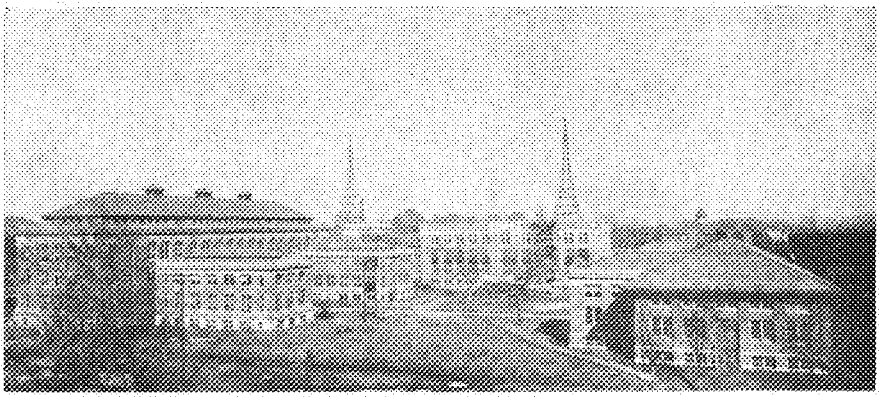
THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

OCTOBER
1 9 2 4

Volum[illegible] 25 CENTS A COPY Number 1
MEM[illegible] OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED
PUBLISHED MONTHLY BY THE
TECHNICAL COLLEGES



THE MAIN ENGINEERING, ELECTRICAL AND EXPERIMENTAL BUILDINGS

With the completion last spring of the $300,000 electrical building, housing the department offices and laboratories, the central group of the technical colleges more nearly approaches the ideal arrangement outlined in the Greater University plan of Cass Gilbert.

The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

ALBERT W. MORSE, *Managing Editor* RICHARD W. JONES, *Business Manager*

VOLUME 5 NUMBER 1

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines.

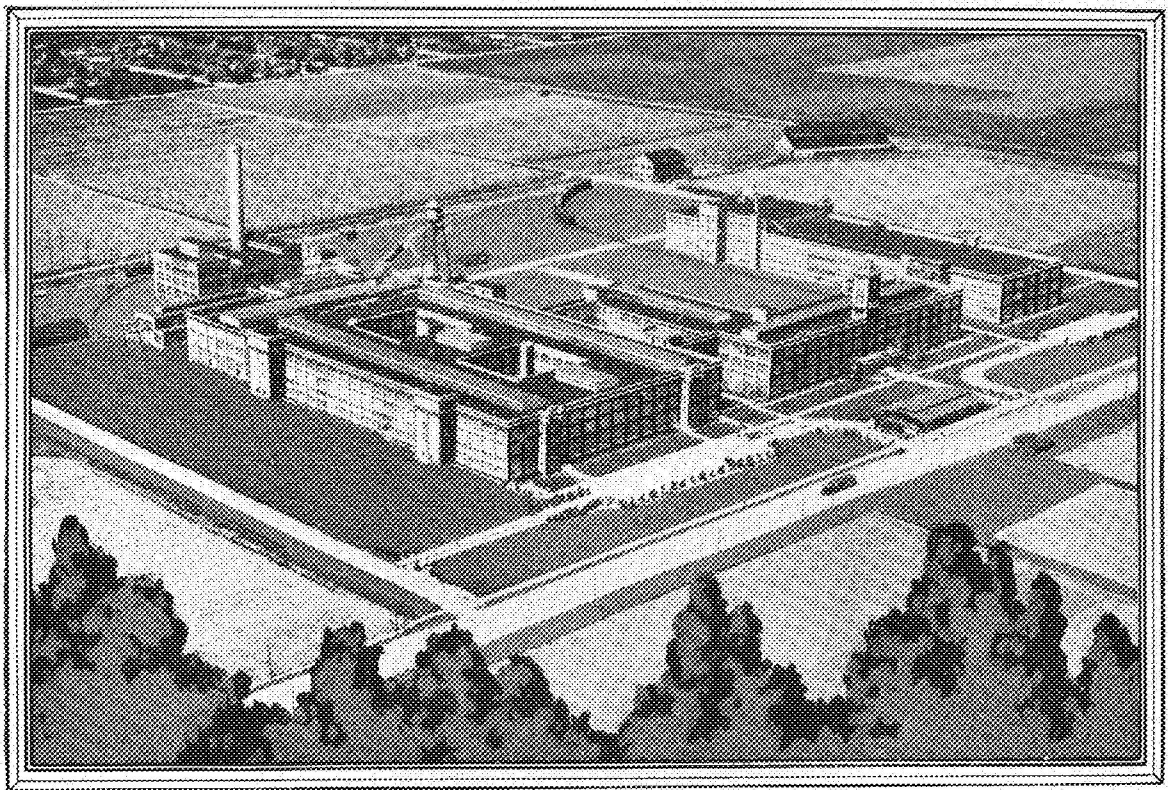
TABLE OF CONTENTS

Cover Design by Joel S. Carlson.

MEMBERS OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: PROF. EDWIN KURTZ, Iowa State College, Ames, Iowa

The Cornell Civil Engineer
The Transit
Iowa Engineer
Colorado Engineer
Nebraska Blue Print
Penn State Engineer
Armour Engineer
Sibley Journal of Engineering
Rose Technic
Michigan Technic
Minnesota Techno-Log
Virginia Journal of Engineering
Ohio State Engineer
The Towne Scientific Journal
Wisconsin Engineer
Illinois Technograph
Tech. Engineering News
Kansas State Engineer
Princeton E. A. News Letter
Kansas Engineer
Purdue Engineering Review



PLANT OF THE GOODYEAR TIRE & RUBBER COMPANY OF CALIFORNIA, LOCATED AT LOS ANGELES. GENERAL CONTRACTORS: HUNKIN CONKEY CO., CLEVELAND. PLUMBING CONTRACTORS: ARTHUR HESS, LOS ANGELES, AND H. E. TRYDAY, LOS ANGELES

THE ARTERIES OF A MODERN FACTORY

In tunnels, behind walls, beneath floors in every American factory, complex systems of piping inter-connect the various departments. Delivering water, steam, compressed air, oil and gas to every point where they are needed, these pipe-lines enable each department of the institution to specialize in its particular function.

They make possible the centralizing of the production of power, heat and gas at efficient large-capacity plants. They allow the isolation of fire hazards and obnoxious processes.

