulphate which is sufficiently soluble in water to be dissolved.

(*Continued on page 302*)

Sophomore Miners Sojourn in the Field

By James A. Helbling, Met. E. '28



SOPHOMORE MINERS AT CHISHOLM (MINN.)
Reading from left to right: Heines, Brace, Deringer, Walsh, Sahi, Finberg, Johnson, Helbling, Bloom, Coolidge, Boeger, Thomason, Davies, Armstrong.

On Sunday, the second of May, the class of sophomore miners left for Duluth for the commencement of their summer field work. The majority of the boys drove to the "Key To the Arrowhead Country" in various collections of antiquated heaps of the vintage of Henry the 4th. To make the field trip start properly, we were greeted in Duluth by a mixture of snow, rain, and sleet, carried along by a fine wind which made the driving very unpleasant with each tiny particle of snow trying to imitate a needle. By midnight all of us were tucked in sleep in preparation for the start of a most strenuous field trip.

The gang reported for work at 7:30 in the morning and went directly to the steel plant for a detailed inspection and study of the intricate process of the conversion of the crude ore into the finished steel product. After signing our lives away at the gate, we were marched in martial array to the blast furnace. There we saw the crude ore of various analyses being charged into skips and hoisted to the top of the blast furnace to await the proper time of charging. The ore was followed by skips of fuels and fluxes. We were next taken to the tapping floor at the opportune moment to see the iridescent stream of white hot metal shoot forward down the troughs into the ladle accompanied by a shower of sparks and a choking odor of sulphur. Scarcely had the metal begun to flow when a more viscous substance was noticed to float on the top and which was skimmed off by means of grates in the runners and carried into large tanks of water where it was chilled and later removed as waste slag. The metal was caught in large ladles and conveyed to the open hearth where it was stored in a large mixer till needed.

Our next journey was to the open hearth where we saw the large 80 ton furnaces charged with the metal from the blast furnace, mixed with various amounts of scrap iron and flux. Here we strained our eyes to see the metal boil and splash in the process of removing the impurities. Due to the short time available it was impossible to see the complete process, but the tapping of a furnace and the casting of the ingots was witnessed nevertheless.

Next we were ushered to the big blooming mill where the large blooms were rolled to billets and then transferred to the merchant mill to be rolled into small rods. Here we were shown the large piles of steel fence posts ready to be shipped. Having seen the posts, our attention was next drawn to the wire mill where the long rods were heated and rolled into smaller and smaller sizes until they found themselves wound around a spool and roughly ejected into cars. These cars conveyed the coils of hot wire to the nail mill where it was soon changed into entirely different forms. The one room contained several machines used in the manufacture of kegs for nails, etc.

To see these machines perform the work of a man at such a speed was a treat to all of us. Farther along we saw the wires being drawn down to smaller sizes to be used in the manufacture of nails. We marveled at the great speed at which the nails and rivets were made. Each machine poured forth a steady stream of nails which was collected from time to time to be loaded and shipped.

The next wonder was the machines making the woven wire fence. They held the crowd in awe and wonder until the foreman was so kind as to stop the machine and show us the working of it in detail. The kindness and unceasing efforts of our guide to answer the million questions asked him was greatly appreciated.

Having seen the entire plant, the gang was ready to go on to see what more wonders were in store for them further on. By 6:30 we were all on our way in our heaps of tin for the north. The next leg of the journey brought us to Chisholm where we were greeted by icy winds carrying snow and sleet. After reporting to Mr. Carlson all sought the feathers.

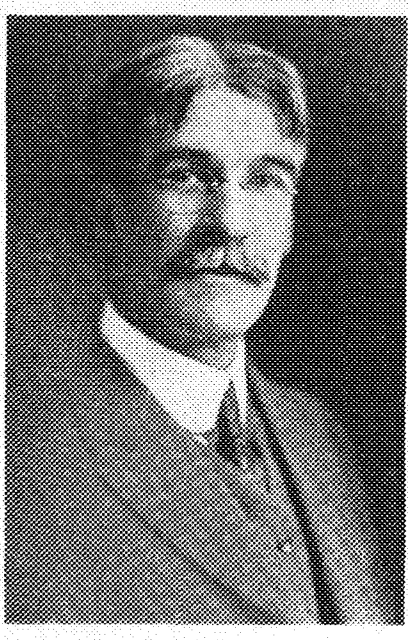
Next morning found a tired, sleepy bunch ready to go forth on a cold frosty morning to see what the day held in store. The greeting was in the nature of a job of taping through a swamp which required a high boot and a steady nerve to navigate only to merge forth into a tangle of brush which brought forth any stored up axmanship the crew might have. The hillside was covered with red and white poles, each waving a handkerchief, a cap, a sweater or what not to distinguish it from its neighbor. Having finished the job to the satisfaction of the instructors the boys were permitted to go home early, it being 4:30.

In the days that followed the crews were given levels and rods to run a line around a section covered by swamps and ore dumps and what not. On these occasions the parties saw their first internal strife. From every hill could be heard the cry of "Round Head" or "Where the ——— are you working," or some irate rodman speaking to his instrument man at a quarter mile distance in an anything but pleasing tone. Having finished this job in record time we were shown a large open pit mine and told to make a yardage estimate of the stripping which had been removed. This required but a few days for the crew adopted themselves to the tasks of running traverses around it and leveling. Last but not least was the scaling the steep banks to give sights for stadia shots.

This job being finished in record time, the next problem was to run a spur line of railroad from a switch into the mine and give all the necessary information for the grading. This required more leveling and setting of grade stakes ready for the contractor to step on the job. At this time, the job was halted frequently to take observations on the sun and calculate the location from that.

The work has not been confined to the ten hour days but several times each week there has been night school where the instructions are given for the future work and the calculations on the past are checked and accepted or refused. About four days of the trip found all of

(*Continued on page 304*)



Professor Shepardson Dies in Florence, Italy, May 26.

The entire university populace was shocked to read in the morning papers of May 29 of the death of Professor George D. Shepardson which occurred at Florence, Italy, on May 26. In company with his wife and daughter, Mary, Professor Shepardson was touring the world while on sabbatical leave and had travelled through India, China, and other parts of the Orient. He was planning on a summer in Europe before returning home. Death, which was sudden, was due to pneumonia.

Professor Shepardson was born November 20, 1864, at Cincinnati, Ohio, of Daniel and Eliza (Smart) Shepardson. He attended the Granville, Ohio, high school and graduated from Denison University in 1885. Later he received his master's degree in 1888, specializing in Latin, Greek, German, and French languages. He was granted the degree of mechanical engineer from Cornell in 1889. During a sabbatical leave in 1912, he received the degree of Doctor of Science from Harvard.

Following graduation, Shepardson taught at the Young Ladies Institute at Granville, at Cornell University and since 1891 has been the head of the department of electrical engineering at the University of Minnesota. During that period, that department has grown from almost nothing to the largest in the College of Engineering and Architecture and this year, housed in its half million dollar building, graduated over 80 seniors.

George D. Shepardson—1864-1926

By PAUL B. NELSON

THERE is an imposing looking electrical engineering building at the University of Minnesota. Of sturdy, yet refined appearance, it forms an important part of the engineering quadrangle. Two giant radio towers stretch skyward while at their feet, students throng the halls, rush to and from classes intent upon their studies. High on the south cornice of the laboratory are carved four figures symbolic of the uses of electricity—Light, Power, Transportation and Communication. Far above the noise and turmoil of the busy streets, these goddesses silently portray the significance of this wonderful force.

In passing, men leave many memorials. Some are remembered by large estates or fortunes, others by skyscrapers which bear their name. This building will serve as a lasting memorial to Professor George D. Shepardson through whose direction the department was raised to its present high standard. We of today have only faint recollections of the dreary old building into which this branch of the college was crowded a few years ago. We cannot imagine how meagre a start it had when a corner in a basement housed the varied collection of apparatus that composed the department then.

Electrical engineering is the newest branch of the profession of engineering. Simultaneous with its growth and widespread adaption to serve mankind, has been the advance of this department at Minnesota. In 1887 when the catalogue of the University announced for the first time that the College of Mechanic Arts offered a course in electrical engineering, horse carts were in use in Minneapolis; kerosene lamps illuminated homes and radio broadcasting was undreamed of. Just the other day, 80 electrical engineers received their degrees. A few hundred feet away, electrically propelled street-cars ran, the commencement speaker's voice was made audible to the vast assembly by means of a clever adaption of electricity to the art of communication. Every step in the advancement in this department at Minnesota has been a milestone in the life of Professor Shepardson.

It was in the spring of 1891 that he came to Minnesota. When the course in electrical engineering was first announced in 1887, the physics and electrical engineering departments occupied five rooms on the first floor of the new Mechanic Arts building which had been erected in 1886. The summer of 1890 saw the completion of the new physical and chemical laboratory building and the combined electrical and physics department occupied the east half. The increase in the number of students taking work in the departments of chemistry, physics and electrical engineering made this building inadequate eventually and in 1899, it was turned over to the exclusive use of the Chemistry Department. In 1892 preliminary plans had been made for the "U" shaped engineering building to be built on the site south of Pillsbury Hall and facing Church street. In 1899 the first unit was erected to house the mechanical engineering shops.

During this time the electrical department was scattered in four or five different places about the campus. In 1901 the legislature made appropriation for the engineering college and during February, 1902, the Electrical Department moved into its new building which had been built at a cost of $13,782.

The college had so grown by 1906 that these quarters were inadequate. The legislature of 1907 made an appropriation for $250,000 for an engineering building and laboratory and as an additional sum was awarded for extension purposes, the main engineering building was built on the new campus. At this time, the congestion of the electrical building was partly relieved by adding a basement and installing a skylight. Finally, after much waiting and pleading, an appropriation of $375,000 was made in 1923 for a new building. This was started on Decoration Day, 1923, and was practically completed by the following May. In brief, this is the history of the department. Today, its teaching staff numbers many men who are nationally known; its laboratories are the best in the country; its scores of successful graduates are winning names for themselves and their Alma Mater.

Professor Shepardson's life is one of inspiration. After graduation from Denison University in 1885, he was with the Edison Electric Illuminating company of Boston from 1887 to '88. Returning to Denison, he received his Master's degree in 1888 and in 1889 was granted the degree of mechanical engineer from Cornell. Shepardson was a member of the teaching staff at Cornell until 1891 when he received the call to become head of the Electrical Department at the University of Minnesota.

He was a scholar. During his academic years, he was elected to membership in Phi Beta Kappa. Other Greek fraternities which claim him as member are Tau Beta Pi, Eta Kappa Nu and Sigma Xi. He was also a member of Kappa Eta Kappa, professional electrical engineering fraternity.

His wide interest in the many branches of science is evidenced by the many so-

(Continued on page 312)

Disadvantages of the Big Company

Student training courses do not educate, original thought and initiative is discouraged with a large concern, graduate alleges

From the Bridge of H K N

By Dallas R. Lamont
University of Wisconsin, '20,
Director of Patents and Research, Spray Dryer Process Corporation, New York City

THERE has recently appeared many articles extolling the benefits and opportunities patent to a young engineer going with large engineering and manufacturing concerns. The nature of these articles necessitated that for the most part, they be written by employees of the big companies, and consequently some of the articles which were published read more like real estate circulars telling the world about Hollywood or Coral Gables than like comprehensive and accurate presentation intended for the credulous reading of young college men not yet thoroughly accustomed to the art of properly discounting the extravagant expression of partisan enthusiasts. Hence, to more fairly present the situation as it really is, I seem to have been elected to take up the negative on this proposition of the advantages of employment with a big company.

The average engineering college senior has little opportunity to learn of openings for employment with the smaller companies in the electrical industry except through individual acquaintance with people associated with such companies or through having made an investigation among such companies by personal solicitation. On the other hand many of the big companies send representatives to the leading colleges each year so that practically all of the senior "Electricals" are apprised of the opportunities available with such companies and many of them are invited to accept positions with such companies. Most of these big companies conduct student courses for the benefit of the recent engineering graduates and in which the graduates are supposed to learn those phases of their profession, or rather of that branch of the profession with which the company deals, which were not to be found in the college text books. Such courses may be and often are very useful if properly conducted and if the student engineer is permitted to touch upon various phases of the work without being required to spend an unreasonable amount of time in the process. The practical experience given the young engineer by actually getting out in the field or into the shop and coming in contact with the practical side of the industry is excellent, and every prospective engineer should have a certain amount of this type of experience before he embarks seriously into the professional engineering field. Probably the best time to obtain this experience, however, is during the summer vacations in his college course. Too often the big companies use their student courses as a means of getting an intelligent class of labor at a low cost, and they sometimes keep the men in the shop for a year or more on the theory that it requires that long for them to get thoroughly dirty and thoroughly educated to the fact that they do not know anything about engineering. In the shop courses the object of the company is primarily to get the work turned out and is not primarily any philanthropic motive of giving the engineer students a free education. The student is ordinarily assigned to work in the course of the commercial manufacture of a product and is kept at that job long enough so that he has been turning it out in a money-making fashion for some time before he is given an opportunity for other work. My own experience in this regard, in common with that of many other engineering graduates with whom I associated, was that I was performing a higher class of labor than were the regular laborers on the same floor, was turning out a goodly quantity of work every day and was getting paid approximately half as much as the rustlers who hauled the motors and mechanical parts about the factory.

Apart from the fact that these courses familiarize the engineering student with the actual handling of electrical machinery,—which experience he certainly should get in a respectably sized dose at some stage of his training,—the much advertised advantages of the student courses are largely fallacious. Although the men on the course are rotated from one kind of work to another so that they may gain experience in different lines of work, they are usually kept about three months on every job where the average intelligent student graduate ought to be left about three days. For the purpose of obtaining the training he needs, the engineering graduate does not have to become a skilled machinist, a skilled coil winder or a skilled anything else as far as actual manual manipulation is concerned. He needs only to learn the practical aspects of the work and he can do that by contacting directly for a short time with such work as it is being done. When the student is moved from one place in the plant to another it is true that he learns new things at each move, but I have found that by far the greater portion of what new things he learns and by far the greater amount of time and energy required in the learning lies in finding out such things as the particular methods of shop routine in each of the factory divisions, the particular type of switchboard connections used on different tests and other similar things which go not at all to the essence of electrical engineering, but consist rather of those shop details which constitute a part of the knowledge of mechanical manipulation which any laborer going into a specific task is required to know for the profitable execution of that task. Most of these things are not at all matters of general knowledge of the profession.

During the time the student actually spends in the shop no means ordinarily are taken to assist him in his alleged process of education. The one exception to this rule is that once or twice a week the students on the course are assembled at some convenient point and are entertained by impromptu lecturers drafted from the ranks of the company's employees and imbued with the spirit of telling the students what a good company they are working for, how well off they are, how fortunate they are to have had the opportunity to enter the sacred portals, what a great amount of experience they have yet to acquire before they will be of any value to the company, and above all that they should not ask for a raise in salary in the near future. This sort of thing gradually palls on the engineering student of average intelligence and affects him in one or two ways; namely, he either gets disgusted with the line of propaganda and decides to pack up and leave or he finally becomes convinced that he actually does not know anything and therefore must expect to be subjected to an extended period of servitude before attaining those qualifications which will render him able to take upon himself any amount of original responsiblity.

The life of the student engineer employed by the big company is, to my mind, strictly analogous to the life of a buck private in the army. If he thinks of anything he is always wrong. Instead of a bonus there is a penalty on original ideas. Also the regime is full of exasperating injustices,—which thought brings to my mind an incident that happened to me during my life as a private in the army and which illustrates the point fairly well. This was at a training school. A study hour was scheduled from 7 to 9 o'clock in the evening. On this particular night I was unfortunate

(*Continued on page 300*)

NEWS FROM THE TECHNICAL CAMPUS

New Concrete Test Machine Is Perfected by A. A. Jakkula

A machine for testing the time-of-set of various kinds of concrete has been perfected by Arne A. Jakkula, senior civil engineer. The work was done in conjunction with faculty members of the experimental laboratories.

This apparatus, though embodying the same principles as other devices of its kind on the market, is quite different in construction. Small rectangular trays, 30 in. long and 4.5 in. wide, are filled with cement and placed on angle iron tracks. An electric motor fitted with reduction gears is used to operate a cam which automatically lifts two sets of weights and move the trays forward one notch at a time. Each movement represents a ten minute lapse of time. Pointed wires and needles fastened to the weights are suspended vertically and held in place by means of holes drilled in a strip of wood. The wires are raised and lowered while the trays remain stationary, preventing any horizontal motion in the cement. The gradual lowering of the weights produced by the cams introduces no force other than the weights of the needles themselves. These needles make a clean cut impression and the exact time in which the final set was reached can be readily determined.

The cement is allowed to set for one hour in the trays to prevent it from sticking to the needles. The distance traveled is one-eight of an inch every ten minutes which allows 40 hours for the cement to reach a degree of hardness in which the heavier weights will no longer make an impression.

This device obviously eliminates the tedious job of constant attention by some observer.

Teaching Fellowships Are Awarded for Next Year

The following appointments have been made and reappointments announced for teaching fellowships in the College of Engineering and Architecture.

Experimental engineering: Arne A. Jakkula to succeed Donald O. Nelson; James R. Johnson to succeed Frank E. Nichol; L. L. Johnson, Russell E. Backstrom, and Charles Prichard, who will enter upon their second year of research.

Electrical engineering: Marcus Fiene to succeed George Corcoran; Carl B. Feldman to succeed Louis J. Schnell; Ikel Benson and Henry Reed, who will commence their second year of graduate work.

"Condenser" of Pi Tau Sigma Fraternity Is Edited Here

"The Condenser," national publication of Pi Tau Sigma, honorary mechanical engineering fraternity, has recently moved its office of publication to the University of Minnesota, the first number to be issued here appearing last week. Professor John V. Martenis, associate professor of machine design, who is grand secretary of the fraternity, is editor and Theodore Corbett, senior mechanical and associate editor of the Techno-Log, is assistant.

The publication is published each year by a different chapter. Its contents deal with matters of general interest to the profession as well as to the various chapters.

Girl Civil Graduate Receives Appointment on Wisconsin Staff

MISS ESTHER M. KNUDSEN

The appointment of Miss Esther M. Knudsen, a 1925 graduate of the department of civil engineering, to the position of engineer on the staff of the Wisconsin highway commission, has been announced. She holds the distinction of being the first woman engineer on the staff of the comcommission of that state. Miss Knudsen, whose home is in St. Paul, has been previously in the drafting department of the Wisconsin commission.

The 1925 class of civil engineers was a distinctive one inasmuch as its rolls included two 'co-ed' members, Miss Knudsen and Miss Ursulla Quinn. These are the first women to graduate from the College of Engineering and Architecture of this university and are among the few women graduate engineers in the country. Miss Quinn is now with the Western Union Telegraph company in their St. Paul offices.

Burmeister Heads A. I. E. E., Vye Elected President of Commission

Charles H. Burmeister, junior electrical, was recently elected chairman of the student branch of the American Institute of Electrical Engineers over Seth Witts by a vote of 55 to 46. Harry Dubois was named secretary and Joseph Wald treasurer. The latter two ran unopposed.

Mr. Burmeister has been active in the work of the A. I. E. E. the past year and was in charge of the parade for Engineer's Day.

At a meeting of the Technical Commission recently held in the Minnesota Union, Lloyd Vye was elected president of the commission to succeed Clyde Lighter and Charles Burmeister was elected to the position of secretary-treasurer and succeeds Ray L. Christen in that office.

The Technical Commission is composed of the heads of the student engineering societies as well as faculty members and has to do with the regulation of various engineering student activities.

Additional elections in which engineers figure are the Union Board of Governors of which Louis Schaller was chosen secretary and the All-U Council of which Russell Sorenson was made treasurer.

Electrical Faculty Designs Lighting Effects for Aida

The production of Verdi's Aida in the Memorial Stadium on June 4 brought into play many departments of the university. Music was furnished by the concert band in addition to the orchestra, costumes were made by the departments of art, education, and home economics, and the choral society and chorus formed the bulk of the ensemble. As a matter of fact, its success was due to the cooperation of these many branches. In connection with this, the lighting effects which were designed and executed by faculty members of the department of electrical engineering brought much comment and are deserving of mention.

The immense scale of production of the outdoor performance brought with it many engineering problems in the lighting and communication. Four huge flood lights were used to produce the brightness of a sunny day in Egypt, that the colorful setting and costumes might be brought out in all their brilliance. These floods also were employed to give the soft glow of tropical moonlight upon a temple near the Nile.

These lights had to be set back of the audience upon the outer wall of the stadium over 300 ft. from the stage. The illumination was so concentrated that the light would not shine on the front part of the temple. Small flood lights were placed on the floor of the stage in front of the temple's pillars and the light directed upward upon them. Thus, the illumination was intense upon the lower part of the front of the pillars and gradually faded out toward the top where the incense pots glowed. At the same time, deep shadows were produced on the front of the temple, which served further to bring out its great proportions.

Three giant 120-ampere spot lights placed on a platform over the main driveway concentrated their beams on the stage over 160 ft. away. The complete theatre lighting from the dressing rooms to the flood lights almost a block away with the switchboard and controls was installed and wired in two days.

The distance between flood lights necessitated a means of communication. A telephone system was installed from the director's position in front of the orchestra to the back of the stage, so that the director might know when the principals, the chorus and the armies were ready. Also, telephone communication was established between the director and the main switchboard, the spotlight and flood lights enabling them to operate at the proper time and with the correct color screen.

Prof. Zelner Convalescing From Appendicitis Operation

Otto S. Zelner, associate professor of surveying, who was operated on May 18 for appendicitis, is rapidly recovering. He was stricken suddenly and immediately rushed to the St. Paul hospital for a successful operation.

Professor Zelner is now convalescing at his home, 2265 Carter avenue, St. Paul, and hopes to resume his teaching with classes in the first session of summer school. He is very active in student affairs, being a supporter of the Arabs, a member of the Engineers' Bookstore board and intra-mural athletic committee.

Mechanicals of 1924 Show Preferences In Questionnaire

A questionnaire recently sent to the mechanical engineering class of 1924 shows the following:

Exactly 42 questionnaires were mailed out, but only 26 replies were received. Of these, 25 said they liked their work very much. In answer to the question, "Would you care to change?", 12 said they didn't want to change at all, nine would change if the consideration was great enough and five wanted to make a change. As to the number of changes already made since leaving school, 16 were in the same organization with which they first started; seven were on their second job, one on the third and two on the fourth. Eleven were in positions either pure mechanical or very closely related to it. 13 were in positions somewhat related to mechanical engineering, but more of a business or salesmanship type. One was doing purely electrical engineering work and one civil engineering work. 19 answered that a college education was necessary for the performance of their duties and seven said it was not necessary at present, but would be valuable later on.

The average salary wanted to start with if they made a change was from $175 to $225 per month; the most asked for was $300 per month and the least $150 per month.

With the exception of three who took a year of graduate work, these men will have been out of school two years in June.

Broadcast Station Remote Control Devise Is Developed

A new type of control equipment whereby it will be possible for a radio station attendant to immediately set in operation a broadcasting station several miles distant by simply turning an automatic telephone dial, has been developed by members of the Electrical Engineering Department working under the direction of Professor G. W. Swenson together with the cooperation of the Engineering Department of the Gold Medal Station, WCCO.

In tests made recently, it was found that the transmitting station of WLB which was linked with WCCO, can be automatically turned on from WCCO operating rooms without even an operator being on duty at the university transmitter. The device which was used has been developed by Lawrence Hafstad, senior electrical, and John K. Hilliard, graduate student.

The unit is so complete that it will turn on the amplifier, start the motor-generator, throw a change-over switch to remove the ground and connect the antenna, and apply the high voltage to turn on the carrier. The only equipment necessary at the WCCO studios is a small automatic telephone dial, which sends a series of impulses over the line to the university station according to the number dialed. These small electrical impulses operate a relay at the university station which in turn operates a more powerful relay to turn on the power at that station.

The unit was also designed to be used on remote control broadcast to eliminate the necessity of having an operator at the place from which the program was coming. For instance, if a station is broadcasting a program from a church or cafe, it has always been necessary to have an operator on duty to operate an amplifier. With the new system it will be possible to install the equipment at a place from which the program is to be taken and then automatically control it from the WCCO operating rooms.

The equipment at the university consists of the 500-watt station formerly used by WCCO. It was loaned by the Washburn-Crosby company when the new 5000-watt set was purchased for the Gold Medal station. It is linked with WCCO and is used in cases of emergency when the high-powered transmitter develops trouble or when the lines between the studios at St. Paul and Minneapolis and Anoka are out of commission, as has been the case at times of severe storms. When such an emergency arose in the past it was always necessary to get in touch with the relief station in the electrical building and have an operator immediately go on duty.

Luethi, Johnson, Selected As Techno-Log Heads for 1926-27

The appointments of Carl F. Luethi, junior civil, and Sheldon F. Johnson, junior electrical, to the posts of managing editor and business manager of the Minnesota Techno-Log for the year 1926-27 was made recently by the Techno-Log board.

Mr. Luethi has been active on the editorial staff for over a year and his appointment is the culmination of a rapid rise from civil department representative and assistant editorship. He is an ensign in the Naval Reserve and also president of Tau Beta Pi, honorary scholastic fraternity for next year. Mr. Johnson has been on the advertising staff the past year handling local accounts. He was advertising manager of the Central High News and has had commercial experience.

Concurrent with these appointments is that of the selection of Lawrence A. Clousing, sophomore electrical, as editor-in-chief of the magazine for the ensuing year. Clousing was engineering editor on the Minnesota Daily for some time the past year and besides work on the Techno-Log, has been editor of the Psi-Ren, local publication of the Theta Xi fraternity.

Bachelor of Science Degrees Granted 169 Technical Students

Exactly 169 seniors were awarded diplomas at the annual commencement exercises held at the Memorial Stadium on the afternoon of June 14. The number receiving Bachelor of Science degrees in the College of Engineering and Architecture were distributed as follows: architectural engineering, 2; civil engineering, 33; electrical engineering, 70; mechanical engineering, 27; architecture, 5; interior decoration, 3.

School of Mines were as follows: engineers of mines, 8; engineer of mines in geology, 1; metallurgical engineers, 4.

In the School of Chemistry: bachelor of science in chemistry, 4; in chemical engineering, 12.

Five received Masters of Science degrees from the technical colleges and two received the professional degree of civil engineer. Two from the School of Chemistry received their degree of Doctor of Philosophy. In the military department, 27 engineering students were awarded commissions in the Officers Reserve Corps of the United States Army.

Parcel and Maney Complete Indeterminate Stresses Text

"Statically Indeterminate Stresses" is the title of the book by Professors John I. Parcel and George A. Maney of the Civil Engineering Department, which made its appearance on the technical press this spring. The lack of a text covering this phase of a structural building prompted the writing of this book and its issue marks several years of work.

The book aims to give a fairly thorough treatment of the fundamental theory of statically indeterminate stress analysis in so far as this theory has become embodied in the science of structural engineering. Main emphasis is laid upon principles and methods of attack and a special effort has been made to exhibit the essential unity of the subject.

Particular attention may be called (a) to the thorough treatment and wide application of the slope-deflation method, and (b) to the simplified solution of the secondary stress problem. It is believed that this is the first appearance in a textbook of so full a consideration of these subjects.

Within the limits of the work, every effort has been made to treat the theory in a clear, thorough, and logical manner, and to make the application thoroughly practical. A wealth of numerical problems accompany the text.

Memorial Flagpole Erected At Stadium, Is Dedicated

Due to intervention of the department of buildings and grounds, the senior class was not permitted to erect their flagpole on the proposed location between the main and experimental engineering buildings. Permission was granted, however, to set the pole in a prominent place at the end of the stadium and the memorial was duly dedicated on June 14.

Dean Leland and Dean Kelly representing the administration were present as were several faculty members and students. It is planned to add to the height of this standard and replace the old cedar pole now in use and which is in constant danger of collapse. This addition will be financed by the university.

Nine Members of Faculty Receive Promotions Recently

Promotion of the rank of several faculty members of the technical colleges was made at the recent session of the Board of Regents. They are as follows:

Associate professor to professor: Jacob O. Jones.

Assistant professor to associate professor: S. Chatwood Burton, George C. Priester, George H. Montillon, Lloyd H. Reyerson.

Instructor to assistant professor: Orrin W. Potter, George L. Tuve, Charles Boehnlein, R. L. Dowdell.

Dean O. M. Leland Is Named President of S. P. E. E. for 1927

Just as we go to press we learn that Dean O. M. Leland has been elected president of the Society for the Promotion of Engineering Education for the coming year at the convention held at the State University of Iowa during the week of June 14-19. This group is composed of faculty members of leading universities in the United States and has to do with the furthering methods of instruction for technical students.

AROUND THE WORLD WITH OUR ALUMNI

Architects

'20—Harry J. Korslund finished the course in architecture which he was taking at Harvard in 1925 and is now with William G. Upham, architect, to design and oversee the erection of a city hall for Norwood, Massachusetts. He plans to take a trip to Europe with Damberg ('21) before returning to the west. Damberg is with Strickland, Blodgett and Law, architects, in Boston.

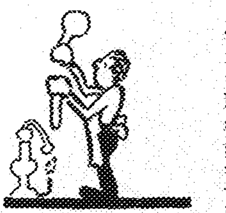
'23—Olaf Fjelde has accepted the Eveleth scholarship at Harvard University and will study next year towards a master's degree in architecture. He has been an instructor in architecture at the University of Idaho during the past year.

'25—Helen Jean MacGregor is studying architecture in New York City.

'25—Peter P. Bross is now located at Rochester, Minnesota, where he is with J. U. Miller, architect.

'25—Edwin W. Molander is in business for himself being located in Minot, North Dakota, with offices in the Union Metropolitan Bank Annex. He is in partnership in the firm Bugenhagen and Molander, Architects.

Chemists



'18—Goodwin Joselowitz, city chemist for Minneapolis for the last five and a half years, recently resigned from the position to take effect on June 30. The vacancy will be filled by civil service examination and by appointment. Mr. Joselowitz did not state his plans for the future except that he intended to spend the coming year in Canada.

The resignation was made to Dr. C. H. Harrington, city health commissioner. On entering the world war, Joselowitz was stationed at Edgewood Arsenal in Maryland in the Chemical Warfare Department. He lives at 2555 Bryant avenue south.

'20—We are the recipient of a letter telling of the arrival of a daughter, Margaret Elizabeth, at the home of Mr. and Mrs. Glenn E. Matthews at Rochester, New York. Mr. Matthews took movies of the young lady the fourth day after her advent into this world and will probably take more, as he is a research chemist for the Eastman Kodak company and specializes in moving picture photography.

Civils

'94—Andrew O. Cunningham, 62, Mayor of University City, a suburb of St. Louis, consulting engineer of the St. Louis Terminal Railroad Association, inventor and well known in engineering circles, died at 5:20 o'clock Sunday morning, May 9, at his residence, 6328 Washington avenue, after an illness of one week, induced by heart disease and pneumonia.

The St. Louis Globe-Democrat says of him:

Mr. Cunningham was born in Rangoon, India, in 1864, his father being Gen. Scudemore Cunningham, a British Army officer stationed at that post. He lived in India for fifteen years and when his parents returned to London, he elected to seek his fortune in America. As a youth he went to Minnesota, worked in the harvest fields, attended the University of Minnesota, where he was a star football player, and graduated with the degrees of bachelor of arts and civil engineering.

Shortly after graduation he made a connection with the Wabash Railroad, and after several promotions came to St. Louis as chief engineer of that road fourteen years ago. He continued in that capacity until two years ago, when he resigned to become consulting engineer of the St. Louis Terminal Railroad Association.

During the past decade he became well known in the engineering profession by virtue of having been a lecturer at Cornell University, a contributor to trade magazines and an inventor whose products came into general use by the railroads. He was the first engineer, it is said, to use concrete for bridge floors, and his patented process for "mattressing" the retaining walls along river banks is accepted in the profession. He was a member of the bridge section of the American Railway Association and of the American Society of Civil Engineering.

He was elected mayor of University City in the spring of 1925, prior to which he had served four years as a member of the board of aldermen. During his term of office he had turned his engineering skill to the benefit of his city, personally supervising the construction of a sewage system and being responsible in large part for the widening of Westgate avenue. Because of his expert knowledge and his willingness to dispense it for the public's good, he had been favorably mentioned recently as a candidate for president of the St. Louis County Court, although he had made no overtures in that regard.

He is survived by his widow, Mrs. Georgia Quinn Cunningham, to whom he was married twenty-three years ago, and three sisters, Mrs. Edmund Penny, Miss Alice Cunningham and Miss Annie Cunningham of London, England, and a brother, Bertie, an officer in the British Army.

He was a member of the Scottish Rite and the Shriners, being a thirty-second degree Mason. He was a member of Glen Echo and other country clubs.

Cunningham was exceedingly proud of his American citizenship which he gained by naturalization shortly after attaining his majority. He never returned to England after coming to America.

Indicative of his love for his adopted country was the fact that he refused to accept an earldom in England because it would have entailed his permanent absence from the United States. By the death of his father and the subsequent death of his older brother without issue, he became, by right of succession, the Earl of Glencairne, a proud title and a name of distinction. He declined, however, to go overseas to claim the title.

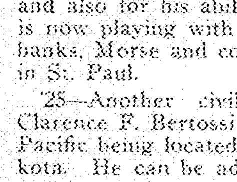
Following announcement of Cunningham's death yesterday morning, Eugene D. Ruth, acting mayor and president of the Board of Aldermen, issued this proclamation:

"Our city has suffered an irreparable loss in the death of its Chief Executive, Hon. A. O. Cunningham, who, for little more than a year, has served us as our mayor.

"In the office of mayor, and formerly as an alderman for many years, he gave the best that was in him to promote the progress of our city and the welfare of our community. He always worked faithfully and unselfishly for the good of all. The public has lost a true and sincere friend. We who knew him intimately grieve and mourn his loss beyond words.

"Because of his great public service during his many years as a resident of this city, I request that all of our citizens join with city officials in paying him proper respect and tribute. Let all who can attend his funeral at 3 o'clock Tuesday afternoon from his late residence. All places of business within the limits of our city should be closed between the hours of three and four of the afternoon of the funeral.

"The flag at the city hall and all other public flags in the city shall be placed at half mast and remain so for a period of thirty days in respect of the memory of him who was our friend and leader."



'11—George C. Mattison now commands the United States Coast and Geodetic survey steamer "Ranger" which is engaged in making a survey of the West Indies. His address when on land is 15 McCleary, s. o., Cor Cordero, San Juan, P. R.

'23—Frank B. Christlieb who will be remembered for his tuneful melodies which he wrote for Arabs former productions, and also for his ability to play the piano, is now playing with oil engines for Fairbanks, Morse and company and is located in St. Paul.

'25—Another civil is in railroading. Clarence F. Bertossi is with the Northern Pacific being located in Fargo, North Dakota. He can be addressed at 1019 First avenue south.

'25—The call of railroading has been heard by John A. Banovetz who is an assistant engineer with the Northern Pacific railway and located in the Bridge Department of their Minneapolis branch.

'25—William C. Auxer is with Reeve, Hawkins and company and is located at 4505 First avenue south, Minneapolis.

'25—Garvin E. "half pint" Peterson is with the army engineers in Milwaukee and is engaged in harbor survey work. From all reports he is working as hard as ever and is also pounding the old drum in his spare time.

'25—Harold "Boozy" Beese and Frank "Duke" Austin are with the U. S. Engineers on a survey of the St. Croix River. Austin returned from California late last winter where he was employed as a movie actor and cab driver. He now demonstrates his ability in the latter profession by driving Beese to town every week, in fact some weeks two or three times.

'25—Miss Ursulla Quinn is in the offices of the Western Union Telegraph company at St. Paul. She is one of the few woman graduates in civil engineering.

'25—Clarence R. Peterson, who is now a draughtsman with the C. M. and St. P. railroad and is located at 1575 West Monroe street, Chicago, visited friends on the campus recently. He says that he likes his work very much and that Chicago alumni are organizing.

Ex-'27—Dick Scott is in town at present and expects to leave soon for the Glacier National Park where he will be employed for the summer. He has been attending theological school in Wisconsin for the past year where he has been studying for the Episcopal ministry.

Electricals

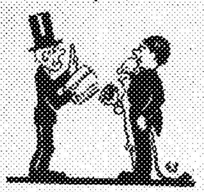
'08, '09, '11—Dr. L. W. McKeehan of the Bell Telephone Laboratories gave a series of lectures before the Franklin Institute of the State of Pennsylvania under the Bartol Research foundation during the month of April. These lectures were concerned with the magnetistriction in iron, nickel and cobalt; in alloys, compounds and in non-uniform bodies.

'08—Glenn H. Hoppin is associated with "Bill" Stout in his all-metal airplane building enterprises at Detroit as secretary and assistant treasurer. His address is in care of the Stout Air Services, Inc., 3-216 General Motors Building, Detroit.

'08—Alfred B. King is the eastern sales manager for the Electric Machinery company of Minneapolis. His headquarters are at 52 Vanderbilt avenue, New York City. Harold W. Dahl ('24) is traveling for them in the east and is making his headquarters at the same address.

'14—The design and execution of the elaborate lighting effects for Aida, outdoor opera which was presented in the Memorial Stadium of the U of M on June 4, was under the direction of Elmer W. Johnson of the electrical department. Mr. Johnson was transferred last year from the department of mathematics and mechanics to the electrical department and advanced to associate professor.

'19—Arthur P. Peterson who is field representative of the Electragists-International, is active in work of that organization in all parts of the U. S. He can be addressed at Room 602, 15 West 37th street, New York City. Peterson was a former instructor in the department of drawing and descriptive geometry at this university.



'19—The marriage of Albert E. Peterson to Miss Mary Louise Osgood occurred on April 17 in Chicago. Peterson is with the Commonwealth Edison company as engineer in their Fisk street station. He can be addressed at 3417 West Adams street, Apt. 2.

'20—R. M. Peterson sends us a card announcing the arrival of Charles Richard on May 26. Mr. Peterson is with the Northern States Power company in their St. Paul branch.

'23—Charles M. Burill was a recent visitor on the campus. He will soon complete the two year advanced engineering course of the General Electric company at Schenectady. Burrill is now in the radio department after being in several of the company's departments at their various plants.

'23—Vernon Babcock who is in the Detroit office of the Cutler-Hammer Electric company, recently reports having spent a week-end with friends in the suburbs of that city where he met Sidney Smith whose summer home is in that neighborhood.

'24—Clarence W. Teal will be in the employ of the N. W. Bell Telephone company after resigning his position as treasurer of the Engineering Appraisal company of Minneapolis. He will be remembered as a former managing editor of this publication and also president of the Arabs.

'24—Laurence C. Warren who has been on the test course of the General Electric company for the past year and a half is now with the International General Electric company with his headquarters still in Schenectady, New York.

'24—Fayette C. Anderson visited friends on the campus during commencement week. He drove from Schenectady, New York, where he is with the G. E. company.

'24—Charles T. Skarolid who has been with the N. W. Bell Telephone company since graduation, is contemplating a trip around the world and expects to be gone for several years.

'25—Kenefick Robertson who is with the Northern States Power company at their Sioux Falls, South Dakota, branch spent Decoration day in the Twin Cities visiting old friends. He was a former editor of the Techno-Log.

'25—Clarence W. Thyberg is finishing his training with the Western Union Telegraph company at their Minneapolis offices and expects to be transferred to other branches in the near future.

'25—Robert V. Ludlum, who has been with the Century Electric company at St. Louis, Mo., recently severed connections with that concern and is now located in Minneapolis.

'25—Harry H. Schneckloth is a central office equipment engineer in the chief engineer's office of the Northwestern Bell Telephone company at Omaha, Nebr.

'25—Roy Franzen has been spending his two weeks vacation in the Twin Cities. He is with the Western Electric company of Chicago and having completed the student training course is now an investigation engineer. Franzen says that he enjoys meeting other alumni at the rallys held frequently at the Y. M. C. A. in the loop. His address is 244 North Waller avenue.

'25—Carl C. Nelson has finished his graduate work at Massachusetts Institute of Technology and received his M. S. degree recently. He is spending a short vacation in the Twin Cities before going East again. In all probability, he will be with the Westinghouse company.

'25—Ernest G. Albrecht is in the Transmission Department of the Tri-State Telephone company in their St. Paul offices. He can be reached at 898 East Fifth street.

'25—Henry F. Brossard has been with the Northern States Power company since graduation and is studying the problems of rural electrification.

'25—Charles J. Cosandey is an instructor in the department of electrical engineering at Iowa State College at Ames, Iowa.

'25—Ikel Benson and Henry Reed have received their appointments as teaching fellows in the department of electrical engineering at the U of M for the second year.

Mechanicals

'08—H. Cole Estep is now the vice-president of the Penton Publishing company of Cleveland. This firm publishes several trade journals and other technical literature prominent among which is the Iron Trade Review, Power Boating, Marine Review, The Foundry as well as the Daily Metal Trade, a daily newspaper dealing exclusively with matters pertaining to the iron and steel industry. Mr Estep was formerly the firm's European representative with headquarters in London. Mr. Estep has the following to say concerning technical journalism as a career for the graduate:

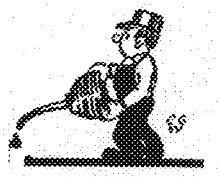
Modern engineering progress is vitally dependent upon the constant interchange of technical, scientific, and business information. Engineers on the Pacific Coast must know what their confreres in the Mississippi valley and the East are doing and vice versa. Industrial executives likewise find it necessary to keep fully advised not only of the latest developments in manufacturing processes, but also the movements of the markets, prices, volume of orders placed, and the thousand and one constantly changing factors which go to make up the business situation. To fill this great essential need for accurate and up-to-date information, regarding technical and commercial developments, American ingenuity and resourcefulness has developed a group of business publications which cover all branches of engineering and commercial activity thoroughly.

In the past two decades, the publishing of business and technical papers has grown to an exceedingly important place in American commercial affairs. The aggregate capital invested in this line of activity runs into millions of dollars, while the expenditures of only three or four of the leading publishing organizations adds up to around $25,000,000 a year.

Furthermore, business journalism, affording as it does an unusual opportunity to make contacts, opens the way to many attractive opportunities, but the writer would not recommend it merely as a stepping stone. It should be entered with the full understanding that it is a line of work offering as great an opportunity for a complete career as any other.

'24—To the furthermost parts of the world is the direction of Glenn Larson, who left recently for a jaunt around the old sphere. Upon graduation, Glenn was with the Stockland Road Machinery company of Minneapolis and later played in the Minneapolis Symphony as well as other orchestras. He plans on travelling leisurely and to be gone over a year.

'24—The aviator of the '24 class, Paul M. Boyd is now in Garden City, Long Island, New York, with the Curtiss Airplane and Motor company as a project engineer.



'25—General manager of the Specialty Manufacturing company, located at University and Raymond avenues, is the title of Ronald W. Boss. Not so bad for one year out of school, eh what?

'25—Axel B. Algren has advanced to the position of production engineer with the A. T. Rydell, Inc., manufacturers. Algren can be addressed at 2300 Second street north, Minneapolis.

'25—"I'm having a capital time in Washington," writes Alfred J. Jacobi who is with the U. S. Patent office as a junior patent engineer.

Miners

'18—Guy E. Ingersoll is now chief engineer of the Talache Mines, Inc., at Talache, Idaho. For a vacation last summer he drove from Miami, Arizona, to San Diego, California, then to Tiajuana, Mexico, up to Portland, Oregon, and along the Columbia river highway across the state of Washington to Northern Idaho.

'22—After spending six months in various mining camps in western United States and Canada, Arnold A. Gustafson is back in Crosby, Minnesota, doing exploration work at Rabbit Lake, Cuyuna. He is with Pickards, Mather and company.

'24—The engagement of Willard C. Jensen of Anaconda, Montana, and Pauline Hagen of Minneapolis has been announced. The wedding will take place early in June. Miss Hagen is a graduate of the Chicago Academy of Fine Arts.

'25—Alvah J. Haley is a group sampler for the Anaconda Copper Mining company in Butte, Montana.

THE past year has been one of steady advancement of the technical colleges in all lines of endeavor. A careful glance through all of the departments, the personnel, the student life and activities, reveals marked growth. In closing this volume, we can well reconsider for a moment some of the events of the closing year.

The addition of a course leading to a degree in agricultural engineering was announced early in the fall. Though the registration has been light, this will gradually become an important part of the curricula at this university, and very appropriately so, Minnesota ranking as she does, a leader in agricultural pursuits. It is in keeping with the movement to better farming and farming conditions. The application of engineering methods marks the downfall of the "old school" way of doing things. Farmers of the future—college graduates and ones well versed in the technical sides of the profession, will be better qualified—true engineers of the soil as they rightfully can be termed.

The department of architecture has been changed to a school. The organization remains the same, but this change in nomemclature is a step forward, one of anticipated expansion. In passing we can well comment upon the work of this branch of the college with its many successful graduates, its efficient faculty, and its very good spirit of cooperation.

Closely related with the architectural department is the founding of a professional course in interior decorating and the graduation of the first students to receive their professional degree. Preparation is required in the College of Science, Literature, and Arts but work is later taken in our college and the degree granted therefrom. Though this is a highly specialized line, it is nevertheless distinctive and will be subject to growth.

The college has been unfortunate this year in the loss of several of its prominent faculty members. James H. Forsythe, associate professor of architecture and consulting architect to the Board of Regents, died on last November 1. His rise to an associate professorship was rapid and as head of the student's work committee, he displayed a rare sympathy and understanding of student's problems. The Mechanical Department mourns the loss of John J. Flather, professor of mechanical engineering and head of the department. Under his tutelage, that division grew till it now enrolls over 200 students. Professor Flather was noted as an author and his texts as well as articles occupy a prominent place in the engineering field of letters. In the death of George D. Shepardson, professor of electrical engineering and also head of his department, that division lost its creator, for it was he who developed it from a motley collection of instruments in the corner in the old chemistry building to its present splendid establishment with laboratories noted the country over.

The places of these men will be hard to fill. In every instance, they have seen their department develop. All honor and glory is due them for accomplishment.

Perhaps the most outstanding undergraduate accomplishment has been the founding of Plumb Bob, an honorary society in the College of Engineering and Architecture and the School of Chemistry. Exactly 15 men were chosen at the spring election upon their qualifications of leadership, scholarship and service towards the technical colleges and the university at large.

The senior class, the largest yet to graduate, is one which reflects much credit to the college. Singularly enough, the senior of 1926 is one who has seen perhaps more physical development of the technical campus than any other. A brief four year ago, this part of the university had a much different appearance. The new library was in the first process of construction; the spur track divided the campus and engineering students had to negotiate an old iron bridge before gaining the main building. Northrop field was in use as was the ancient electrical building as well as the old post office.

The library has been in use for over a year. Gone are the tracks and in their stead lies a flat, green quadrangle flanked on one side by the new administration building and on another by the electrical engineering building. New roadways, walks, a bit of landscape gardening and the technical campus presents a striking appearance. It has been interesting for seniors to note the past developments, occurring as they did with their onward march in the pursuit of education.

Appropriations have been recently made for a new physics building. The highway materials laboratory is nearing completion; it is only a matter of time before mechanical engineering will expand into new buildings.

Our graduates are winning success in every field; the vigor of the student body is a byword; our faculty are gaining fame in all educational lines; some are national authorities. The greater Minnesota Technology is here in spirit—a spirit of expansion that will find home in the structures of the future.

JUST what qualities in an engineering graduate do large companies deem most desirable, what phase of the student's collegiate training must he stress most that he make his career most successful? Students often wonder what the representatives of big concerns consider most in their interviews. The other day, we unknowingly ran across the following article in the Saturday Evening Post, written as an interview with the employment head of a large eastern company. It brings out many points which were new to us. One of these was the disregard with which employers regard the faculty grading given the various students. Thinking that this story would be of interest, it follows in full:

Every year numbers of big companies send representatives to colleges to interview seniors. When promising young men are found they are invited to sign up for jobs, reporting for duty

(*Continued on page 298*)

Across the Editor's Desk

Summertime

Vacation time has many meanings to different students. For some, it is a grand and glorious chance to loaf; to others, it is a chance to work and replenish the pocketbook that their program of education may be furthered. Some of the more fortunate will travel, even though a cattle boat will provide the passage to Europe. Many will spend the summer back on dad's farm or in the old home town.

Summer days, though a period of mental rest, should furnish a supplemental part of one's education. Particularly for technical students is this true. Work with engineering firms in some capacity, however menial, is advised. Though it may be only as a lowly rodman in a surveying crew or the 'boy' who makes blue prints in a construction gang, certain contacts are made with the profession that are valuable. You will be with engineers, those of the school of hard knocks and also college trained men. A certain respect and understanding will be forthcoming; your chosen life work will take on a clearer aspect.

An experienced engineer has asserted that summer vacations are the time for certain shop work, not during test courses after graduation. Each undergraduate should so spend his time for the next three months that he will be healthier, wealthier, and, we hope, wiser before October comes. Whatever you do, give the old brain a good rest. Play is as important as study.

Student Societies

There is a constant cry that student populace is becoming overorganized. When one glances through the long list of clubs, societies and other kinds of organizations that exist on our campus, he is lead to believe that this is true and especially when he runs across many whose names are unfamiliar.

Organization is valuable, that is, active organization. Ones that exist for the sole reason of furnishing gratification for its members in belonging to something have no reason for life. In turning to our own campus, foremost among our clubs are the student branches of national engineering societies. Two of these have been quite active while the others have been dormant.

We firmly believe that if the rest of these societies do not show more signs of virility, they should cease existing. Let us sincerely hope that the next year will see a new burst of life and that all of our own organizations will justify their right of existence by some exertion. In doing this they will set a precedent for others.

Read the Newspapers

Have you ever noticed the great amount of engineering news that appears in our newspapers? Every day the observer will note items of a genuine technical interest in the columns of the literature of the populace. It is true that they do not carry s t r e a m e r head-lines, but nevertheless, sometimes even on page one, are stories telling of recent achievements, new plans and developments, proposed changes in civic structures, local and national in character.

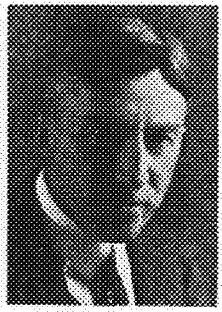
One of the tests of learning is to recognize its principles in practice. Most commonplace, yet before the eyes of all are recorded the progress of our profession, more and more each day. This recognition is increasing, as does the service the engineer is rendering to mankind.

Finis

And now the year is over. It has been pleasant to appear each month before you: it has been a pleasure to record the events of the ever energetic student body, the notable achievements of our alumni the world over. We have endeavored to mirror the true engineering spirit of Minnesota as evidenced by her students and faculty, her worthy alumni.

The year has been most successful in all respects. It has been one grand round of events since last fall when we were the first publication to appear on the campus till today when we issue the June number, the largest one ever published and with more readers than ever before. In passing, we acknowledge the scores of friendly relations with all departments of the college, the Dean's offices, their forces, the staff members, Art O'Shea of the Bureau of Engraving, Martin, Einar, and Chris to say nothing of "Bill" of the Lund Press as well as many more whom space forbids mention. The efforts of Ted Corbett, 'Doc' Halbkat and Clarence Johnson on the editorial staff have been worthy.

And now as we mark "30" on the last piece of copy and close the battered desk, we pause in passing to bid all a farewell.



FACULTY SKETCHES

William H. Kirchner

It has been a long time since our 'old man' of the engineering college, Professor William H. Kirchner first awoke to the fact that he was out in the cold world. In fact, he voiced his first cry in the battle of life on the day of October 24, 1868, at Otter River, Massachusetts, which is in the town of Templeton. As his name implies, he is of German descent.

He attended public school at Templeton and at high school participated in all of the activities there were, namely baseball, it being the only one. On the baseball team he filled the position of pitcher, a southpaw, and was also manager. It has been such a long time since the school days of Kirchner that modern football and basketball were unknown.

Kirchner went to college at the Worcester Polytechnic Institute and graduated in 1887. There it was all work and no play and no secret fraternities, either honorary or social were permitted. In college he specialized in the design and manufacture of textiles and also became somewhat of a linguist, having studied German, French and Italian. Following graduation, he spent a year visiting all of the large textile establishments in New England. He then decided to teach and accepted a position with Rose Polytechnic Institute at Terre Haute, Indiana, in 1888, as instructor in drawing and mathematics. In 1890 he was advanced to the position of junior professor in drawing and also made librarian.

It was in 1894 that he came to the University of Minnesota as assistant professor in charge of the department of drawing and descriptive geometry. In fact he was the whole department. At that time the department was located in the old Mechanics Arts building, which is now occupied by the School of Business. The machine shop occupied the north half of the basement, the wood-working department and the experimental laboratories were on the other side and the foundry and forge were in the rear part of the basement. The drawing rooms were on the second, third and fourth floors and the roof was also used, as some of the early grads will recall. The main part of the building was taken over by the civil and mechanical engineering, drawing and mathematics departments. In 1907 Kirchner was advanced to full professorship

The engineering library was also located there and the room in which the few books were kept was sometimes used as a classroom. Professor Kirchner has been very interested in the development of the engineering college library. He had charge of the library after leaving the Mechanics Arts building, and has been a member of the college library committee for more than 10 years.

Professor Kirchner has served on a number of committees—the students' work committee, the program, the senate committee of education, the bulletin, the committee on unclassed students and the advisory committee. He has been a member of the Engineers' Bookstore board since its inception. Kirchner has been interested in all student activities and is a staunch supporter of Arabs, engineering men's dramatic club.

A number of engineering societies claim him as member. He is a charter member of Sigma Xi, a member of the Mathematical Association of America, of which he was chairman of the Minnesota section in 1925, member of the Society for Promotion of Engineering Education, the American Mathematics Society and the Circolo Mathematico di Palermo, an Italian society. In the year of 1923-24, he toured Europe during sabbatical leave. His only weakness is fishing.

In his classes have been many members of the present faculty: Professors Erikson, Cutler, Ryan and Pease, Rodney West, registrar, and Henry Hildebrandt of the department of buildings and grounds, not to mention some 30 or 40 younger men, such as Professors Herrick, Hermann, Lagaard, Lang, Maney, Eggers, Levens, Potter, Johnson, Todd, Hartig, Wilcox, Boehnlein, Robertson and Tuve, who have sat at his feet in learning.

(*Continued from page 290*)

shortly after graduation. One of these scouts for new business talent has just returned from a trip that took him to numbers of leading colleges. I asked him if he found any difficulty in deciding which of the men he wanted.

"Not a bit!" he assured me. "The boys we want stand out from the rest like new roadsters in a fleet of motortrucks. I can usually spot them before I talk with them. You see, we are looking for men to join our sales staff. Our products are scientific and technical, and we want to get men who have majored in engineering and science. But we must have men with a commercial point of view—men to whom selling appeals instinctively. Men of that type enjoy meeting people. They sell themselves to us without being egotistical. They have reasons why they want to come into our business."

"Do you mean," I asked him, "that the men you want were born with the sales instinct, and that the commercial urge has governed the activities of those boys right up to the time you meet them?"

"In some cases, yes. For example, I often find that the men I have selected had newspaper or magazine routes when they were in school. During summer vacations they may have sold subscriptions or aluminum ware or lighting units. But I like to believe that any boy who wants to get into business can start the minute he makes up his mind to develop himself for the job. Good commercial sense is really good common sense, specifically applied. Some of our division managers of 1936 are training right now on the campuses of a dozen different colleges."

"In classrooms, or out?"

"Now there's an interesting point! Classroom work is basic and important. Don't make any mistake about that. So is the ability to fit into the routine of a business organization. But the things that get one man promoted faster than the average are the things he does outside of routine, without neglecting his basics. I think the same principle holds true on the campus.

"You know when we visit a college to interview seniors, the faculty representative in charge of employment relations gives us a list of the seniors, with their ages, grades and a brief rating of their personalities and capabilities. Unfortunately, these faculty opinions seem to be based on how the student looks from the platform end of the classroom. Here! I have one of the sheets in my pocket. Let me read you some typical faculty opinions:

" 'Low grades: not desirable.'
'Just passes: not recommended.'
'Honor man: excellent material.'
'Fine ability; highest marks in E. E.'
'Cannot recommend: conditioned math in freshman year.'

"Let me tell you about Mr. Just Passes. We found out that he is working in a bookstore afternoons and evenings, writing the advertising for two local stores, paying his own board and room and sending money to his kid brother in prep school. This boy's father died the year he was to enter college, but that didn't even slow him up. Why, this lad is a business man already. Responsibility? He has majored in it for three and a half years!"

"That's an unusual case," I suggested. "What are some of the outside-of-routine things that the average man can do in college to make him better commercial material when he gets out?"

"Well, class and student-government work always helps. A boy who runs for the job of class president and gets it, learns a lot about selling himself to other people. If he holds the job down with any degree of credit, it is because he finds how to get other people to work with him and for him, how to mediate wide differences of opinion and how to lay a straight course toward a definite objective.

"Then there are the management jobs in athletics. Did you ever think of the problems a football manager has to solve in running the business side of that sport for one term? First, last and always, he has to have money. He has to get it, account for it, and spend it right. He has to see that the team has properties, correct in quantity, quality and price. He has to be a traffic expert to get his team to the right place at the right time. If he starts too soon, the faculty demands to know why the team should miss all those lectures. If he starts too late the team has to go into the game without sufficient time to rest up after the trip. He has to plan for schedules, issuing of tickets, alumni reservations and parking privileges. I want to tell you that a student who manages a college team for a season and does a good job is several kinds of business man when he gets through.

"Another activity that does its full share of business initiation is the college publication. A student enters the competition for the business staff of a college paper in his freshman or sophomore year. He does clerical work in the office, typing letters to prospective advertisers, following up cuts and copy for advertisements already contracted for, and other routine jobs. If he is not eliminated for incapacity he gets a chance to go out after advertising. In order to score at this job he has to persuade business men to part with money, and when he finally succeeds in getting some advertising contracted for, he usually has to write the copy himself. Suppose he wins his competition and lands the job of assistant business manager of his paper in his junior year. As a senior he becomes business manager. In that job he is responsible for the sale of advertising space, for the credit of the advertisers, for the collection of bills, for the purchase of paper and engravings, for execution of the contract with the printer. He has to check the work of the circulation manager, making sure that circulation is not falling off, that expiring subscriptions are promptly renewed, the copies come out on time and get to the news stands when they should. He has to meet the office rent, replace worn-out equipment, check the light bill and see that the temperamental art staff doesn't pay a dollar a sheet for cold-pressed drawing paper, which ought to be available at thirty-four cents.

"Now, when a man who has been through a few years of that sort of experience and kept his marks up above passing comes into the employment secretary's office for a chat with me, he isn't worried or nervous or self-conscious. He is used to dealing with business men. I'm just another one. He'll be sizing me up as rapidly as I am forming an opinion of him. He wants to know how our business is run. About how much should a good man be able to earn in five or six years? What happens to our branch managers when they are ready to go higher up? How many of our directors are college men? What will be the market for our products twenty years from now? How fast are we approaching saturation?

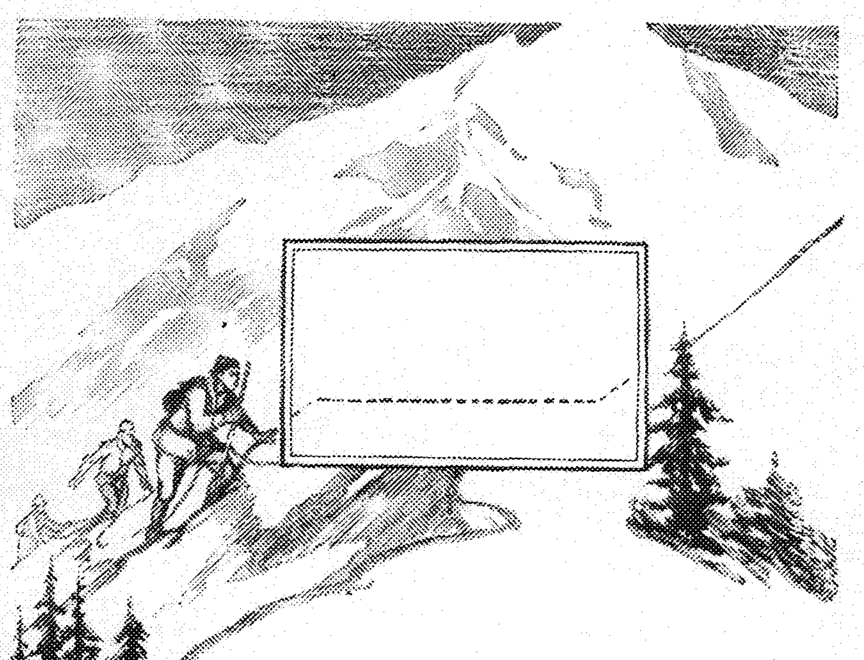
"That's the type of boy we like to talk with. That's the type of boy that stays with us and develops faster than the average. Give us the chaps who do the routine things well, and the extra things exceedingly well. We need a lot more than we can get!"

—CHARLES LOOMIS FUNNELL.

DURING the past four years, an all-engineering man's dramatic club, Arabs, has each spring presented a musical comedy. The absence of the annual show this year leaves a vacancy in the pleasant round of activities—something is missing.

The decline of an institution of this sort is alarming. It shows a certain lack of student spirit and interest which is so needed in a large institution such as ours. Four years ago, interested persons assembled and formed this club and under the guidance of a willing faculty member and backed by several of the older teaching staff, the group soon came into full power. The Caliph of Colynos, presented in April, 1922, as a curtain raiser, proved a great success, financially and otherwise. Every line of patter and every note of its fantastic music was written by club members—hard-boiled engineers commonly thought of as lacking in sophistication. The club, which now numbered about 60 men, prospered and in 1923 again gave to the university populace a musical extravaganza, the Blue God, from the pen of Glanville W. Smith, one of the most prolific writers the campus has ever seen. This play, "fast, light and rollicking and with a plot" to use their own words, went over big and the organization prospered.

It remains for some enterprising student to start things going again, to rally all of the old, to gather in those who are new. A lot of pep and industry was necessary to start Arabs, an abundance was needed to keep it going. Enthusiasm, as evidenced on April 23, leads us to predict that this band of players will have a new birth, the eligibility rules and envying onlookers notwithstanding. Hasten the day when another Flim-Flam, a Princess Gardens-In-the-Rain or even Mona Lizzie herself will disport on the boards—when Arabs have emerged from their tents of lethargy.



Disadvantages of the Big Company

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in being caught for K. P. duty and was busily engaged in partially getting the bean stains off the knives and forks until about 8 o'clock at which time, being an industrious and conscientious young man, I promptly reported at the study hall. Upon arriving there I was taken into custody by the M. P.'s for being late to study hour and, without opportunity for explanation, was taken to the company headquarters and finally relegated to the floor in a cold, draughty upper hall to spend the night. A somewhat analogous incident experienced while in the employ of one of the big companies of the electrical industry comes to mind. We were all working on test. Each test required two men, and one man was put in charge of the test while the other man was supposed to take orders. While I was in charge of one of the tests one of the "higher-ups" in the company, which class of individuals are commonly referred to in a mysterious fashion, but are never seen, got the idea that production on our test was falling off and accordingly expressed such opinion to the man in charge of our test floor. To remedy affairs this man in charge of test immediately issued an order reversing the authority on each test; that is, every man who had been in charge of a test was demoted to assistant while the former assistant went into charge of the test. This all took place, of course, without any specific inquiry into the individual capabilities of the various men. My assistant at the time happened to be a nice young fellow who had been taking engineering for a pastime and had rather unwittingly dropped into the student course not knowing what it was going to be like. After he was put in charge of the test our first job was on a big direct current motor and, after puzzling for a time on the situation, he came to me and in a cautious tone asked me to tell him just how the current got into the armature of a DC motor anyway. Needless to say I was convinced that the whole proposition was being operated in the most efficient fashion possible.

I am not arguing that this practical experience is not necessary to the young engineer. It is. But it can be obtained without making a "wop" out of yourself, and the best time to get it is before you ever graduate from college so that when your college course is completed you are ready to step into an engineering job instead of a laborer's job and to begin to learn the practice of your profession without having first to serve time as a laborer under conditions which are at best but doubtfully satisfactory.

After the young engineer gets off the student course he is usually assigned definitely to some one of the departments of the company. There he usually meets promptly the first sad experience of his newly begun engineering career. He finds that he hasn't any work to do and furthermore cannot get any. He is told that he has not the necessary experience to enable him to take over any responsible work, and therefore he must read technical magazines, reports, papers and the like until he feels qualified to become the editor of the A. I. E. E. Journal or Snappy Stories. This attitude which the young engineer frequently meets is entirely wrong and unfair. The only way to get experience is to take over and do work involving real responsibility, and there is no reason why you should have to wait until you are fifty before you get the chance to do it. One of the reasons for this enforced idleness among the younger engineers is the desire of the "straw bosses" in charge of the various engineering groups to have under them as many men as they can gather into the fold. This in turn is due to the tendency of the companies to rate the importance of their men according to the number of men reporting to them. If some of our big companies would fire half of their employees, put the rest of them to work and pay them the salaries which were previously paid to those who were fired, a much better and more wholesome situation would be established.

But the young engineer inducted into this regime of enforced idleness must appear to be busy. When he comes in in the morning he must arrange his stock set of blue prints before him on his desk, get out his slide rule and other equipment and, having thus set up the camouflage for the day, he may proceed to his task of doing nothing. The question of whether this man will be successful in his position is usually not a queston of his ability but rather a question as to whether he can adjust himself satisfactorily to such conditions as those just indicated and others in such a way that he will himself be satisfied and will at the same time get along smoothly with his superiors. The reactions of young engineers under these conditions are interesting. Some chafe under the idleness into which they are forced; some like it on the theory that they are getting their salary for nothing; a great many become indifferent and assume the attitude that "it might be worse" or "we are not faring so badly." At any rate it is usually a sadly different world than that which the young engineer had visualized before having had the chance to observe it at first hand.

When the ambitious young man in the employ of the big company finally succeeds in getting his first bit of work, he usually begins it enthusiastically, goes into it thoroughly and probably makes a pretty good job of it, considering that it is his first attempt. He works out the problem and writes his report on it. Naturally he would like to have the report considered by one of the older men in the company and would like to be told whether it is good and would like to have a fair criticism of it made to him. What usually happens, however, is that he passes it in to his immediate superior who lets it lie around on his desk for a week or two and then rewrites it for no good reason at all and without discussing it with the young man who prepared it. In rewriting it probably most of the changes made are mere matters of expression or language rather than anything which goes to the substance of the report, and as often as not the changes introduced make worse rather than improve the grammatical structure of the letter. It seems to be a chronic failing with most of the men who think they have a little authority in the company to criticize the work of their inferiors not from a fair sense of what is right and what is wrong, but rather from the aspect of whether or not it has been done in the way that they themselves would have done it. There is a great deal of difference between these two types of criticism, and it takes a large calibre man to criticize along only the first line mentioned.

All reports, of course, have to run the gauntlet of the various "bosses" all the way up the line. Each successive individual through whose hands the report passes must make some changes in it on the theory that if he passes it along unchanged his boss will think either that he does not know anything about the proposition or that he is loafing on the job. Viewed from the standpoint of our younger engineer time passes and nothing happens. Naturally his enthusiasm wanes. It is pretty hard to become enthusiastic over a proposition which you have worked out and then remain enthusiastic over it for a large part of the remainder of your life without ever hearing anything as to what has become of it. Probably after three months or so the report will come back down the line in unrecognizable condition. Not only has it lost its style but also a substantial part of its substance. In all probability certain parts of the report

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The net effect with either reducer is that the shadows of the negative are proportionately attacked the most, since they have less available silver to lose than the rest of image.

When a negative image has excessive contrast caused by overlighting or over development, a reducer of the second type is necessary. An acidified solution of ammonium persulphate is the only solution known to act on the heavy silver deposits more than on the lighted ones. A fairly satisfactory explanation of the chemistry of this reaction has been reached; and it is now known that silver sulphate is formed which dissolves in the solution.

When it is advantageous to reduce the printing time on a good negative, a true scale or proportionate reducer (type three) is sometimes employed. This solution consists of a compounded mixture of the permanganate and the persulphate reducers and it weakens the image in direct proportion to the amount of silver deposit present.

Although several methods have been worked out for chemically reducing the photographic image, it is quite another problem to add to or build up an image. As the saying goes, "what isn't there is hard to put there." A few solutions have been found, however, with which an underexposed or an underdeveloped image may be improved.

Usually intensification is performed by depositing a silver, mercury, or chromium compound upon the image. The most common mercury intensifier is Monckhoven's solution which uses a solution of mercury bichloride and potassium bromide for the bleach; this reacts with the silver forming a mixture of mercurous chloride and silver chloride. The image may be re-developed in several ways, with 10 per cent sulphite solution, with an elon-hydroquinone developer, with 10 per cent ammonia, and with a solution of potassium cyanide and silver nitrate, each solution giving proportionately greater intensification.

A chromium intensifier consists of an acidified solution of potassium bichromate which is used for the bleach. After a thorough washing, the image is redeveloped in a regular developer such as elon-hydroquinone. The chemistry of this intensifier is not very well understood but its use has found increasing favor owing to the ease and certainty of its operation and the permanency of the intensified image.

Tinting and Toning Film

In order to obtain more pleasing effects on the screen, motion picture film is often colored by treatment with various chemical solutions. Tinting is accomplished by evenly staining the gelatin emulsion or the support by means of slightly acidified dye solutions. It is rarely necessary to tint the emulsion since positive film on tinted support or base has been supplied for several years in nine different colors by the Eastman Kodak Company. This tinted positive film is printed and processed in the ordinary way. The use of tinted film thus eliminates several extra operations which are both expensive and troublesome.

Toning consists in changing the original silver image to a colored inorganic salt of silver or to a dye image. There are three commonly used methods of inorganic toning. In the first method, known as sulphide toning, the film is bleached in a ferricyanide-bromide bleach and subsequently treated with a weak solution of sodium sulphide which yields a final brown image composed of silver sulphide. Very beautiful blue tones are obtained by the use of a solution containing potassium ferricyanide and ferric alum in the presence of an alkaline salt of oxalic acid, a mineral acid and certain other salts. The silver image is thereby converted to a mixture of silver ferrocyanide and iron (ferric) ferrocyanide which forms the blue-toned image. Tones ranging from chocolate to reddish brown may be produced in a somewhat analogous way as the iron tones by the use of a bath containing uranium ferricyanide, the final image consisting of silver and uranium ferrocyanide.

If a silver image is converted more or less to a silver ferrocyanide image and the film immersed in a basic dye solution, a mordanted dye image is produced. What happens is that the dye will attach or mordant itself to the silver ferrocyanide, whereas it will not stick to the silver alone. This chemical reaction provides a method of obtaining a wide range of tones which may be still further extended by double toning. Basic dyes are the most suitable for use since they do not readily dye gelatin. Other effects may be produced by combined tinting and toning. For detailed information see the booklet, "Tinting and Toning Eastman Positive Motion Picture Film," published by Eastman Kodak Co.

Renovating Motion Picture Film

After film has been projected and handled several times, it accumulates a certain amount of grease and dirt which detract from its projection value. If this is permitted to continue, the film may be badly damaged by scratching from grit. It is customary to renovate the film by treating it with solutions which will dissolve the grease and loosen the dirt. Gasoline, benzene, toluene, and xylene may be used for cleaning film, but because of the inflammability of these chemicals, commercially pure carbon tetrachloride is preferable. All cleaning chemicals or solvents must be used with discretion, however, and the liquid allowed to completely evaporate before the film is rewound, or the image may be subsequently attacked. Traces of sulphur chloride present in impure samples of tetrachloride probably cause fading due to deposition of sulphur which combines with the image forming silver sulphide. If pure tetrachloride is used and the film wound spirally on a drum, and the solvent applied with a soft cloth or velvet, the solvent will have sufficient time to evaporate before rewinding the film. Another non-inflammable solvent which does not fade the film is tetrachlorethylene. Similar precautions for cleaning on a large drum should be used. There are machines on the market in which the film passes over several moist felt pads saturated with solvents and then over a series of polishing wheels made with small pieces of velvet fastened around the periphery of the wheels. The polishing wheels rotate very rapidly and ensure thorough drying and polishing of the film before rewinding.

It is now usual practice to apply a narrow line of melted wax to new or first run prints along the center of the perforation area which provides against the liability of strain in first projection. Similarly when film is renovated it should always be rewaxed as the cleaning chemicals remove all or nearly all the wax.

Splicing of film is essentially a chemical problem since the film cement must possess certain properties, such as good adhesiveness, fairly rapid evaporation or drying, and have no corrosive action on the film support. When film has been projected many times it sometimes acquires scratches which fill up with dirt and grease and show up plainly on projection. Cleaning the film removes the dirt from the scratches, but as soon as the film is put into use again the tiny grooves fill up as much as before. To prevent this, varnishes have been compounded for treating the film. Such varnishes have to be made very carefully as they must possess the same refractive index as film base, or in other words the varnish layer must not change the direction of the light rays when the film

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Sophomore Miners Sojourn in the Field

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us in the drawing room making contour maps and calculating the various problems of the past.

Having completed the surface work, we were introduced to a 28 hour day, which was taken up in plumbing the shafts of the mine and transfering the surface lines to the underground. The big day started at 1:30 p. m. on Saturday when the wires were hung and the first party went underground. Then followed the long tedious process of jiggling in a transit to set the required line. Having completed the first shaft, we were given an hour to eat and report at the other shaft. This started at 10:30 p. m. and by the time the last party had reached the surface, it was nearly Sunday noon. Here some of the boys received their first sensation and thrill of being underground. During the wee small hours of the morning there was heard the strains of a mouth organ playing "Show Me The Way To Go Home," and it expressed the attitude of all present. By noon the job was completed and all the boys were home in bed preparing for the morrow.

After the introduction the climb up the ladders was not hard. In a few days the gang was ushered down to work the underground territory where we were busy sighting on plumb-bob cords and taping the distances in preparation for mapping the entire mine.

Life has not been all work, for the evenings on which there is no night school, the boys are busy setting the styles and taking care of social obligations. The boys started the style of going bareheaded and the town has taken it up with enthusiasm.

When we had scarcely landed, the Junior and Senior Prom was held and we were invited, many of us accepted. This was the starting of acquaintances which for some have burst into thriving romances, the outcomes of which must yet be determined. As usual, the teachers' club is the retreat of many of our number, strange as it may seem. The main item is that there is no lack of interest or shortage of girls.

One evening the boys organized a kitten ball team to play the Chisholm champion team. The El Queeno were not a complete washout but a very close score in favor of them. Not to be outdone, another game was arranged for the next week with much better results, the score being 31 to 15 in favor of the college boys. No further games have been played, although one was arranged for the next week.