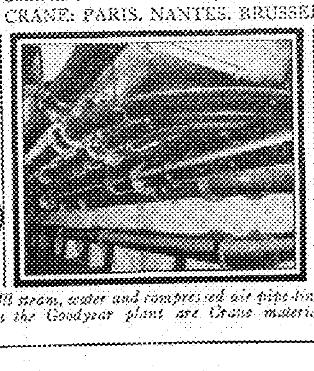
Should one of them fail, however, production might be crippled, even stopped. That is why it is so important to get uniform quality in every part of a piping installation; why the Crane name, the assurance of dependable quality on products that cover all piping needs, means so much to architects, engineers and owners.

CRANE

GENERAL OFFICES: CRANE BUILDING, 836 S. MICHIGAN AVENUE, CHICAGO
CRANE LIMITED: CRANE BUILDING, 386 BEAVER HALL SQUARE, MONTREAL

Branches and Sales Offices in One Hundred and Forty-five Cities
National Exhibit Rooms: Chicago, New York, Atlantic City, San Francisco and Montreal
Works: Chicago, Bridgeport, Birmingham, Chattanooga, Trenton and Montreal

CRANE EXPORT CORPORATION: NEW YORK, SAN FRANCISCO
CRANE-BENNETT, LTD., LONDON
CE CRANE: PARIS, NANTES, BRUSSELS



All steam, water and compressed air pipe-lines in the Goodyear plant are Crane materials

The EDITORS' PAGE

AFTER a night spent on the proofs, with a few hours of sleep on a pile of galley proof sheets in the sub-basement of the Tribune press room, the editor returns, with the hum of the presses still in his ears, to put out the first October number of THE MINNESOTA TECHNO-LOG ever issued. A further dis-distinction which this magazine has is that it is the first campus publication out this fall.

This number of the Techno-Log is different in make-up from the previous issues, and it has been a little confusing to decide upon the various details so as to make the whole magazine "hang together."

The cover was designed by Joel S. Carlson, and this able artist has produced something which should give the Techno-Log a distinctive appearance. To have a drawing in color each month, with some appropriate subject, is the plan of the staff. This month's represents the main engineering building, since this is the logical center of interest for students returning to college this fall.

It is with a great deal of pleasure that THE MINNESOTA TECHNO-LOG affords its readers an opportunity to learn of the "Romance and Technique of Etchings," and the pleasure is greater because the article is written by no less an authority than our own S. Chatwood Burton, assistant professor of architecture. We believe that the information in this article is not generally known, and that this is the first time it has appeared in print. Accompanying this article are three of Mr. Burton's most prized etchings. "Gull Lake" is a view of the favorite summer resort known by that name, situated near Brainerd, Minnesota. This particular spot seemed to Mr. Burton to be the most decorative one; the pine is one of a number growing on the shore. "Ronda Bridge" is a reproduction of one built by the Romans at the same place. It crosses one of the many deep gorges which often separate Spanish towns. "Cuenca From the Park" shows the Lower town of Cuenca, which is across a gorge from the Upper town. Cliff dwellers inhabit the Upper town, a section not as modern as the one shown by Mr. Burton. It is interesting to note the different types of etchings; the more recent Spanish ones are made with more fine detail than the earlier ones, as shown by "Gull Lake."

Elton K. Crowell, the author of "Minneapolis' Federal Reserve Bank," experienced considerable difficulty in gaining admittance to this modern fortress. It was only after a lot of maneuvering at the office of the contractor and the present offices of the bank that he was permitted beyond the masonry wall which is generally believed to be the true wall of the building, but which we find is not. Mr. Crowell was fortunate in having as his guide Mr. Sumtor, the superintendent of construction, the man who also superintended the construction of the Woolworth building in New York. It is on Mr. Sumtor's word that we are told that this new building in Minneapolis is of better construction than even that monument to the "five and dime" king. Is was impossible for the Techno-Log to obtain floor plans for publication; these are zealously guarded from the public eye.

Through the courtesy of the Greater University Corporation, the Techno-Log it able to give its readers the most complete and by far the most attracive view of the Memorial stadium yet printed. Within a few days, this mighty structure will resound to cheers from fight-mad football fans which, we hope, will urge on Minnesota's gridiron warriors to the Conference championship.

Just what the chances of our team are for victory can best be decided after reading an account of "Maroon and Gold Gridiron Prospects," written by a man who is recognized as the greatest sports authority on the campus, Michael J. Fadell. "Mike," as he is more familiarly known, knows the game well, and his intimate acquaintances with the ability of each Minnesota player is ample reason to take his word as correct. "Mike" is a newspaper man all the way through, and the Techno-Log readers are fortunate in having from his pen the first football "dope" to appear on the campus this fall. His ability to "butcher" copy certainly is an indication that he is made of the stuff of which engineers are made.

In the first number of volume one of the Techno-Log, the name of Howard C. Jacobson appears as manager of the Engineers' Bookstore. It is due to the work of this man, a member of the class of 1921, that the students now have a store where they can not only conveniently buy supplies, but where they receive dividend returns from their purchases.

Milo E. Todd, assistant professor of electrical engineering, has written an interesting article about a cautery transformer, which he himself developed. This instrument, which is an important aid to the medical profession, is a good illustration of the indispensibility of engineering to human welfare.

It is not the policy of the Techno-Log to publish syndicated articles which appear also in other publications; we try to give our readers exclusive material. In the case of "Opportunities in Technical Writing," written by Mr. A. B. Zerby, assistant to the manager of the department of publicity of the Westinghouse Electric and Manufacturing Co., we believe that the students will get reliable information, and with the assurance from the Westinghouse Company that this was written exclusively for the Techno-Log, we present it to our readers. The article is a splendid account of the opportunities in this field, and the staff appreciates the interest of the Westinghouse Company in the Techno-Log.

The Techno-Log wishes to express its appreciation of Harrington Beard's courtesy in coming over to the Men's Union to grant an interview on the works of art which he has placed there, so that the students may more fully understand their meaning. Mr. Beard certainly is adding much to the education of University men by choosing such matchless pieces of art to place before them.

The MINNESOTA TECHNO-LOG
University of Minnesota

Volume V — OCTOBER, 1924 — Number 1

ROMANCE AND TECHNIQUE OF ETCHINGS

By S. Chatwood Burton
College of Engineering and Architecture

LONG ago the armourers enriched weapons by intricate and beautiful ornamentation bitten into metal with acid. In the grooves made by the acid, precious metals were inlaid. To study the design before inlaying the metal, an impression was obtained by pressing ink into the grooves, and then overlaying the work with a moist piece of paper which was rubbed with a flat tool. The process of printing etchings was thus discovered.