In two weeks the rambling heaps of tin and rubber bearing such inscriptions as 10,000 jolts, Jordan Plow Boy and the like, will wend their way to Eveleth where the geology trip will start. Here the mines will be left in the background for travel in the fields searching for outcrops and formations. Having seen the wonders of this section, we will journey to Ely where another type of forma-

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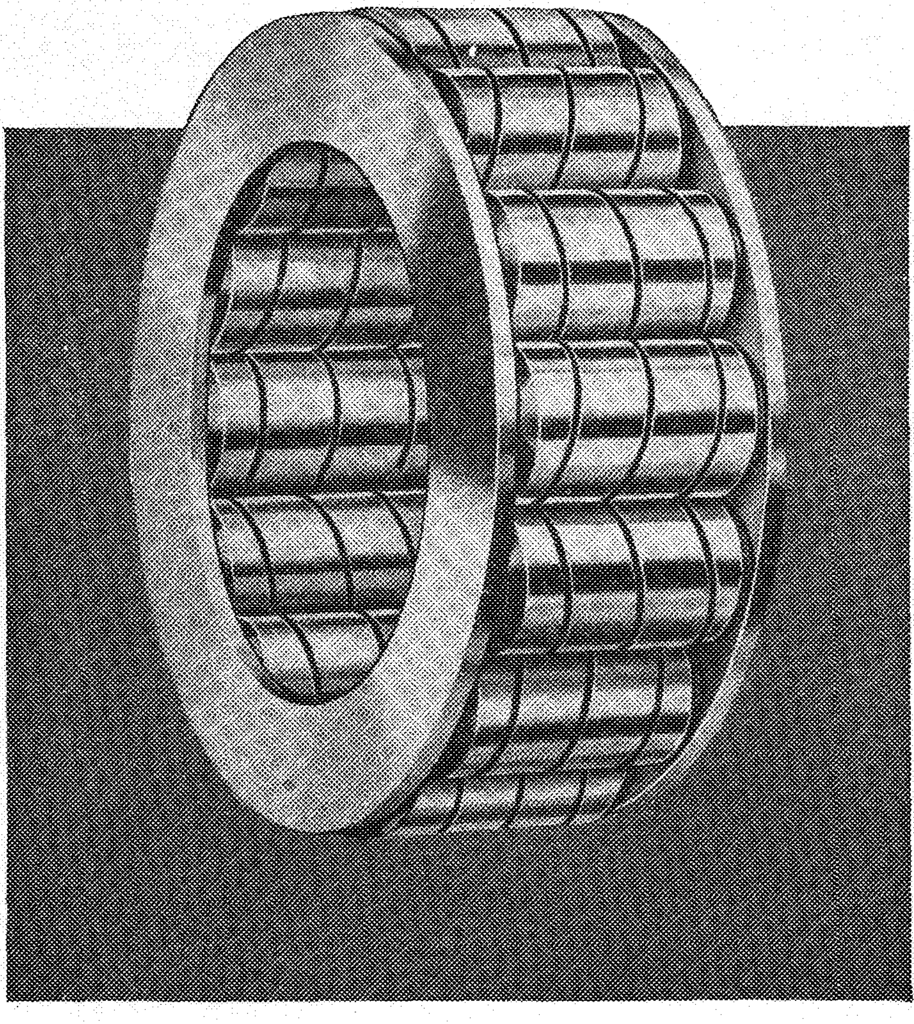

Disadvantages of the Big Company

(*Continued from page 300*)

have been changed by men not intimately acquainted with the facts on which it was based to such an extent that either by inference or positive statement the report is wrong. In short, it has been so operated upon and disfigured that the young engineer cannot, with any heart, place his signature on the approved report. Also the data upon which it was based has perhaps become antiquated or modified so that the report, which was intended to be acted upon three months ago, no longer accurately represents present conditions. And all this happens over a two day job that the young engineer would no doubt have been perfectly able to handle in a satisfactory fashion if he had not been interfered with by people who were supposed to know more about it than he did.

Another pet grievance of mine is the way big companies, as a part of their program of discouraging original thought, resort to the time clock system of rating their young engineers. The young engineer may or may not be required to go through the actual mechanics of punching a time clock,—in many places he does. At any rate the office hours are from 9 to 5 o'clock, or some other less desirable hours, and the young engineer must conform strictly to these hours. No overtime work is encouraged. It makes little difference whether he does anything during the day, but he must be there during the prescribed business hours. The man who checks in at one minute before 9 and checks out at 5:01 and shoots paper wads and puts thumb tacks in his neighbor's chair all day stands higher in the eyes of the company than does the man who gets to the office at 9:15 or 9:30 occasionally but often stays until 9 or 10 o'clock at night if he has some important work to do. In general the employee of the big company gets no thanks for extra hours of effort at home or in the office or for real conscientious application and hard work during office hours. The young engineer is judged largely on form rather than on the substance of his work. The supervisors and group heads are too often inclined to form an estimate of a young man's ability by looking at the left hand column of his time card and noting how many times during the month he checked in at the office later than 9 o'clock.

One characteristic of employment with the big company is that you have a life lease on your job. No one is ever discharged unless he exhibits too much initiative or fails to assent tactfully enough to the wishes of his superiors. Likewise, no one is ever advanced in position merely because of his ability. Time of service with the company is the important factor in advancement. Salary increases usually come yearly and in small increments. An aggravating feature of the salary situation is that, although you may have been working conscientiously all year, your neighbor at the next desk who has not done a piece of work from July to January gets his $300 raise just as you do. If you are the type of individual who wants to play it safe, who does not mind such inequalities and injustices as I have just noted, who wants something soft or who does not much care what he does as long as he gets enough money to make a living, the situation in the big company is ideal.

Advancement in position in the big company is largely a matter of physical hardihood and the ability to outlive your superiors. There is much to be heard about the lack of opportunity in a one-man concern based on the fact that there are no positions available and that the boss must die before any change in the company can take place. This no doubt is to a certain extent true, but it is infinitely more so in the big company than it is in the small company. In the big company you are, in the first place, confined in the matter of advancement to your own department. Immediately above you is your own boss; above him is his boss; above him is another boss, and so on practically ad infinitum. Before there is any chance for advancement somebody must die, and the minute that happens there are you and a hundred others from whom the one who is to be advanced is chosen. The chance of advancement is further minimized by the fact that life in a big company is easy, and your superiors are probably thriving on it and will live to a ripe old age. Quick advancement in a big company can, as I see it, be due to nothing else but pure luck. I often think that an excellent tonic for some of our big companies would be a large quantity of the business equivalent of potassium cyanide administered systematically throughout the organization.

I think the inherent character of the big company is admirably illustrated by its organization chart. Every big company has an organization chart. Likewise, every big company is proud of its oragnization chart. Copies of the chart are furnished to employees. The chart is a very systematic and orderly appearing diagram with the men or groups of men usually represented by squares upon the paper. The various individual squares are all connected together to show their relationship and order of authority. Every organization chart tapers up nicely at the top so that all of the various lines converge into the square which represents the president of the company. But the significant thing about these charts is that each man in the company is represented on the chart merely by his printed name, a symbol or most likely a small square or rectangle. Each of these little squares is like every other little square. This exactly typifies the attitude of the big company. Each of the numerous employees of the company is regarded as exactly like every other one of the employees. The employees are all identical little units cogged together to constitute the ultimate structure of the company, and each of the employees just goes on living from day to day in an endless routine of sameness. Again the army illustration comes up. The relation of the young engineer to the company as a whole is very much the same as is that of a private in the army to the army as a whole. He is cooperating and is correlated with every other employee of the company, but he is such a small unit in the machine that his individual effort meets with absolutely no response insofar as the net movement or activity of the company is concerned. His daily effort is not in any sense intimately associated with the direction of movement of the company, with its success or failure, or with any outward evidence of its operation. It is just routine.

Following further this idea of the submergence of individuality that takes place when one becomes a well-seasoned employee of a big company I think the most disappointing, the most deadening feature of the whole thing is the absolute lack of opportunity for individual attainment. There is no such thing for the big company employees as beginning a task and following it through to its completion. Each little phase or part of every problem is classified and handled in a separate department. You as an employee of the big company are a specialist, and you are supposed to do only certain things. The big company scorns the idea that one man is capable of doing a multitude of different things. For instance, you may be a designer of brush holders for direct current motors. You may keep on designing these little parts all of your life and never do anything else. You never have the opportunity of seizing a problem at its inception, and in its entirety, developing it and following it up in all of its ramifications, solving it, putting the results of your work into competition in the com-

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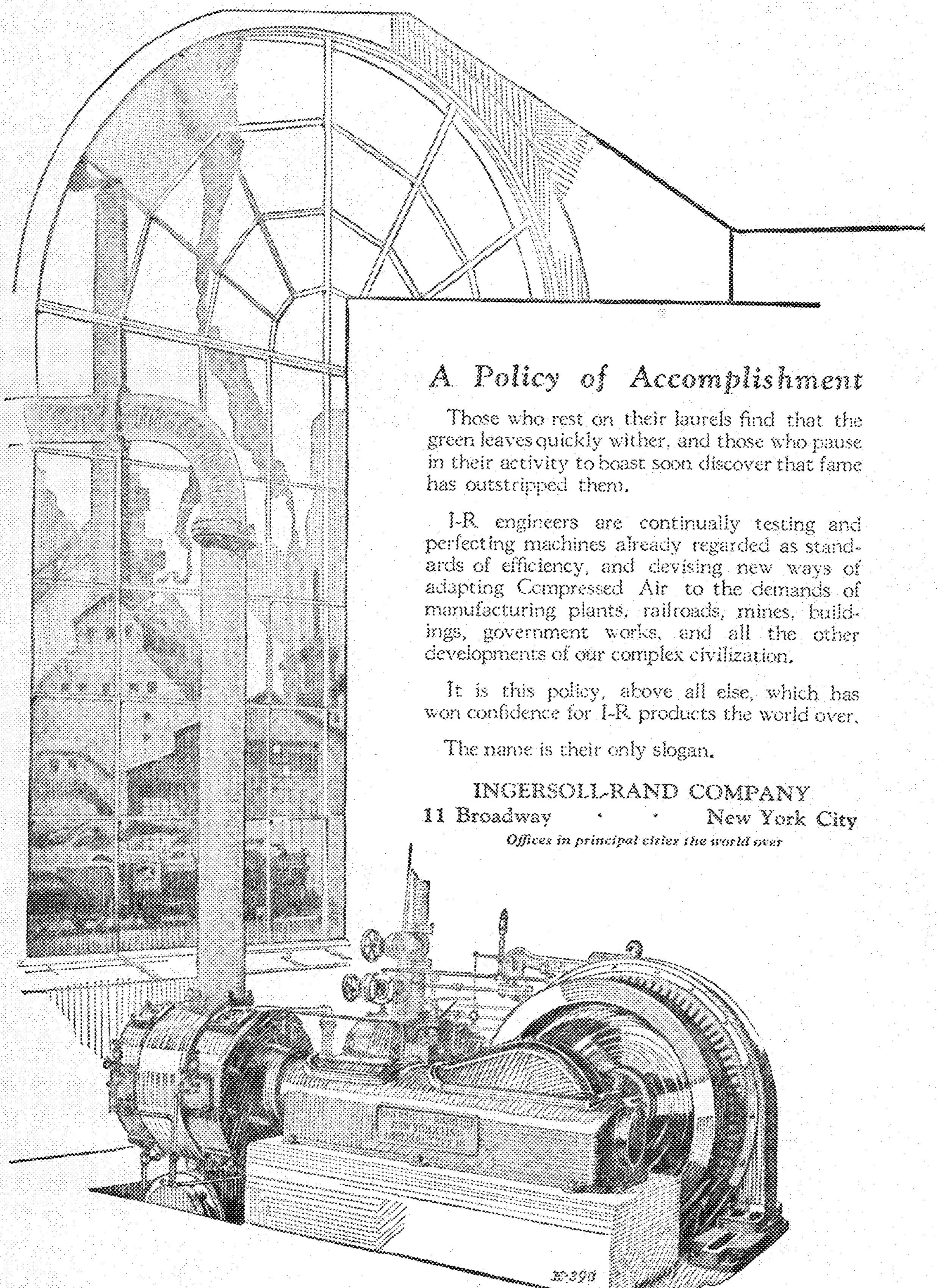

Chemistry in the Motion Picture Industry

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is projected. Furthermore, these varnishes must give a hard non-abrasive surface when coated very thinly on the film and must not attack the support, the gelatin or the image.

Chemistry and Color Motion Pictures

A field which is demanding more attention yearly is that of natural color motion pictures. This problem is both an optical as well as a chemical one; optically it demands unusual refinements in the design of lens systems and chemically it imposes a difficult probem in processing and in final dyeing of the film. There are two general classes of natural color motion pictures: those produced by additive and those by subtractive methods. These are further subdivided according as they use three color or two color ranges in color reproduction. In the additive process, several distinct color records are taken and projected separately and are either superimposed or shown in rapid succession, the colors being added to or built up on the screen. These processes usually require complicated and expensive apparatus. Whereas in the subtractive method which has found most public favor the color records are taken separately but are incorporated on a single film and projected in the same way as standard pictures.

In the foregoing description of the value of chemistry in the motion picture industry, it has not been possible in view of the nature of this article and the diversity of the subject matter to discuss in much detail the actual chemistry involved. It is hoped that some idea may have been gained, however, of the importance of chemistry in every phase of the industry from the assembling of the raw material for manufacture to the final projection of the film.

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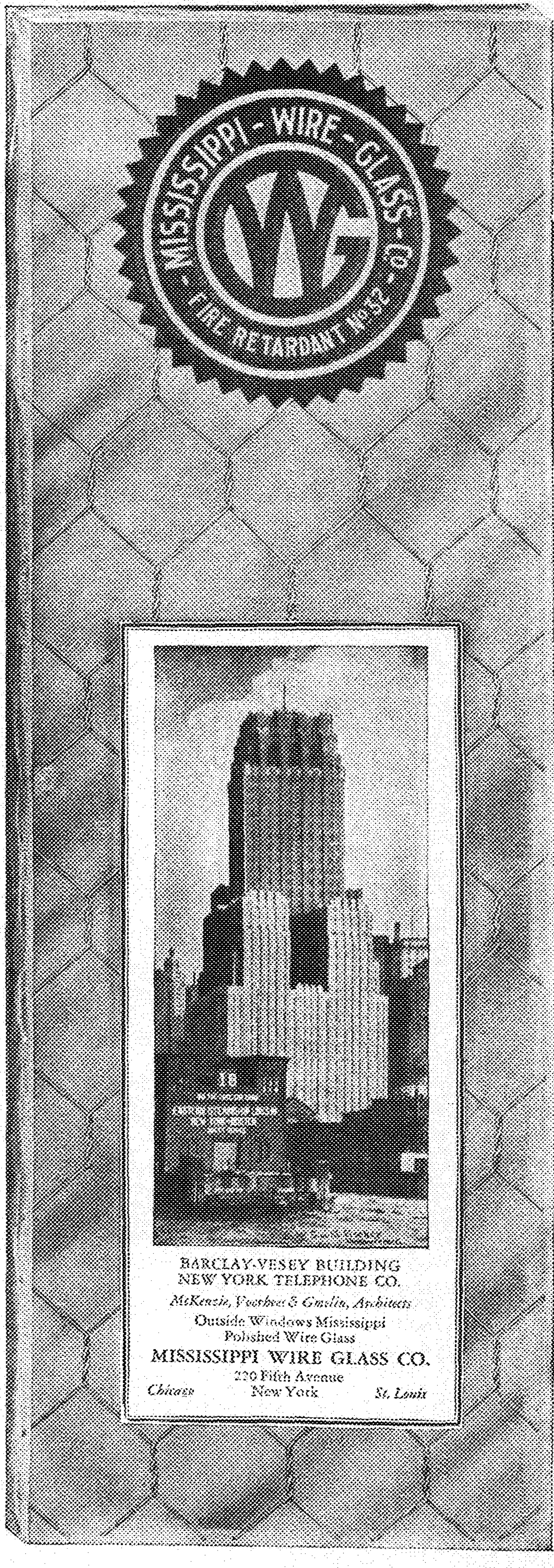
MISSISSIPPI - WIRE - GLASS - CO.
MWG
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NEW YORK TELEPHONE CO.
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Outside Windows Mississippi
Polished Wire Glass
MISSISSIPPI WIRE GLASS CO.
220 Fifth Avenue
Chicago New York St. Louis

Disadvantages of the Big Company

(*Continued from page 306*)

mercial field and then getting the thrill that comes from the feeling that you have followed the thing through to its successful conclusion. You are robbed of that sense of achievement which comes even to the most menial laborer at the completion of a task which he has accomplished himself,—as to the blacksmith of whom Longfellow said:

"Toiling,—rejoicing,—sorrowing,
Onward through life he goes;
Each morning sees some task begun,
Each evening sees its close:
Something accomplished, something done,
Has earned a night's repose."

Such a sense of accomplishment is every man's due. It is essential to sustained enthusiasm for work; it is the vital force which changes the mechanics of making a living from drudgery to a joy.

Long-timed satisfied employees of the big company take unto themselves a smug, self-centered, superior attitude. To them their company is the acme of business attainment. They are almost compassionate toward those who are employed outside of the sacred bounds of their company. They inwardly wonder how such people get along, and they really believe that such people cannot be happy in their seemingly hectic and hard-working business world. When an employee of the big company has reached this stage he has usually lost his "pep," his "snap," his joy in work, and even his ability to do hard work. He is no longer "on his toes." He is too comfortable, too contented. When a man reaches this stage he is lost as far as the possibility of ever attaining any real accomplishment in life is concerned. And the atmosphere of the big company fosters the development of this type of man. He lives primarily for his activities outside the office which may consist in a pleasant round of social activity, a home in the suburbs with its garden and other attractive features, a mania for radio, or any number of other pursuits. All of this to a certain extent is desirable, but at the same time it goes to show that this work is just routine from which he gets no real joy and is something for the most part to be thought of as lightly and disposed of as quickly as possible.

One of the most pernicious fallacies in the arguments which are advanced to induce young men to enter the employ of big companies is that of opportunity of contact with men of large calibre—men who direct the activities of a monstrous organization and sway the business policies of the world. The fact is that in most big companies the new men never get the opportunity to in any sense associate with the men in the higher positions of the company. They are thoroughly insulated from the "higher-ups" through the petty chiefs. It is nothing short of criminal for the young man to even think of directly approaching the vice-president of the company. He must confine his efforts to reaching his own immediate superior. I know a man who has been a very able engineer with one of our big companies for six years and who has never talked with any vice-president or with the president of his company, although he has on several occasions endeavored in a business way to approach men in these positions. In fact, he succeeded in becoming personally acquainted with the man next below the vice-president only by reason of the fact that his habitual irregularity in arriving on the job in the morning attracted the attention of this particular

(*Continued on page 314*)

George D. Shepardson—1864-1926

(*Continued from page 290*)

cieties of which he was member. The American Association for the Advancement of Science, the American Institute of Electrical Engineers, The National Electric Lighting Association, the I. E. S., The Society for the Promotion of Engineering Education, the American Radio Relay League, the National Geographic Society all were proud to call him a member. In addition, he was a member of the joint committee of awards of the Buffalo Exposition in 1901 and the St. Louis exposition in 1904.

As an author, his articles have been published in scores of journals and magazines. Among his books are "Electrical Catechism," "Telephone Apparatus," and "Elements of Electrical Engineering," the latter being in use by the sophomore class at Minnesota as well as at several other universities of the middle west.

Professor Shepardson had a hobby, that of collecting historic objects used in early illumination and communication. The electrical museum which occupies a large room in the new building and which is one of the few of its kind in existence, contains specimens of devices used by early Egyptians, in colonial days as well as those now employed by primitive people in other lands. Much time during his tour of the world was spent in search of relics. Several packages of these are now lying in bond at the Minneapolis custom house.

Every one of his students will remember him—his quiet yet forceful methods, and his ever present humor. He believed in personal contact with his pupils and the frequent dinners and evenings of enjoyment at his home, before the department grew to such proportions, are sources of fond recollections by graduates. We can remember the interviews we have had when he would tell us of the work of scores of graduates, all being easily called to mind.

He was an efficient and faithful faculty head. In the many letters which were received from him during his tour, were contained remembrance to the "old gang." To use the words of Professor Springer, "The faculty cannot get over the fact that he is not coming back."

As he had often stated, it was his desire to die "in the harness." During his sojourn in Benton Harbor, Michigan, he started work on a new book, "The Engineer's Religion." Professor Shepardson carried a portable typewriter with him and was gradually finishing this while on his tour. Arriving in Italy, he was taken ill. The few pages which remained were finished while propped up in bed and final arrangements for publishing were made shortly before his death.

He is gone . . . . Burial was June 21 at Granville, Ohio—his old home. A leader in the realms of science has gone. Yet in the memories of the thousands who knew him, pleasant recollections will linger—an educator, faithful faculty member—and friend.

Miners

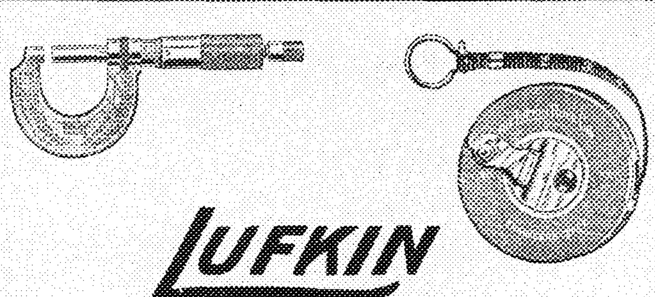
(*Continued from page 304*)

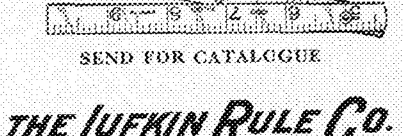
tion will be studied and the mines inspected.

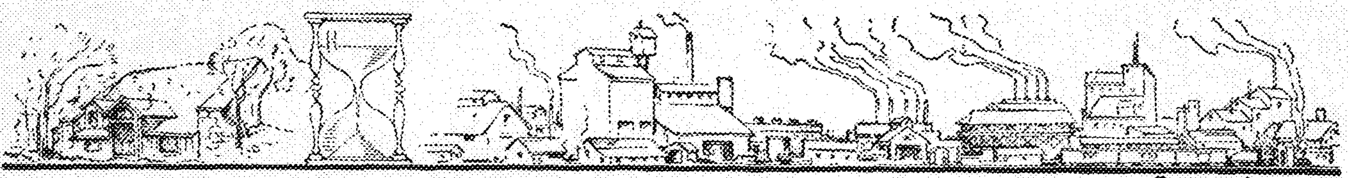
By the fourth of July, the entire party will be dismissed to return home for summer vacation. Many of the boys plan on staying on the range or going west while others will seek the city to earn their stoke for the coming year. No doubt some of the old Fords will remain in the north; one day a junk dealer jumped from his wagon and passed a critical eye over one of them parked in an alley.

Soon the pleasant days of the trip will be at an end. For an all too brief space of time the class have eaten, slept, and worked together. Work should not be placed last in order of magnitude as the purpose of the sojourn was to better acquaint sophomores of the duties of a full-fledged miner, and that spells work. This field trip, coming as it does early in the four year course, serves to give the students a foretaste of the principles of his profession that he may better predict his aptitudes. And what's best of all, the vast resources of Minnesota, our native state have been seen. Wherever we go, the remembrance of the Range will linger. Mining engineers wander the world over—to South America, the Orient. Minnesota, at whose state university they received their training, now occupies a place in their minds.

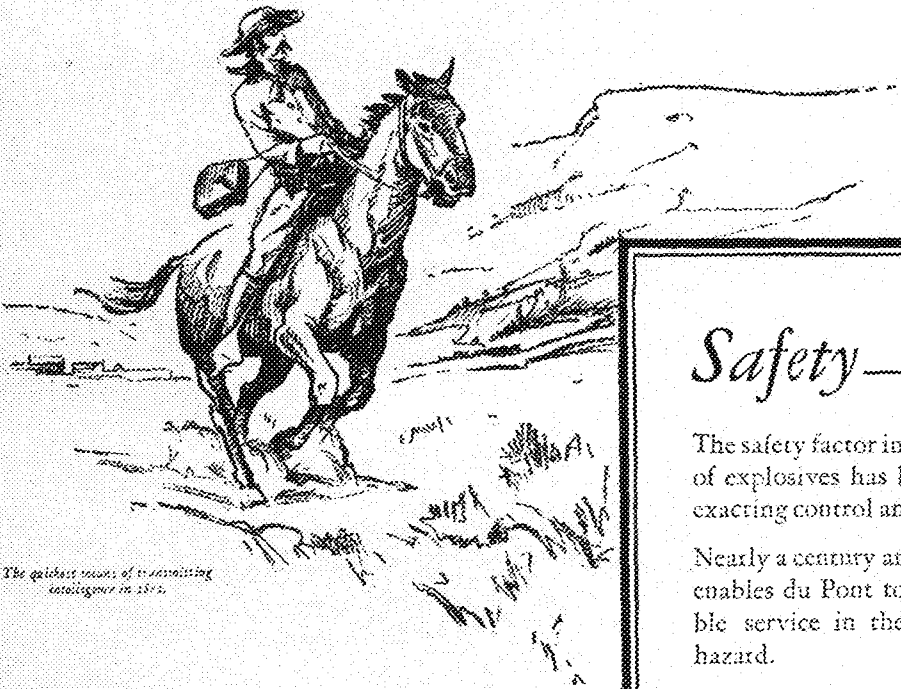
The trip has been a success and the boys feel that the time was well spent and that they are better qualified for any job that may come up.







MAKERS OF POWDERS SINCE 1802



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Nearly a century and a quarter of experience enables du Pont to render industry a notable service in the reduction of blasting hazard.

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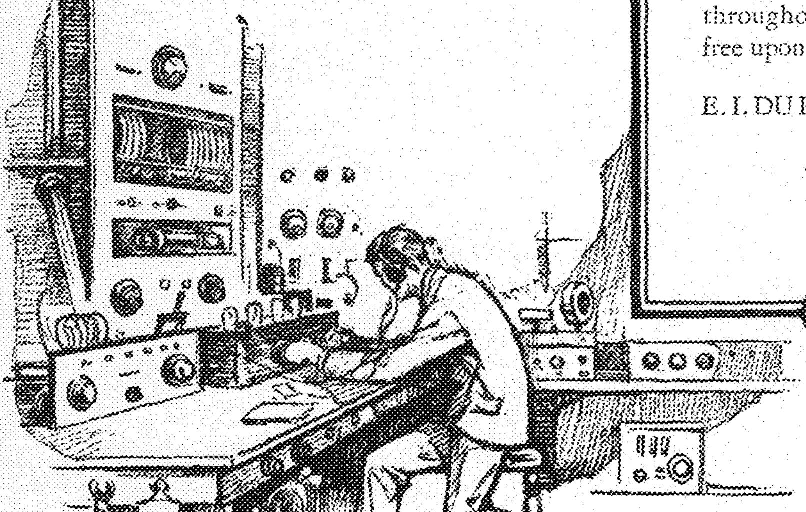


Radio—the miracle of the new day.

123 YEARS OF LEADERSHIP IN THE SERVICE OF INDUSTRY

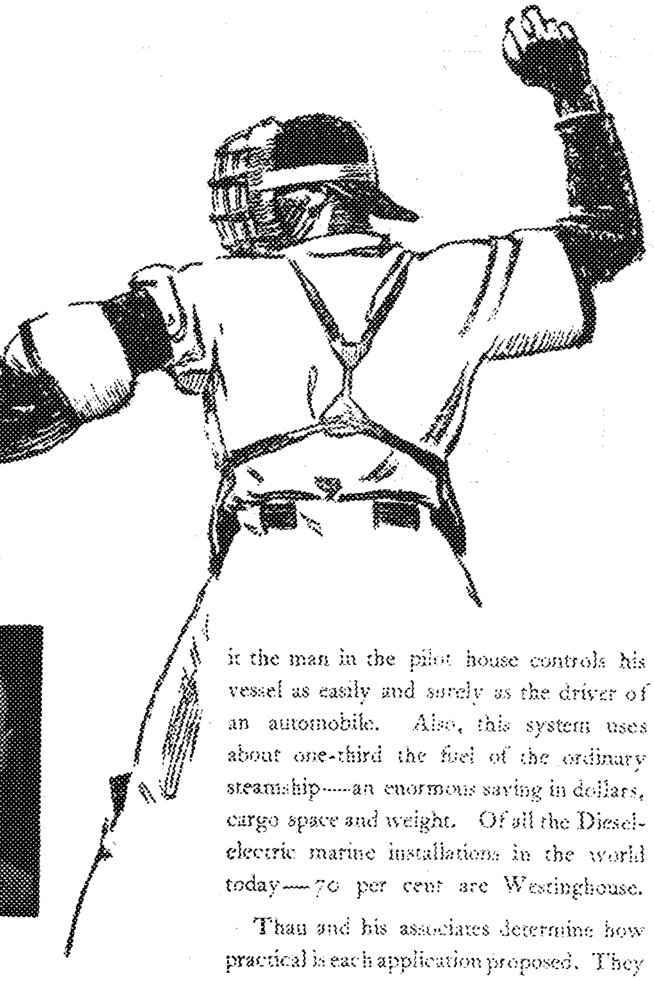
Disadvantages of the Big Company

(*Continued from page 310*)

official to such an extent that he invited the young man in question into his office for a conference on the subject. If the young engineer does chance to meet the higher officials of his company it is commonly only the most perfunctory contact. Happily there have been some notable exceptions to this condition, where men of large calibre have appreciated the need of the new men for contact with them. I refer to the late Benjamin G. Lamme and the late Charles P. Steinmetz. These men and some few others have, by talking to and being friendly with the young men entering their companies, imparted to them inspiration and learning of inestimable value. But unfortunately the officials of the big companies are usually not of that large calibre. The militaristic policy of the big company works against the development of that sort of spirit in the company official. The attitude of superior and subordinate, of "we're we" and "you're you" predominates the big company. The young engineer is thoroughly insulated by the very organization of the company itself from those holding the higher positions in the company. His contact is essentially limited to the other employees of substantially his own rank. This is not so in the smaller company. It is my experience that the young engineer with the smaller company contacts daily with one or more men of as large calibre as the average high official of the big company.

I cannot see any attractive opportunity offered by the big company to the ambitious, intellectually able young engineering graduate. The chief appeals of the big company are easy work, a comfortable, although not large income, a gradually increasing income as time goes on and the security of having a position for life. The consideration moving from the young man entering the employ of the company in order that he may have these things just mentioned is largely the capacity and willingness to forsake his real character and adjust himself to the way of the big company, which essentially includes the ability to tactfully agree at all times with his superiors, to surrender up his individuality and initiative and to spend the remainder of the active part of his life in a prearranged fashion for a predetermined result, the style and character of which may be almost exactly ascertained by examining the present structure and working of the company.

It seems to me that the opportunity for the young engineer lies in the smaller and preferably expanding organization. A new company is ideal. True enough, the element of security is lacking. The company may "go on the rocks" and he will be out of a job. If this happens he must start over and try again. But it is up to him to make the organization go. If the proposition is meritorious he has a good chance. He can probably get a participation in the company, he can take over a real responsibility and a real work in building up the company and he can justly derive a full measure of satisfaction from his accomplishments as the company grows and develops. As the company grows he grows with it, and in breadth of experience, sense of accomplishment and financial return he is far ahead. It is this type of activity that appeals to the active, progressive young man of courage and ability, and it is this type of virile living which keeps up the intellectual strength and spirit of the generation.



YOU *can't always tell from the Campus*

THIS is a plain tale of a regular, everyday American undergraduate—an engineer from the University of Cincinnati, with a college record much like that of thousands of other students.

He got a kick out of playing varsity basketball. He caught on the baseball team. When Cincinnati won at football, he celebrated with the rest. For a year he supervised the student cooperative bookshop. He was president of the Engineering Tribunal, the student governing body. In a word, he did the things well, that college students everywhere like to do.

But of the specialization which he was to undertake at Westinghouse—there wasn't a clue.

The case of W. E. Thau is another example of unforeseen opportunities afforded by such an organization to a man with a healthy aptitude for getting things done.

After the usual training given college men, he entered the General Engineering Department. Later he became Engineer in Charge of the Marine Section, handling all marine and government application jobs. That was six years ago.

Within Thau's time, the Diesel-electric drive has come to be the most advanced method of ship propulsion. By means of

W. E. THAU

The question is sometimes asked: Where do young men get when they enter a large industrial organization? Have they opportunity to exercise creative talents? Or are they forced into narrow grooves?

This series of advertisements throws light on these questions. Each advertisement takes up the record of a college man who came with the Westinghouse Company within the last ten years or so, after graduation.

it the man in the pilot house controls his vessel as easily and surely as the driver of an automobile. Also, this system uses about one-third the fuel of the ordinary steamship—an enormous saving in dollars, cargo space and weight. Of all the Diesel-electric marine installations in the world today—70 per cent are Westinghouse.

Thau and his associates determine how practical is each application proposed. They diagnose each customer's needs. They prescribe the right Westinghouse equipment.

For instance, when the Government sent word: "Electrify the battleships Tennessee and Colorado," the Marine Section was on the job to install turbine electric drives, which helped to make these warcraft the most powerful units in the National Defense.

Or the Clyde Steamship Line says: "We want to load these lumber-cargo carriers electrically. How can we do it? What will it cost?" Thau must figure to a fine point the exact requirements.

Thus does the Westinghouse application engineer combine commercial and engineering sense to advance the interests of the customer being served.

Westinghouse

THE LUND PRESS, INC., 416 N AVE. SO., MINNEAPOLIS

ALUMNI DIRECTORY

of the

Technical Colleges
University of Minnesota

~ CONTENTS ~

GRADUATES OF

The College of Engineering and Architecture
The School of Chemistry
The School of Mines

ARRANGED

1. In Chronological Order
2. Alphabetically
3. By Geographical Location

PUBLISHED BY THE MINNESOTA TECHNO-LOG, UNIVERSITY OF MINNESOTA
AS A SUPPLEMENT TO THE JUNE, 1926, ISSUE

Chronological
Alphabetical
Geographical

ALUMNI DIRECTORY of the Technical Colleges UNIVERSITY of MINNESOTA

College of Eng.
& Arch. School
of Chemistry
School of Mines

HISTORICAL NOTES CONCERNING THE DEGREES

From 1875 to 1896, inclusive, the 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, Mechanical Engineer, and Electrical Engineer were regularly awarded at the close of the four-year courses, and a few were thus given in 1912 and 1913. In 1912, 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, mechanical, and electrical, and also a general course in engineering, which last had been begun in 1900. Upon the completion of the fifth year's work, the professional degrees, civil engineer, mechanical engineer, and electrical engineer were given.

In 1921, the first degree became Bachelor of Science in Civil Engineering, Mechanical Engineering, or Electrical 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, etc., were adopted in 1921 and these degrees were placed in the Graduate School.

Abbreviations of Courses

A, Architecture; Ae, Architectural Engineering; Ag, Agricultural Engineering; C, Civil Engineering; G, General Engineering; I, Interior Decoration; M, Mechanical Engineering; Ch. E, Chemical Engineering; Ch, Chemistry; 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 (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.

* Deceased.

Chronological Directory

Complete list of graduates of the technical colleges of the University of Minnesota to 1926 arranged in sequence of years

COLLEGE OF ENGINEERING AND ARCHITECTURE

1875

Bachelor of Civil Engineering

*Leonard, Henry C. (B. S. 1878)
Rank, Samuel A. (B. S. 1875)
*Stewart, Clark (B. S. 1875)

1876

Bachelor of Civil Engineering

*Gillette, Lewis S. (B. S. 1876, C. E. 1898)
*Hendrickson, Eugene A. (B. S. 1876)
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.
*Forbes, Pierce P.

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 Civil Engineering

Crane, Fremont (B. S. 1886, C. E. 1898)

Bachelor of Mechanical Engineering

Andrews, George C.

1888

Bachelor of Civil Engineering

Anderson, Christian

Bachelor of Mechanical Engineering

Loe, Eric H.
Morris, John (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, Therwald F.
Woodward, Herbert N.

1891

Bachelor of Civil Engineering

Chowen Walter A.
*Douglas, 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)
Burtis, William H.
Gray, William I. (E. E. 1898)
Howard, Monroe S.

Bachelor of Mechanical Engineering

Felton, Ralph P.
Gill, James H. (M. E. 1894)

1893

Bachelor of Architecture

Washburn, Delos C.

Bachelor of Civil Engineering

*Anderson, Ole J.
*Batchelder, Frank L.
*Ert, John W. (C. E. 1898)
Hoyt, Hiram P.
Mann, Fred M.

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, Frank W. (E. E. 1898)

Bachelor of Mechanical Engineering

Avery, Henry B. (M. E. 1898)
Couper, George R.

1894

Bachelor of Civil Engineering

Cunningham, Andrew O. Johnson, Noah
Gilman, James R. 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.
*Bishmam, Horace T. (E. E. 1903)
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, Cloyed P.
Burch, Albert M. Long, Fred W. (C. E. 1898)

Bachelor of Electrical Engineering

Erikson, Henry A. (Ph. D. 1908)
Magnuson, Carl E. (M. S. 1897, E. E. 1897)
*Wheeler, Herbert M.

Bachelor of Mechanical Engineering

Hastings, Clive
Hilferty, Charles D.
*Hugo, Victor
Lang, James S. (E. E. 1897, M. E. 1899)

ADVANCED DEGREE

Electrical Engineer

Eddy, Horace T. (B. E. E. 1895)

1897

Civil Engineer

*Hewett, Frank M. Walker, Frank B.
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 DEGREES

Electrical Engineer

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

Master of Science

Magnuson, C. E. (B. E. E. 1896, E. E. 1897)

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 DEGREE

Civil Engineer

Crane, Fremont (B. S. 1886, B. C. E. 1887)
*Gillette, Lewis S. (B. C. E. 1876)
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, Frank 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) Hildebrandt, Henry A.
Graling, Verney MacKusick, Elwood M.
Pratt, Arthur C.

Mechanical Engineer

Bayless, Harry C. Wennerlund, Elias C.
Richardson, Wilbur P.

ADVANCED DEGREE

Civil Engineer

Douglas, Fred L. (B. C. E. 1891)

Electrical Engineer

Huntoon, Milton B. (B. S. Michigan)

Mechanical Engineer

Lang, James S. (B. M. E. 1896, E. E. 1897)

1900

Civil Engineer

Grime, Edwin M. Whitman, Edward A.
*Prendergast, Paul S.

Electrical Engineer

Dow, James C. Stussy, William T.
*Johnson, Frank E. Thaler, Joseph A.
Kinsell, William L. Thompson, Roy E.
Parkhurst, Harleigh *Tracy, Fred G.
Shumway, Ernest J. Wiltgen, E.

Mechanical Engineer

Daniel, T. Lester Johnston, William W.
*Higgins, Charles C. Newhall, William B.

Bachelor of Science (in Engineering)

Ashbaugh, Lewis E. (C. E. 1907)

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 Tuller, Chas. E.
Houlton, Amos D.

Mechanical Engineer

Robertson, Philip M.
Wilson, Ebel F. (E. E. 1902)

Bachelor of Science (in Engineering)

Grout, Ben. F. (L. L. B. 1908, L. L. M. 1911)

1902

Civil Engineer

Allee, David A. Lambert, Fred T.
Beaulieu, Richard L. McClelland, Claude L.
Hallen, Christian Sheplay, Charles R.
Houstan, 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.

1903

Civil Engineer

Barlow, Harry E. Oltman, Charles A.
Bennett, Walter J. Prendergast, 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 M. Stewart, Clarence H.
*Nevig, Ole S.