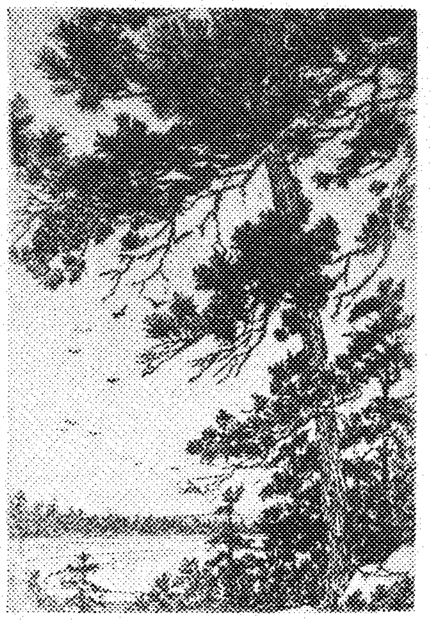
The first etchings produced in Germany in the early 16th century were mostly on iron plates. Dürer was one of the first great etchers. Germans probably introduced it into Italy, where it took on an entirely different character from the heavier German work. Some of the Italian etchings were made on plates of silver.

It was not until the 17th century that Rembrandt freed the etched line from its subservience to engraving and made of it a separate and independent art. Claude Gellee (1600-1682) also produced etchings full of charm and beauty which never suggested the use of the graver. During the late 16th and early 17th centuries, there began the prolific output of etchings by the Dutch School. These embrace the greatest variety of subjects: figures, portraits, landscape, marine and animal subjects.

Practically no etchings were produced in the 18th century, with the exception of those in Italy by Canaletto, Tiepolo and Piranesi, and some in Spain by Goya. Late in the 19th century, there came a great revival of etching in France; Meryon, Bracquemond, Millet, Jacque, Lalanne and Jacquemart etched many excellent plates. The immediate result was the revival of etching in England, a development followed closely by another with Haden, Whistler and Palmer as the leaders. Haden's etchings are direct, powerful and brilliant. Whistler's are masterly and full of magical passages, only to be equaled in the works of Rembrandt. More recent etchers of merit are Anders Zorn, Sir Frank Short, D. Y. Cameron, Muirhead Bone, James McBey and Frank Benson.

Etchings are proofs, made from metal plates upon which lines have been etched or deepened by acid. The process is as follows:

Use a polished piece of copper or zinc about 1-16 or 1-18 of an inch thick, taking care not to touch the surface with the fingers. Now grip the plate firmly with a handvice, after covering the jaws with paper, cardboard or rag to prevent the teeth from marking the plate.



"GULL LAKE" (MINN.) EARLY ETCHING

Heat the plate and rub the ground (a preparation of wax, asphaltum and pitch) lightly over the surface, melting just sufficient ground to cover the plate thinly, and taking care not to burn the ground. Dab the plate lightly with a dabber, made of a round piece of cardboard covered with silk and padded with horse hair, until the surface is covered with a thin and perfectly even coat of the ground. While the plate is still hot, hold it by the handvice, face down, and above two twisted, lighted tapers, which, if moved to and fro just below the plate, will smoke the wax. The surface of the wax should turn jet black; if it becomes grey, it is burnt, and the plate must be cleaned with turpentine and the ground relaid.

After allowing the plate to cool, the drawing can be made through the wax by means of a needle fastened in a penholder. Care should be taken to see that the point of the needle, when passing through the wax, uncovers the copper completely throughout the entire length of each stroke. It is better to use too much pressure than too little. When the drawing has been made in this way, paint the edges and back of the plate with varnish and allow it to dry.

Place the plate in the acid bath, nitric acid 3 parts and water 5 parts. The lines will soon be covered with tiny, green bubbles, which indicate that the copper is being eaten or etched by the acid. Remove these bubbles by means of a cheap brush or a feather until the acid has bitten the lightest work to the desired depth. Lift the plate from the bath, wash it well under the tap and dry it with blotting paper. With a small soft brush, varnish all the light work and allow it to dry. Now continue the biting by stages, being careful after each group of lines have been bitten deeply enough to wash the plate under the water tap and dry it with blotting paper. Then the lines must be painted over with varnish. Proceed in this manner until just the darkest work is left. When the etching is completed, the plate can be cleaned with gasoline or turpentine.

Twelve hours before printing, etchers generally prepare their paper by dipping it in water or sponging it, and putting it between blotters which are weighted down. The ink used in printing etchings is made of fine black powder and oil.

This is forced into the lines made by the acid, with a roller or dabber until the whole surface of the plate is black. With a pad of mosquito netting, the ink lying on the surface of the plate is carefully wiped off, care being taken to leave the sunken lines full. Now the hand or a soft netted fabric can be used to free the plate from unnecessary surface ink in order to get the effect required.

The plate is often warmed to allow the ink to come from the lines freely, after placing the plate on the iron plank of the press, a piece of moistened paper is laid over it, and on this paper are placed several fine felt blankets. The whole, iron plank, plate, paper and blankets pass between two heavy steel cylinders exactly as clothes are fed through a wringer. The pressure is great enough to force the paper into the lines and make it take all the ink from them. After carefully taking the paper from the plate, it will be found that the ink from the lines has been permanently embossed upon its surface and the result is called the first proof or etching.

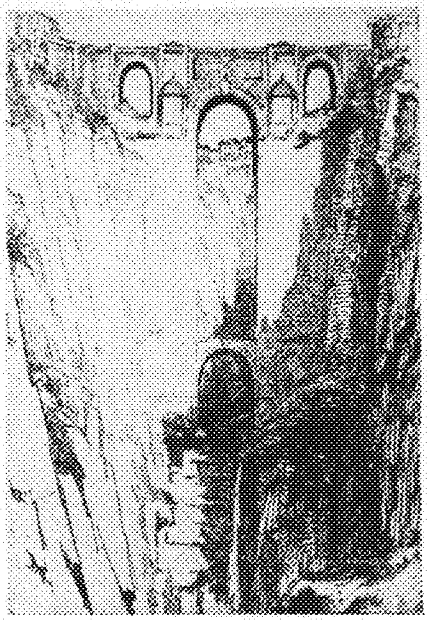
The first proof from the plate may not be perfect; portions or even the whole may be underbitten. In such a case a rebiting ground is laid, and the same lines bitten again with acid to the desired depth. The ground used is the ordinary ground mixed into a paste with spike oil of lavender placed upon a piece of glass. A leather-covered roller is next passed backwards and forwards over the plate on the glass until it is charged with a thin, even covering of the paste. The roller is then run lightly over the plate with very little pressure until the whole surface of the plate is covered with the ground. The ground is allowed to harden for two days before using the acid. Rebuilding is hazardous and should be done sparingly, as the work almost always loses its freshness.

If the proof shows that additional work is necessary, a reworking ground is laid, and all the previously bitten lines are filled with the ground. The new lines can then be drawn with the needle, and the plate bitten with care. The plate may be re-grounded and re-bitten as many times as are necessary to complete the etching.

Lines which are slightly overbitten can be reduced by pouring a little oil on the surface and rubbing the burnisher across them. Lines which are too deeply etched can be scraped with the scraper and then burnished and polished.

Foul biting, which is made by the acid finding its way through or under the ground in unexpected places is best removed with a scraper. If over-bitten work is very deep it has to be scraped, and then hammered up from the back of the plate with a punch until the pit or depression on the surface is brought to the level of the rest of the surface. Snakestone used with water is invaluable for reducing lines quickly and also for removing marks left by the scraper. Scratches left by the snakestone can be removed by rubbing the plate with charcoal, using either oil or water.

Very fine scratches left by the charcoal may be removed with the oil rubber and crocus powder mixed



"RONDA BRIDGE" (SPAIN)

with oil. Emery paper of an extremely fine texture will polish the burnisher and remove slight scratches.

Stains can be removed with a solution of common salt and vinegar.

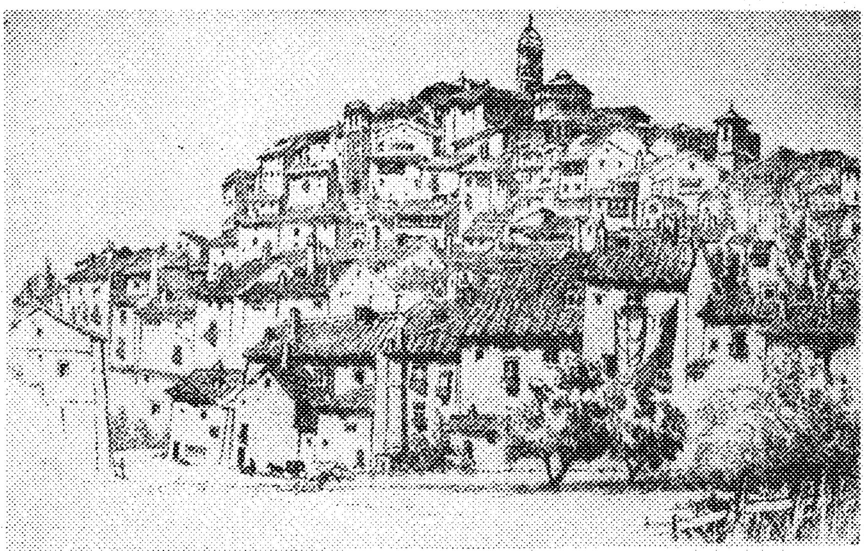
A drypoint is not an etching. Though it is printed in the same way, it's lines are not etched with acid, but are cut directly into the metal with a sharp steel needle. The needle cuts into the metal to different depths, according to the amount of pressure used. As the needle plows its way through the metal, it turns up a bur of copper. This bur on the edge of the line holds the ink and spreads it, making a richer, more velvety line than can be obtained by an etched line.

Etching is to painting and sculpture what the violin is to other forms of instrumental music, and just as there are few great violinists, so there are few great etchers. The purer the art or musical expression, the fewer are its masters or lovers.

In times past, etchings of great artistic merit have gone begging or been sold for a few dollars or cents, only to be sold in our day for thousands of dollars. Only a few weeks ago an etching by Seymour Haden was sold for $1,500; this same proof was purchased by a twin city gentleman for $90, and no doubt it was originally purchased for less than $10.

Unfortunately the artistic value of a proof is not the only factor controlling its dollar and cent value.

(Continued on page 18)



"CUENEA FROM THE PARK" (SPAIN) ETCHED BY MR. BURTON RECENTLY.

MINNEAPOLIS' FEDERAL RESERVE BANK

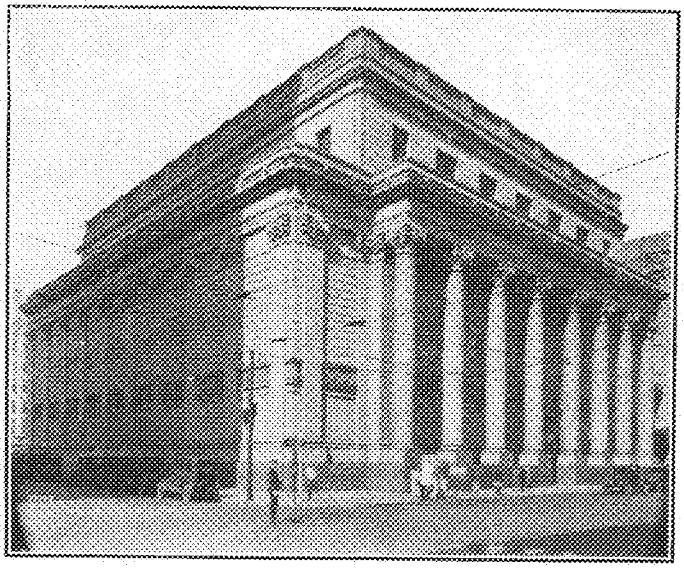
By Elton K. Crowell

CASS GILBERT, the eminent architect of New York, has developed in the new Minneapolis Federal Reserve Bank a building that is considered by architects and bankers generally to be the most successful and unique design yet devised for the safe keeping of money not in circulation. In view of this fact, the federal authorities are considering the advisability of restricting the design of all future buildings of this character to this one type. Mr. Sumtor, the superintendent of construction for Mr. Gilbert, believes this building to be the best constructed of any of the recent, large buildings in the United States. By December first, three years will have been devoted and two and one half million dollars spent in its construction. As a comparison, we might say that only two years were necessary for the completion of the Woolworth building in New York.

As one looks at the Federal Reserve Bank, one is impressed by its solidity and immensity; the blank walls on all sides aid in giving this effect. Then one wonders how light is obtained for the interior. This problem has been very effectively solved by offsetting the building from the outside wall about fifteen feet. This street wall extends upward as a solid expanse of masonry, composed of brick and Indiana limestone, a distance of eighty-five feet. Near the top of this wall is a runway with a railing extending on three sides, where armed guards will keep constant watch. Steel sash is placed in the wall of the building in a way that would not be visible from the street. White glazed brick acts as a reflector on the inside of the street wall, so the interior is as well lighted as any modern structure.

The granite colonade along the front of the building is carried out in the Corinthian order, the columns running to a height of thirty-five feet. The general appearance of the building reminds one of the Bank of England.

The whole structure rests on foundation walls of reinforced concrete three to three feet and six inches thick, extending down from fifty to sixty feet to a limestone ledge.