Electrical Engineer

Benedict, George F. *Miller, Lucius W.
Dibble, Barry Page, Mark L.
Eberhard, Otto I. Rask, Louis G.
Erickson, Carl Rosok, Ingvald A.
Ireland, Roy R. (B. S. 1901) Schumacher, John H.
Vincent, Jay C.
Laird, Lee R.

Mechanical Engineer

Hughes, Frank C. Williams, Edward H.
Kjosness, Ingram G.

Bachelor of Science (in Engineering)

Crounse, Avery F. Whitney, Alfred C.

ADVANCED DEGREE

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

Boque, Nathan H. Holland, Jay C.
Downing, Frank E. Nelson, Nels B.
Fernald, Frank O. Rothi, Paul

Electrical Engineer

Bouman, Bernhard M. Otto, Fred A.
Cheney, Edward J. *Rosok, Peter A. M.
Grabbe, George Tsplin, Robert B.
Goodwin, Victor E. Tomlinson, L. C.
*Helms, Frank C. (M. S. 1909)
Howatt, John Wicks, John
Morton, Harry G.

Mechanical Engineer

Fager, Gilbert 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

Stevens, Jesse E. (B. S. 1896)

1905

Civil Engineer

Bisbee, E. 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 Kochendorfer, Milton J.
Billau, Louis S. LeBlond, Edmund J.
Boman, Carl E. LeTourneau, Edward H.
Coleman, Frank D. Lundquist, Reben A.
Davis, Charles A. Morris, Robert
Ely, Irving R. Ryan, William T.
Frankoviz, John J. Simmon, Karl A.
Gibson, Charles B. *Smith, Clinton B.
Jackson, Earle D. Wood, John W.

Mechanical Engineer

Andrews, George L. *Johnson, Ernest P.
Bates, Albert H. Lewis, Edward B.
Clipfell, Carroll D. *Pauratz, 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, Tresham D. (C. E. 1906)

1906

Civil Engineer

Adams, Elmer E. Hanauer, Monroe
Alrick, Bannon G. Hayward, George I.
Alsop, Ernest B. Malloy, Charles J.
Bowen, Fred P. Murphy, John G.
Childs, Hervey B. Reed, Arthur L.
Childs, John C. Wiesner, Frederick E.

Electrical Engineer

Albrechts, George M. *Gunther, Albert N.
Bunce, Paul F. Haeberle, Elmer H.
Calmeyer, John P. Hoff, Christopher
Cohen, Nathan Hokanson, Clarence E.
Cooper, Leo H. Hubbard, Robert T.
Cornelius, Martin Lang, Charles A.
Dunn, Andrew P. Mowry, Harry W.
Englin, Charles F. Payne, Harold G.
Finchy, Jacob O. Roepke, Otto B.
Glascock, Henry H. *Schow, Harry A.

Electrical Engineer

Schwedes, Walter F.
Shuck, Gordon R.
Stenger, Laurence A. (M. S. 1916)
Stone, Harris G.
Ungerman, Carl M.
Weber, Erwin L. F. (M. E. 1908)
Wiggins, Gerald G.
Zimmer, William A.

Mechanical Engineer

Armstrong, Thomas S.
Crawford, Wallace T.
Garber, Gabriel E.
Loye, Benjamin W.
Matteson, Frank E.
Ringsred, Arthur C.
Rose, Norman W.

ADVANCED DEGREE

Civil Engineer

Gregg, Tresham D. (B. S. Eng. 1905)

1907

Civil Engineer

Batson, Charles D.
Blomquest, Hjalmer F.
Cram, Clyde M.
*Dougherty, Joe
Dunham, John A.
Grant, James A.
Green, Fred H.
Haverson, Henry D.
Hawley, Harry G.
Hobart, Walter B.
Huston, David B.
Jones, Lewis A.
Kelly, Earl W.
Swenson, Charles A (L. L. B. 1910)
Tondel, Mandel G.
VanCleve, Horatio P.
Yager, Louis

Electrical Engineer

Alton, Herbert D.
Andrus, Raymond J.
Baer, Louis E.
Countryman, Peter F.
Eddy, Lynne W.
Fairchild, Albert R.
Kerns, Ralph W.
Norcross, Arthur F.
Pearce, John H.
Rezab, John J.
Schaw, William P.
Smith, Byron E.
Smithson, John E.
Sternberg, Carl
Uzzell, George W.
Woehler, William L.

Mechanical Engineer

Bell, Maurice D.
Bjorge, Oscar B.
*Brown, Oliver L.
Buhl, Paul S.
Burwell, Loring D.
Fee, E. Franklin
Gessert, George R.
Gilman, Nicholas A.
Krag, Walter C.
Meany, James M.
Nekola, John W.
Rawson, Ralph H.
Spring, Willis W.
*Stacy, Elmer N.
Stephenson, Oliver H.
Tubby, Oliver G.
Wagner, Otto H.

ADVANCED DEGREE

Civil Engineer

Ashbaugh, Lewis E. (B. S. in Eng. 1900)

1908

Civil Engineer

Ash, James W.
Bergquist, Oscar J.
Borrowman, LeRoy F.
Brenchley, Harry E.
Comstock, John W.
Dallimore, Arthur N.
Doeltz, William F., Jr.
Dougan, Henry K.
Fleming, Douglas R.
Furber, Pierce P., Jr.
Gage, Hugh N.
Hustad, Andrew P.
Knowlton, Herbert H.
Krauch, William L.
Lang, Fred C.
Longfellow, Dwight W.
McCall, Harry J.
McCree, Andrew A.
Mowery, Clarence W.
Norelius, Lewis M.
Okes, Day I.
Olsen, Melvin S.
Quinn, John
Robertson, Charles N.
Schlattman, Edward C.
Walker, George W.
Widdell, Gustaf F.
Willis, Roy
Wodrich, Oscar F.

Electrical Engineer

Anderson, Frank A.
Bachrach, Alfred
Brown, George J.
Carter, Robert J. S.
Cosberg, James W.
Currie, Neil, Jr.
Frahm, Alfred R.
Hoppin, Glenn H.
*Hovelson, Henry
Kauffman, Roy
King, Alfred B.
McAfee, Allan L.
Pancratz, Frank J.
Peterson, Clarence A.
Prentice, Robert S.
Schildt, William F. H.
Schoepf, Alfred W.
Scobie, Francis G.
Sperry, Leonard B. (M. E. 1905)
Sturtevant, Percy G.
Svendsen, George P.
Swanstrom, Frank
Sweningsen, Oliver
Weibeler, William M.
Zimmerman, Louis P.

Mechanical Engineer

Anderson, Ole A.
Bingham, Stanley E.
Councilman, Halsted P. (B. S. Eng. 1909)
Cox, Richard F.
Estep, Harvey C.
Fleming, Frank R. (E. E. 1909)
*Frary, Hobart D. (M. S. 1909)
Harwood, Stanley G.
Hetherton, Percival
Morris, Thomas C.
Norelius, Emil F.
Norton, Clyde W. (M. E. 1909)
Priedeman, George W.
Peterson, George T.
Walsh, James (E. E. 1909)
Weber, Erwin L. F. (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)
Schmid, Robert J.
Rowe, Harry B.

1909

Civil Engineer

Childs, James A.
Ellison, Jay T.
Ellsberg, William
Esser, Frank F.
Fiske, F. William, Jr.
Houston, Cecil C.
Hubbard, Frederick A.
Hubbard, Henry A.
Ingberg, Simon H.
Jaques, Robert
King, Lawrence W.
Mitchell, John B.
Nelson, Edward
Okes, Sidney R.
Paul, Frederick T.
Sheffield, Fred W.
Shepard, George M.
Siverts, Samuel A., Jr.
Torrance, Aliakim, Jr.

Electrical Engineer

Beckjord, Walter C.
Brockway, Alvah E.
Cobban, Rollo J.
Converse, Clovis M.
Davies, Ralph M.
Fitts, Joel A.
Fleming, Frank R. (M. E. 1908)
Gadsby, Lester H.
Grant, Fred R.
Harris, Clayton
*Hitzker, Albert J.
Hopkins, Mark L.
Hornibrook, James W.
Japs, Bernard G.
Johnson, Herman R.
Kruschke, George A.
Lindelef, Charles G.
McKenzie, Lauren F.
Murrish, Frederic E.
Poore, Orson B.
Robison, Arch R.
Stillman, Marcus H.
Todd, Milo E.
Turner, Leslie E.
Vita, Theodore
Walling, Benjamin B.
Walsh, James (M. E. 1900)
Williams, Fred M. (B. A. 1905)

Mechanical Engineer

Beery, Charles B.
*Bieri, John B.
Birnberg, Zingel C. J.
Buck, Frederick W.
Buhl, John E.
Forfar, Donald M.
Holmgren, Charles E.
Kircher, Frank J.
Kircher, George A.
Knopp, William R.
Lambert, Edwin M.
Mark, Walter J.
Morris, John E.
Moyer, Malcolm B.
Nemec, Frank L.
Shippam, Willis
Souba, William H.
Starrett, Howard M.
Udell, Carl D.
Williams, Wilber S.
Wright, Harris H.

Bachelor of Science (in Engineering)

Curtiss, Lindsley B.
Councilman, Halstead P. (M. E. 1908)
Swensen, Karl P. (E. M. 1907)
Norton, Clyde W. (M. E. 1908)

ADVANCED DEGREE

Civil Engineer

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)
Tomlinson, L. C. (E. E. 1904)

1910

Civil Engineer

Adams, Benjamin W.
Asleson, Hans
Bolme, Ole M.
Boyum, Benjamin O.
Brownell, Otto E.
Chapman, Burton L.
Dahlquist, Philip L.
Ekman, Class T.
Garen, George M.
Godward, Alfred C.
Jevne, George W.
Leach, Edward W.
Meyer, Carl F.
Motl, Charles L.
Nason, George L.
Overholt, Harley G.
Olsen, Arthur O.
Sawyer, Emerson D.
Sommerfeld, Adolph A.
Timperley, William D.

Electrical Engineer

Anderson, Oscar P.
Anderson, Oscar V.
Bock, Vernon S.
Conley, Wilfred E.
Dahlstrom, Raymond E.
Finke, Walter J.
*Hagstrom, Herbert E.
Hansen, Christian
Hustad, Byron P.
Jespersen, Clarence M.
Johnson, Leonard T.
Josephson, Eliot R.
Landeen, Arvid G.
Nelson, Carl H.
Phelps, Ray R.
Powles, James W.
Reid, Harry A.
Skytte, Ernest E.

Mechanical Engineer

*Atkinson, William B.
Comb, Fred R.
Cook, Harry C.
DuToit, George A., Jr.
Fleming, Laurence T.
Frear, Jenness B.
Kaplan, Eugene V.
Martin, Wallace H.
Meixer, Bernard A.
Moyer, Amos F.
Nichols, Browning, Jr.
Pease, Maynard W.
Wesbrook, Donald M.

Bachelor of Science (in Engineering)

Salisbury, Willis R.

1911

Civil Engineer

Ainslee, Arthur F.
Arnesen, Herbert P.
Boerner, Francis C.
Cottingham, William P.
Croft, Ernest B.
Elfstrom, Axel E.
Enger, Edward H.
Fieldman, David P.
Hodnett, Ralph M.
Hoffman, Michael J.
Johnson, Carl A.
Kvitrud, Ingvald
Maney, George
Mark, Reuben A.
Mattison, George C.
Methven, Clyde L.
Miller, Erwin J.
Orbeck, Martin J.
Roth, Lewis M.
Siverson, Sigvel J.
Smith, Sydney H.
Swedberg, M. Roy
Walby, Arthur C.

Electrical Engineer

Ashworth, Roy H.
Burrows, Robert F.
Blossom, George W.
Butterworth, Allan C.
Chapman, Arthur G.
Demarest, Charles S.
Drinkall, Leon R.
Emerson, Lynn A.
Forsberg, Peter W.
Fredrickson, Harry R.
Hansen, Maurice J.
James, Henry C.
Johnson, John E.
Jones, Watkin W.
Lyford, Dartt H.
McCoy, Ira C.
McQuillan, Raymond E.
Markuson, Oscar S.
Mittag, Albert H.
Nebel, Walter H.
O'Brien, Raymond J.
Pengilly, Joseph H.
Riegel, Louis F.
Shepard, Donald D.
Soulek, Joseph H.
*Stinson, Will V.
Walker, William A.
Wilson, Glenn W.

Mechanical Engineer

Barnum, Marvin C.
Bishop, Ira L.
Farnam, Julian P.
Kasper, Walter F.
Larson, Martin S.
Olstad, Oscar A.
Orn, Robert C.
Owens, Leo E.
Sneve, Jack S.
Woodman, Joseph C.

Bachelor of Science in Science and Technology

Klopsteg, Paul E. (M. A. 1913) (Ph. D. 1916)
Hoffman, Ralph M.

ADVANCED DEGREE

Electrical Engineer

Morse, George H. (B. E. E. 1893)

1912

Civil Engineer

Adams, John W., Jr.
Curtis, Thomas H.
Flygare, August L.
Hosfield, Raleigh W.
West, Robert W.

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)
Dimond, 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)
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 Engineers

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 M.
Thuras, Albert L. (E. E. 1913)
Towle, Neal C. (E. E. 1913)

Mechanical Engineer

Boyce, Leonard F.
Brown, William P.
Johnson, Frank
Markow, 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 Ed. (C. E. 1914)
Kruse, Helmer V. (C. E. 1914)
Lovering, Harry D. (C. E. 1914)
Montgomery, A.
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 (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)

Critchett, Edward F. (M. E. 1914)
Buenger, Albert (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)
Jergens, 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)
~~Smith, 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)
Hirlemen, 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 K.
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 I.
Weatherill, Cedric S. (C. E. 1915)
Wiegel, Howard N. (C. E. 1915)

Bachelor of Science in Engineering (Electrical)

Adler, Eugene H. (E. E. 1915)
Bisek, Peter P.
Chapman, Wendell P.
Dunham, Roy O. (E. E. 1915)
Elliott, Douglass A. (E. E. 1915)
Fallon, Eugene L. (E. E. 1915)
Garney, 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, Earl 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. (B. S. Eng. 1916)
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)
Hartney, James L. (M. E. 1915)
Hubbell, Arthur C. (M. E. 1915)
Kopper, Edward, Jr. (B. S. Eng. 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)

Asland, Christopher
Anderson, George T.
Christianson, Hilmar B.
Croswell, Thomas L.
Cuddy, William A. (C. E. 1916)
Dorsey, John G.
Handshu, C.
*Haynes, Stanley H. (B. S. 1917)
Helmick, Dan
Johnson, Alexander R.
Johnson, Philip L.
Jones, Idris V.
Jones, Ivor V.
Knight, Ralph J.
Leonard, Thomas K. (C. E. 1916)
McKay, Earle D. (C. E. 1916)
Oustad, Olaf L.
Pratt, Benjamin A.
Rufsvold, Olav M. (C. E. 1916)
Scott, Elmer C. (C. E. 1916)
Skurdalsvold, P. (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)
Jones, Robert A. (E. E. 1916)
Lawrence, Scott W. (E. E. 1916)
Lutz, Richard E.
Olaison, Clifford E. (E. E. 1916)
Skagerberg, Rutcher (E. E. 1916)
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.
Giltman, 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 Wm. (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)
Hartney, James L. (B. S. Eng. 1914)
Hubbell, 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

*Allbee, Pierce
Heath, Donald C.
Liebenberg, Jacob J.
Tannehill, Louis Wm.

Bachelor of Science in Engineering (Civil)

Askew, Thomas A., Jr.
Biskup, William F.
Bruce, Hjalmer N. (C. E. 1917)
Carlson, Anders J. (C. E. 1917)
Doell, Chas. E. (C. E. 1917)
Ellingson, E.
Grow, Robert
Hendrickson, Norman
*Johnston, Ralph E. (C. E. 1917)
Kivley, Warren O.
Knauss, Archibald C. (C. E. 1917)
Larson, Carl
Lux, Arthur E.

Bachelor of Science in Engineering (Civil)

McCullough, Bruce M.
Nortner, Sylvester E.
Pan, Wen H.
Peterson, Harold L. (C. E. 1917)
Peterson, William W.
Watson, Fred O'C.
Weinke, Ernest (C. E. 1917)
Williams, Charles A.

Bachelor of Science in Engineering (Electrical)

Abbott, Amos H. (E. E. 1917)
Anderson, Frank L.
Arenson, Timothy G.
Bleecker, George W.
Blomberg, Evar H. (E. E. 1917)
Brown, Louis M.
Burt, Fred R.
Butterworth, Russell I. (E. E. 1917)
Covell, Russell O.
Croswell, Daniel R.
Dow, William G. (E. E. 1917)
Edelman, Philip (E. E. 1917)
Ellefson, Selmer
Fasteneau, Karl DeV.
Gannett, Danforth K. (E. E. 1917)
Hult, George A.
Irwin, Frank H. (E. E. 1917)
Love, 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)
Wentz, Walter W. (E. E. 1914)

Bachelor of Science in Engineering (Mechanical)

Corser, John
Dresser, Harry S.
Johnson, Ira L. (M. E. 1917)
Kopper, Edward, Jr. (M. E. 1914)
*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. 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. 1916)
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. 1916)
Jones, Robert A. (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. 1915)
Thompson, Harry T. (B. S. Eng. 1915)
Turner, Roy H. (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)
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.
Poulsen, George F.
Prudden, George H., Jr
Riedesel, George M.

Bachelor of Science in Engineering (Civil)

Boyce, Ellsworth R.
Brataas, Mark
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, Chauncey M.
Dunlap, Lemuel J.
*Ebert, Solomon B.
Eckanbeck, Everett E.
Jacobs, Arthur R.
Juvrud, Edwin C.
Lilly, Clarence W.
McKibben, Roy (E. E. 1918)
Malmstrom, Axel L.
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)

Andersen, Edward I. (M. E. 1919)
Boehnlein, 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. (M. E. 1922)
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 Q. (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)
Love, 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 Engineers

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)

1918

Bachelor of Science in Architecture

Forsberg, Enock
Kaplan, Seeman
King, Harvey
Moorman, Albert J.

Bachelor of Science in Engineering (Civil)

Battles, Leon
*Chamberlain, Herbert D.
Deutsche, Richard E.
Eliassen, Sigurd
*Gould, Reed D.
Konstantinopoulos, Nicholas
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
Smith, Hugh A.
Talbot, Thomas F.

Bachelor of Science in Engineering (Mechanical)

Abrahamson, Howard B.
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 W.
Deane, George B.
Deneen, David J.
Emery, George C.
Fraser, 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.
Hawlik, Henry I.
Rosenthal, Oscar L.

Bachelor of Science in Engineering (Electrical)

Christensen, Edgar W.
Cotton, Ernest H.
Drinkell, John F.
Duncan, George R.
Grimes, David
Hartman, Walter K.
Heinemann, Robert
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
Bros, Raymond J. (M. E. 1920)
Cosh, Richard A.
Dowd, Archie J.
Elliott, 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.
Kapphahn, Harvey E.
Kroeze, Herbert A.
Lewis, Carroll E.
Lilly, Eugene
Montgomery, Albertus

ADVANCED DEGREES

Mechanical Engineer

Andersen, Edward I. (B. S. Eng. 1917)
Bierman, George H. (B. S. Eng. 1918)
Boehnlein, Charles (B. S. Eng. 1917)
Hvoslef, Fredrik W. (B. S. M. E. 1917)

Master of Science

1920

Bachelor of Science in Architecture

Anderson, Milton J.
Kleinschmidt, Florian
Korslund, Harry J.
Lynn, Glenn H.
Lin, Shu M.
Love, Edwin M.
Raugland, Arnold I.

Bachelor of Science in Engineering (Civil)

Alexander, George D.
Beneke, Walter E.
Berg, Karl A.
Bernt, Hans E.
Bleifuss, Donald
Dever, Francis A.
Fitzgerald, William J.
Fries, Floyd M.
Gilbert, Roy
Gould, Edward S.
Hanke, Carl C.
Hansen, Carlos
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.
Purdy, Irving E.
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.
Molakness, 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
Cerney, Glen
Curry, Ezra B. (M. E. 1921)
Czock, Jacob H.
Egilerud, Fridtjof S.
Fortune, Harry G.
Gerow, Theron G.
Hayes, Edward J. (M. E. 1921)
Jeachim, 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, N.
Madsen, Olav
Moore, Clarence F.
Swenson, Gustav A.
Vallacher, 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 O. (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.
Dein, Eltor A.
Del Plaine, Carlos W. (C. E. 1922)
Enke, Fred A.
Grochau, Earl H.
Halladay, Leslie L.
Hansen, 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. S. 1921) (E. E. 1922)
Briggs, William G.
Carlson, Carl P.
Colson, Lauren G.
Donahoe, Robert E.
Hagelin, Lawrence W.
Hammerstrom, Aleck A.
Hayward, Laurence W.
Haugan, 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.
Maugney, Elmer J.
Merritt, Alva W.
Miller, Andrew L.
Nelson, Richard L.
Palmer, Roy A.
Pearson, Charles W.
Peterson, Harold W.
Podosin, John
Sannicola, Joseph F.
Satori, Roy H.
Selander, Karl W.
Shuirman, Gabe
Stanius, Godfrey
Sweet, Ray R.
Wahlquist, Hugo W. (E. E. 1922)
Wessale, George
Wilson, Paul R.

Bachelor of Science in Mechanical Engineering

Arneson, Lloyd O.
Elmer, Lloyd A.
Farmer, John W.
Forsberg, Elmer J.
Gjesdahl, Maurice S.
Hamlin, Lehan H. (M. E. 1922)
Johnson, Carl A. (M. E. 1922)
Lewis, George R.
Luce, Alexander W. (M. E. 1923)
Reuter, Peter T.
Roy, Milo C.
Umbehocker, Frank
Vaule, Sven A. (M. E. 1922)
Von Rohr, Herbert H.

Bachelor of Science in Engineering

Adams, Edward H.
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.
Papenthein, Roy O.
Young, Joseph E.

ADVANCED DEGREES

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921)
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, Garnet
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)
Cribbs, Harry E.
Erickson, Edwin C. O.
Espenett, Edward L.
Feder, Max
Fraser, Carlisle G.
Frost, Herbert J.
Greenberg, Jack
Hertskotte, Arthur E.
Johnson, Ellsworth
Keeler, Jasper F.
Kelley, Wm. S., Jr.
Levens, Alex S. (M. S. in C. E. 1924)
Lund, Earl H. (C. E. 1923)
Mattson, Dewey F.
Markuson, Christian O.
Morrison, John E.
Newbery, Lester W.
Ost, Roland E.
Palda, Chas. H.
Paulson, Thorvald S.
Palmer, Howard B.
Peterson, Neander E.
Pinska, Lawrence F.
Reardon, John M.
Rosenthal, Paul
Silverman, Emil M.
Soshnik, Edward J.
Slade, Loring
Stoutland, Oliver A.
Swanson, Clifford L.
Tarbell, William P.
Teberg, Lawrence
Thompson, Claudius
Tierney, Festus P.
White, Arden D.
Wilson, Charles A.
Wood, Victor

Bachelor of Science in Electrical Engineering

Aultfather, David
Bergstrom, Marlow
Bisbee, Bertin
Bjonerud, Earl
Bochus, Gerald
Bosshardt, Willmert C.
Carlson, Richard
Clark, John S.
Cooley, Gilbert
Dahl, Hjalmer
Downie, John
Drost, Henry
Dunnum, Orney
Ellestad, Irwin M.
Enger, Arne
Fiske, Harold C.
Forbes, Henry C.
Heidelberger, Roy J.
Hendrickson, Arnold B.
King, John E.
Linhoff, Carl H.
McEachin, John
McMillan, James S.
Magnuson, John E.
Mentzer, Clarence A.
Mintz, Nathaniel
Nielsen, Walter M.
Nordhem, Berger W.
Olson, Arnim G.
Oscarson, Gerhard L.
Pangburn, Carroll G.
Plank, Howard G.
Ransom, Glen B.
Rome, Robert C.
Rood, Arnold E.
Sorensen, John E.
Steffens, Robert A.
Tuve, Merle A.
Wichman, Martin F.
Willard, Arthur C.
Williams, Percival H.
Wilson, Abner W.

Bachelor of Science in Mechanical Engineering

Aune, 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.
Holmstine, 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

Brown, Harry
Capstick, Donald
Dock, Chester
Forssell, William
Hayes, Harold
Meili, Rudolph E., Jr.
Olson, Clarence

ADVANCED DEGREES

Civil Engineer

delPlaine, Carlos W.

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921, B. S. 1921)
Wahlquist, Hugo Wm. (B. S. Eng. 1921)

Mechanical Engineer

Hamlin, Lehan H. (B. S. Eng. 1921)
Holmstine, Arthur G. (B. S. Eng. 1917)
Johnson, Carl A. (B. S. Eng. 1921)
Vaule, Sven A. (B. S. Eng. 1921)

Master of Science in Engineering

Stackle, Gilbert C. (B. S. 1920)

1923

Bachelor of Science in Architecture

Backstrom, Wilburg 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 M.
Christlieb, Frank B.
Curry, Byron K.
Darrell, James E.
DeFreece, Paul R.
Dindorf, Edward C.
Flindt, Richard H.
Guesmer, George O.
Hill, Hibbert M.
Hiner, Walter G.
Hosmer, Orville H.
Johnson, Albert W.
Johnson, Nels
Judd, Maurice D.
Kotz, Walter E.
Lazerowitz, Morris W.
Leonard, Aubrey C.
Maiser, Walter L.
Manger, Henry J.
Meskal, George A.
Mitchell, Lloyd S.
Nelson, Elmer A.
Nelson, Glenn
Odquist, Carl
Olson, Elmer J. E.
Peck, Lloyd A.
Sauer, Arthur A.
Schaller, George C.
Schlenk, John J.
Sclarow, Abraham M.
Spencer, Raymond D.
Stephens, Clifford S.
Swanson, Paul H.
Tennstrom, Carl H.
Thompson, Everett
Villaume, Walter F.
Zimmerman, Arthur C.

Bachelor of Science in Electrical Engineering

Babcock, Vernon M.
Bouquet, Otto T.
Braden, Rene A. (M. S. 1925)
Bumgardner, Louis T.
Burrill, Charles M.
Case, Gerald F.
Clausen, Elmer W.
Dunnavan, Ralph R.
Elwood, Daniel H.
Engstrom, Elmer W.
Fairbanks, George W.
Feeney, Wayne I.
Fischer, Harold W.
Friedman, Edwin A.
Goldberg, Maurice G.
Grettum, LeRoy Atwood
Hargraves, Robert A.
Hawkins, Harvey C.
Heidelberger, Otto
Helwig, William F.
Johnson, Gustaf A.
Johnson, James P.
Kannenberg, Walter F.
Kearney, Adrian A.
Koch, Karl L.
Lambie, Horace H.
Lieberman, Henry
Lundquist, John V.
McCullough, Robert T.
Meserve, Ralph H.
Moreno, Gerardo
Nash, Russell O.
Newman, John M.
Nordvall, Glen W.
Olin, Henry A.
Olson, Roy H.
Pause, Harold A.
Pulver, Richard F.
Rath, Harvey C.
Reeve, Howard E.
Russell, Winfred W.
Ryan, Robert M.
Sampson, Clifford L. (M. S. 1925)
Schottler, George J.
Schweiso, Clifford C.
Scott, Herbert L.
Sickel, Edward C.
Swift, George E.
Trask, Alfred M.
Thorne, Donald E.
Ward, Alvin C.
Wellisch, Walton
Wiggins, John B.
Williams, Roy N.
Willis, David C.
Wilson, Frank W.
Zimmerschied, Clarence

Bachelor of Science in Mechanical Engineering

Acker, Sidney H.
Amidon, Lee L.
Ascher, Raymond C.
Bachmann, Graydon A.
Bergslund, Grant C.
Bros, Ben M.
Brossard, Edward V.
Copeland, Floyd E.
Cross, Roland E.
Eige, Elmer H.
Gilstad, Arthur
Halden, Herbert O.
Hibbard, Sheldon S.
*Keiser, Karl W. (M. S. in M. E. 1924)
Kuhlmann, Rudolph H.
Larson, Glen M.
Lindelien, Eugen
Marshall, Chester R.
Messer, Harold D.
Parkin, Orrin G.
Peckham, Harold E.
Ransom, Ralph W.
Sear, Arthur W.
Swanson, Philip G.
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.
Barnum, Charles R.
Bonsall, Wallace C.
Hawkins, Edward W.
Hinman, Charles H.
Johnson, Anton
Kraft, Edwin W.
Magoon, H. A.
Nelson, Mark L.
Nystrom, Paul E.
Rosenberg, Rahil
Silverman, Isadore W.

Bachelor of Science in Architectural Engineering

Person, Otto C.
Root, Frank R.
Tvedt, Lawrence A.

Bachelor of Science in Civil Engineering

Bachelder, William H.
Bauer, Roscoe W.
Berquist, Edwin T.
Berquist, Philip L.
Bestor, George C.
Bevan, R. Louis
Braddock, Edward
Brady, Mace F.
Bullis, Everard J.
Chapin, Samuel C.
Dedic, Richard J.
Erickson, Carl E.
Garzon, Julian R.
Gillard, Herbert W.
Grant, Elberth R.
Guerin, George V.
Gustafson, Reuben W.
Haskins, Nathaniel R.
Harrington, Marzy V.
Hayden, Claude E.
Herberg, Saniord
Holder, Laurence E.
Johnson, Raymond V.
Kaufman, Morris B.
Larson, Peter L.
Liese, Herbert
Lund, Roy V.
McCrady, Archie R.
Nelson, Martin E.
Normann, Rolf
Olson, C. Milford
Parker, Robert M.
Peterson, Lloyd L. H.
Powell, Louis H.
Ranger, Donald R.
Roos, Frank T.
Somero, Waino M.
Spreehn, George H.
Stoddart, Hugh A.
Stoner, Clifford M.
Tews, Arthur
Thompson, Theodore S.
Velz, Clarence J.
Wilson, Walter E.

Bachelor of Science in Electrical Engineering

Anderson, Emil G.
Anderson, Fayette C.
Anderson, Matthew A.
Appleman, Frank C.
Arstad, Leonard W.
Carlson, Warren

Bachelor of Science in Electrical Engineering

Cass, Hoyt R.
Cassidy, Walter J.
Dahl, Harold W.
Diment, Morton J.
Dunlap, George
Eckberg, Curtis R.
Frazee, Leonard M.
Furber, John
Garthus, Ira
Greene, Chauncey
Grettum, Walter A.
Gremer, Harry S.
Harrington, Russell A.
Hecht, Henry W.
Heggen, Reuben
Holbeck, John I.
Huseby, Gisle E.
Jacobson, Frank H.
Johnson, Iver W.
Juran, Joseph M.
Kappie, Frederick R.
Kator, Jozef J.
Kline, Frank W.
Krause, Fred E.
Lampher, Murray
Lauritzen, Carl W.
Lewis, John G.
Little, LeRoy C.
Lobeck, Torarin E.
McConnell, E. S.
McGregor, F. A.
McLeland, Lyle K.
Mabbott, Leonard E.
Mangney, Hilding O.
Marcroft, Harold C.
Marshman, Irving H.
Mathes, Richard E.
Mayer, Joseph S.
Miller, Archibald T.
Miller, William J.
Monson, Manley A.
Monseth, Ingwald T.
Morton, Lyle W.
Nee, Harold E.
Nelson, Edgar M.
Pelley, Lloyd L.
Schilling, Theodore F.
Schow, Garfield G.
Sheekman, Harvey Z.
Skarolid, Charles T.
Stauffacher, Edward L.
Strege, Henry W.
Swift, Charles D.
Taplin, George
Teal, Clarence W.
Troka, Benjamin C.
Tunell, Robert H.
Tyvand, James A.
Waligoski, Adam A.
Warren, Laurence C.
Weber, Hanard P.
Wolfe, George E.

Bachelor of Science in Mechanical Engineering

Anderson, Joseph A.
Berry, George F.
Blodgett, Charles R.
Borst, Wellington L.
Boyd, Paul M.
Collis, Norman S.
Dale, Dallas W.
Darmody, William J.
Earl, Donald F. (M. S. M. E. 1924)
Engh, Harris S.
Erskine, Robert K.
Estabrooks, Clyde F.
Grobel, Lloyd F.
Hiers, Charles R.
Holmstine, Ralph D.
Kiesner, Frank C.
Koehler, Edwin F.
Langford, George, Jr.
Langman, Harley R.
Logue, John F.
Mehandru, Behari L.
Montgomery, Ralph M.
Moore, John H.
Morris, Frank A. (B. S. M. E. 1924)
Nelson, Edward K.
Nelson, Einer
*Olien, Hamlet C
Olson, Arthur L.
Peterson, Arthur S.
Rathburn, George A.
Ross, Kenneth R.
Rosseau, Clifton C.
Saltwick, Andrew
Sartell, Page M.
Scho, Arthur O.
Sesseng, Gunnar
Simms, Charles G.
Stachle, Haswell E. (M. S. M. E. 1924)
Stauffacher, Edward L.
Thomas, W. Alan
Tuttle, Stanley B.
Wagner, John W.
Willson, Stuart V.
Woolman, Harry D.

ADVANCED DEGREES

Master of Science in Civil Engineering

Levens, Alex (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)
Stachle, Haswell E. (B. S. M. E. 1924)

1925

Bachelor of Science in Architecture

Bross, Peter P.
Erickson, Clarence P.
Freeberg, George
Kendall, Walter A.
Lantz, Reuben S.
Lumm, Allan G.
Molander, Edwin
Olson, Edwin E.
Peterson, Everett L.
Rigg, Alwin E.

Bachelor of Science in Architectural Engineering

Brimeyer, Ferdinand J.
Elmburg, LeRoy M.
Grisson, Aubrey H.
Larson, Emil L.
Pesek, Cyril P.
Wicklund, Paul E.
Rankin, Dean W.

Bachelor of Science in Interior Decoration

Cote, Rhoda H.
Parker, Helen R.
MacGregor, Helen J.
Slocumb, Mary G.
Smith, Verna G.

Bachelor of Science in Civil Engineering

Auxer, William L.
Banovetz, John A.
Bartholomew, Neal W.
Beese, Harold
Berg, Thorsten
Bertussi, Clarence F.
Bird, Harold E.
Blue, Clarence W.
Bonner, Donald E.
Bruce, William C.
Burns, Dwight T.
Carlbom, Leonard H.
Cornell, George M.
Craig, Hamilton S.
Donahue, Stephen
Dungay, Herbert F.
Duvall, Arndt J.
Eilers, Baldwin C.
Frantz, Willard F.
Fulton, Edwin G.
Galanter, Samuel
Gerdes, Carl H.
Gobeli, Arthur W.
Haima, Mark
Hansen, Arthur A.
Hartman, Philip F.
Hendricks, Clifford L.
Hendricks, C. Edward
Imsande, Fred L. S.
Jones, Harold W.
Knudsen, Esther M.
Kroll, Arthur J.
LaBonte, Anton E.
Larson, Fred H.
Lushene, Joseph P.
McAndrews, Harry N.
Macgowen, Irvin S.
Mark, Max B.
Moore, Norman K.
Morris, Russell F.
Nelson, Edwin W.
Nelson, George A.
Nichol, Frank E.
Nordstrom, Milton E.
Nutting, Horace W.
O'Brien, Thomas E.
Olson, Kenneth M.
Olson, Vernon H.
Peterson, Clarence R.
Peterson, Harold C. E.
Prichard, Charles E.
Quinn, Edward I.
Quinn, Ursula R.
Schmidt, Roland L.
Skrukrud, Odean M.
Sullivan, Frederick V.
Swanberg, John H.
Thompson, Clarence W.
Ward, John Jr.
Walder, N. T.
Wold, Milton C.
Youngquist, Eder B.

Bachelor of Science in Electrical Engineering

Albrecht, Karl J.
Albrecht, Karl J
Anderson, Arthur P.
Benson, Ikel C.
Boe, Lester L.
Borchert, Oscar H.
Bordeau, Sanford P.
Brossard, Henry F.
Burlingame, Robert E.
Cameron, Harry D.
Childs, Morris P.
Christensen, Arthur L.
Cosandey, Charles J.
Countryman, M. Alden
Cousins, Van M.
Edwards, Richard G.
Ellis, Carl E.
Franzen, Roy O.
Gilman, Gaylord
Hammer, Harold E.
Hanit, Hugo H.
Heuss, Harold H.
Hill, Edward L.
Holmes, Raymond H.
Hussey, Norman W.
Jacobson, Arthur C.
Johnson, Enan C.
Johnson, Robertson B.
Kauppenen, Heino
Keller, Raymond W.
Franklin, Oker K. (B. S. C. E. 1922) (St. Thomas)
Koch, Winfield R.
Lewis, Berkeley R., Jr.
Ludlum, Robert V.
Lund, Jeffery L.
McClung, K. Rex
McCully, James P.
McEwen, Alexander D.
Malmgren, Richard V.
Meagher, Joseph E.
Nelson, Carl C.
Nelson, Clarence H.
Nickerson, Edward
Nierling, Grant C.
Parsons, Sidney A.
Peterson, Lewis E.
Postma, John, Jr.
Reed, Henry R.
Richardson, Philip E.
Robertson, Kenelick
Schenckloth, Harry H.
Schuck, Roy D.
Shavor, George J.
Smith, Harold D.
Solomonson, Lawrence D
Steinert, Emil
Taylor, Richard G.
Thomas, Richard L.
Thomson, Andrew
Thyberg, Clarence W.
Tunell, Clement R.
Untinen, August L.
Upton, Albert P.
Westigard, Glenn A.
Wieland, Willard W.
Winslow, Harry J.
Wurzbach, Henry A.

Bachelor of Science in Mechanical Engineering

Algren, Axel B.
Backstrom, Russell E.
Beseler, Herman F.
Bjerre, Folmar I.
Boss, Ronald W.
Caswell, Thomas R.
Donnelly, William H.
Eggleston, Smith
Erskine, Lawrence F.
Forseth, George O.
French, William O.
Heath, Arthur C., Jr.
Hoisveen, Leonard F.
Holmes, Roland W.
Jacobi, Alfred J.
Jacobson, Reuben A.
Jenkins, Clifford H.
Ludvigsen, Elliot L.
Lundquist, C. D. Vernon
Martino, Anthony D.
Mills, Hartzell
Pendergast, Webster G.
Peterson, Laurence L.
Robinson, Parke D.
Sonha, John I.
Stevens, Everett B.
Whitten, Robert C.
Wilson, Roy A.