WHERE THE FEDERAL RESERVE'S MONEY WILL BE PROTECTED

The rear, or party wall is two feet thick and composed of reinforced concrete. The building is framed with steel, with the main ceiling supported by girders five feet deep on which rest light lattice trusses. All the floors are of concrete nine inches thick reinforced with wire mesh. For covering, batileship linoleum is employed. All the upper floors are sound-proofed by the use of the Johns-Manville acoustical treatment.

The building is composed of the following floors: the sub-basement, containing the mechanical equipment; the basement containing the receiving rooms, storerooms, shooting gallery and guardrooms; the street floor where there are the counting, canceling and general work rooms. Then there is the first or main banking floor, with its vaulted ceiling thirty feet from the floor. Two upper floors are devoted to general offices and the cafeteria. There are also two mezzanine floors; and a roof garden is arranged for the use of the employees during their hours of recreation. All the floors are served by seven elevators and four dumb waiters conveniently placed.

The main vault is of five story construction and is equipped with the latest protective devises. Reflecting mirrors have been placed so that one guard stationed in the sub-basement can see all sides of the vault at any instant.

The principle entrance to the building is guarded by the largest bronze door in the world, which is opened and closed by a vertical movement controlled by compressed air. The garage doors are also closed in this manner and may be shut instantly by a controller in the guard room.

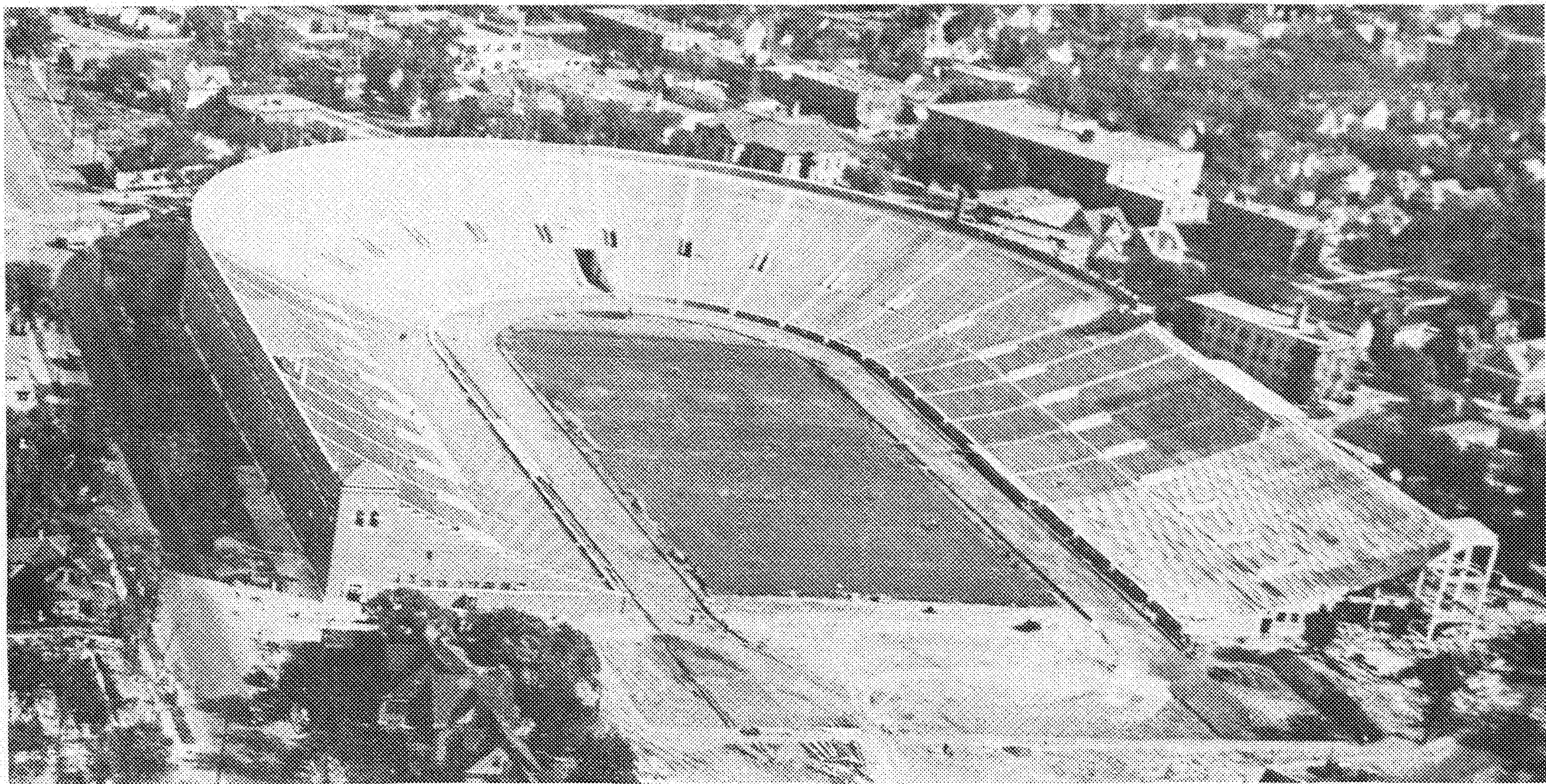
Stair rails and all important metal trimmings are of bronze. All doors are of metal, which assists in making this building as nearly fireproof as is possible for it to be constructed.

This building is equipped so that it is a complete unit. Steam is generated by three Wilcox & Babcock boilers of two hundred and sixty-eight horsepower each. Oil burners have been installed so that either coal or oil may be used for fuel. A twenty thousand gallon tank resting on bed rock provides storage space for the oil.

The main banking room is heated by 8,000 square feet of radiation, and in the summer it is cooled by the same equipment. Where the building is connected to the outer wall, a double ceiling has been constructed, and here are located steam coils for melting snow. Steam coils are also used in all sky lights for the same purpose. All together,

(Continued on page 18)

THE AMPHITHEATRE OF MINNESOTA SPORT—A LIVING TRIBUTE



UNIVERSITY STADIUM AS SEEN FROM THE AIR

With the completion of the stadium ahead of contract time, Minnesota is assured of its use for the North Dakota game. This mighty amphitheatre will ring with fifty thousand voices as Minnesota once more takes the field.