ADVANCED DEGREES

Master of Science in Architecture

Dayu, Doon (B. S. 1924)

Master of Sience in Electrical Engineering

Braden, Rene A. (B. S. E. E. 1923)
Heidelberger, Otto (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)

SCHOOL OF CHEMISTRY

1897

Chemical Engineer

*Chapin, Lewis P.
Hamilton, Herbert C.
Linton, James H.
Webber, Frederick W.

1902

Bachelor of Science in Chemistry

Benner, Raymond C.
*Lando, Maximillian N.
Rice, Edgar W.

1903

Bachelor of Science in Chemistry

Bakke, Oliver M.

1904

Bachelor of Science in Chemistry

Grout, Frank F.
Gutsche, Edward J.
Hopkins, Joseph I.
Rose, Anton R.

1905

Analytical Chemist

Borrowman, George L.
Dahlberg, Arnold V.
Frary, Francis C. (M. S. 1906, Ph. D. 1912)
Jackson, Myron B.
Longworth, Fred J.
Pennock, Edward M.
Poore, Charles D.

1906

Analytical Chemist

Bernhagen, Lewis O.

Master of Arts in Chemistry

Wilbot, 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.
Halvorson, John O.
Kennedy, William W.
Manuel, Earl V.
Von Kustre, Edith I. (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)
*Cressey, Charles K. (M. S. 1913)
Lowe, John M.
McBride, Russell S.
Porter, Allen H.
Whited, Oric O.

1909

Bachelor of Science in Chemistry

Bacon, Charles B.
Dresser, Eva L. (Alves)
Kueffner, Otto K.
Selvig, Walter
Sterling, Faith (Curtiss)
Walker, George W.

Bachelor of Science in Chemical Engineering

Barnaby, William E.
Roehrich, Victor H. (M. S. 1910)
Morey, George W.

Master 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 H.
Dietrichson, Gerhard
Fiske, Wilbur W. M.
*Peterson, Andrew P. (M. S. 1911)
*Smith, Carolyn H.
*Stone, George H.
Taylor, Carl A.
Tronson, Carl A.
Wollett, Guy H. (M. S. 1916, Ph. D. 1918)

Bachelor of Science in Chemical Engineering

Dahlberg, Henry W.
Gutsche, Frank C.
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.
Halverson, 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

Ball, Grace M. (B. A. 1909)
Daniels, Farrington (B. S. 1910)
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.-F. (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.
Taylor, Cyril S.
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

Reck, Maud G. (B. A. 1905)
Skartvedt, Peter M. (B. A. 1906, St. Olaf)

Master of Science in Chemistry

Brinton, Paul H. M.-F. (B. S. 1912, Ph. D. 1916)
Cressey, 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

Jevrud, Ingvald O.
Tibbling, Ernest F.
Merton, Howard V.
Berman, Harry C. (Ch. E. 1914)
Tinkham, Willis M.
May, Darwin (Ch. E. 1915, M. S. 1916)

Chemical Engineers

Anderson, Fredolf T. (B. S. 1913)
Berman, Harry C. (B. S. 1914)
Kern, Herbert A. (B. S. 1913)
Peterson, Henry (B. S. 1913)
Porter, Ralph E. (B. S. 1913)

Master 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)
Morse, Guilford A. (Ch. E. 1915)
Olsen, Leslie R.
Kingstrom, Hugo (M. S. 1917)
Toncheff, Stanil
May, Darwin (B. S. 1914)
Morse, Guilford A. (B. S. 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

Master of Science in Chemistry

Dunningham, Merton
Souther, 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. 1914)
Newman, Allen T. (B. S. 1912, Nebraska)
Stenger, Lawrence A. (E. E. 1906)
Woollett, 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 and Chemistry

Corson, Benjamin L.
Durham, Samuel W.
*Eckman, Lawrence K.
*Egge, Walter
Markus, Benjamin
Marr, Horace S.
Marshall, Olive W.
Owens, Jay C.
Rask, Olaf S.

Bachelor of Science in Chemical Engineering

Burningham, Foster A. (Ch. E. 1918)
Domovsky, Aaron
Higburg, William
Kuentzel, Ward E.
Luft, Oscar W. v. d.
Strong, Frank D.
Washburn, Frederick M.
Widell, Gideon

Chemical Engineer

Bell, Alexander D. (B. S. 1916)

Master of Science in Chemistry

Barrows, Vera (B. A. 1906)
Cade, Arthur R. (B. S. 1915, Worcester Polytechnic Inst.)
Joyce, Floyd E. (B. A. 1912, Iowa)
Lauer, Walter M. (B. A. 1913, Ursinus College, Ph. D. 1924)
Ringstrom, Hugo (B. A. 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
Kesselman, Leo
Nelson, Harry G.
Pan, Wen Ping

Bachelor of Science in Chemical Engineering

Donauer, Max (Ch. E. 1925)
Hogness, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 1920)
Neilson, Christ

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)
Woollett, Guy H. (B. S. 1910, M. S. 1916)

1919

Bachelor of Science in Chemistry

Beckel, Arthur C.
Brooks, Leslie C.
Engstrom, Leslie G.
Heck, Frank J.
Thorson, Stuart J.

Bachelor of Science in Chemical Engineering

Fischer, Earl B.
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)

1920

Bachelor of Science in Chemistry

Hoff, 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

Johnson, Donald L. (B. S. 1919)
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.
Epstein, Hymen
Kryger, Edward R.
Nygard, Edwin M.
Riley, Philip J. (M. S. 1924)
Seymour, Merrill W.
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)
Leerskov, Gerhard W.
Nicholson, Harry G.
Peterson, Marshall A. (Ch. E. 1922)
Riddington, Frederick W. (Ch. E. 1922)
Roberts, Wesley J. (Ch. E. 1922)
Schermer, Oscar C. (Ch. E. 1922)
Swart, Richard H.

Chemical Engineers

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. 1920)
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, Sigfred 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.
Schwartz, Marcel M.
Stone, Leslie F. (Ch. E. 1923)
Wyman, LeRoy L. (Ch. E. 1923)

Chemical Engineers

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)
Schemer, Oscar C. (B. S. 1921)

Master of Science in Chemistry

Fulmer, Jervis M.
(B. S. 1920, Washington State College)
Harris, Elmin E. (B. S. 1921, Hamline)
Heing, 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.
Paulson, Paul M. (M. S. 1924)
Peterson, Clifford E.
Rademacher, Richard L. (M. S. 1924)
Sorenson, Ben. E. (M. S. 1924)
Thordarson, William (M. S. 1924)
White, Robert H. (M. S. 1924)

Chemical Engineers

Barrett, Joseph O. (B. S. 1922)
Cassel, Norman S. (B. S. 1922)
Chadbourne, L. Rodney (B. S. 1922)
Halvorson, Halvor O. (B. S. 1922)
Langseth, Axel O. (B. S. 1922)
Morin, William T. (B. S. 1922)
Stone, Leslie F. (B. S 1922)
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)
Fagel, Herbert A. (B. A. 1922)

Master 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.
Humphrey, Gertrude J.
Ludwig, Llewellyn G.

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)
Thordarson, William (B. S. 1923
White, Robert H. (B. S. 1923)

Doctor of Philosophy

Fuson, Reynold C. (B. A. 1920,
Montana, M. A. 1921, California)
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.
Johnson, Lester L.
Johnston, Charles L.
McKee, John B.
Reiter, Alfred A.
Scandling, Joseph E.
Sprung, Murray M.
Stier, Ruth I.
Zeidlik, William J.
(Mrs. Cecil Mayo)

Chemical Engineer

Donauer, Max (B. S. 1918)

Master of Science in Chemistry

Cheney, 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)

SCHOOL OF MINES

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, Oliver 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.

O'Connor, Edward S.
Rawson, Horace C.
Rose, William A.
Wallace, George W.
Wheeler, Walter H.

1903

Engineer of Mines

Cohen, Samuel W.
Field, Edward M.
Flynn, John G.
Heard, Harold J.
Kait, Donald M.
Smith, Franklin W.
Sowle, Lawrence K.
Truesdale, William H.
M. S.
Whiteley, Eugene E.
Winther, Arno

Metallurgical Engineer

Bresius, Harold I.

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
Shonts, Sydney L.

Metallurgical Engineer

Bresius, Harold I.

1905

Engineer of Mines

Angst, Harry H.
Boyd, Robert R.
Cadwell, W. Chauncey
Calhoun, Allan B.
Curry, Duncan E.
Field, Thorold 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.

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 R.
Grimes, John A.
Haase, 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.
Conkey, Charles R.
Devereux, Lawrence
Duncan, Kenneth J.
Farnam, Henry E.
Fritzberg, Ernest A.
Goodrich, Norman P.
Harmon, Benjamin G.
Heath, Clarence L.
Heidel, C. Sumner
Herting, William E.
Holler, Frederick W.
Johnson, Algot F.
Jones, Philo E.
Larson, Clarence L.
Leonard, Forest M.

Engineer of Mines

McKenzie, James R.
Moody, Revilla G.
Newell, John R.
Ostrand, Peter M.
Stewart, G. Gordon
Strane, Archie J.
Swanson, Axel H.

1911

Engineer of Mines

Abbott, Theodore S.
Anderson, Joseph
Anderson, Walter C.
Bailey, Paul T.
Baker, Emory P.
Beck, Charles S.
Borgeson, Anshelm C.
Burgess, Robert J.
Crouse, Charles S.
Drake, George M.
Ekloff, Victor E.
Elliott, Jay R.
Fixen, Victor L.
Jahn, William F.
Kingsley, Neil S.
Lindholm, Milton S.
Rahilly, Harold J.
Tetlie, John R.
Walker, E. Harold
Walters, Charles W.
Wehr, Arthur J.
Whitson, Lloyd R.
Bjorge, Guy N.

Metallurgical Engineer

McCullough, Ervin W. Met. E.

1912

Engineer of Mines

Bjorge, Guy N.
Coventry, Edward D.
Dickson, Robert H.
Hagstrom, Leonard J.
Harrington, George L.
Hewitt, Ezra A.
Knox, La Fayette
Kremer, Edward G.
Lea, John
Lewis, John W.
McAdams, Howard R.
Martin, Lynn
O'Brien, J. Charles
Olson, Walter S.
Perry, Joe B.
Prouty, Roswell W.
Quinn, Max F.
Stevens, Howard E.
Taylor, William L.
Wallinder, Arthur
Walter, Rollie R.
Woodis, Clark N.

1913

Engineer of Mines

Coady, Leo J.
Ely, Robert H.
Fosness, Arthur W.
Hammond, Arthur H.
Hanson, J. Bernard
Hondrum, Olaf
Ladd, Greeley
Michie, Roy G.
Nissen, Arvid M. S.
Ofsthen, Norman
Walker, Chas. A.

1914

Engineer of Mines

Anderson, Arthur F.
Bierman, Alfred C.
Eidemiller, Howard N.
Larson, Ernest L.
Potter, Orrin W.
Quinlan, Howard
Ravicz, Louis G.
Robertson, John H.
Wasson, Harold J.

1915

Engineer of Mines

Butler, William V.
Christenson, Alfred
Coller, Walter A.
Collins, Leon T.
Haugen, Albert C.
Heilig, Louis S.
Kerr, Charles D.
Neerland, Herman
Ramsing, Fred C.
Sanchez, Richard M.
Urquhart, George K.
Wade, Henry H.
Williams, Paul S.

1916

Engineer of Mines

Aronson, Sam.
Craig, John J.
Davies, Fred A.
Dovre, Adolph
Lee, Oscar
McDermid, Archie J.
McHardy, Roy H.
Nord, Harry H.

Metallurgical Engineer

Krogh, Alvin T.

1917

Engineer of Mines

Anderson, Edwin H.
Buresch, Charles E.
Dennis, Richard C.
Dopp, J. Lawrence
Elson, William H.
Ernster, Omer F. M. S.
Fearing, Edward J.
Harmon, Sydney
Levorsen, A. Irving
Woodruff, John J.
Armstrong, Harold K.
Cowin, Percy G.
Hsieh, Chung
Jerrard, Walther L.
Moga, John A.

Metallurgical Engineer

Peterson, Paul A.
Allard, Raymond W.
Dowdell, Ralph L. M. S.

Engineer of Mines in Geology

Coryell, Lewis S.
Hubbard, W. Earle
Kwong, Yih Kun
Sweetman, Edwin A.
Wallace, Carleton S.
Foley, Lyndon L.
Gannett, Roger W.
Ingersoll, Guy E.
Quinn, Howard E.

1919

Engineer of Mines

Frellsen, Sidney A.
Goldberg, Bert
Goldberg, Samuel B.
Mellem, Walter R.

Metallurgical Engineer

Pan, Wen Ping

Engineer of Mines in Geology

Hosted, Joseph O.

1920

Engineer of Mines

Ainsworth, Robert E.
Arnold Lewis E.
Bailey, A. K., Jr.
Clark, Fred E.
Donaghue, Abner J.
Edwin, John
Frank, Harry O.
Johnson, Axel L.
Kersten, Erwin H.
Mark, Israel
Nichols, Clifford R.
Peterson, Clarence D.
Raiter, Clifford R.

Engineer of Mines in Geology

Copeland, Wm. A.
Wheeler, James D.

1921

Engineer of Mines

Butler, Roy G.
Chadbourn, Charles H.
Frank, Elden
Gandrud, Bennie W.
Johnston, Kenneth A.
Sebenius, Carl H.
Sponberg, Edwin C.
Zanger, Eugene

Metallurgical Engineer

Dawson, Loren W.
Hamernik, Frank J.
Nichols, William J.
Wenger, Frank B.
West, Herbert S.

Engineer of Mines in Geology

Carlson, Edwin N.
Davies, Herman F.
Walz, C. M.

1922

Engineer of Mines

Adams, E. Maurice
Anderson, Oscar B.
Barker, Clifton T.
Barr, J. Carroll
Chang, Chen Ping
Echebarria, Luis de U.
Gustafson, Arnold A.
Hansen, Mayer G.
Hoffman, Louis
Hope, Lawrence L.
Johnson, Ralph C.
Kilp, Raymond G.
Lin, Sze Chen
Lovering, Thomas S. M. S., Ph. D.
McKenzie, Frederick R.
Moga, Gregory M.
Plut, Frank J.
Thoeni, Victor T.
Wilson, J. Byron

Metallurgical Engineer

Johnsen, Trygve

Engineer of Mines in Geology

Patton, Richard C.

1923

Engineer of Mines

Anderson, Alfred T.
Brawley, John N.
Brenner, Walter W.
Calhoun, Robert A.
Chang, Chi
DeVaney, Fred D.
Dinmore, Harry C.
Erickson, Arthur C.
Gallagher, Luke J.
Gow, Alexander M.
Hawlick, Hartley H.
Hezzelwood, George
Jeffers, Gordon B. M. S.
Kwong, Shou Kun
Levy, Julian H.
Lundquist, O. William
Pabst, Henry A.
Ridgway, Robert H.
Russell, Charles B.
Searles, John N.
Sjolander, Anthony
Smith, Carl James
Swensen, Clifford H.
Thellin, Herbert E.
Tolleison, Everett H.
Vivian, Edgar W.
Winter, William M.
Wrbitzky, Harry M.

Metallurgical Engineer

Mooney, Frank E.
Persons, Robert W.
Queneau, Roland B.
Schneid, Adolph J.

Engineer of Mines in Geology

Clay, J. Withers
Conhaim, Howard J.
Erdmann, Chas. E.
Foss, Adolph L.
Friedl, Arthur J.
Griswold, Willis R.
Henkel, Howard
Kegler, Vern L.
LaTendresse, H. E.
Lilly, Richard J.
Middleton, John L.
Wilcox, Fred H.
Wolfer, Donald H.

1924

Engineer of Mines

Ballard, John A.
Brunner, Donald G.
Case, Leslie M.
Huang, Ta Heng
Hutchinson, Bernard C.
Jensen, Willard C.
Larsen, Raymond M.
Lee, Clarence O.
Moe, Cecil J.
Olson, Stanley G.
Oscarson, Philip E.
Sung, Kuo Hsiang

Metallurgical Engineer

Curran, Francis J.
Forsyth, Arthur C.

Engineer of Mines in Geology

Graeber, Clyde P.
Knutson, Clarence J.
Nelimark, John H.
Stewart, James L.

1925

Engineer of Mines

Haley, A. J.
Hennen, E. H.
Kamb, Hugo R.

Metallurgical Engineer

Johnson, George A.
Larpenteur, Bernard J.

1926

Engineer of Mines

Alexander, J. W.
Griffith, E. H.
Haase, C. C.
Johnson, A. M.
Martin, H. K.
Van Duzen, E. N.

Metallurgical Engineer

Boreen, M. S.
Huck, G. M.
Johnson, R. L.
Wiley, R. E.

Engineer of Mines in Geology

Andrews, T. F.

Alphabetical Directory

Graduates of the Technical Colleges of the University of Minnesota up to 1926 arranged in alphabetical order

COLLEGE OF ENGINEERING AND ARCHITECTURE

AASLAND, ARNE '23 C
620 South 4th St., Minneapolis, Minn.
Harrison & Smith Co., Estimator.

AASLAND, CHRISTOPHER '15 C
Minnesota State Highway Dept., Minneapolis, Minn.

ABBOTT, AMOS H. '16 BEE, '17 E
St. Paul, Minn.
N. S. P. Co., Supt. of Gas Distribution.

ABBOTT, ARTHUR L. '97 E
15 W. 37th St., New York City.
Assn. of Electragists, International, Technical Director.

ABRAHAMSON, HOWARD B. '18 M
N. S. P. Co., St. Paul, Minn.

ABRAMSON, HARRY W. '23 C
1125 Fremont Ave. N., Minneapolis, Minn.

ACKER, SIDNEY H. '23 M
Engineering Dept., N. S. P. Co., St. Paul, Minn.

ACOMB, WILLIAM E. '02 M
Waukegan, Ill.
American Steel & Wire Company, Superintendent.

ADAMS, BENJAMIN W. '10 C
Asst. Engr., M. of W., Seattle, Wash.

ADAMS, EDWARD H. '22 G
1004 Marquette Ave., Minneapolis, Minn.
Adams Construction Co., Bldg.

ADAMS, ELMER E. '06 C
Spokane, Wash.
Great Northern Ry., District Engineer.

ADAMS, GEORGE F. '95 E
Realty Bldg., White Plains, N. Y.
Real Estate.

ADAMS, JOHN W., JR. '12 C
245 Plymouth Bldg., Minneapolis, Minn.

ADAMS, WILLIAM C. '05 E
121 Shearer St., Montreal, Quebec, Canada.
Northern Electric Co. Ltd., Chief Engineer.

ADLER, EUGENE H. '14 E, '15 EE
619 S. Main Avenue, Sioux Falls, S. D.
McGraw Co., Salesman.

AINSLIE, ARTHUR F. '11 C
P. O. Box 714, Staples, Minn.

ALBRECHT, ERNEST G. '25 E
898 E. Fifth St., St. Paul, Minn.
Tri-State Tel. and Telg. Co.
Transmission Department.

ALBRECHT, GEORGE M. '06 E
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
Patent Attorney.

ALBRECHT, KARL J. '25 E
University of Minnesota, Minneapolis, Minn.
Graduate student.

*ALLBEE, PIERCE '16 A

ALDRICH, LOUIS W. '23 C
240 S. Broadway, Los Angeles, Calif.
Street Design Division, Engr. Dept.

ALEXANDER, GEORGE D. '20 C
916 New York Life Bldg., City.
J. W. Shaffer Co.

ALGREN, AXEL B. '25 M
2300 2nd St. N., Minneapolis, Minn.
Production Engr., A. T. Rydell Inc.

ALLEE, DAVID A. '02 C
Schenectady, N. Y.
G. E. Co., Civil and Mechanical Engineer.

ALRICK, BANNONA G. '06 C
300 Builders Exchange Bldg., Minneapolis, Minn.
C. A. P. Turner Co.

ALSOP, ERNEST B. '06 C
Arling, Idaho.
Morrison-Knudsen Company.

ALTON, HERBERT D. '07 E
E-2004-Sprague, Spokane, Wash.
Electrical Contractor.

AMIDON, LEE L. '23 M
West Virginia University, Morgantown, W. Va.
Instructor Steam and Experimental Engr.

ANDERSEN, CHRISTIAN '88 C
New Post Office Bldg., Portland, Ore.
U. S. Bureau of Public Roads, Engineer.

ANDERSEN, EMIL '05 E
240 Plymouth Building, Minneapolis, Minn.
Sec., Standard Electric Service Company.

ANDERSON, ARTHUR P. '25 E
10 Illinois St., Chicago Heights, Ill.
Public Service Co. of Northern Ill.

ANDERSON, ARTHUR R. '12 E
1114 Mission St., San Francisco, Calif.
Lundstrom Hat Works, Salesman.

ANDERSEN, EDWARD I. '17 M '19 ME
Attica, N. Y., Westinghouse Elec. & Mfg. Co.
Asst. Works Manager.

ANDERSON, EDWARD S. '21 E
Box 457, International Falls, Minn.
Minnesota and Ontario Paper Co.

ANDERSON, EMIL G. '24 E
240 Plymouth Bldg., Minneapolis, Minn.
Standard Elec. Service Co.

ANDERSON, FAYETTE C. '24 E
505 15th Ave. S. E., Minneapolis, Minn.

ANDERSON, FRANK A. '08 E
935 Sandy Blvd., Portland, Ore.
National Appliance Co., Mgr.

ANDERSON, FRANK L. '16 E
Anderson Co., Farm Implement Mfgr., St. Paul, Minn. Engineer.

ANDERSON, GEORGE T. '15 C
Chisholm, Minn.
City Engineer.

ANDERSON, HARVEY B. '12 C '13 CE
Hopkins, Minn.

ANDERSON, HELMER N. '20 M
220 E. 5th St., St. Paul, Minn.
Fairbanks Morse & Co., Mgr., Pump and Elect. Dept.

ANDERSON, HILDER A. '18 M
N. S. P. Co., St. Paul, Minn.

ANDERSON, JOHN G. '99 C
Minneapolis, Minn., M. St. P. and S. Ste. M. R. R., Asst. Engineer, Structural Design.

ANDERSON, JOSEPH A. '24 M
A. C. Spark Plug Co., Flint, Mich.

ANDERSON, JOSEPH W. '15 E
N. W. Bell Tel. Co., Minneapolis, Minn.
Engineer, Exchange and Equipment.

ANDERSON, MARTIN E. '01 E
610 Interstate Trust Co. Bldg., Denver, Colo.
Patent Attorney.

ANDERSON, MILTON J. '20 A
321 Rives Strong Bldg., Los Angeles, Calif.
Asst. Chief Engr., John M. Cooper.

ANDERSON, MILTON L. '21 A
321 Rives Strong Bldg., Los Angeles, Calif.
John M. Cooper, Asst. Chief Engineer.

ANDERSON, NELS S. '22 C
Board of Education, City Hall, Minneapolis, Minn. Draftsman.

*ANDERSON, OLE J. '93 C

ANDERSON, OLE A. '93 M, '08 ME
Shop Instructor, Hibbing Junior College, Hibbing, Minn.

ANDERSON, OSCAR P. '10 E
Harrison, N. J. Edison Lamp Works. Director of Commercial Engineering.

ANDERSON, OSCAR V. '10 E
Toronto & Niagara Power Co., Toronto, Ont.
Supt., T. N. P. Division.

ANDREWS, GEORGE C. '87 M
2629 University Ave. S. E., Minneapolis, Minn.
Andrews Heating Co., President.

ANDREWS, GEORGE L. '05 M
R. F. D. No. 2, Canterbury Road, Euclid, Ohio.

ANDRUS, HARRY J. '22 C
131 State St., Boston, Mass.
Twin State Gas & Elec. Co., Vice President.

ANDRUS, RAYMOND J. '07 E
131 State Street, Boston, Mass.
Vice President, Twin State Gas & Elec. Co.

APPLEMAN, FRANK C. '24 E
212 W. Washington St., Chicago, Ill.
Equipment Eng'g Dept., Ill. Bell. Tel. Co.

ARENSON, TIMOTHY G. '16 E

ARMSTRONG, THOMAS S. '06 M

ARNESEN, HERBERT P. '11 C
Toltz, King & Day, Inc., St. Paul, Minn.
Office Engineer.

ARNESON, LLOYD O. '21 M
Bailey Meter Co., Cleveland, Ohio.
Engineer.

ARSTAD, LEONARD O. '24 E
N. W. Bell Tel. Co., Minneapolis, Minn.

ARTZ, EMMANUEL A. '99 E
Electrical Construction Company.
Sioux City, Iowa.

ASCHER, RAYMOND C. '23 M
Bethlehem Steel Co., Lackawanna Plant, New York.
Asst. Billet Yard Foreman.

ASH, JAMES W. '08 C
206 E. Grand Ave., Des Moines, Iowa.
American Horticulture Co., Landscape Architect.

ASHBAUGH, LEWIS E. '00 M '07 CE
1427 Dearborn St., Chicago, Ill.
Sessions Engineering Co. of Chicago.

ASHWORTH, ROY H. '11 E
520 Kearns Bldg., Salt Lake City.
Utah Power & Light Co., Asst. Coml. Mgr.

ASKE, IRVING E. '20 E
2921 Stevens Avenue, Minneapolis, Minn.
Pres. and General Mgr., Aske-Fuemer Co.

ASKEW, THOMAS A., JR. '16 C
Plainview, Minn.
Thomas Askew Co., General Merchandise.

ASLAKSON, BAXTER M. '91 M
Monadnock Bldg., Chicago, Ill.
Consulting Engineer.

ASLAKSON, CARL I. '23 C
U. S. Coast and Geodetic Survey, Washington, D. C. Deck Officer.

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County Engr., Chippewa County.

Middleton, John L. E. M. (Geol.) '23
66 Rue des Colonies, Brussels, Belgium.
Societe Internationale Foresiere et Minerie du Congo, Belgian Congo.

Mills, Eugene Co. E. M. '97
Sacramento, Calif.
Cons. Engr., Irrigation and Drainage.

Minder, E. G. E. M. '05
Slayton, Minn. Cons. Engr.

Moe, Cecil J. E. M. '24
1602 28th St., Superior Wis.

Moenke, William F. E. M. '06
Box 69, Sunrise, Wyo. Geologist.

Moga, Gregory M. E. M. '22
115 E. 1st St., Duluth, Minn.
Foreman, Western Tool and Forge Co.

Moga, John A. E. M. '18
271 Charles St., St. Paul, Minn.
Student, Medical School, U. of M.

Moody, Revillo G. E. M. '10
3439 10th Ave. S., Minneapolis, Minn.
Eng. Dept., City of Minneapolis.

Mooney, Frank E. Met. E. '23
405 Monroe St., Gary, Ind.
Ill. Steel Co., Gary Plant.

Morgan, Charles S. E. M. '02
2019 Clarendon Ave., Bessemer, Ala.
Supt., Brown Ore Mine, Woodward Iron Co.
Woodstock, Ala.

Neerland, Herman E. M. '15
1246 University Ave., St. Paul, Minn.
Right-of-way Engr., Minn. Highway Dept.

Nelimark, John H. E. M. (Geol.) '24
Virginia, Minn. Oliver Iron Mining Co.

Neustadt, Bertholdt R. E. M. '06
634 2nd St., LaSalle, Ill. Merchant.

Newell, John R. E. M. '10
Box 1033, Spokane, Wash.
Mgr., Spokane Concrete Pipe Co.

Nicholls, William J. Met. E. '21
International, Utah.
Assayer, International Smelter.

Nichols, Clifford R. E. M. '20
Plymouth, Calif.
Eng., E. J. Longyear Development Co.

Nissen, Arvid E. E. M., M. S. '13
Bldg. 86, Edgewood Arsenal, Md.
Associate Physicist, Chem. Warfare Service.

Nord, Harry H. E. M. '16
Billings Mine, Chisholm, Minn.
Mine Capt., Stambaugh Iron Co.

Oberg, Anton C. E. M. '07
316 Sellwood Bldg, Duluth, Minn.
Cons. Min. Engr.

O'Brien, J. Charles E. M. '12
A. C. M. Co., Conda, Ida.
Foreman, A. C. M. Phosphate Mine.

O'Connor, Edward S. E. M. '06
P. O. Box 696, Mayville, Wis.
Mine Supt., The Mayville Iron Co.

Ofsthun, Norman H. E. M. '13
923 W. 34th St., Los Angeles, Calif.

Olmstead, John S. E. M. '08
Ajo, Ariz.
Leaching Dept., New Cornelia Copper Co.

Olson, Walter S. E. M. '12
Cmsn. of Drainage and Waters, Old Capitol Bldg., St. Paul. Office Engineer.

Olson, Walter S. E. M. (Geol.) '25
Sampler, Anaconda Copper Co., Butte, Mont.

Olund, Henning E. E. M. '07
615 A. G. Bartlett Bldg., Los Angeles, Calif.
Cons. Min. Engr.

Oscarson, Philip E. E. M. '24
Bisbee, Ariz.
Eng. Force, Calumet & Arizona Mining Co.

Ostrand, Peter M. E. M. '10
Crosby, Minn.
Member Contracting Firm, Ostrand and Hallett.

Pabst, Henry A. E. M. '23
Hibbing, Minn. Fit Eng., Mahoning Mine, Pickands, Mather & Co.

Pan, Wen Ping Met. E. '19
Hibbing, Minn.
Min. Eng., Oliver Iron Mining Co.

Parker, Walter H. E. M. '07
School of Mines, U. of M., Minneapolis, Minn.
Professor of Mining.

Patten, Richard C. E. M. (Geol.) '22
337 S. Reno St., Los Angeles, Calif.

Perry, Joseph B. E. M. '12
Porterville, Calif.
Supt. of Mines, Sierra Magnesite Co.

Persons, Robert Wayne Met. E. '23
Ingersoll-Rand Co., 11 Broadway, New York City. Sales Eng., Rock Drill Sales Dept.

Peterson, Andrew Y. E. M. '99
Coleraine, Minn. Gen. Supt., Canisteo Dist., Oliver Iron Mining Co.

Peterson, Clarence D. E. M. '20
1927 Washington Ave. S., Minneapolis, Minn.
Field Engr., Bureau of Bldgs., Board of Education, Minneapolis, Minn.

Peterson, Joseph S. E. M. '08
Smuggler, Colo.
Asst. Gen. Mgr., Tomboy Gold Min. Co.

Peterson, Paul A. Met. E. '17
Address unknown.

Plut, Frank J. E. M. '23
P. O. Box 484, Ironton, Minn.
Eng., Whitmarsh Mining Co.

Potter, Orrin W. E. M. '14
1803 Princeton Ave., St. Paul, Minn.
Instr. in Drawing and Descriptive Geometry, U. of Minn.

Probst, Elmer A. E. M. '07
Amalfi, Columbia, S. A. Mgr., La Viborita Co., Amalfi, Colombia, S. A.

Prouty, Roswell W. E. M. '12
Riverside Portland Cement Co., Riverside, Calif.
Examining Geologist.

Queneau, Roland B. Met. E. '23
The Pitometer Co., 50 Church St., New York City.

Quinlan, Howard E. M. '14
542 Ashland Ave., St. Paul, Minn.
Vice Pres., Allen Quinlan Co.

Quinn, Howard E. E. M. (Geol.) '18
Tex. Sch. of Mines, El Paso, Tex.

Quinn, Max F. E. M. '12
Care Mina Tiro General, Charcas, S. L. P., Mex. Supt., A. S. & R. Co., Sierra Mojada, Mex.

Rahilly, Harold J. E. M. '11
Care of Anaconda Copper Mining Co., Butte, Mont. Mine Supt., Tramway, Mine.

Rait, Donald M. E. M. '03
Box 744, Warren, Ariz. Asst. Supt. of Mines, Calumet and Arizona Mining Co.

Raiter, Clifford R. E. M. '20
1303 Sherburne Ave., St. Paul, Minn.
Asst. Supt., Constr. and Repr., City of St. Paul.

Ramsing, Fred C. E. M. '13
125½ Elm St., Anaconda, Mont.
Chem. Research Lab., A. C. M. Co.

Ravicz, Louis G. E. M. '14
Hayden, Stone & Co., 25 Broad St., New York City. Petroleum Geol. and Engr.

Rawson, Horace C. E. M. '06
2015 W. 49th St., Minneapolis, Minn.
Bldg. Constr.

Ridgway, Robert H. E. M. '23
U. S. Engineers' Office, Municipal Bldg., Chattanooga, Tenn. Surveyor.

Robertson, John H. E. M. '14
Box 1405, Miami, Ariz.

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2818 10th Ave. S., Minneapolis, Minn.
ROOD, LYNN E. M. '09
Care of Chas. Weinhagen & Co., St. Paul, Minn. Sec. and Treas., Chas. Weinhagen & Co.
ROSE, WILLIAM A. E. M. '06
Duluth, Minn. Asst. Gen. Mgr., Pickands, Mather & Co.
RUSSELL, CHARLES B. E. M. '23
Min. Eng., Bethlehem Mines Corp.
SANCHEZ, RICHARD M. E. M. '15
Casapalca, Peru, S. A. Chief Eng., Sociedad Minera Backus y Johnston del Peru.
SANDERSON, HENRY S. MET. E. '01
406 Interstate Bldg., Denver, Colo. Cons. Min. Engr. and U. S. Mineral Surveyor.
SANTO, JULIUS H. E. M. '09
Ely, Minn.
Dean of Junior College, Ely, Minn.
SCHEID, ADOLPH J. MET. E. '23
Columbia Tool Steel Co., Chicago Heights, Ill.
SCHEID, CHARLES F. MET. E. '25
With Columbia Tool Steel Co., Milwaukee, Wis.
SCHRADER, ERICH J. E. M. '05
Reno, Nev. Cons. Engr.
SEARLES, JOHN E. M. '23
State Highway Dept., Wabasha, Minn.
SEBENIUS, CARL H. E. M. '21
Annapolis, Mo. Annapolis Lead Co.
SHERMAN, HOWARD P. E. M. '25
With Stanley Mining Co., Duluth, Minn.
SHONTS, SYDNEY L. E. M. '04
Wallace, Ida. Cons. Min. Engr.
SJOLINDER, ANTHONY O. E. M. '23
1917 Feronia Ave., St. Paul, Minn.
Const. Div., Eng. Dept., N. P. Ry., St. Paul.
SMITH, EDGAR W. E. M. '07
3520 W. Lake Calhoun Blvd., Minneapolis.
Engr., Winston Bros. Co.
SMITH, ELMO V. MET. E. '01
1610 Walker Bank Bldg., Salt Lake City.
U. Contracting Mgr., American Bridge Co.
SMITH, FRANKLIN W. E. M. '03
Box 919, Bisbee, Ariz. Smith & Ziesemer, Bisbee, Ariz.
SMITH, HOVAL A. E. M. '01
Warren, Ariz. Min. Engr.
SODOMA, JOSEPH MET. E. '25
Tennessee Copper Co., Copperhill, Tenn.
SOWLE, LAWRENCE K. E. M. '03
219 Union Mortgage Bldg., Cleveland, O.
Real Estate and Mortgage Securities.
SPONBERG, E. CLARENCE E. M. '21
Berkshire Mine, Mellen, Wis. Asst. Chem. Engr., Berkshire Mining & Dev. Co.
STEELE, CHARLES W. E. M. '07
Elec. Steel Foundry, Portland, Ore.
Sales Engr., Elec. Steel Foundry.
STEVENS, HOWARD E. E. M. '12
Northwest Amalgam. Fuel Co., Duluth, Minn. Vice Pres.
STEWART, G. GORDON E. M. '10
Roseburg, Ore. Private Eng. Practice and U. S. Mineral Surveyor.
STEWART, JAMES L. E. M. (GEOL.) '24
4628 Lyndale Ave. S., Minneapolis, Minn.
Instrumentman, N. P. Ry. Co.
STRANE, ARCHIE J. E. M. '10
1140 Dayton Ave., St. Paul, Minn.
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STRONG, JOHN L. E. M. '08
615 Walvin Bldg., Duluth, Minn.
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SUNG, KUO HSIANG E. M. '24
Care of 37 S. 9th St., Minneapolis, Minn.
SWANSON, AXEL H. E. M. '10
Care of Castle-Trethwey Mines, Gowganda, Ont., Can.
SWEETMAN, E. A. E. M. (GEOL.) '17
Virginia, Minn.
Min. Eng., Interstate Iron Co.
SWENSEN, CLIFFORD H. E. M. '23
Constr. Eng., Bethlehem Mines Corp.
SWENSEN, KARL P. B. S., E. M. '07
51 Chambers St., New York City.
Oriental Mgr., Allied Mach. Co. of America.
TANNER, WALLACE N. E. M. '96
520 Hennessy Bldg., Butte, Mont.
Mech. Eng.
TARESH, JOHN E. M. '01
Rio Oso, Calif. Engr. and Sec., Reclamation District No. 1001.
TAYLOR, HAROLD G. E. M. '09
1046 McKnight Bldg., Minneapolis, Minn.
Northwestern Sales Engr., Permutit Co.
TAYLOR, WILLIAM L. E. M. '12
Plymouth Mining Co., Verona, Mich. Supt.
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310 Oak St., Detroit, Minn.
TETLIE, JOHN R. E. M. '11
Box 431, Tonopah, Nev. Chemist United Comstock Mines Co., Gold Hill, Nev.
THELLIN, HERBERT E. E. M. '23
Box 333, Crosby, Minn.
THOENI, VICTOR T. E. M. '22
519 McKinley Ave., Kellogg, Idaho. Assayer, Assay Office, Bunker Hill & Sullivan Smelter.
THOMASSEN, MARK W. MET. E. '26
Phillipsburg, N. J. Ingersoll-Rand Co.
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1970 Atlantic Ave., Long Beach, Calif.
TOLLEFSON, EVERETT H. E. M. '23
Office Engr., Roxana Petroleum Corp., Dallas, Texas.
TRUESDALE, W. H E. M. '03
Ray, Arizona.
URQUHART, GEORGE K. E. M. '15
Elcor, Minn. Eng., Elva and Corsica Mines, Pickands, Mather & Co.
VAN DUZEE, E. N. E. M. '26
Roxana Petroleum Corp., Dallas, Texas.
VIVIAN, EDGAR W. E. M. '23
Engr., Utica Mine, Hibbing, Minn.
WADE, HENRY H. E. M. '15
Hopkins, Minn. Metallurgist, School of Mines Exp. Sta., U. of Minn.
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2 Sylvan Place, New Rochelle, N. Y.
Liomin & Wales Co., Inc., of New York City.
WALKER, CHARLES A. E. M. '13
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650 Highland Ave., Piedmont, Oakland, Calif.
Capt., Eng., U. S. R.
WALKER, E. H. E. M. '11
Elizabethville, Katanga, Congo-Belge, Africa.
Mine Mgr., Union Miniere Du Haut-Katanga.
WALLACE, C. S. E. M. (GEOL.) '17
Hollywood, Calif.
Tile and Marble Contractor.
WALLACE, GEORGE W. E. M. '06
122 23rd Ave., Oakland, Calif.
WALLINDER, ARTHUR E. M. '12
Iron Mask Mine, Kamloops, B. C.
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Salt Creek, Wyo.
WALTERS, CHARLES W. E. M. '11
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WASSON, HAROLD J. E. M. '14
6115 Kimbark Ave., Chicago, Ill.
Geol. and Eng., New England Oil Corp., Ltd.
WEHR, ARTHUR J. E. M. '11
Fort Riley, Kan. Capt., U. S. A.
WENGER, FRANK B. MET. E. '21
Deerwood, Minn.
Eng., Potts Exploration Co.
WEST, HERBERT S. MET. E. '21
Dept. of Public Works, City of St. Paul, Civil Engineer.
WHEELER, JAMES D. E. M. (GEOL.) '20
Standard Oil Co. of Calif., Columbia, S. A.
WHEELER, WALTER H. E. M. '06
1110 Met. Life Bldg., Minneapolis, Minn.
Special Engr. for Hennepin County.
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Box 705, Warren, Ariz. Supt. of Mines, Calumet & Arizona Min. Co.
WHITSON, LLOYD R. E. M. '11
1009 Southwestern Life Bldg., Dallas, Tex.
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311 Phoenix Bldg., Minneapolis Dist. Mgr., Mutual Life Ins. Co. of New York.
WILCOX, FRED H. E. M. (GEOL.) '23
Cisco, Tex. Geologist for Firm, Lind-Wilcox.
WILEY, RICHARD E. MET. E. '26
Computing Clerk, U. S. Bureau of Mines, Univ. of Minnesota.
WILKINSON, CHARLES D. E. M. '95
Goldfield, Nev. Consulting Engr., Diamondfield Black Butte Mining Co.
WILLIAMS, HOMER A. E. M. '09
883 Lakeview Ave., St. Paul, Minn.
Valuation Engr., D. F. Wilcox Co.
WILLIAMS, PAUL S. E. M. '15
810-13 Mid-Continent Bldg., Tulsa, Okla.
Oil Operator.
WILSON, J. BYRON E. M. '22
5053 Penn Ave. S., Minneapolis, Minn.
WINTER, WILLIAM MORSE E. M. '23
Olivia, Minn.
Jr. Eng. for Kircher Bros., Contractors.
WINTHER, ARNO E. M. '03
Comstock, Nev.
Mgr., United Comstock Mines Co.
WOLFER, DONALD H. E. M. (GEOL.) '23
111 Cambridge Ave., St. Paul, Minn.
Geologist and Eng., Campbell Oil Co.
WOODIS, CLARK N. E. M. '12
Deer Trail, Colo. Ranching.
WOODRUFF, JOHN J. E. M. '17
National Carbon Co., Niagara Falls, N. Y.
WRRITZKY, HARRY M. E. M. '23
Illinois Highway Dept., Peoria, Ill.
Jr. Highway Engr.
ZANGER, EUGENE D. E. M. '21
New York & Honduras Rosario Mining Co., San Juancito, Honduras, C. A.
ZIESEMER, HARRY M. E. M. '07
Box 394, Bisbee, Ariz.
Chief Engr., Phelps-Dodge Corp.
ZIESEMER, RALPH A. E. M. '05
Box 394, Bisbee, Ariz.
Member of Firm of Smith & Ziesemer, Bisbee.