MAROON AND GOLD GRIDIRON PROSPECTS

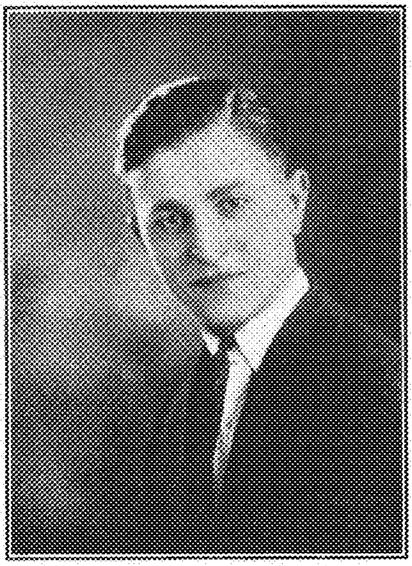
By 'Mike' Fadell
Special Correspondent

WHAT will Minnesota do this fall? "Bill" Spaulding is about to start his third year as football coach here. Will he be able to give us a championship team? Where will the Maroon and Gold be flying when the race is over and the honors are awarded? What effect will the new stadium have on our own Minnesota eleven this fall? Can our fighting Gophers come through with a clean slate in every one of the eight games on the schedule this season? Will the great name which the "Giants of the North" blazed on the western gridiron years ago continue to glitter in the wesern conference? Will the Gophers be able to break Michigan's long string of victories and bring the little brown jug home again? How will Harold Grange and the Illini behave when they are given the honor of helping to dedicate our new Memorial stadium?

These, and a thousand other questions are running through the minds of Minnesota's football followers as they are upon the threshold of another season. It is a pretty big task to answer all these, but with all the Big Ten football camps going in full swing, the dopesters are in a position to start the season's line of chatter and begin naming conference champions, to say just who will defeat the big teams, and even dare to tell some of the scores of the many star attractions on the calender for every conference school this season. It is seldom that conference schedules comparing with the one for this season have been arranged to satisfy the fans of every western institution.

Every school with the exception of Indiana, which is having trouble with a defective stadium, will see plenty of good home games this fall. This is especially true of Minnesota with six home games and only two battles set for foreign fields, one of the hardest schedules ever arranged for a Gopher team. The season will open in the new stadium with North Dakota, traditional rivals for many years. This game will be played on October 4, as the first contest on the new field, giving Minnesota students and followers an early start in watching the golden-clad athletes fight for the glory of "old" Minnesota. Captain Cox will lead his men into battle Saturday, and will start the 1924 season with one of the strongest teams which have ever trod a western field as a representative of the great university of the state of Minnesota.

Two ends and two backfield men remain to be placed in the new Spaulding machine for the fall before the cogs will be in working order again. Ray Eklund, Clint Merrill, and Carl Schjoll have played their last games for Minnesota, and the biggest task facing our Coach "Bill" at the present time is to fill the gaps left by the passing of these stars. At the present writing, there are four likely prospects in the race for the wing positions in "Freddie" Just, "Chuck" Morris, Roger Wheeler, and Tuttle, all scrappers from the start, who have been working since Sept. 15, and who will put forth their last efforts in practice this week to impress upon Spaulding the fact that they are the men for the positions. These gridders are all rookies, not having taken part in any conference games, and the strength of North Dakota Saturday will determine whether or not they will all get a tryout before the crucial battles with the powerful western elevens get under way.



Michael J. Fadell

The rest of the Minnesota line is one solid wall of power from tackle to tackle, every position being filled by men who have played part or all of the games during the past two seasons, and who are veterans who should make the plowing through the line a hard proposition for our opponents this fall.

Captain Ted Cox needs no introduction to followers of the gridiron sport on the campus, for it was only after a display of "iron-man" grit that he was able to take his position at tackle with the varsity last fall. Our new chief had a great deal of trouble with injuries to his knee in early season games last season, and for a time he was on crutches with no hope of ever returning to play football. But the old time Minnesota fight and spirit was hard to keep down, and Captain Cox took his post at tackle and finished the big games of the year by using knee braces.

Louie Gross at the other tackle is another "vet" who has made life miserable for more than one opponent last fall. His work stood head and shoulders over any of the other tackles in the conference last fall, and his services were honored by many sport critics in naming him on many of the first all-star teams selected throughout the east and middle-west.

One will search a long time before he will be able to find a sweeter pair of guards than "Bill" Spaulding boasts of in Chet Gay and George Abrahamson, both veterans of two years. Gay has completed the wonderful record of playing in every minute of every game which Minnesota has had on its schedule since he has completed his freshman year and was eligible for the regular team. Before coming to Minnesota, Gay knew very little about football, but he learned fast and made the first eleven on the frosh varsity during his freshman year on the campus.

His mate, Abrahamson, on the other side of the line, is another stellar performer who has made the going rough for teams which have bucked the Maroon and Gold during the past two seasons. Many times the old stands have roared with an "Atta boy, Abe" after the little guard has stopped a rival halfback back of the line even before he had started. "Too much Abrahamson" is the answer given to dopesters who try to figure out why the one side of the Minnesota line is a hard thing to puncture.

With four sturdy linemen back in the harness, the Gopher front wall will be complete with the return to Conrad Cooper as the fifth "vet" and regular center of last year's team, and one of the best recognized centers of the whole conference last season. His return has boosted the stock of our team to a great extent. Other football stars who have been in the moleskins since the first day of practice on September 15th, and who will bid for berths on the varsity are: Manning Rollitt (substitute center of last year), "Mark" Matthews, Percy Clapp, Swanbeck, Ziolkowski, McDonald, Swanbeck, and Farmiloe, with a large list of other men on deck for a first string berth.

Malcolm Graham, regular quarterback of last season, has a man size job on his hands this fall, for many big things are expected of him. Graham will be one of the fastest men on the varsity team this year, and his wonderful record of the past season marks him as the logical player to fill the shoes of the great Earl Martineau, passing captain of our team last fall. Michigan fans breathed a great deal easier when Graham was taken out of the game at Ann Arbor last fall, for they knew that one of the stumbling blocks in the path of a Michigan victory had been removed from the game.

Carl Lidberg, sturdy halfback, will be back in the fold again this fall and he has been working with the varsity since the first day of practice. Lidberg is a dangerous back, who always "dents" an enemy line with his terrific line smashing. He will probably be used at fullback this season. The name of Herman Ascher, plunging backfield ace, must also be reckoned with in drawing up the probable lineup of the new Gopher football machine.

The loss of Fred Oster, last year's fullback, who was ordered to retire from the game by the doctor's orders, will be felt, but there will be Van Duzee, Schutte and Peplaw, all good workers, who will make strong bids for varsity posts, and who should make one of the fastest backfields in the conference after "Bill" Spaulding gets them lined up in the best possible combination. Both Peplaw and Schutte are speed demons, who should tear off considerable yardage on end plays.