Geographical Directory

Graduates of the College of Engineering and Architecture, School of Chemistry and School of Mines arranged by location

ALABAMA

Anniston
- Jesperson, Clarence M. 1910 E

Bessemer
- Morgan, Charles 1906 E.M.

Birmingham
- Cowin, Percy G. 1918 E.M.
- Soshnik, Edward J. 1922 C

East Florence
- Grant, James A. 1907 C

Gadsden
- Downing, Frank E. 1904 C

Mobile
- Batson, Charles D. 1907 C

Tuscaloosa
- DeVaney, Fred D. 1923 E.M.
- Gandrud, Bennie W. 1921 E. M.

University
- Lee, Oscar 1916 E.M.

ARIZONA

Ajo
- Olmstead, John S. 1908 E.M.

Bisbee
- Oscarson, Philip E. 1924 E.M.
- Rosok, Ingwald 1903 E
- Smith, Franklin W. 1903 E.M.
- Ziesemer, Harry M. 1907 E. M.

Calumet
- Rait, Don M. 1903 E.M.
- Whitley, Eugene E. 1903 E.M.

Casa Grande
- Chandler, Eugene D. 1909 E.M.

Clarksdale
- Kerns, Ralph W. 1907 E

Hayden
- Johnson, Nels 1905 C

Inspiration
- Donaghue, Abner J. 1920 E.M.

Jerome
- Calhoun, Robert A. 1923 E. M.
- Dickson, Robert H. 1912 E.M.
- Hansen, Mayer G. 1922 E.M.
- Hundrum, Olaf 1913 E. M.
- Kruse, Helmer V. 1913 C

Miami
- McDermid, Archie J. 1916 E.M.
- Robertson, John H. 1914 E.M.

Morenci
- Beck, Charles S. 1911 E.M.
- Becker, George 1897 E.M.

Prescott
- Lytzen, Walter W. 1905 E.M.

Ray
- Hewitt, Ezra A. 1912 E.M.
- Ingersoll, Guy E. 1918 E.M.
- Truesdale, William H. 1903 E.M.

Tucson
- Lovering, Thomas S., 1922 E. M. (Geol)

Warren
- Lindholm, Milton S. 1911 E.M.
- Rait, Donald M. 1903 E.M.
- Smith, Hoval A. 1901 E.M.
- Whiteley, Eugene E. 1903 E.M.

CALIFORNIA

Alhambra
- Cram, Clyde M. 1907 C

Albemarle
- Huston, David B. 1907 C

Aurberry
- Thompson, Jesse L. 1916 E

Bellflower
- Bowman, Frank A. 1904 E.M.

Berkeley
- Bostwick, Ross D. 1923 Ch.E.
- Hogness, Thorfin 1918 Ch.E.
- Ramstad, Edward C. 1902 M

Beverly Hills
- Boyd, Robert R. 1905 E.M.

Big Creek
- Barber, Harold A. 1921 C
- Nelson, Martin E. 1924 C

Burbank
- Oustad, Olaf L. 1913 C

Carmel-by the Sea
- Smith, Catherine 1922 A

Cartago, Inyo Co.
- Marshall, Olive W. 1917 Ch.

Claremont
- Taylor, Edward 1898 C

Coronado
- Smith, Carl J. 1923 E.M.

Covina
- Douglass, Fred L. 1891 C

Delano
- Hawley, Harry G. 1907 C

Fresno
- Councilman, Halsted P. 1908 M

Glendale
- Everington, James W. 1901 C
- Gillan, Silas L. 1907 E.M.
- Hunt, Walter E. 1900 E.M.
- Poore, Charles D. 1905 Ae.

Grafton
- Crowley, Jay 1909 E.M.

Hollywood
- Wallace, Carleton S., 1917 E.M. (Geol.)

Independence
- Vita, Theodore 1909 E

Jackson
- Nichols, Clifford R. 1920 E.M.

Kennett
- Egleston, Oliver J. 1900 E.M.

Lodi
- Cullyford, James A. 1908 E.M.

Long Beach
- Gulick, Hervey 1905 E.M.

Los Angeles
- Ainsworth, Robert E. 1920 E.M.
- Aldrich, Louis W. 1923 C
- Anderson, Milton L. 1921 A
- Arnold, Lewis E. 1920 E.M.
- Bachrack, Alfred 1908 E
- Bass, William C. 1899 E.M.
- Beneke, Walter E. 1920 C
- Bushnell, Elbert E. 1883 M
- Clark, Fred E. 1920 E.M.
- Collins, Leon T. 1915 E. M.
- Dorr, William R. 1914 M
- Dunn, Andrew P. 1906 E
- Durham, Samuel W. 1917 Ch.
- Gibbs, Clayton T. 1918 E
- Greenwood, Williston W. 1890 C
- Hanover, Monroe H. 1906 C
- Hansen, Edwin L. 1921 C
- Hartzberg, Edward M. 1919 M
- Hendrickson, Arnold E. 1922 E
- Henkel, Howard L. 1923 E.M.
- Jerrard, Walther L. 1918 E.M.
- Jevne, George W. 1910 C
- Kauffman, Roy 1908 E
- Kessel, Herbert 1918 Ch E.
- Kreinkamp, Herbert A. 1922 A
- Kreinkamp, Linton H. 1917 A
- Layden, Arthur L. 1915 E
- Lea, John 1912 E.M.
- Lyford, Dorr H. 1911 E
- McIntosh, Joseph B. 1898 E.M.
- McKenzie, Leonard F. 1920 E
- Morin, William T. 1922 Ch.E.
- Murrish, Frederic E. 1909 E
- Nelson, Glenn 1923 C
- Ofsthen, Norman 1913 E.M.
- Olund, Henning E. 1907 E.M.
- Oram, Robert C. 1911 M
- Palmer, Roy A. 1921 E
- Patton, Richard C., 1922 E.M. (Geol.)
- Pengilly, Joseph H. 1911 E
- Schmid, Robert J. 1908 C
- Stone, Harris G. 1906 E
- Sweningsen, O. 1908 E
- Talbot, Thomas F. 1918 E
- Tannehill, Louis W. 1916 A
- Udell, Carl D. 1909 M
- White, Arden Dean 1922 C
- White, Charles W. 1913 E.
- Ziesemer, Ralph A. 1905 E.M.

Mare Island
- Page, Mark L. 1903 E

Mountain View
- Wilson, Glenn W. 1911 E

Oakland
- Bestor, George C. 1924 C
- Duncan, George R. 1919 E
- Elfstrum, Axel E. 1911 C
- Walker, Clinton L. 1898 E.M.
- Wallace, George W. 1906 E.M.

Ocean Park
- Curry, Duncan E. 1905 E.M.

Oleum
- Boxell, Morris L. 1921 Ch.E.

Palo Alto
- Rask, Olaf S. 1917 Ch.

Pasadena
- Clapp, W. Howard 1901 E.M.

Petaluma
- Comstock, John W. 1908 C

Porterville
- Perry, Joe B. 1912 E.M.

Redland
- Dibble, Barry 1903 E

Rio Oso
- Tatesh, John 1901 E.M.

Riverside
- Frouty, Roswell W. 1912 E.M.

Sacramento
- MacKusick, Elwood M. 1899 E
- Mills, Eugene C. 1897 E.M.

San Bernardino
- Barnes, Dean M. 1921 M
- Spencer, Raymond D. 1925 C

San Diego
- Blossom, Wilbur W. 1890 C
- Dunn, Wilbur W. 1890 C
- Holden, Henry H. 1903 Met. E.
- Petrick, Alfred C. 1919 E
- Thompson, Roy E. 1909 E

San Francisco
- Anderson, Arthur R. 1912 E
- Benham, Claude F. 1912 E
- Bisbee, Elmer 1905 C
- Bjonerud, Earl S. 1922 E
- Bjerge, Guy N. 1912 E.M.
- Brown, William P. 1912 M
- Burrows, Robert P. 1911 E
- Chowen, Walter A. 1891 C
- Dresser, Eva L. (Alves) 1909 Ch.
- Godwin, Kenneth A. 1921 G
- Green, Fred H. 1907 C
- Hoyt, Hiram P. 1893 C
- Jones, Raymond L. 1905 E
- Ringstrom, Hugo 1915 Ch.
- Taylor, Duane L. 1917 M
- Torgerson, I. E. 1912 C
- Tubby, Oliver 1907 M
- Tuck, George A. 1905 M

San Leandro
- Moody, Chester 1916 M

Strathmore
- Smith, Paul S. 1903 C

Vallejo
- Bicknell, Henry R. 1910 Ch.

Visalia
- Godsby, Lester H. 1909 E

Westwood
- Miller, Hollis 1913 E

Winthrop
- Winther, Arno 1903 E.M.

Yankee Jims
- Bailey, Paul T. 1911 E.M.

COLORADO

Boulder
- Fulmer, Jervis M. 1922 Ch.
- Rank, Samuel A. 1875 C

Deer Trail
- Woodis, Clark N. 1912 E.M.

Denver
- Anderson, Martin E. 1910 E
- Dahlberg, Henry W. 1910 Ch.E.
- Johnson, Carl A. 1921 M
- Johnson, Carl A. 1911 C
- Lee, Engbert A. 1897 C
- McCarty, Edward P. 1900 E.M.
- Nekola, John W. 1907 M
- Newman, Allen T. 1916 Ch.
- Sanderson, Henry S. 1901 Met.E.
- Stenger, Laurence A. 1906 E
- Wolfe, George E. 1924 E

Fowler
- Knowlton, Herbert H. 1908 C

Meeker
- Lumm, Gordon 1925 A

Pueblo
- Dallimore, Arthur N. 1908 C

Smuggler
- Peterson, Joseph S. 1903 E.M.

CONNECTICUT

New Haven
- Bean, William L. 1902 M
- Erdmann, Charles E. 1923 E.M.
- Hiers, Charles R. 1924 M
- McLean, Milton D. 1921 G

DELAWARE

Wilmington
- Parrett, Arthur N. 1920 Ch.E.

WASHINGTON, D. C.

Washington
- Anderson, Emil G. 1924 E
- Becker, Ward E. 1917 E
- Bekkedahl, Norman P. 1925 Ch.E.
- Cohen, Nathan 1906 E
- Doran, James M. 1907 Ch.
- Earl, Donald E. 1924 M
- Engstrom, Leslie G. 1919 Ch.
- Grimes, John A. 1908 E.M.
- Hamm, Homer A. 1925 Ch.
- Hoass, Ole G. 1908 E.M.
- Ingberg, Simon 1909 C
- Jacobi, Alfred J. 1925 M
- Jones, Lewis A. 1907 C
- Kracek, Frank C. 1920 Ch.E.
- Kuentzel, Ward E. 1917 Ch.E.
- Leonard, Forest M. 1910 E.M.
- Lundquist, Reuben A. 1905 E
- McBride, Russell S. 1908 Ch.
- McCrady, Archie R. 1924 C
- Morey, George W. 1909 Ch.E.
- Nortner, Sylvester E. 1916 C
- Peterson, Barney J. 1913 C
- Peterson, Clarence A. 1908 E
- Ridgeway, Robert H. 1923 E.M.
- Robbins, Orison 1903 C
- Roepke, Otto B. 1906 E
- Schottler, George J. 1923 E
- Willis, Benjamin S. 1917 E
- Zimmerman, Arthur C. 1923 C

FLORIDA

Babson Park
- Morse, George A. 1914 C

Jacksonville
- Coe, Clarence S. 1889 C
- Long, Fred W. 1896 C

Lake Worth
- Hoag, Wm. R. 1884 C

Lakeland
- Dindorf, Edward C. 1924 C
- Purdy, Irving 1920 C

Leesburg
- Hallidy, Leslie L. 1921 C

Miami
- Laurence, Philip J. 1915 C
- Zimmerman, Arthur C. 1923 C

St. Petersburg
- Lushene, Joseph 1925 C

Tampa
- Hamilton, Jefferson M. 1919 A
- Grochan, Earl H. 1921 C
- Schow, Garfield G. 1924 E

GEORGIA

Atlanta
- Chase, Arthur W. 1893 E

Brunswick
- Ren, Albrecht H. 1919 Ch.E.

Ft. McPherson
- Cox, Richard F. 1908 M

Savannah
- Kiegel, Louis F. 1911 E

IDAHO

Arling
- Alsop, Ernest B. 1906 C

Avery
- Janzen, William H. 1920 E

Boise
- Markhus, Olaf G. F. 1897 E
- Morse, Guilford A. 1915 Ch.E.
- Smith, Hugh A. 1918 E

Conda
- O'Brien, J. Charles 1912 E.M.

Granite
Peterson, Harold R. 1918 E
Kellogg
Thoeni, Victor T. 1922 E.M.
Lewiston
Kjosness, Ingraham G. 1903 M
Quartzburg
Brunner, Donald G. 1924 E.M.
Wallace
Merriam, Robert S. 1903 E.M.
Shouts, Sydney L. 1904 E.M.

ILLINOIS

Alton
Cosh, Richard A. 1919 M
Brown, Homer L. 1917 M
Aurora
Zeleny, Frank 1898 M
Belle Rive
Moris, Russel F. 1925 C
Champaign
Mark, Max 1925 C
Potter, A. Harold 1903 Ch.
Chicago
Appleman, Frank C. 1924 E
Ashbaugh, Lewis E. 1907 C
Aslakson, Baxter M. 1891 M
Aultfather, David 1922 E
Baker, Emery P. 1911 E.M.
Bayless, Harry C. 1899 M
Bergquist, John E. 1913 C
Borchert, Oscar H. 1925 E
Borrowman, George L. 1905 A.C.
Braden, Rene A. 1923 E
Brimeyer, Ferdinand J. 1925 Ae
Brinker, Howard C. 1925 Ch.
Carlbom, Leonard H. 1925 C
Carson, Lauren G. 1921 E
Clausen, Elmer W. 1923 E
Cook, Walter K. 1922 C
Copeland, Floyd E. 1923 M
Crosby, Milton E. 1915 M
Curtis, Benjamin J. 1913 C
Dahlquist, Philip L. 1910 C
Daniels, Elmer A. 1913 Ch.
Drost, Henry F. 1922 E
Eckenbeck, Everett E. 1917 E
Eddy, Clarence J. 1922 M
Erickson, Carl E. 1924 C
Fitt, Joel A. 1909 E
Fleming, Laurence T. 1910 M
Franzen, Roy O. 1925 E
Fuhrman, Alvin O. 1924 Ch.E.
Galanter, Samuel S. 1925 C
Gilchrist, Chas. C. 1898 E
Grath, Arthur W. 1920 E
Grow, Harry A. 1903 A
Gutsche, Frank C. 1910 Ch.E.
Hanke, Carl C. 1920 C
Harmon, Benjamin G. 1910 E.M.
Hartman, Walter K. 1919 E
Hawkins, Edward W. 1924 A
Hayes, Harold 1922 G
Holmsten, Victor T. 1922 M
Hornibrook, James W. 1909 E
Houston, Cecil C. 1909 C
Hontz, Guy J. 1901 E
Howatt, John 1904 E
Hubbell, Arthur C. 1914 M
Hughes Frank C. 1903 M
Huseby, Gisle E. 1924 E
Hutchinson, Bernard C. 1924 E.M.
Johnson, Albert W. 1923 C
Johnson, Ivar W. 1924 E
Juran, Joseph M. 1924 E
Katz-Nelson, William 1913 Ch.E.
Kaufman, Morris B. 1924 C
Keller, Orin E. M. 1905 E.M.
Kelsey, Howard C. 1922 M
Kern, Herbert 1913 Ch. E.
King, John E. 1922 E
Kivley, Roy Chas. 1918 M
Klopsteg, Paul E. 1911 G
Konstant, Nicholas 1918 C
Krause, Fred E. 1924 E
Kristy, George A. 1909 E
Kriz, J. J. 1912 C
Langford, George Jr. 1924 M
Lazarus, Morris W. 1923 C
Liddle, Ralph W. 1921 G
Lindelien, Engen 1923 M
Luedeman, Clarence H. 1923 Ae
Lundquist, O. W. 1923 E.M.
McKenzie, James R. 1910 E.M.
McMeekin, Glenn D. 1921 G
McMillan, Franklin R. 1905 C
Malmgren, Richard 1925 E
Martin, Edmund W. 1912 Ch.E.
Messer, Harold D. 1923 M
Moore, Norman 1925 C
Morris, John O. 1888 M
Nelson, Clarence H. 1925 E
Newbery, Lester W. 1922 C
Nierling, Grant C. 1925 E
Olson, C. Milford 1924 C
Olson, Kenneth M. 1925 C
Olson, Roy H. 1923 E
Oscarson, Gerhard L. 1922 E
Owens, Jay C. 1917 Ch.
Pangburn, Carroll 1922 E
Pardee, C. A. 1912 E
Pavek, William J. 1919 M
Peoples, John S. 1914 M
Peterson, Albert E. 1919 E
Peterson, Clarence R. 1925 C
Putnam, George Wm. 1918 G
Rankin, Dean W. 1925 Ae
Rankin, Renville S. 1914 C
Ransom, Glen B. 1922 E
Rezab, John J. 1907 E
Rickman, Herman W. 1917 C
Rosenthal, Paul 1922 C
Ruemmeli, A. E. 1912 M
Russell, Winfred W. 1923 E
Sauzen, Bert R. 1913 M
Schwartz, John S. 1919 A
Schwartz, Marcel M. 1922 Ch.E.
Sear, Arthur W. 1923 M
Selander, Karl W. 1922 E
Skagerberg, Rutcher 1915 E
Smith, Cedric B. 1918 C
Sorenson, John E. 1922 E
Sperry, Leonard B. 1905 M, 1908 E
Strate, Thomas H. 1901 C
Strom, Arthur 1923 A
Taylor, Richard G. 1925 E
Tiberg, Ernest J. 1916 E
Thompson, Everett 1923 C
Turner, Leslie E. 1909 E
Von Schlegell, Frederick 1895 E
Walujoski, A. Arnold 1924 E
Ward, Alvin C. 1923 E
Washburn, Frederick W., 1917 Ch.E.
Wasson, Harold J. 1914 E.M.
Weber, Hanard F. 1924 E
Wicklund, Paul E. 1925 Ae
Wicks, John 1904 E
Widell, Gustaf F. 1908 C
Wilk, Benjamin 1913 C
Williams, Fred M. 1909 E
Williams, Myrl J. 1920 M
Williams, Wilbur S. 1909 M
Wills, David C. 1923 E
Wilson, Frank W. 1923 E
Chicago Heights
Anderson, Arthur P. 1925 E
Heggen, Reuben 1924 E
Schneid, Adolph J. 1923 Met.E.
Cicero
Carlson, Richard E. 1922 E
Wiggins, John B. 1923 E
Decatur
Elwood, Daniel H. 1923 E
Dixon
Marcroft, Harold C. 1924 E
Silverman, Emil 1922 C
Downers Grove
Eddy, Lynne W. 1907 E
Evanston
Kester, Ernest B. 1923 Ch.E.
Geneva
Kapphahn, Ernest H. 1919 G
Joliet
Emerson, Lynn A. 1911 E
McCoy, Ira C. 1911 E
Somero, Waino M. 1924 C
Stoner, Clifford M. 1924 C
Umbehocker, Frank 1921 M
Villaume, Walter F. 1923 C
La Salle
Holler, Frederick W. 1910 E.M.
Neustadt, Berthold R. 1906 E.M.
Peck, Lloyd 1923 C
Maywood
Kruse, Orlin O. 1920 E
Oak Park
Cottingham, George Jr. 1915 C
Dowd, Archie Joseph 1919 M
Olson, Arnim G. 1922 E
Pierson, Joe W. 1919 E
Waby, Delton T. 1923 M
Ozark
Ott, Leonard E. 1915 C
Peoria
Barnum, Charles R. 1924 A
Chapin, S. Caryl 1924 C
Whitzky, Harry M. 1923 E.M.
River Forest
Lambie, Horace 1923 E
Rockford
Bates, Albert H. 1905 M
Underhill, Editha 1925 Ch.
Rock Island
Chapman, Burton L. 1910 C
Springfield
Abramson, Harry W. 1923 C
Bailey, George R. 1922 C
Thompsonville
Kroll, Arthur J. 1925 C
Urbana
Dietrichson, Gerhard 1910 Ch.
Larson, Louis J. 1914 C
Waukegan
Acomb, Wm. Edward 1902 M
Xenia
Weis, Wallace D. 1921 C

INDIANA

Bedford
Saltwick, Andrew 1924 M
East Chicago
Reck, Robert C 1920 Ch.E.
Fort Wayne
Cass, Hoyt R. 1924 E
Ellis, Carl E. 1925 E
Rath, Harvey C. 1923 E
Gary
Cottingham, Wm. P. 1911 C
Mooney, Frank E. 1923 Met.E.
Indiana Harbor
Merton, Howard V. 1914 Ch.
Indianapolis
Higburg, William 1917 Ch.E.
McCullough, Ervin W., 1911 Met.E.
Markoe, James Cox P. 1912 M
Prentice, Robert S. 1908 E
Wagner, Adolph 1898 E
South Bend
Muessel, Robert W. 1921 C

IOWA

Algona
Winslow, Harry J. 1925 E
Ames
Clement, Lester L. 1906 E.M.
Cosandey, Chas. J. 1925 E
Askaloose
Weatherill, Cedric 1914 C
Boone
Lentz, Reuben 1925 A
Cedar Rapids
Blomquist, Hjalmar F. 1907 C
Charles City
Finke, Walter J. 1910 E
Davenport
Moyer, Malcolm B. 1909 M
Norelius, Emil F. 1908 M
Des Moines
Reeve, Howard E. 1923 E
Wesley, Ash. J. 1908 C
Dubuque
Madden, Francis 1903 C
Independence
Dunlap, George M. 1924 E
Janesville
Wild, Carl D. 1915 C
Logan
Bradley, Byron H. 1913 C
Marshalltown
Blodgett, Charles R. 1924 M
Eige, Elmer H. 1923 M
Mason City
Cribbs, Harry E. 1923 C
Judd, Maurice D. 1923 C
Ost, Roland E. 1922 C
Newton
Stanius, Godfrey 1921 E
Thayer, Paul W. 1914 M
Oakland
Haines, Howard N. 1922 A
Ottumwa
Smith, Leighton 1903 C
Triem, Ralph H. 1920 E
Redfield
Olsen, Arthur O. 1910 C
Sioux City
Arzt, Emmanuel A. 1899 E
Donauer, Max 1918 Ch.E.
Hoard, Harold J. 1903 E.M.
Joyce, Floyd E. 1917 Ch.
Mitchell, Lloyd S. 1923 C
Ward, John, Jr. 1925 C
Waterloo
Locke, Alfred M. 1908 E.M.
Waukon
Howard, Monroe S. 1892 E

KANSAS

Arkansas City
Larsen, Fred 1925 C
Werdenhoff, James H. 1921 C
Atchison
Hastings, Clive 1896 M
Fort Riley
Grow, Robert W. 1916 C
Wehr, Arthur J. 1911 E.M.
Kansas City
Langman, Harley R. 1924 M
Lawrence
Graham, Eugene C. 1902 G
Manhattan
Kleinschmidt, Florian A. 1922 M
Pittsburg
Woodman, Howard H. 1897 C
Wichita
Carlson, Edwin N. 1921 E.M.

KENTUCKY

Ashland
Porter, Ralph E. 1913 Ch.E.
Lexington
Crouse, Charles S. 1911 E.M.
Louisville
King, Harvey 1918 A
Midland
Peterson, Neander E. 1922 C
Paducah
Bartholomew, Neal W. 1925 C
Knapp, Lester 1912 E

LOUISIANA

Marrero
Fleming, Douglas R. 1908 C
Shreveport
Blue, Clarence W. 1925 C
Clay, J. Withers 1923 E.M. (Geol.)

MARYLAND

Baltimore
Billau, Lewis S. 1905 E
Tuve, Merle A. 1922 E
College Park
Linden, Henning 1917 E
Edgewood Arsenal
Hartnett, John G. 1911 Ch.
Nissen, Arvid 1913 E.M.

MASSACHUSETTS

Boston
Andrus, Raymond J. 1907 E
Emery, George O. 1919 A
Fallon, Eugene L. 1914 E
Holien, Edward O. 1923 A
Lang, James S. 1896 M
McVean, Norman S. 1921 E
Miller, Andrew L. 1921 E
Nebel, Walter H. 1911 E
Olstad, Oscar A. 1911 M
Payne, Harold G. 1906 E
Reuter, Peter T. 1921 M
Walker, Frank B. 1897 C
Webster, Harry M. 1915 E
Woodward, Herbert M. 1890 M
Brookline
Andrus, Harry J. 1922 C
May, Albert E. 1896 E.M.
Cambridge
Bonsall, Wallace C. 1924 A
Craig, Hamilton S. 1925 C
Crock, Jacob H. 1920 M
Darling, Stephen F. 1922 Ch.
Ellestad, Reuben B. 1922 Ch.
Forssell, William O. 1922 G
Fuson, Reynold C. 1924 Ph.D.
Graf, Donald T. 1922 A
Korslund, Harry J. 1920 A
Ludwig, Llewellyn G. 1924 Ch.
Plowman, George T. 1892 A
Yngve, Victor 1913 Ch.
Franklin
Tomlinson, L. C. 1904 E
Northampton
Morse, Minerva 1920 Ch.
Quincy
Morrow, Leon W. 1916 Ch.
Pittsfield
Currie, Niell, Jr. 1908 E
Goodwin, Victor E. 1904 E
Springfield
Jones, Ivor V. 1915C
Walker, William A. 1911 E
Williamstown
Lilly, Richard J. 1923 E.M. (Geol.)

MICHIGAN

Ann Arbor
Badger, Walter L. 1908 Ch.
Hoorn, Frederick W. 1912 E
Mehandru, Behari L. 1924 M
Orbeck, Martin J. 1911 C
Bessemer
Holmberg, Abner W. 1915 M
Crystal Falls
Anderson, Edwin H. 1917 E.M.
Christenson, Alfred 1915 E.M.

DETROIT
Babcock, Vernon M. 1923 E
Brooke, Harold L. 1918 E
Dale, Dallas W. 1924 M
Dedic, Richard J. 1924 C
Elliot, Harry C. 1919 M
Gutsche, Edward J. 1904 Ch.
Hamilton, Herbert C. 1897 Ch.E.
Hoppin, Glenn H. 1908 E
Huntoon, Milton B. 1899 E
Hvoslef, Fredrik W. 1917 M
Loye, Benjamin W. 1906 M
Malmstrom, Axel L. 1917 E
Morris, Thomas C. 1908 M
Prudden, George H., Jr. 1917 A
Rand, Lars 1913 M
Riddington, Frederick W. 1921 Ch.E.
Shepard, Donald D. 1911 E
Staehle, Haswell E. 1924 M
Swenson, Clarence O. 1917 M
Walker, George W. 1909 Ch.
Wennerlund, Elias C. 1899 M

FLINT
Anderson, Joseph A. 1923 M
Murray, John H. 1917 M
Rhame, Paul W. 1920 M
Wagner, John W. 1924 M

GRAND RAPIDS
Langland, Harold S. 1919 E
Lyon, Glenn H. 1920 A
Mahoney, William L. 1913 E
Tallmadge, Hiram 1916 E

HOUGHTON
Hamernik, Frank J. 1921 Met.E.

IRONWOOD
Sears, Dow I. 1914 C

JACKSON
Briggs, William G. 1921 E

RAMSAY
Eidemiller, Howard N. 1914 E.M.
Foss, Adolph L. 1923 E.M.

SAULT STE. MARIE
Sawyer, Emerson D. 1910 C

VERONA
Taylor, William L. 1912 E.M.

MINNESOTA

ALBERTA
Schlattman, Edward C. 1908 C

ALBERT LEA
Dock, Chester 1922 G
Lee, Clarence O. 1924 E.M.
Pless, Arnold 1920 C

ALEXANDRIA
Lewis, John G. 1924 E

ANOKA
Childs, Harvey B. 1906 C
Reed, Arthur L. 1906 C

ATWATER
Swenson, Charles 1907 C

AURORA
Olson, Vernon H. 1925 C

AUSTIN
Bisbee, Bertin A. 1922 E

BARNESVILLE
Thompson, Claudius 1922 C

BARNUM
Wood, Victor R. 1922 C

BELLINGHAM
Strege, Henry W. 1924 E

BEMIDJI
Shuirman, Gabe 1921 E

BLOOMINGHAM
Scott, Elmer C. 1915 C

BRAINERD
Davison, Joseph H. 1903 C
Jones, Harold W. 1925 C

BRECKENRIDGE
Bratons, Mark 1917 C

BUHL
Johnston, Kenneth A. 1921 E.M.
Walker, George W. 1908 C

CALLAWAY
Chilton, Edward G. 1913 C

CALUMET
Ott, Leonard E. 1913 C

CANBY
Thompson, Theodore S. 1924 C

CANNON FALLS
Slade, Loring 1922 C

CARLTON
Nickerson, Neal C. 1918 C

CASS LAKE
Swanberg, John H. 1925 C

CHISHOLM
Anderson, George T. 1915 C
Borgeson, Anshelm C. 1911 E.M.
Nord, Harry H. 1916 E.M.
Olson, Elmer J. 1923 C

CLOQUET
Aronovsky, Samuel I. 1921 Ch.E.
Glenn, Harry W. 1924 Ch.E.

COKDEN
Peterson, Everett L. 1925 A

COLERAINE
Battles, Leon E. 1913 C
Chang, Chi 1923 E.M.
Elstad, Rudolph T. 1919 C
Peterson, Andrew Y. 1899 E.M.

COLOGNE
McCubrey, Everett J. 1921 C

CROOKSTON
Nicholson, Harry G. 1921 Ch.E.
Riedesel, George M. 1917 A

CROSBY
Fearing, Edward J. 1917 E.M.
Mellem, Walter R. 1919 E.M.
Ostrand, Peter M. 1910 E.M.
Thellin, Herbert E. 1923 E.M.

DEERWOOD
Wenger, Frank B. 1921 Met.E.

DELANO
Brunkow, Herbert E. 1912 Ch.E.

DETROIT
Gunstad, Paul I. 1901 C
Teague, Harold W. 1900 E.M.

DULUTH
Anderson, Milton J. 1920 A
Berg, Thorsten H. 1925 C
Bernt, Hans E. 1920 C
Berry, George F. 1924 M
Bishop, Ira L. 1911 M
Bleifuss, Donald 1920 C
Buck, Frederick W. 1909 M
Burke, Roy L. 1905 C
DeFreece, Paul K. 1923 C
Dinsmore, Arthur T. 1912 M
Dorsey, John G. 1915 C
Farnum, Henry E. 1910 E.M.
Fee, E. Franklin 1907 M
Field, Thorold F. 1905 E.M.
Fieldman, David P. 1911 C
Fitzgerald, William J. 1920 C
Fixen, Victor L. 1911 E.M.
Frank, Elden 1921 E.M.
Gavin, Lawrence T. 1909 E.M.
Grettum, Walter A. 1924 E.
Gustafson, Arnold A. 1922 E.M.
Hammerstrom, Aleck A. 1921 E
Hankins, Nathaniel R. 1924 C
Hargraves, Robert A. 1923 E
Hibbard, Sheldon S. 1923 M
Hoff, John E. 1920 Ch.
Holmes, Raymond H. 1925 E
Holbeck, John I. 1924 E
Hoyt, William H. 1890 C
Hustad, Byron P. 1910 E
Jaques, Robert 1909 C
Jeffers, Gordon B. 1923 E.M.
Kapphahn, R. J. 1912 C
Kelly, Earl W. 1907 C
Knickerbocker, Arthur K. 1903 E.M.
Knutson, Harry 1917 M
Larson, Victor F. 1917 M
Luft, Hans L. 1924 Ch.E.
McEachin, John L. 1922 E
Magnuson, John E. 1922 E
Martino, Anthony 1925 M
Melander, Albin 1921 A
Mitchell, L. Morris 1914 C
Moga, Gregory M. 1922 E.M.
Nelson, Edward K. 1924 M
Nelson, Einer 1924 M
Nystrom, Paul E. 1924 A
Oberg, Anton C. 1907 E.M.
Olin, Henry A. 1923 E
Olson, Arthur L. 1924 M
Person, Otto C. 1924 Ae
Pulver, Richard F. 1923 E
Quinn, John 1908 C
Ringsred, Arthur C. 1906 M
Rose, William A. 1906 E.M.
Ross, Russell H. 1918 E
Roy, Millo C. 1921 M
Schwedes, Walter F. 1906 E
Sherman, Howard P. 1925 E.M.
Simmonds, Richard R. 1921 C
Sneve, Jack S. 1911 M
Spring, Willis W. 1907 M
Stevens, Howard E. 1912 E.M.
Stewart, Clarence H. 1903 C
Strong, John L. 1908 E.M.
Tennstrom, Carl 1923 C
Tondell, Mandell 1907 C
Wilson, Walter E. 1924 C

E. GRAND FORKS
Dahlberg, Arnold V. 1905 A.C.

EASTON
Herring, William E. 1918 E.M.

ELCOR
Anderson, Alfred T. 1923 E.M.
Urquhart, George K. 1915 E.M.

ELK RIVER
Houlton, Lewis K. 1904 E.M.
Johnson, Ralph C. 1922 E.M.
Longfellow, Dwight W. 1908 C
Normann, Rolf A. 1923 C

ELY
Duncan, Kenneth J. 1910 E.M.
Kauppinen, Heino 1925 E
Pearson, Elmer A. 1920 Ch.E.
Santo, Julius H. 1909 E.M.