Gophers Play on These Dates

Oct. 4—No. Dakota at Minnesota;
Oct. 11—Haskell Indians at Minn.
Oct. 18—Wisconsin at Madison;
Oct. 25—Iowa at Iowa City;
Nov. 1—Michigan at Minnesota;
Nov. 8—Ames at Minnesota;
Nov. 15—Illinois at Minnesota;
Nov. 22—Vanderbilt at Minnesota.

After doping the North Dakota tilt, one shudders to think of the contest on October 11th, with the Haskell Indians, with their rangy John Levi, rated by football critics as one of the fastest triple threats in the whole country.

This game, together with the North Dakota clash, will constitute the preliminary contest, and on October 18th "Bill" Spaulding will entertain the husky Wisconsin crew at Madison for the second consecutive year. The nothing-to-nothing score of last season is still fresh in the minds of both teams, and with Jack Ryan working his second year at Wisconsin, the first conference game promises to be a real battle. Captain "Jack" Harris, of Wisconsin, has just become eligible by passing an examination at summer school, and the hopes of the Wisconsin team have risen considerably with the assurance that he will play.

Minnesota will try to make it two victories in succession over Iowa when the Maroon and Gold battle at the Hawkeye homecoming on the following Saturday. Iowa will have her new coach, "Bert" Ingwerson, and a complete list of veterans from last year's eleven to form her 1924 football eleven. Captain Parkin, quarter-back, will be Iowa's best bet this year.

Homecoming at Minnesota on November 1, with the annual clash for the brown jug, together with the attraction of the new stadium, should bring old Gopher grads from every section of the country to see "Bill" Spaulding match his wits with the veteran Fielding Yost, Michigan's mentor. This will be the one big game on the schedule this year, with the Illinois game here two weeks later, at which the new memorial stadium will be dedicated. Michigan and Illinois were joint champions of the Big Ten last fall, and the work of the whole season will point to winning these two important engagements.

Ames comes here for a non-conference game in between these two important dates. "Nellie" Metcalf and George Hauser, former Gopher coaches, who are now at Ames, will combine their efforts to down "Bill" Spaulding's outfit in this game. With practically the same team on hand as Ames had last year, the Iowa school is given an even break with the Gophers.

The finale of the season will see the Gophers playing Vanderbilt on November 22 in an intersectional contest, after which the curtain will be lowered for 1924.

ENGINEERS' BOOKSTORE 'SHOVES OFF' INTO FIFTH YEAR

By Howard C. Jacobson
Manager Engineer's Bookstore

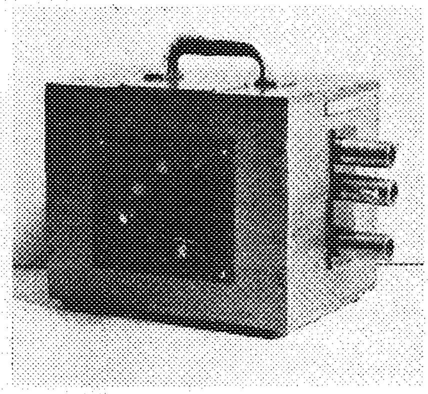
THE Engineers' bookstore this fall "shoves off" into the fifth year of its, so far, very successful existence. Its success, however, has not been dramatic, nor its growth phenomenal, but it has been steady, until at the present time it is one of the most important student organizations within the engineering college.

Its success, too, has not been due to any one particular thing; the bookstore was founded on a business basis with a sound policy, backed each year by a responsible group of student board members and faculty members that have been intensely interested in the growth and life of the store. Not least among the reasons for the store's success has been its efficient management, coupled with abundant student support in the college. The store has appealed to the student body of the college, not only as a convenience, but as a real necessity and a sound investment. Scarcely a man graduating from school the past June left without landing the cause of the bookstore, knowing that he had profited in its membership.

It has been the aim of the bookstore to ever keep the interest of the members of prime importance. This has been made possible by a well balanced board dictating its policies. The board of directors, at present, is composed of student representatives from the departments

(Continued on page 18)

A HEAVY DUTY CAUTERY TRANSFORMER

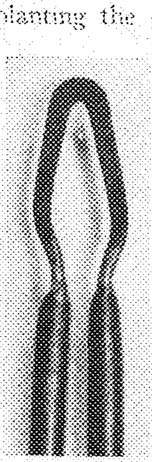


EXTERIOR FITTINGS ON CASE

By Milo E. Todd
College of Engineering and Architecture

THE VALUE of cauterization has long been recognized. Frenchmen are credited with its use even back in the dark ages, and they were the first to develop the electric cautery. About 1848 we find that they had developed a cautery knife, using platinum for the heater element. This was brought to an incandescent temperature by passing through it an electric current obtained from a Grove primary battery. These early forms were rather small, probably because the available electric power was limited when supplied by a battery of the primary type, this being before the perfection of the storage battery.

Recently there has been a demand for a much larger knife in connection with heavy, rapid operations necessary in connection with the removal of large masses of malignant and cancerous growths. It is very essential in such operations that the chance for transplanting the germ cells is reduced to a minimum. This is accomplished by using the cautery, since the removal with a red hot knife sears the blood vessels as it goes.

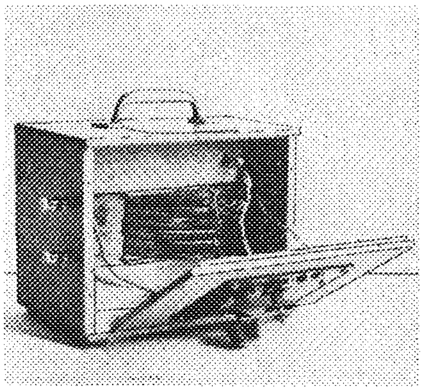


CAUTERY POINT

Dr. Boyd Williams of Minneapolis was endeavoring to procure such a cautery for use in his work, but found there was no such knife to be had on the market. When the matter was referred to the author, it was decided that the best solution was to develop one by experimentation.

Some large knives were made, with nichrome as the heating element, in sizes that required around 100 amperes. These consisted of a length of nichrome wire bent into various forms and welded into heavy copper terminals.

The author's problem then was to design and construct a heavier duty transformer to take care of this heavy knife. After considering the problem from many angles, it seemed best to build a transformer having a secondary with a current capacity of 120 amperes, with a rather wide range of voltages. This was planned in order to take care of a variety of sizes and types of knives, including some of the very small ones requiring only a fraction of a volt and possibly around 2 to 10 amperes.