EVELETH
Boyle, Patrick J. 1908 E.M.
Damberg, Paul S. 1922 A
Efy, Robert H. 1913 E.M.
Johnson, Axel L. 1920 E.M.
Kerr, Charles D. 1915 E.M.
Kingston, Merton S. 1904 E.M.
McAdams, Howard R. 1912 E.M.
Slavor, George J. 1925 E

EYOTA
Cassidy, Walter J. 1924 E

FAIRMONT
Bird, Harold, E. 1925 C
Curtis, Thomas H. 1912 C
Eustis, Irving N. 1917 M
Kasper, Walter 1911 M
Starrett, Howard M. 1909 M

FARIBAULT
Crawford, Wallace T. 1906 M
Gallagher, Luke J. 1923 E.M.
Hanrahan, Edmond C. 1920 G
Hosfield, Raleigh W. 1912 C
Klemer, Frank H. 1901 C
McKellip, Frank W. 1898 E

FEDERAL DAM, CASS CO.
Poore, Orson B. 1909 E

FERGUS FALLS
Flygare, August L. 1912 C
Frankoviz, John J. 1905 E
Hallan, Christian 1902 C

FOLEY
Markson, Christian O. 1922 C

FRONTENAC
Meskal, George 1923 C

FULDA
Price, John R. 1914 C

GAYLORD
Hecht, Henry W. 1924 C
Johnson, Raymond V. 1924 C

GLENCOE
Hankenson, John J. 1892 C

GLENWOOD
Christilaw, George M. 1921 C
Martin, Lynn 1912 E.M.

GROVE CITY
Nelson, Richard L. 1921 E

HALSTAD
Forseth, George O. 1925 M

HANSKA
Haugen, Albert C. 1915 E.M.

HASTINGS
Nelson, Edwin W. 1925 C

HAWLEY
Anderson, Ole 1908 M

HIBBING
Anderson, Walter C. 1911 E.M.
Bassett, Robert H. 1907 E.M.
Brandt, John 1906 E.M.
Friedman, Edwin A. 1923 E
Kurtzman, Paul S. 1906 E.M.
Loye, Henry E. 1905 E.M.
Markus, Benjamin 1917 Ch.
Pan, Wen Ping 1916 C
Reeve, Charles H. 1919 E
Swanson, Philip G. 1923 M
Turnquist, Axel A. 1916 E
Vivian, Edgar W. 1923 E.M.

HILL CITY
Blomberg, Evar H. 1916 E

HOPKINS
Anderson, Harvey B. 1912 C

HUBBARD
LaBonte, Anton 1925 C

HUTCHINSON
Higgins, Elvin L. 1892 C
Sherwood, Edward B. 1920 C

INTERNATIONAL FALLS
Anderson, Ed. S. 1921 E
Busch, John S. 1920 Ch.E.
Cantwell, William F. 1911 Ch.
Wilson, Roy A. 1925 M

IRONTON
Angst, Harry H. 1905 E.M
Deichen, William A. 1908 E.M
Plut, Frank J. 1922 E.M.

KEEWATIN
Bingen, William J. 1912 C
Leach, Edward W. 1910 C

LAKE CITY
Tews, Arthur W. 1924 C

LAKEFIELD
Buresch, Charles E. 1917 E. M.

LESUEUR
Little, LeRoy C. 1924 E

LITCHFIELD
McCullough, Bruce M. 1916 C

LITTLE FALLS
Donahoe, Robert E. 1921 E
Lundquist, O. W. 1923 E.M.
Ryan, Loiel S. 1912 C

LONG LAKE
Kelley, William 1923 C

LUVERNE
Cummings, Elmer F. 1912 C

MANKATO
Esser, Frank F. 1909 C
Gerlach, Henry C. 1922 A
Kleinschmidt, Almin R. 1922 M
Neilson, Christ 1918 Ch.E.
Nelson, Edgar M. 1924 E.

MAPLETON
O'Brien, Thomas E. 1925 C

MAYNARD
Johnson, Alexander B. 1915 C

MELROSE
Quinn, Max F. 1912 E.M.

MENDOTA
Braddock, Edward 1924 C

MINNEAPOLIS
Aaslund, Arne 1923 C
Adams, Edward H. 1922 G
Adams, John W. 1912 C
Adler, Eugene H. 1914 E
Alexander, George D. 1920 C
Algren, Axel B. 1925 M
Allard, Raymond W. 1918 Met.E.
Alrick, Banona G. 1906 C
Anderson, Emil 1905 E
Anderson, Fayette C. 1924 E
Anderson, Hilder A. 1918 M
Anderson, John G. 1899 C
Anderson, Joseph W. 1915 E
Anderson, Minton M. 1920 Ch.E.
Anderson, Nels S. 1922 C
Andrews, George C. 1887 M
Arenson, Timothy G. 1916 E
Astad, Leonard O. 1924 E
Aske, Irving 1920 E
Asleson, Hans 1910 C
Austin, Paul D. 1921 E
Auxer, William Lloyd 1925 C
Avery, Henry B. 1893 M
Ayers, Ellsworth B. 1925 Ch.
Bachelder, William H. 1924 C
Backstrom, Russell E. 1925 M
Backstrom, Wilburg A. 1923 A
Bakken, Lawrence H. 1922 A
Ballord, John A. 1924 E.M.
Banovetz, John A. 1925 C
Barger, Harold L. 1921 E
Barnum, Marvin C. 1911 M
Bauer, Esther E. 1924 Ch.
Beck, Maud G. 1913 Ch.
Beck, Vernon S. 1910 E
Beery, Charles B. 1909 M
Bell, Alexander D. 1916 Ch.E.
Bell, Maurice D. 1907 M
Benson, Ikel Carl 1925 E
Berg, Swan P. 1923 C
Bergford, Lester M. 1923 C
Bergford, Rolf E. 1923 C
Bergstrom, Marlow B. 1923 E
Beseler, Herman F. 1925 M
Bevan, R. Louis 1924 C
Biskup, William F. 1916 C
Bjerre, Folmar L. 1925 M
Blecher, George W. 1916 E
Bochnlein, Charles 1917 M
Boerner, Francis C. 1911 C
Bordeau, Sanford P. 1925 E
Borst, Wellington L. 1924 M
Bouquet, Otto T. 1923 E
Boyum, Irvin 1917 E
Brenchley, Harry E. 1908 C
Briggs, Hiram K. 1919 G
Brinton, Paul 1912 Ch.
Brockway, Roydon R. 1905 C
Brody, Mace J. 1924 C
Brooks, Leslie C. 1919 Ch.
Bros, Bernard M. 1923 M
Bros, Chester W. 1922 M
Bros, Ernest T. 1917 M
Bros, Raymond J. 1919 M
Brossard, Henry F. 1925 E
Brown, Floyd W. 1917 A
Brownell, Otto E. 1910 C
Bruce, Hjalmar N. 1916 C
Bullis, Everard J. 1924 C
Burch, Albert M. 1896 C
Burch, Edward P. 1892 E
Burlingame, Robert E. 1925 E
Burnett, H. V. 1914 C

MINNEAPOLIS

Busch, William A.	1922 Ch.E.
Cade, Arthur R.	1917 Ch.
Callaway, Roy S.	1911 Ch.E.
Capstick, Donald W.	1923 G
Case, Leslie M.	1924 E.M.
Chadbourn, Charles H.	1921 E.M.
Chadbourne, L. Rodney	1922 Ch.E.
Clarke, Charles P.	1908 C
Carlson, Anders J.	1916 C
Carlson, Warren E.	1924 E
Carpenter, Hugh W.	1921 C
Carter, Robert J. S.	1908 E
Chalmers, Charles H.	1894 E
Chernus, Maurice C.	1922 C
Childs, James A.	1909 C
Christensen, Arthur L.	1925 E
Christianson, Peter	1894 E.M.
Clark, John S. D.	1922 M
Cohen, Lillian	1900 Ch.
Cole, Willard A.	1909 E.M.
Collins, Stewart G.	1904 G
Colvin, James A.	1914 M
Comb, Fred R.	1910 M
Conkey, Charles R.	1910 E.M.
Cooper, Leo H.	1906 E
Corser, John	1916 M
Cote, Rhoda H.	1925 I.D.
Cowin, James	1907 E.M.
Craig, John J.	1916 E.M.
Critchett, Edward F.	1913 M
Croft, Edna K.	1922 A
Croft, Ernest B.	1911 C
Cross, Roland E.	1923 M
Crounse, Avery F.	1903 G
Curran, Francis J.	1924 Met.E.
Curtis, Verne F.	1922 M
Cutler, Alvin S.	1905 C
Dahl, George	1921 A
Dahl, Harold U.	1924 E
Dahlen, Miles A.	1924 Ch.E.
Dahlstrom, Raymond E.	1910 E
Darmody, William J.	1924 M
Davies, Edwin T.	1907 Ch.E.
Davies, Ralph M.	1909 E
Dawson, John W.	1922 A
Deane, George B.	1919 A
Deutsche, Richard E.	1918 C
Devereux, Lawrence	1910 E.M.
Dills, Lyle A.	1921 G
Diment, J. Morton	1924 E
Doell, Charles E.	1916 C
Donnelly, William H.	1925 M
Dorrance, Albert P.	1912 E
Douglass, Addison H.	1917 C
Dow, William G.	1916 E
Dresser, Harry S.	1916 M
Drinkall, Leon R.	1919 E
DuToit, George A.	1910 M
Eck, Lester J.	1923 Ch.E.
Edgar, Donald E.	1923 Ch.E.
Eggers, Henry C. T.	1915 E
Ek, Gustaf Albin	1917 M
Ekberg, Carl E.	1914 C
Ekman, Claes T.	1910 C
Ellingson, Elmer	1916 C
Elliott, A. Douglass	1914 E
Elliott, Jay R.	1911 E.M.
Ellsworth, Charles D.	1920 E
Elmburg, LeRoy M.	1923 Ae
Elmquist, Ruth E.	1921 Ch.
Elsberg, Nels W.	1909 C
Enger, Arne	1922 E
Enger, Edward H.	1911 C
Erickson, Clarence P.	1925 A
Erickson, Edwin C.	1922 C
Erikson, Henry A.	1896 E
Ernst, Robert C.	1923 Ch.E.
Estabrooks, Clyde F.	1924 M
Everett, William R.	1914 E
Fager, Simon R.	1904 M
Farmer, John W.	1921 M
Farnam, Julian P.	1911 M
Feder, Max	1922 C
Felton, Ralph P.	1892 M
Field, Edward M.	1903 E.M.
Finle, Joseph E.	1905 C
Firth, Charles V.	1923 Ch.E.
Fischer, Earl B.	1919 Ch.E.
Fischer, Harold W.	1923 E
Flindt, Richard H.	1923 C
Foley, Lyndon L.	1918 E.M.
Ford, Robert E.	1895 E
Forfar, Donald M.	1909 M
Forsberg, Enock E.	1918 A
Fossen, George	1917 C
Frank, Harry O.	1920 E.M.
Frantz, Willard F.	1925 C
Frellsen, Sidney A.	1919 E.M.
Fries, Floyd M.	1920 C
Fruen, Arthur B.	1908 G
Furber, J. Roscoe	1924 E
Gage, Hugh N.	1908 C
Garber, Gabriel E.	1906 M
Garthus, Ira B.	1924 E
Garzon, Julian R.	1924 C
Gee, Harry James	1919 G
Gemmel, John H.	1914 M.
Gerdes, Carl H.	1925 C
Gerow, Theron G.	1920 M
Gerrish, Harry E.	1905 M
Gerry, Martin H. Jr.	1890 M
Gholz, Arthur L.	1901 E.M.
Gillard, Herbert W.	1924 C
Gillette, George L.	1905 C
Gilman, Gaylord	1925 E
Gilman, Howard B.	1917 A
Gilman, James E.	1894 C
Gjesdahl, Maurice S.	1921 M
Godward, Alfred C.	1910 C
Goebel, Rudolph C.	1913 E
Goldstein, Milton M.	1908 E.M.
Goodwin, William R.	1908 E.M.
Gould, Edward S.	1920 C
Gow, Alexander M.	1923 E.M.
Graeber, Clyde P. (Geol.)	1924 E.M.
Gray, William I.	1892 E
Green, Chauncey L.	1924 E
Greiner, Harry S.	1924 E
Grout, Frank F.	1904 Ch.
Guggisberg, Charles F.	1917 M
Hagelin, Lawrence W.	1922 E
Hagstrom, Leonard J.	1912 E.M.
Hale, William H.	1904 E.M.
Halvorson, Halvor O.	1922 Ch.E.
Hammer, Harold E.	1925 E
Hammond, Kathryn	1922 Ch.
Hammond, Laurence D.	1914 M
Hansen, Christian Jr.	1910 E
Harrington, Russell A.	1924 E
Harris, Harold R.	1914 E
Harris, Nathan	1920 G
Harris, Sigmund	1905 M
Hartig, Henry E.	1918 E
Hartney, James L.	1914 M
Harwood, Stanley G.	1908 M
Hawkins, Harvey C.	1923 E
Heath, Donald C.	1916 A
Heidelberger, Otto F.	1923 E
Heilig, Louis S.	1915 E.M.
Helmick, Dan S.	1915 C
Herberg, Sanford	1924 C
Herrick, Carl A.	1902 M
Herrmann, Raymond R.	1912 E
Hibbard, Truman	1897 E
Hickok, Mrs. Harvey (Miss Jesse E. Stevens)	1896 G
Higgins, John T.	1890 C
Hildebrandt, H. A.	1899 E
Hill, Edward L.	1925 E
Hill, Hibbert M.	1923 C
Histleman, Clark W.	1912 M
Hobart, Walter B.	1907 C
Hoffman, Louis	1922 E.M.
Holmstine, Arthur G.	1917 M
Hope, Lawrence I.	1922 E.M.
Hopkins, Joseph I.	1904 Ch.
Hopkins, Mark L.	1909 E
Hotchkiss, Fred W.	1918 E
Houlton, Amos D.	1901 E
Houston, George S.	1902 C
Hubbard, Henry A.	1909 C
Huhn, George P.	1891 E
Humphrey, Gertrude J.	1924 Ch.
Hunter, Mrs. W. H. (Miss Lillian M. Seyfried)	1915 Ch.
Hustad, Andrew P.	1909 C
Hustad, John C.	1914 C
Jackson, Otto E.	1914 E
Jacobsen, Arthur C.	1923 E
Jacobson, Frank H.	1924 E
Jacobson, Howard C.	1921 G
Jacobson, Reuben A.	1925 M
Jensen, John A.	1905 C
Johnson, Alphonse N.	1921 C
Johnson, Algot F.	1910 E.M.
Johnson, Donald L.	1918 Ch.E.
Johnson, Edgar W.	1914 C
Johnson, Evan C.	1925 E
Johnson, Elmer W.	1914 E
Johnson, Ira L.	1916 M
Johnson, Lester L.	1925 Ch.E.
Johnson, Nels	1923 C
Johnson, Robertson B.	1925 E
Johnston, Charles K.	1921 E
Jones, Ernest J.	1920 Ch.E.
Jones, George R.	1914 E
Juselowitz, Goodwin	1918 Ch.
Kamb, Hugo R.	1925
Kampa, Edmund	1923 Ch.
Kaplan, Seeman	1918 A
Karatz, Lucian	1912 Ch.
Katter, Reuben L.	1922 M
Kapple, Frederick R.	1924 E
Keeler, Jasper F.	1922 C
Keller, Raymond W.	1925 E
Kersten, Erwin H.	1920 E.M.
Kilp, Raymond G.	1922 E.M.
King, F. V.	1912 C
Kingsley, Neil S.	1911 E.M.
Kinsell, William L.	1900 E
Klass, Frederick	1919 E
Kline, Frank W.	1924 E
Knoll, Franklin O.	1925 E
Krafft, Edwin A.	1924 A
Kranz, Lucille (Mrs. G. R. Heisig)	1919 Ch.
Kremer, Edward G.	1912 E.M.
Kumm, Arthur W.	1922 M
Kvitrud, Ingwald	1911 C
Ladd, Greeley	1913 E.M.
Lagaard, Alex S.	1913 E
Lagaard, Maurice B.	1914 C
Lambert, Edwin M.	1909 M
Lang, Charles A.	1906 E
Lang, Fred C.	1908 C
Larpenteur, Bernard J.	1925 Met.E.
Larson, Amandus C.	1920 C
Larson, Carl	1916 C
Larson, Glen M.	1923 M
Lauer, Walter M.	1924 Ph.D.
Laurence, Paul A.	1912 G
Lauritzen, Carl W.	1924 E
Levine, Irvin	1924 Ch.E.
Lebeck, Carl E.	1920 C
Lee, Melville R.	1921 Ch.E.
Lee, Oscar C.	1919 E
Leerskov, Gerhard W.	1921 Ch.E.
Leede, Henry M.	1920 C
Levens, Alexander S.	1922 C
Levin, Jake M.	1918 E
Lewis, Berkeley R.	1925 E
Lewis, Edward B.	1905 M
Lewis, George R.	1921 M
Liebenberg, Jacob J.	1916 A
Lobeck, Torstin E.	1924 E
Love, Percival E.	1921 E
Lund, Roy V.	1924 C
Lundquist, C. Vernon	1925 M
Lutz, Richard E.	1915 E
Macgowan, Irvin	1923 C
MacGregor, Helen	1925 I.D.
McClung, Karl	1925 E
McGregor, Frazer A.	1924 E
McHardy, Roy H.	1916 E.M.
McKay, Earle D.	1915 C
McKee, John B.	1925 Ch.E.
McKibben, Lloyd S.	1921 E
McLeland, Lyle K.	1924 E
McMillen, Elliott R.	1923 Ch.E.
McMiller, Paul R.	1911 Ch.
Mabbott, Leonard E. J.	1924 E
Maney, George A.	1911 C
Mangney, Elmer J.	1921 E
Mangney, Hilding O.	1924 E
Mann, Fred M.	1893 C
Manuel, Douglas R.	1922 Ch.E.
Mark, Israel	1920 E.M.
Markuson, Miner J.	1923 A
Mattison, Oliver	1905 C
Mattson, Dewey F.	1922 C
Mayer, Harris J.	1914 M
Meagher, Joseph	1925 E
Meili, Rudolph E. Jr.	1922 G
Mentzer, Clarence A.	1922 E
Merrill, Elmer W.	1912 E
Merrill, Lewis E.	1920 M
Merritt, Lucien	1904 E.M.
Meyer, Carl F.	1910 C
Meyer, Herb. W.	1914 E
Mills, Hartzell	1925 M
Mitchell, Donald F.	1920 Ch.E.
Mixer, Walter B.	1917 A
Molskness, Nels S.	1920 E
Moody, Revillo G.	1910 E.M.
Moore, Clarence F.	1920 G
Morken, Carl H.	1922 Ch.E.
Morris, Frank A.	1924 M
Morrison, John E.	1922 C
Morse, George	1893 A
Morton, Harry G.	1904 E
Mowery, Clarence W.	1908 C
Moyer, A. F.	1910 M
Nash, Russell D.	1923 E
Nason, George L.	1910 C
Nelson, Carl C.	1925 E
Nelson, Elmer A.	1923 C
Nelson, George A.	1925 C
Nelson, Gustaf A.	1919 E
Nelson, Nels B.	1904 C
Nelson, Oscar B.	1905 C
Nelson, Otis S.	1917 M
Nemec, Frank L.	1909 M
Newhall, William B.	1909 M
Nichol, Frank E.	1925 C
Nickerson, Edward	192
Nielson, Eunice V.	1923
Nilsen, Thorvald	1890
Noble, John F.	1921
Nordenson, Arnold	1922
Nordlien, Berger W.	1922
Nordstrom, Ernest A.	1922
Nordstrom, Milton E.	1925
Nordvall, Glenn	1923
Nutting, Horace W.	1925
Nygaard, Edwin M.	1921 C
Okes, Sidney R.	1909
Olaison, Clifford	1915
Olmstead, Charles F.	1922
Olsen, Leslie R.	1915 C
Olsen, Melvin S.	1908
Olson, Edwin E.	1925
Orr, George M.	1915
Otterstein, Earl F.	1913 C
Otto, Robert W.	1904
Overholt, Harley G.	1910
Pagel, H. Armin	1922 C
Parker, Helen R.	1925 I.D
Parker, Robert M.	1924
Parker, Walter H.	1907 E.M
Paul, Frederick	1909
Pelley, Lloyd L.	1924
Pendergast, Webster G.	1925 M
Pennock, Edward M.	1905 A.C
Pesek, Cyril P.	1925 A
Peterson, Arthur S.	1924 M
Peterson, Clarence D.	1920 E.M
Peterson, Harold W.	1921
Peterson, Laurence L.	1925 M
Peterson, Lewis E.	1925
Pratt, R. A.	1915 C
Prendergast, Arthur	1903 C
Prichard, Charles E.	1925 C
Quiggle, Arthur W.	1913 C
Rademacher, Richard L.	1923 Ch.E.
Raugland, Arnold I.	1920 A
Rawson, Horace C.	1906 E.M.
Reed, Henry R.	1925 E
Reidhead, Frank E.	1893 E
Reiter, Alfred A.	1925 Ch.E.
Riley, Philip J.	1921 Ch.
Ritchie, John R.	1916 M
Robertson, E. J.	1914 E
Robinson, Parke D.	1925 M
Robinson, Rhea B.	1912 Ch.
Roed, Olaf	1907 E.M.
Roos, Frank T. W.	1924 C
Rosenberg, Rahil A.	1924 A
Rosendahl, Harold R.	1922 M
Ryan, Robert M.	1923 E
Ryan, W. T.	1905 E
Salisbury, Willis R.	1910 G
Sampson, Cliff L.	1923 E
Sarver, Landon A.	1924 Ph.D.
Schaller, George C.	1923 C
Schermer, Oscar C.	1921 Ch.E.
Schilling, Theodore F.	1924 E
Schmidt, Roland L.	1925 C
Schuck, Roy D.	1923 E
Schweiss, Clifford C.	1923 E
Scott, Herbert L.	1923 E
Sebo, Arthur O.	1924 M
Seemann, Ernest W.	1920 C
Sesseng, Gunnar	1924 M
Shenehan, Francis	1895 C
Shepley, Charles R.	1902 C
Siverson, Sigvel J.	1911 C
Siverts, Samuel A.	1909 C
Skarolid, Charles T.	1924 E
Skurdalsvold, Peter	1915 C
Smith, Harold D.	1925 E
Smith, Edgar W.	1907 E.M.
Smith, Verna G.	1925 I.D.
Snow, Clarence J.	1914 M
Sorenson, Ben E.	1923 Ch.E
South, W. A.	1912 C
Springer, Frank W.	1893 E
Sprung, Murray M.	1925 Ch.E
Stephens, Clifford	1923 C
Stephenson, Oliver H.	1907 M
Sternberg, Carl	1907 E
Sternberg, Heime A.	1920 Ch.E
Stewart, Elwood L.	1924 E
Stone, Charles W.	1916 M
Stone, Leslie F.	1922 Ch.E
Stoppel, Arthur E.	1920 Ch.E
Sullivan, Betty	1922 Ch
Sullivan, Frederic V.	1923 C
Sung, Kuo Hsiang	1924 E.M.
Sutherland, Samuel J.	1923 A
Svendsen, George P.	1908
Swanson, Clifford L.	1922 C
Swanson, Edwin W.	1919
Swanson, Paul H.	1923
Swanstrom, Frank N.	1908
Swedberg, M. Roy	1911
Sweet, Roy R.	1921

MINNEAPOLIS
Swenson, George W. 1917 E
Swenson, Gustav A. 1920 G
Swenson, H. Seymour 1912 C
Swift, George Earl 1923 E
Taylor, Harold G. 1909 E.M.
Teal, Clarence W. 1924 E
Thayer, Charles E. 1876 C
Thomson, Andrew 1925 E
Thorshov, Olaf 1921 A
Thorson, Stuart J. 1919 Ch.
Thyberg, Clarence W. 1925 E
Timperley, William D. 1910 C
Tinkham, Willis M. 1914 Ch.E.
Todd, Milo E. 1909 E
Torrance, Ell. 1909 C
Trask, Birney E. 1890 C
Trcka, Benjamin C. 1924 E
Tryon, Philip D. 1917 C
Tunnell, Clement R. 1925 E
Tupper, Charles E. 1915 M
Turner, Roy H. 1915 E
Tuve, George S. 1920 M
Tvedt, Lawrence A. 1924 Ae
Ungerman, Carl M. 1906 E
Untinen, August L. 1925 E
Upton, Albert 1925 E
Vallacher, Theodore L. 1920 G
Vaule, Sven Alfred 1921 M
Vincent, Jay C. 1903 E
Von Rohr, Herbert H. 1921 M
Wade, Henry H. 1915 E.M.
Wahlquist, Hugo W. 1921 E
Walby, Arthur C. 1911 C
Wallfred, Carl L. 1920 Ch.E.
Walling, Benjamin B. 1909 E
Walquist, John A. 1923 A
Walz, C. M. 1921 E.M. (Geol.)
Wangaard, Oscar H. 1912 C
Wanless, Lynn A. 1912 Ch.
Warren, Frank M. 1899 E.M.
Washburn, Delos C. 1893 A
Watson, Fred O. 1916 C
Webber, Frederick W. 1897 Ch.E.
Weber, Ludwig J. 1920 Ch.E.
Webster, Cora H. 1923 Ch.
Weigel, Howard N. 1914 C
Wentz, Walter W. 1914 E
Westerberg, Carl O. 1921 Ch.
Westigard, Glenn A. 1925 E
Wheeler, Walter H. 1906 E.M.
White, Robert H. 1923 Ch. E.
Whited, Otie O. 1908 Ch.
Whitney, Alfred C. 1903 G
Wickman, Martin F. 1922 E
Wiest, Michael A. 1907 E.M.
Wilcox, Hugh B. 1914 E
Wiley, Richard E. 1926 Met.E.
Wilhoit, Albert D. 1906 Ch.
Williams, Charles A. 1916 C
Williams, Percival H. 1922 E
Williams, Roy N. 1923 E
Wills, Arthur D. 1921 A
Willson, Stuart V. 1924 M
Wilson, Eliel F. 1901 M
Wilson, J. Byron 1922 E.M.
Woehler, William L. 1907 E
Woolrick, Oscar F. 1908 C
Zeidlik, William J. 1925 Ch.E.
Ziegler, Mildred R. 1914 Ch.
Zims, Albert G. 1924 Ch.E.
MINNESOTA
Hognason, George B. 1909 E.M.
MONTEVIDEO
Kircher, Frank J. 1909 M
Lawrence, Scott 1915 E
Michie, Roy G. 1913 E.M.
MONTGOMERY
Soulek, Joseph H. 1911 E
MOORHEAD
Hopeman, Albert M. 1905 C
MORA
Handschu, C. E. 1915 C
New Duluth
NEW DULUTH
Rose, Norman W. 1906 M
NEW ULM
Backus, Gerald H. 1922 E
Haeberle, Elmer H. 1906 E
Robertson, Charles N. 1903 C
NORTHFIELD
Freche, Bertha R. 1919 Ch.
NORTH HIBBING
Anderson, Oscar R. 1922 E.M.
Lundquist, John V. 1923 E
OAK TERRACE
Greene, Alfred E. 1924 E
OLIVIA
Winter, William M. 1923 E.M.
OWATONNA
Nelson, Mark L. 1924 A
Palda, Charles H. 1922 C
Souba, John I. 1925 M

PELICAN RAPIDS
Ranger, Donald R. 1924 C
PERHAM
Pancratz, Frank J. 1908 E
PETERSON
Boyum, Benjamin C. 1910 C
PINE ISLAND
Parkin, Orrin G. 1923 M
PLAINVIEW
Askew, Thomas A. J. 1916 C
RAYMOND
Haima, Mark 1923 C
RED WING
Barrows, Vera 1906 Ch.
Cook, Harry C. 1910 M
Cornell, Reuben W. 1921 Ch.E.
Dungay, Herbert F. 1925 C
Josephson, Eliot B. 1910 E
REDWOOD FALLS
Clipfell, Carroll D. 1905 M
RENVILLE
Henry, Burt C. 1921 C
ROBBINSDALE
Merritt, Alva W. 1922 E
Shumway, Ernest J. 1900 E
ROCHESTER
Beckel, Arthur C. 1919 Ch.
Boyce, Ellsworth R. 1917 C
Bross, Peter P. 1925 A
Leonard, Aubrey C. 1923 C
Pagenhart, Clarence C. 1912 C
ROTHSAY
Juvrud, Edwin C. 1917 E
RUSHFORD
Engh, Harris S. 1924 M
ST. CHARLES
Childs, Morris P. 1925 E
ST. CLOUD
Freeberg, George 1925 A
Jorgens, C. R. D. 1912 C
Kearney, Adrian A. 1923 E
ST. JAMES
West, John C. 1915 C
ST. PAUL
Abbott, Amos H. 1916 E
Abbott, Theodore S. 1911 E.M.
Abrahamson, Howard R. 1918 M
Albrecht, Ernest G. 1925 E
Albrecht, Karl J. 1925 E
Anderson, Frank L. 1916 E
Anderson, Helmer N. 1920 M
Arnessen, Herbert P. 1911 C
Aure, Roy 1922 M
Bache, Edmund 1924 Ch.E.
Bachmann, Graydon A. 1923 M
Baer, Louis E. 1907 E
Baker, Russell E. 1911 Ch.E.
Barlow, Harry E. 1903 C
Barnaby, William E. 1909 Ch.E.
Barrett, Joseph O. 1922 Ch.E.
Beeman, Harry J. 1921 G
Bertossi, Clarence F. 1925 C
Bingham, Stanley E. 1908 M
Bohland, John A. 1893 C
Boss, Ronald W. 1925 M
Bosshardt, Willmert C. 1922 E
Boyles, Ralph R. 1915 M
Brawley, John N. 1923 E.M.
Brossard, Edward V. 1923 M
Brown, Harry E. 1922 G
Buenger, Albert 1913 M
Buenger, Edgar W. 1919 A
Bumgardner, Louis T. 1923 E
Calmeyer, John P. 1906 E
Carlson, Arvid P. 1917 M
Carlson, Chauncy M. 1917 E
Carlson, Ernest F. 1923 M
Carlton, Richard P. 1921 G
Carr, Harvey C. 1903 C
Chapman, Leslie H. 1895 C
Chapman, Wendell P. 1914 E
Christlieb, Frank B. 1923 C
Coller, Walter A. 1915 E.M.
Collis, N. Stuart 1924 M
Cooley, Gilbert 1922 E
Converse, Clovis M. 1909 E
Corl, Cady S. 1921 Ch.
Cornell, George M. 1925 C
Cotton, Ernest H. 1919 E
Crawford, Allen S. 1912 M
Curry, Byron K. 1922 C
Curtiss, Lindsley R. 1909 G
Darrell, James E. P. 1923 C
Daum, H. Arno 1912 E
Davis, Charles A. 1905 E
Davis, Gilbert N. 1904 M
Dehn, Elmer A. 1921 C
Del Paine, Carlos W. 1921 C
DeWars, Allen G. 1913 E
DeWitt, Joseph H. 1910 Ch.
Diamond, Grover W. 1912 C
Dimond, Harvey G. 1914 C
Donaldson, Frank A. 1912 M

Doolittle, William Y. 1914 C
Dougan, Harry K. 1908 C
Dowdell, Ralph L. 1918 Met.E.
Drake, George M. 1911 E.M.
Dunnavan, Ralph B. 1923 E
Dunnigan, Merton 1916 Ch.
Duvall, Arndt J. 1925 C
Eggleston, Smith 1925 M
Egilsrud, F. S. 1920 M
Eilers, Baldwin C. 1925 C
Ellison, Jay T. 1909 C
Engquist, Victor E. 1920 E
Erskine, Lawrence F. 1925 M
Erskine, Robert K. 1924 M
Fahland, Frank Jr. 1922 M
Feeney, Wayne I. 1923 E
Felton, Arthur J. 1913 Ch.
Feyder, William H. 1905 C
Fieger, Ernest A. 1920 Ch.E.
Fiske, Frederick W. 1909 C
Fiske, Harold C. 1922 E
Fleming, Frank R. 1908 M
Forsberg, Elmer J. 1921 M
Francis, Paul E. 1918 M
Frazer, Carlisle G. 1922 C
Frederickson, Hubert M. 1923 Ch.E.
Friedl, Arthur J. 1923 E.M. (Geol.)
Garen, George M. 1910 C
Gessert, George R. 1907 M
Giertsen, Marcus O. 1912 C
Gilstad, Arthur 1923 M
Goldberg, Bert 1919 E.M.
Goldberg, Maurice 1923 E
Goodkind, Leo 1892 A
Greenberg, Morris 1918 M
Grimm, Edwin N. 1900 C
Grisson, Aubrey H. 1925 Ae
Guerin, George V. Jr. 1924 C
Gustafson, Reuben W. 1924 C
Halvorson, Henry A. 1911 Ch.
Harmon, Sydney 1917 E.M.
Hatch, Lloyd 1923 Ch.E.
Hayes, Edward J. 1920 M
Hayward, George I. 1906 C
Heck, Frank J. 1919 Ch.
Hedenstrom, Ernest A. 1912 E
Hendrickson, Norman E. 1916 C
Hennessy, Hugh J. 1913 Ch.
Hewett, Maurice W. 1913 C
Hiner, Walter G. 1923 C
Hodnett, Ralph M. 1911 C
Hoff, Christopher 1906 E
Hoffmann, Henry J. 1912 Ch.
Hoffman, Michael J. 1911 C
Hoisveen, Leonard F. 1925 M
Holder, Laurance E. 1924 C
Hosmer, Orville H. 1923 C
Hovden, Conrad D. 1912 E
Howes, Frank T. 1906 E.M.
Jackson, Earl D. 1905 E
Jacobs, Arthur R. 1917 E
James, Henry C. 1911 E
Jenkins, Clifford H. 1925 M
Johnson, Einar 1911 Ch.
Jones, Edwin F. 1917 M
Johnson, Trygve 1922 Met.E.
Kater, Calvin K. 1922 M
Keiser, Karl W. 1923 M
Kennedy, William W. 1907 Ch.
King, Lawrence W. 1909 C
King, Wesley E. 1905 C
Knight, Ralph 1915 C
Koch, Arthur 1919 Ch.E.
Koch, Karl L. 1923 E
Kochendorfer, Milton J. 1905 E
Kopper, Edward Jr. 1914 M
Kotz, Walter E. 1923 C
Krauch, William L. 1908 C
Kryger, Edward R. 1921 Ch.
Larson, Alfin 1914 C
Larson, Edwin 1921 A
Larson, Emil L. 1925 Ae
Larson, Martin S. 1911 M
LeBlond, Emond J. 1905 E
Leonard, Thomas K. 1915 C
Levy, Julian H. 1923 E.M.
Lieberman, Henry 1923 E
Liese, Herbert W. 1924 C
Lilly, Clarence W. 1917 E
Lilly, Eugene 1919 G
Livermore, Harvey J. 1922 Ch.E.
Lockwood, Raymond 1920 E
Loeffler, Henry S. 1914 E
Logue, John F. 1924 M
Lovering, Harry D. 1913 C
Lux, Arthur E. 1916 E
McCartney, Floyd A. 1913 M
McCree, Andrew A. 1908 C
McPherson, William B. 1902 E
Mackintosh, William S. 1921 C
Maiser, Walter L. 1923 C
Malloy, Charles J. 1906 C

Marshall, Chester R. 1923 M
Mayer, Joseph S. 1924 E
Meixner, Bernard A. 1910 M
Mertz, Karl J. 1914 E
Meserve, Ralph H. 1923 E
Methven, Clyde 1911 C
Mikesh, Edward S. 1922 M
Miller, Ervin J. 1911 C
Miller, George W. 1920 E
Mitchell, John B. 1909 C
Moga, John A. 1918 E.M.
Moorman, Albert J. 1918 A
Moorman, Frank S. 1922 A
Morton, Harold S. 1912 M
Motl, Charles L. 1910 C
Muller, Carl Christ 1918 M
Neerland, Herman 1915 E.M.
Nelson, Clarence L. 1920 E
Nelson, Edward S. 1909 C
Neville, Earle L. 1920 C
Nordstrom, Carl T. 1914 C
Nortono, Clyde W. 1908 M
Nye, Lillian L. 1909 Ch.
Odquist, Carl 1923 C
Okes, Day I. 1908 C
Olson, Arthur O. 1911 Ch.
Olson, Clarence E. 1922 G
Olson, Walter S. 1912 E.M.
Oltman, Charles A. 1903 C
Parkin, Guy G. 1912 Ch.
Paulsen, Thorwald 1922 C
Pausse, Harold A. 1923 E
Peckham, Harold E. 1923 M
Peters, Walter C. 1922 M
Peterson, A. M. 1914 E
Peterson, Harold C. E. 1925 C
Peterson, Marshall A. 1921 Ch.E.
Peterson, Richard M. 1920 E
Pinska, Lawrence F. 1922 C
Potter, Orrin W. 1914 E.M.
Poulsen, George F. 1917 A
Powles, James W. 1901 E
Priedeman, George W. 1908 M
Quinlan, Howard 1914 E.M.
Quinn, Ursula R. 1925 C
Raiter, Clifford R. 1920 E.M.
Reardon, John M. 1922 C
Richardson, Wilbur P. 1899 M
Rigg, Alvin E. 1925 A
Ringstrom, Ivan G. 1912 E
Rockwell, Harvard S. 1914 C
Rockwood, Fletcher 1914 M
Rockwood, Ralph H. 1912 Ch.
Roe, Harry B. 1908 E
Roehrich, Victor H. 1909 Ch.E.
Rood, Lynn 1909 E.M.
Roth, Lewis M. 1911 C
Ruisvold, Olav M. 1915 C
Sander, Theodore Jr. 1919 E
Sauer, Arthur A. 1923 C
Schlenk, Hugo 1918 E
Sheekman, Harvey Z. 1924 E
Shepard, George M. 1909 C
Sickel, Edwin C. 1923 E
Sjolinder, A. 1923 E.M.
Skon, Herman W. 1915 M
Smith, Sheldon H. 1910 Ch.E.
Sommerfeld, Adolph A. 1910 C
Souther, M. Edwin 1912 C
Sprehn, George H. 1924 C
Staehle, Gilbert C. 1920 C
Stanton, Raymond E. 1904 M
Stevens, Everett B. 1925 M
Stewart, George A. 1922 A
Stier, Ruth I. 1925 Ch.E.
Strane, Archie J. 1910 E.M.
Streich, Harry C. 1912 E
Sudheimer, Edward L. 1902 M
Swart, Richard H. 1921 Ch.E.
Swenson, Theodore M. 1912 E
Swift, Donald C. 1924 E
Tallmadge, Everett S. 1914 E
Teberg, Lawrence E. 1922 C
Thomas, William A. 1917 E
Tonchelt, Stanil 1915 Ch.
Vievering, William A. 1925 Ch.
Waldor, Ted N. 1925 C
Waterous, Fred A. 1920 M
Webster, Donald W. 1913 C
Welin, Arthur G 1912 C
Wellisch, Walton 1923 E
West, Herbert S. 1921 Met.E.
Whitman, Edward A. 1900 C
Williams, Homer A. 1909 E.M.
Willis, Roy 1908 C
Wilson, Charles A. 1922 C
Winslow, Raymond 1919 Ch.E.
Wolf, Milton C. 1925 C
Wolfangle, Raymond J. 1917 C
Wolfer, Donald H. 1923 E.M.
Wolff, William S. 1915 M
Wright, Stewart V. 1919 A
Wunderlick, Milton S. 1919 M
Wyly, Lawrence T. 1920 G

Minneapolis
Yager, Louis 1907 C
Young, Joseph E. 1921 G
Youngquist, Eler B. 1925 C
Sacred Heart
Skrukrud, Odean M. 1925 C
Sandstone
Postma, John 1923 E
Sauk Center
Bonner, Donald E. 1925 C
Sauk Rapids
Hendricks, Clifford L. 1925 C
Slayton
Minder, Emil G. 1905 E.M.
Spring Grove
Hansen, Carlos C. 1920 C
Spring Valley
Graling, Verney 1899 E
Staples
Ainslie, Arthur F. 1911 C
Stillwater
Englin, Charles F. 1906 E
Ovestrud, Melvin 1913 M
Tierney, Festus P. 1922 C
Twin Valley
Croswell, Daniel R. 1916 E
Croswell, Thomas L. 1915 C
Nilson, Wilhelm 1902 E
Two Harbors
Johnson, Austin G. 1905 M
Peterson, George T. 1908 M
Tyler
Johnson, Anton A. 1924 A
Virginia
Damberg, Rheuben P. 1921 A
Erickson, Arthur C. 1923 E.M.
Halden, Herbert O. 1923 M
Nelmark, John H. 1924 E.M.
Sannicolo, Joseph F. 1922 E
Sweetman, Edwin A. 1917 E.M.
Wabasha
Searles, John N. 1923 E.M.
Waconia
Martin, Curtis R. 1921 G
Wessale, George 1921 E
Wadena
Hayden, Claude E. 1924 C
Hayden, John F. 1890 C
Imsande, Fred 1925 C
Waseca
Johnson, Edgar F. 1921 E
Zimmerman, Louis P. 1908 E
Waverly
Quinn, Edward I. 1925 C
Wayzata
Bergquist, Edwin T. 1924 C
Wheaton
Heidelberger, Roy J. 1922 E
Willmar
Beese, Harold U. 1925 C
Bergquist, Philip L. 1924 C
Coventry, Edward D. 1912 E.M.
Peterson, Peter I. 1920 E
Winona
French, William O. 1925 M
Grettum, Leroy A. 1923 E
Hendrickson, C. Edward 1925 C
McAndrews, Harry 1923 C
Miller, William L. 1897 E
Winthrop
Eckberg, Curtis R. 1924 E
Malmberg, Victor A. 1920 C
Winton
Frost, Herbert J. 1922 C

MISSISSIPPI

Jackson
Kroeze, Herbert A. 1919 G
University P. O.
Woollett, Guy H. 1910 Ch.

MISSOURI

Annapolis
Sebenius, Carl H. 1921 E.M.
Jefferson City
Grant, Elberth R. 1924 C
Sverdrup, Leif J. 1921 C
Kansas City
Glass, Clifton A. 1898 C
Koehler, Edwin F. 1924 M
Tibbling, Ernest F. 1914 Ch.
Wright, Harris H. 1909 M
Knob Lick
Rydeen, Francis G. A. 1905 M
New Florence
Espenett, Edward L. 1922 C
New London
Glascock, Henry H. 1906 E
St. Louis
Dawley, William S. 1879 C
Didriksen, Philip H. 1920 G
Haines, Allen K. 1913 E
Johnson, Noah 1894 C
Ludlum, Robert 1925 E
Olson, Richard H. 1919 E
Tuttle, Stanley B. 1924 M
Sedalia
Butterworth, Russell I. 1916 E

MONTANA

Anaconda
Andrews, T. F. 1926 E.M.
Cadwel, W. Chauncey 1905 E.M.
Jensen, Willard C. 1924 E.M.
Ramsing, Fred C. 1915 E.M.
Billings
Berg, Karl A. E. 1920 C
Coleman, Frank D. 1905 E
Davies, Fred A. 1916 E.M.
Davies, Herman F. 1921 E.M.
Stewart, James L. 1924 E.M.
Bozeman
Silverman, Isadore W. 1924 A
Thaler, James A. 1900 E
Butte
Brenner, Walter W. 1923 E.M.
Coady, Leo J. 1913 E.M.
Haley, A. J. 1925 E.M.
Jordan, Frank W. 1919 E.
Olson, Walter S. 1925 E.M.
Pratt, Arthur C. 1899 E
Rahilly, Harold J. 1911 E.M.
Rolfe, West A. 1913 C
Stussy, William 1900 E.
Tanner, Wallace N. 1896 E.M.
Glendive
Knutson, Clarence J. 1924 E.M.
Great Falls
Adams, Elmer E. 1906 C
Case, Gerald F. 1923 E
Dow, James C. 1900 E
Hougan, Sander 1921 E
Wiesner, Frederick E. 1906 C
Havre
Haverson, Henry D. 1907 C
Helena
Heidel, C. Sumner 1910 E.M.
Kivley, Warren O. 1916 C
Livingston
Blake, Robert P. 1897 M
Miles City
Aasland, Christopher 1915 C
Phillipsburg
Fritzberg, Ernest A. 1910 E.M.

NEBRASKA

Crete
Hawlick, Hartley H. 1923 E.M.
Kearney
Edwards, Richard G. 1925 E
Lincoln
Lund, Earl H. 1922 C
Mitchell
Rothi, Paul 1904 C
Omaha
Bunce, Paul F. 1906 E
Christensen, Edgar W. 1919 E
Eddy, Horace T. 1895 E
Ellestad, Irwin M. 1922 E
Fulton, Edward G. 1925 C
Johnson, Gustav A. 1923 E
Johnson, James P. 1923 E
Kingsley, Norman W. 1920 E
Luce, Alexander W. 1921 M
Podosin, John 1921 E
Rome, Robert C. 1922 E
Schmeckloth, Harry H. 1923 E
Wallfred, John E 1920 M
Weihler, William M 1908 E
Wilcox, Halsey H. 1915 E
Wilson, Paul R. 1921 E
Zimmer, William A. 1906 E
University Place
Japs, Barney G. 1909 E

NEVADA

Comstock
Winther, Arne 1903 E.M.
Goldfield
Wilkinson, Charles D. 1895 E.M.
Gold Hill
Goodrich, Norman P. 1910 E.M.
Tetlie, John R. 1911 E.M.
Las Vegas
Toll, Rensselaer 1900 E.M.
Reno
Schrader, Erick J. 1905 E.M.
Virginia City
Burgess, Robert J. 1911 E.M.

NEW HAMPSHIRE

Berlin
Burmingham, Foster A. 1917 Ch.E.
Hanover
Hartshorn, Elden B. 1912 Ch.

NEW JERSEY

Bloomfield
Widell, Gideon 1917 Ch.E.
Camden
Corson, Benjamin I. 1917 Ch.
Carteret
Kerns, Clinton B. 1915 M
Glen Ridge
Beckjord, Walter C. 1909 E
Harrison
Anderson, Oscar P. 1910 E
Wyman, LeRoy L. 1922 Ch.E.
Kearney
Helmstine, Ralph D. 1924 M
Newark
Frederickson, Harry B. 1911 E
Rose, Anton R. 1904 Ch.
Williams, Arthur H. 1919 M
Young, Charles N. 1912 E
New Brunswick
Von Kuster, Edith I. 1907 Ch.
(Mrs. W. Johnson Kenyon)
Perth Amboy
Kohlhase, Arthur H. 1921 Ch.
Paulson, Paul M. 1923 Ch. E.
Temple, Sterling N. 1905 Ph.B.
Phillipsburg
Haase, Conrad C. 1926 E.M.
Hennen, Edward H. 1925 E.M.
Johnson, Alfred M. 1926 E.M.
Mann, Victor I. 1925 E.M.
Union Hill
Finchy, Jacob O. 1906 E

NEW MEXICO

Hurley
Knox, LaFayette 1912 E.M.
Santa Fe
Harrington, Guy P. 1906 E.M.
McCarty, Andrew L. 1904 E.M.
Valedon
Dickson, Robert H. 1912 E.M.

NEW YORK

Albany
Dinsmore, Harry C. 1923 E.M.
Attica
Anderson, Edward I. 1917 M
Bay Shore
McCullough, Robert T. 1923 E
Brooklyn
Ely, Irving R. 1905 E
Kokatnur, Vaman R. 1914 Ch.
Stoppel, Ernest A. 1911 Ch.
Sushan, Harry M. 1919 C
Thorne, Donald 1923 E
Buffalo
Frear, J. R. 1910 M
Johnson, Carl S. 1921 C
Kiesner, Frank C. 1924 M
Luft, Oscar W. 1917 Ch.E.
Schildt, William F. H. 1908 E
Swenson, Oscar E. 1915 C
Canajoharie
Mastin, Marion G. 1913 Ch.
Ft. Hancock
Solomonson, L. D. 1925 E
Glens Falls
Miller, Archibald T. 1924 E
Ithaca
Barr, John H. 1883 M
Fraser, George 1919 A
Jersey City
Grimes, David 1919 E
Lackawana
Ascher, Raymond C. 1923 M
Long Island City
Boyd, Paul M. 1924 M
Forbes, Henry C. 1922 E
Wagner, Otto H. 1907 M
New York City
Abbott, Arthur L. 1897 E
Adams, George F. 1895 E
Backstrom, Emil F. 1924 A
Bacon, Charles B. 1909 Ch.
Bauer, Ruben B. 1920 E
Benner, Raymond C. 1920 Ch.
Bolme, Ole M. 1910 C
Boman, Carl E. 1905 E
Bouman, Bernhard M. 1904 E
Buhl, John E. 1909 M
Buhl, Paul S. 1907 M
Burns, Harvey L. 1902 E
Chapman, Arthur G. 1911 E
Cheney, Edward J. 1904 E
Covell, Russell O. 1916 E
Crabbe, George 1904 E
Craig, Robert 1897 M
Crane, Eugene C. 1913 M
Daly, Richard T. 1921 C
Demarest, Charles S. 1911 E
Dewey, William H. 1893 E
Edelman, Philip 1916 E
Elmer, Lloyd A. 1921 M
Gannett, Danforth K. 1916 E
Gewalt, Carl H. 1921 A
Gregg, Tresham D. 1906 C
Hagerman, Oliver S. 1918 M
Hahn, Stanley W. 1922 A
Hokanson, Clarence E. 1906 E
Hillerty, Charles D. 1896 M
Ireland, Roy R. 1903 E
Johnson, Byron F. 1920 C
Johnson, Edward J. 1911 E
Kannenberg, Walter F. 1923 E
Keene, Amor F. 1904 E.M.
Kennedy, John J. 1908 E.M.
King, Alfred B. 1908 E
Koepke, Walter E. 1913 C
Laird, Lee R. 1903 E
Landeen, Arvid G. 1910 E
LeTourneau, Edward H. 1905 E
Loye, Donald P. 1916 E
Loye, Edwin M. 1920 A
Luger, Karl E. 1922 Ch.E.
McKehan, Louis W. 1908 G
McRae, Randolph J. 1907 E.M.
Magoon, Herbert A. 1924 A
Manderfeld, Emanuel 1921 E
Markuson, Oscar S. 1911 E
Mathes, Richard E. 1924 E
Mathes, Robert C. 1912 E
Mitchell, Alexander C. 1920 E
Morris, John E. 1909 M
Mowry, Harry W. 1906 E
Myers, Mortimer 1897 E
Norcross, Arthur F. 1907 E
O'Brien, Raymond J. 1911 E
Otto, Frederick A. 1904 E
Owens, Leo E. 1911 M
Persons, Robert W. 1923 Met.E.
Peterson, Arthur P. 1919 E
Queneau, Roland B. 1923 Met.E.
Ravicz, Louis G. 1914 E.M.
Robertson, Phillip W. 1901 M
Robison, Archer R. 1909 E
Siegmann, Chester W. 1920 E
Simons, Walter W. 1916 E
Smith, Donald C. 1918 E
Strothman, Russell A. 1920 E
Swenson, Karl P. 1907 E.M.
Thordarson, William 1923 Ch.E.
Thorse, Albert L. 1912 E
Tunell, Robert H. 1924 E
Velz, Clarence 1924 C
Walters, Charles W. 1911 E.M.
Wheeler, Herbert H. 1917 E
Wiggins, Gerald G. 1906 E
Willner, William E. 1922 A
Woodman, Joseph C. 1911 M
Wright, Roydon V. 1898 M
Zimmerschied, Clarence R. 1923 E
New Rochelle
Wales, Roland T. 1897 E.M.
Niagara Falls
Dobrovolny, Frank J. 1924 Ch.
French, Edwin L. 1902 E
Marr, Horace S. 1917 Ch.
Woodruff, John J. 1917 E.M.
Rochester
Matthews, Glenn E. 1920 Ch.
Nietz, Adolph 1913 Ch.
Savage, Edward S. 1897 M
Seymour, Merrill W. 1921 Ch.
Schenectady
Allee, David A. 1902 C
Beardmore, Albert 1921 E
Bill, Earl M. 1912 E
Boe, Lester L. 1925 E
Burrill, Charles M. 1923 E
Caswell, Thomas B. 1925 M
Downee, John M. 1922 E
Dunham, John A. 1907 C
Dunham, Roy O. 1914 E
Engstrom, Elmer W. 1923 E
Forsberg, Peter W. 1911 E
Frazee, Leonard M. 1924 E
Grant, Fred R. 1909 E
Grobel, Lloyd P. 1924 M
Heinemann, John R. 1919 E
Hoyt, Samuel L. 1909 E.M.
Kater, Jozef J. 1924 E
Linhoff, Carl H. 1922 E
Lund, Jeffery L. 1925 E
McCully, James 1925 E
Marshman, Irving H. 1924 E
Mittag, Albert H. 1911 E
Morton, Lysle W. 1924 E
Parsons, Sidney A. 1925 E
Rask, Louis G. 1903 E
Richardson, Philip E. 1925 E
Ross, Kenneth R. 1924 M
Satori, Roy H. 1921 E

SCHENECTADY
Tullar, Charles E. 1901 E
Warren, Laurence C. 1924 E
Wiltgen, Edward 1900 E
SYRACUSE
Jones, Robert R. 1915 E
YONKERS
Rice, Edgar W. 1902 Ch.

NORTH CAROLINA

DURHAM
Nielsen, Walter M. 1922 E
RALEIGH
Halverson, John O. 1907 Ch.
Hemsey, Clayton E. 1922 M

NORTH DAKOTA

BARTON
Tyvard, James A. 1924 E
CARRINGTON
Cousins, Van Meter 1925 E
CROSBY
Rosseen, Clifton C. 1924 M
ENDERLIN
Nelson, George A. 1912 E
FARGO
Peterson, Albert L. 1914 M
Peterson, Lloyd L. H. 1924 C
Sheffield, Fred W. 1909 C
Tarbell, William P. 1922 C
GRAND FORKS
Anderson, Edward X. 1909 Ch.
Harris, Elwin E. 1922 Ch.
Schulz, Elton A. 1916 E
JAMESTOWN
Dawson, Loren W. 1921 Met.E.
McCall, Harry J. 1908 C
Weinke, Ernest 1916 C
KELSO
Pease, Maynard 1910 M
LAMOURE
Johnson, Carl J. 1914 E
MINOT
Molander, Edwin 1925 A
Pease, Raymond A. 1912 C
Peterson, William W. 1916 C
PAGE
Miller, William J. 1924 E
SHARON
Holmgren, Charles E. 1909 M
WILLISTON
Bisek, Peter P. 1914 E
Jackson, Myron B. 1905 A.C.

OHIO

AKRON
Hartman, Philip F. 1925 C
CANTON
Edmunds, Alvin M. 1923 Ch.E.
Hektner, Joel 1917 M
CINCINNATI
Cassel, Norman S. 1922 Ch.E.
Jewett, Ernest E. 1925 Ch.E.
Marshall, Donald E. 1919 E
Moore, John H. 1924 M
Rosenthal, Oscar L. 1919 C
Woolman, Harry D. 1924 M
CLEVELAND
Arneson, Lloyd O. 1921 M
Bierman, George H. 1918 M
Brewster, William E. 1912 E
Conley, Wilfred E. 1918 E
Drinkall, John F. 1919 E
Estep, H. Cole 1908 M
Hayward, Laurence W. 1921 E
Johnson, Leonard T. 1910 E
Larson, Walter J. 1920 E
Ludvigsen, Elliot 1925 M
Reid, Harry A. 1910 E
Sowle, Lawrence K. 1903 E.M.
Thompson, Harry T. 1915 E
COLUMBUS
Clark, William G. 1912 M
Krag, Walter G. 1907 M
Moffat, George N. 1919 M
DAYTON
Knapp, William R. 1909 M
EAST CLEVELAND
Hinman, Charles H. 1924 A
EUCLID
Andrews, George L. 1905 M
IVORYDALE
Hamlin, Leban H. 1921 M
KENT
Pettijohn, Earl 1911 Ch.
LIMA
Cutter, Frances C. 1905 M
MANSFIELD
Goss, Harold R. 1920 E
Langseth, Axel O. 1922 Ch.E.
Noel, Clay W. 1920 E
Wieland, Willard 1925 E
MARION
Brose, William Carl 1925 C
Johnson, Ralph L. 1926 Met.E.
SANDUSKY
Mikesh, Martin A. 1912 M
TOLEDO
Fortune, Harry G. 1920 M
WILLOUGHBY
Taylor, Lyman D. 1913 E
YOUNGSTOWN
Birnberg, Zingel C. J. 1909 M
Ramm, Theo. D. 1913 E

OKLAHOMA

ARDMORE
Hubbard, W. Earle 1917 E.M.
BARTLESVILLE
Hoffman, Richard H. 1922 M
Stauffacher, Edward L. 1924 M
BRISTOW
Coryell, Lewis S. 1917 E.M.
MUSKOGEE
Larson, Clarence L. 1910 E.M.
OKLAHOMA CITY
Edwards, Frank R. 1908 E.M.
Montgomery, Albertus 1913 C
OKMULGEE
Leversen, A. Irving 1917 E.M.
Paul, Karl F. 1924 Ch.E.
PAWHUSKA
Burns, Dwight T. 1925 C
TULSA
Conhaim, Howard J. 1923 E.M.
Elson, William H. 1917 E.M.
Foley, Lyndon L. 1918 E.M.
(Geol.)
Giltinan, George M. 1910 E.M.
Lewis, John W. 1912 E.M.
Williams, Paul S. 1915 E.M.

OREGON

CORVALLIS
Martin, W. H. 1910 M
HARRISBURG
McAfee, Allan L. 1908 E
HOOD RIVER
Smithson, John E. 1907 E
LINNTON
Larson, Ernest L. 1914 E.M.
MAPLEWOOD
Sterling, Faith 1909 Ch.
MARSHFIELD
Waldron, Ralph E. 1920 E
MEDFORD
Brockway, Alvah E. 1909 E
Wood, John W. 1905 E
ONTARIO
Countryman, Peter F. 1907 E
PORTLAND
Andersen, Christian 1888 C
Anderson, Frank A. 1908 E
Bjorge, Oscar B. 1907 M
Cobban, Rollo J. 1909 E
Cook, Robertson 1902 M
Couper, George B. 1893 M
Doeltz, William F. Jr. 1908 C
Hammer, George E. 1920 Ch.E.
Horstkotti, Arthur E. 1922 C
Hubbard, Fred A. 1909 C
Juvrud, Ingvald O. 1914 Ch.
Meany, James M. 1907 M
Nelson, Donald O. 1920 C
Rawson, Ralph H. 1907 M
Shepard, Burchard P. 1895 M
Steele, Charles W. 1907 E.M.
Stoddart, Hugh A. 1924 C
ROSEBURG
Stewart, G. Gordon 1910 E.M.

PENNSYLVANIA

ALLENTOWN
Reque, Styrke G. 1901 E
BETHLEHEM
Forsyth, Arthur C. 1924 Met.E.
Huck, George M. 1926 Met.E.
Jensen, Cyril D. 1921 C
Johnson, George A. 1925 Met.E.
Russell, Charles B. 1923 E.M.
Swensen, Clifford H. 1923 E.M.
DONORA
O'Connell, Thomas C. 1913 Ch.
EAST PITTSBURGH
Berg, Samuel A. 1922 E
Boreen, M. S. 1926 Met.E.
Brown, Louis M. 1916 E
Burt, Fred R. 1916 E
Cornelius, Martin 1906 E
Daniel, Thomas L. 1900 M
Gibson, Charles R. 1905 E
Hauft, Hugo H. 1925 E
Heins, Harold H. 1925 E
Hussey, Norman W. 1925 E
Kaplan, Eugene V. 1910 M
Krogh, Alvin T. 1916 Met.E.
Leavenworth, Francis M. 1911 Ch.
May, Darwin 1914 Ch.E.
Monseth, Ingwald T. 1924 E
Simmon, Karl A. Jr. 1905 E
Steffens, Robert A. 1922 E
Steinert, Emil 1925 E
Towle, Neal C. 1912 E
Trask, Alfred S. 1923 E
ERIE
Sturtevant, Percy G. 1908 E
HARRISBURG
Morse, George H. 1893 E
LANDISBURG
Gerlach, Arthur C. 1917 M
LESTER
Burwell, Loring D. 1907 M
Powell, Knox A. 1920 M
LIBRARY
McKenzie, Frederick R. 1922 E.M.
NEWCASTLE
Barr, J. Carroll 1922 E.M.
Griswold, Willis R. 1923 E.M.
NEW KENSINGTON
Bakken, Adolph C. 1923 Ch.
Heath, Arthur C. 1925 M
Pippel, Herbert A. 1920 Ch.
Taylor, Cyril S. 1913 Ch.
OAKMONT
Edwards, Junius D. 1913 Ch.E.
Frary, Francis C. 1905 A.C.
PHILADELPHIA
Childs, John C. 1906 C
Danner, Jake 1901 E
Dunnum, Orney E. 1922 E
Goetzenberger, Ralph L. 1913 E
Groat, Benjamin F. 1901 G
Hunt, Gates E. 1920 E
Lowe, John M. 1908 Ch.
Nelson, Carl H. 1910 E
Pearson, Charles W. 1921 E
Peterson, Harold L. 1916 C
Powell, Louis H. 1924 C
Sartell, Page M. 1924 M
PITTSBURGH
Berman, Harry C. 1914 Ch.
Copeland, William A. 1920 E.M.
Dahl, Hjalmer A. 1922 E
Dever, Francis A. 1920 C
Jules, Harold A. 1920 E
Selvig, Walter 1909 Ch.
Skytte, Ernest E. 1910 E
Souther, Benjamin L. 1916 Ch.
Taylor, Carl A. 1910 Ch.
Willard, Arthur C. 1922 E
Wurzbach, Henry A. 1925 E
SCRANTON
Eberhardt, Otto E. 1903 E
STATE COLLEGE
Sime, Theodore L. 1923 A
STOWE
Williams, Edward H. 1903 M
WILKINSBURG
Koch, Winfield 1925 E
McEwen, Alexander 1925 E
Wilson, Abner W. 1922 E
WILMERDING
Holmes, Roland W. 1923 M

RHODE ISLAND

PROVIDENCE
Kuhlman, Rudolph H. 1923 M
Tappan, Ruth W. 1922 Ch.
(Mrs. Joseph Dowling)

SOUTH DAKOTA

ARMOUR
Burtis, William H. 1892 E
BROOKINGS
Enke, Fred A. 1921 C
Mark, Reuben A. 1911 C
Mark, Walter J. 1909 M
DELL RAPIDS
Robertson, Kenefick 1925 E
DOLAND
Hansen, Arthur A. 1925 C
HURON
Ellefson, Selmer 1916 E
LIGHT CAP
Blake, Henry B. 1901 E
MITCHELL
Smith, Sidney H. 1911 C
SIOUX FALLS
Boyce, Leonard F. 1912 M
Countryman, M. Alden 1925 E
Hult, George A. 1916 E
Hanson, Ralph W. 1923 M

TENNESSEE

CHATTANOOGA
Barker, Clifton T. 1922 E.M.
Hawlik, Henry I. 1919 C
Irwin, Frank H. 1916 E
Withee, Warren 1915 C
COPPERHILL
Sodoma, Joseph 1925 Met.E.
ISABELLA
Kegler, Vern L. 1923 E.M.
(Geol.)
MEMPHIS
Hanson, J. Bernard 1913 E.M.
Nichols, Browning Jr. 1910 M
Slocumb, Mary G. 1925 I.D.
(Mrs. Lawrence Tvedt)

TEXAS

AUSTIN
Helwig, William F. 1923 E
BEAUMONT
Bernhagen, Otto L. 1906 A.C.
CISCO
Dovre, Adolph 1916 E.M.
Wilcox, Fred H. 1923 E.M.
(Geol.)
DALLAS
Alexander, J. W. 1926 E.M.
Aronson, Sam 1916 E.M.
Bakke, Oliver M. 1903 Ch.
Biermann, Alfred C. 1914 E.M.
Chestnut, George L. 1897 E
Fernald, Frank O. 1904 C
Harris, Clayton 1909 E
Rounds, Fred M. 1895 E
Smith, Donald T. 1905 C
Tollefson, Everett H. 1923 E.M.
Van Duzee, Everett N. 1926 E.M.
Whitson, Lloyd R. 1911 E.M.
EL PASO
Quinn, Howard E. 1918 E.M.
FORT BLISS
McQuillan, Raymond 1911 E
FORT MCINTOSH
Crane, Fremont 1886 C
LUBBOCK
Harington, Marzy V. 1924 C
WICHITA FALLS
Adam, E. Maurice 1922 E.M.

UTAH

EUREKA
Ekloff, Victor E. 1911 E.M.
Hezzelwood, George 1923 E.M.
INTERNATIONAL
Nichols, William J. 1921 Met.E.
PRICE
Jones, Watkin W. 1911 E
SALT LAKE CITY
Ashworth, Roy H. 1911 E
Beyer, Theodore A. 1903 C
Brenchley, Walter C. 1915 C
Smith, Elmo V. 1901 Met.E.
Stoutland, Oliver A. 1922 C

VERMONT

ST. JOHNSBURY
Stillman, Marcus H. 1909 E

VIRGINIA

DANVILLE
Furber, Pierce P. Jr. 1908 C
FORT HUMPHREYS
Coe, Edward H. 1919 C
Luplow, Walter D. 1917 C
HAMPTON
Joachim, William F. 1920 M
NORFOLK
O'Brien, John Erwin 1898 M
QUANTICO
Strong, Frank D. 1917 Ch.E.

WASHINGTON

DAVENPORT
Campbell, William L. 1900 E.M.
EVERETT
Beaulieu, Richard L. 1902 C
KELSO
Jones, Philo E. 1910 E.M.
Phelps, Roy R. 1910 E
LONGVIEW
Hetherton, Percival 1908 M
MALDEN
Baker, Arthur W. 1919 M
NO. YAKIMA
Gilman, Nicholas A. 1907 M
PASCO
Acker, Sidney H. 1923 M
PUGET SOUND
Benedict, George F. 1903 E
PULLMAN
Levine, Arthur 1923 Ph.D.
SEATTLE
Adams, Benjamin W. 1910 C
Bennett, Walter J. 1903 C
Bowen, Fred P. 1906 C
Bushnell, Charles S. 1878 M
Erickson, Carl G. 1903 E

Seattle
Grimshaw, William E. 1902 M
Guthrie, J. D. 1893 E
Hoffman, Ralph M. 1911 Science & Tech.
Linton, James H. 1897 Ch.E.
McKenzie, Lauren F. 1909 E
Magnusson, Carl E. 1896 E
Norelius, Lewis M. 1906 C
Pearis, John H. 1907 E
Quense, John 1901 C
Schow, William P. 1907 E
Shuck, Gordon R. 1906 E
Silliman, Henry D. 1897 M
Weber, Erwin L. T. 1906 E
Westberg, Russel E. 1920 E
Spokane
Alton, Herb. D. 1907 E
Cowin, Clifford C. 1921 C
Newell, John R. 1919 E.M.
Tacoma
McConnell, Edmond S. 1924 E
Peters, William G. 1883 C

WEST VIRGINIA

Charleston
Giltinan, David M. 1915 M
Fairmont
Schoepf, Alfred W. 1908 E
Harpers Ferry
Guesmer, George O. 1923 C
Huntington
Fairchild, Albert B. 1907 E
Morgantown
Amidon, Lee L. 1923 M
Gill, James H. 1892 M
Wheeling
Root, Frank R. 1924 Ae

WISCONSIN

Appleton
Palmer, Howard B. 1922 C
Poppe, Frederick W. 1911 Ch.
Ashland
Larson, Peter L. 1924 C
Beaver Dam
Butler, Roy G. 1921 E.M.
Beloit
Christiansen, Hilmar B. 1915 C
Bruce
Buhr, Leo 1923 C
Manger, Henry J. 1923 C
Cameron
Gannett, Roger W. 1918 E.M.
Chester
Weston, William S. 1902 C
Chippewa Falls
Berdan, Hubert J. 1922 C
Cray, Seymour R. 1922 C
Vaudreuil, Lionel 1925 Ae
Eau Claire
Dow, Clarence A. 1913 E
Fairbanks, George W. 1923 E
Frahm, Alfred R. 1908 E
Holm, Edwin R. 1920 C
McMillan, James S. 1922 E
Monsen, Manley A. B. 1924 E
Glenwood City
Gobeli, Arthur U. 1925 C
Green Bay
Curry, Ezra B. 1920 M
Odegaard, Harold T. 1920 M
Hudson
Kircher, George A. 1909 M
Hurley
Butterworth, Allan C. 1911 E
La Crosse
Bergsland, Grant C. 1923 M
Madison
Bray, Mark W. 1914 Ch.
Daniels, Farrington 1910 Ch
Dunlap, Lemuel J. 1924 E
Hubbard, Robert T. 1906 E
Knauss, Archibald C. 1916 C
Knudsen, Esther M. 1925 C
Korfhage, Roy 1920 Ch.
Laron, Ludvig C. 1921 E
Luxford, Ronald F. 1917 C
Peterson, Clifford E. 1923 Ch.E.
Mayville
O'Connor, Edward S. 1906 E.M.
Mellen
Sponberg, Edwin C. 1921 E.M.
Menomonie
Mitchell, Ralph W. 1912 Ch.
Milwaukee
Albrecht, George M. 1906 E
Anderson, Alvin P. 1925 Ch.
Bauer, Roscoe W. 1924 C
Chapin, Harold S. 1912 M
Epstein, Hymen 1921 Ch.
Greenberg, Jack 1922 C
Hansen, Maurice J. 1911 E
Johnson, Elving L. 1923 E
Johnson, Herman R. 1909 E
Kendall, Walter 1925 A
Mintz, Nathaniel 1922 E
Montgomery, Ralph M. 1924 M
Newman, John M. 1923 E
Papenthien, Roy O. 1921 G
Price, Clarence R. 1920 E
Reed, Albert I. 1885 C
Roberts, Earl H. 1915 M
Roberts, Wesley J. 1921 Ch.E.
Scheid, Charles F. 1925 Met.E.
Schlenk, John J. 1923 C
Thomas, W. Alan 1924 M
Oconomowoc
Plank, Howard G. 1922 E
Oshkosh
Simms, Charles G. 1924 M
Racine
Reed, Arnold E. 1922 E
Rothschild
Nee, Harold E. 1924 E
Rubicon
Thurston, Harold H. 1913 C
Shell Lake
Cameron, Harry D. 1925 E
Spooner
Putz, John H. 1914 E
Spring Valley
Donahue, Stephen 1925 C
Stevens Point
Rathburn, George A. 1924 M
Superior
Deneen, David J. 1919 A
Moe, Cecil J. 1924 E.M.
Scobie, Francis G. 1908 E
Wauwatosa
Cross, Charles H. 1897 M
West Allis
Foltz, Ross M. 1919 M
Smart, George A. 1916 M

WYOMING

Casper
Uzzell, George W. 1907 E
Midwest
Larsen, Raymond M. 1924 E.M.
Rader, Clarence M. 1917 C
Salt Creek
Walter, Rollie B. 1912 E.M.
Sunrise
Moenke, William F. 1906 E.M.
Yellowstone Park
Lindelef, Charles 1909 E

AFRICA

Congo-Belge

Elizabethville, Katanga
Walker, E. Harold 1911 E.M.

North Rhodesia

Nkana
LaTendresse, H. E. 1923 E.M. (Geol.)

Portuguese West Africa

Angola
Ernster, Omer F. 1917 E.M.

ALASKA

Aslakson, Carl I. 1923 C
Kennecott
Olson, Stanley G. 1924 E.M.
Valdez
Smith, Byron E. 1907 E

BELGIUM

Brussels
Butler, William V. 1915 E.M.
Grant, Roy C. 1909 E.M.
Middleton, John L. 1923 E.M.

CANADA

Alberta

Edmonton
Morris, Robert 1905 E

British Columbia

Kamloops
Wallinder, Arthur 1912 E.M.
Porteau
Burgess, Thomas O. 1901 E.M.

Manitoba

Winnipeg
Borrowman, Leroy F. 1908 C
Brown, George J. 1908 E
Forness, Arthur W. 1913 E.M.
Schumacher, John H. 1903 E

Ontario

Gowganda
Swanson, Axel H. 1910 E.M.
Haileybury
Bischoff, Harry E. 1910 E.M.
Kirkland Lake
Heath, Clarence L. 1910 E.M.
Port Arthur
Souba, William H. 1909 M
Toronto
Anderson, Oscar V. 1910 E

Quebec

Montreal
Adams, William C. 1905 E
Cohen, Samuel W. 1903 E.M.
Spence, William J. 1902 E
Wesbrook, Donald McD. 1910 M

Saskatchewan

Weyburn
Ossberg, James W. 1908 E

CENTRAL AMERICA

Honduras

Minas de Oro
Brozins, Harold I. 1904 Met.E.
San Juancito
Zanger, Eugene 1921 E.M.

CHINA

Changsha, Hunan
Huang, Ta Heng 1924 E.M.
Mukden, Manchuria
Hsieh, Chung 1918 E.M.
Peking
Chir, San Sieh 1922 E.M.
Lin, Shu Ming 1920 A
Wong, Jee Kwun 1916 M
Shanghai
Kwong, Yih Kun 1917 E.M. (Geol.)
Tientsin
Eliassen, Sigurd 1918 C

CUBA

Havana
Romero, Cirilo L. 1917 M
Minas-de-matahambre,
Province Pinar-del-Rio
Devereux, Francis C. 1904 E.M.

CYPRUS

Skouriotissa, Nicosia
Jackson, Charles F. 1907 E.M.

ENGLAND

Newton Abbot, Devonshire
Brackenbury, Cyril 1898 E.M.
Colwick Nottingham
Tronson, Carl E. 1910 Ch.

INDIA

Bombay
Cerney, Glen C. 1920 M
Shellenberger, Hiram R. 1920 M
Burma
Calhoun, Allan E. 1905 E.M.
Madras
Cuddy, William A. 1915 C

ITALY

Rome
Hammett, Ralph W. 1919 A

MEXICO

El Oro, Ostado de Mexico
Flynn, John G. 1903 E.M.
Gudalajara
Burt, John L. 1890 C
Arizpe, Sonora
Hammond, Arthur H. 1913 E.M.
Jahn, William F. 1911 E.M.
Cananea, Sonora
McKay, Henry S. 1905 E.M.

PANAMA CANAL

Irwin, Vincent H. 1913 E

PHILIPPINE ISLANDS

Schofield Barracks, Honolulu
Parkhurst, Harleigh 1900 E
Manila
Moreno, Gerardo 1917 E
Shippam, Willis 1909 M
Weeks, William C. 1894 C
Malabon, Rizal
Roque, Feliciano T. 1924 Ch.E.

SOUTH AMERICA

Argentine

Buenos Aires
Harrington, George L. 1912 E.M.

Bolivia

Llallagua
Bailey, A. K. Jr. 1920 E.M.

Brazil

Rio de Janeiro
Thompson, Herbert L. 1912 M

Chile

Chuquicamata
Carlson, C. Philip 1921 E
Dopp, J. Lawrence 1917 E.M.
Knowles, Everett H. 1920 E
Maine, Basil 1921 E
Pabst, Henry A. 1923 E.M.
Tocopilla
Carlson, Victor H. 1920 E

Colombia

Amalfi
Probst, Elmer A. 1907 E.M.
Barranquilla
Wheeler, James D. 1920 E.M. (Geol.)

Dutch Guiana

Paramaribo
Edwin, John 1920 E.M.

Peru

Casapalca
Sanchez, Richard M. 1915 E.M.
Cerro de Pasco
Armstrong, Harold K. 1918 E.M.
Hosted, Joseph O. 1919 E.M. (Geol.)
Quiruvilca, via Trujillo
Goldberg, Samuel B. 1919 E.M.

Venezuela

Maracaibo
Dennis, Richard C. 1917 E.M.
Echebarria, Luis di U. 1922 E.M.

VIRGIN ISLANDS

St. Thomas
Mattison, George C. 1911 C

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Ralph L. Dowdell, E. M. '17 — Bernard J. Larpenteur, E. M. '25 — Ludwig J. Weber, Ch. E. '20
Edwin M. Nygard, Ch. '21

R. S. Calloway, Ch. E. '11, purchasing agent, University of Minnesota.
Henry A. Hildebrandt, E. '99, superintendent of buildings and grounds.
Walter R. Mixer, A. '17, assistant superintendent, buildings and grounds.