PRIMARY AND SECONDARY WINDINGS

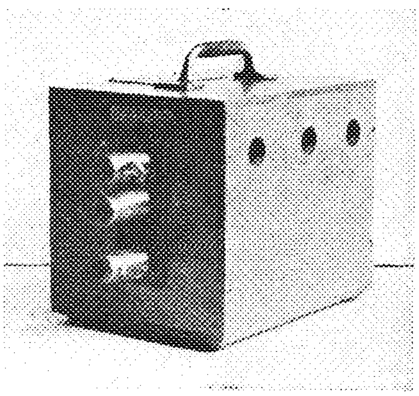
The size developed was such that it came within the national code requirements for use on any standard lamp outlet. As will be seen from the cuts, the transformer was put up in a portable form weighing, complete, about twenty pounds, thus lending itself to use anywhere. It is worthy of note that an additional use to which it might be put would be that of thawing frozen water pipes in the residence or office by sending the secondary output through the pipe.

The primary was wound for 115 volts, 60 cycle current, making it usable almost anywhere nowadays. It might be interesting to note here that occasionally someone might try to use the transformer on D. C. with the disconcerting result of blowing fuses.

The air-cooled type seemed most practical, and circulation is provided for by having holes in the bottom and side of the case. Rubber button feet raise the case enough above the table to allow the required circulation. A simple core type with the primary and secondary both on the same leg made it very compact. One reason for this arrangement was that the secondary could most conveniently be wound in a single-layer, solenoid form. Then for good voltage regulation it was necessary to have close magnetic coupling; so both primary and secondary must be on the same leg of the core. By placing the primary winding inside the secondary, this was accomplished. The cut with front of case open shows the arrangement.

A fair efficiency is approached, but it will be remembered that in the design, efficiency was sacrificed for a light portable size. After a thorough test indicated by a forty-hour run with the largest cautery point drawing around 120 amperes, the temperature of the transformer was well below what would be a 40 deg. rating.

On the whole, this seems to have proved to be a satisfactory solution for the immediate demand, for some six or eight complete outfits have been placed in the larger hospitals in the Twin Cities, and as many more outside, including some Canadian hospitals. There is an increasing call for these outfits as their merits are realized.



HOLES FOR AIR CIRCULATION

OPPORTUNITIES IN TECHNICAL WRITING

By A. B. Zerby
Westinghouse Electric Co.

PERHAPS the most important question in the mind of any engineering student as he is completing his college course is, "What kind of a position should I attempt to secure immediately after my graduation?" The universal spread of college and university education today is releasing thousands of young men every spring from their educational work to their constructive life work. The increasing number of such men, all looking to their future, has introduced keen competition for the worth-while jobs. It is, therefore, well worth a man's time considering carefully what he shall do with his talents when he leaves his alma mater.

After four years spent in pursuing a course in electrical engineering, it is quite natural for the student to dream of electrifying great railroads, harnessing great water falls, electrifying industry and doing the larger and more spectacular things in electrical engineering. I wonder how many such men ever think of the possibilities of combining their engineering knowledge with whatever talent they may have for writing, and so devote their future to the literary end of engineering rather than to the design and construction fields. Since this is, perhaps, a new thought to many students, the question naturally arises, "What are the opportunities in the technical writing field?" This brief article will attempt to point out some of these opportunities.

The electrical manufacturing business is based fundamentally on inventions. Some inventions are arrived at by accident, but by far the most are arrived at by patient, systematic experiment and research directed by high-grade engineering talent. Around the invention is built a machine which forms the basis of the manufacturing company's product. Multiply the inventions and you will multiply the classes of apparatus which the company manufactures. All these, added together, cumulatively form the company's products.

It is now necessary to sell this apparatus into those fields—in the home, in industry, or in transportation—where they will be beneficial to mankind. The men who invent the machines, the men who develop the machines and the men who make the machines, do not sell them. How then is the salesman to have sufficient information and knowledge of the machine so that he can sell it? Here enters the technical writer. His talents are twofold. His background of engineering knowledge permits him to fully comprehend the device and his ability to intelligently write this knowledge gives him the power of informing the salesman about its construction, application and operation.

In this connection, it is interesting to record briefly the evolution of selling in the technical field, of which the electrical industry is representative. In the early days of the industry, neither the salesman who sold the goods, nor the customer who bought the goods, were thoroughly acquainted with them. The construction and operation of the device was a mystery to both parties, and in nearly every case the final purchase was made on the word and faith of the salesman. A salesman, therefore, could make almost any claim for his product and his customer had no easy way of checking whether he was right or not. Very little descriptive literature was written on the product and frequently the purchaser was compelled to do his own experimenting to determine whether the device would fill his needs. Service and safety engineering were in the nebulous stage and after a customer once bought a piece of apparatus he was confronted with the necessity of making it operate. In so doing, he gradually accumulated a very definite and intimate knowledge of the apparatus and so, in the evolution of things, it came about that in many cases the customer knew more about the product than the man selling it.

This condition forced the electrical manufacturing companies to reconstruct their selling forces and men with engineering knowledge who could talk intelligently about the products which they were selling were in great demand. That their selling force might be better equipped with a knowledge of the specific products which they were manufacturing, many of the electrical companies instituted training schools in which young technical graduates with the desire for salesmanship were put through an intensive course of training in the works, studying the installation and the operation of the various apparatus manufactured. The customers of electrical equipment also gradually changed over their organizations until they were well supplied with fully trained engineering talent, and today both the buyer and seller meet on a common plane of engineering knowledge.

Since this is so, the manufacturing companies must of necessity maintain a staff of technically trained men capable of translating knowledge into the language of every day communication. The district offices and the salesmen in the field must be constantly acquainted with the changes and improvements in apparatus and the new devices perfected, so that they can intelligently sell the company's products. The technical writer must serve as a pioneer for the salesman, and his articles must be interesting and descriptive so that the prospective customer will recognize his need for such apparatus and the reason for his selection. In this way, the customer is in a very receptive mood when he is approached by the salesman, and the message of the writer has accomplished its appointed task.

Service work is an important branch in every organization today, and in this connection the technical writer has a definite duty to perform. He must supply installation and operation information to those customers who have already purchased apparatus and give the necessary information for ordering repair and replacement parts. The writer plays an important part in building up the good will of the company by keeping the customers satisfied, and assists the salesman in obtaining future orders from these same customers when the need again arises. Competition in business is becoming keener every year, and customer service work, the outgrowth of this competition, is receiving more attention and study; it is the technical writer who must serve as the connecting link between the company and the customer.

To a large extent the newspapers have been neglected as regards technical stories, and this neglect may be attributed to the purely scientific language in which these articles have been presented in the past. The newspapers are one of the chief instruments by which the people may be reached, and they afford a splendid channel for educating the public in the latest engineering developments. The time is now at hand to supplant the sensational stories appearing daily in our current newspapers by interesting, educational stories concerning the latest engineering developments, but the engineering articles must be written into the language of everyday communication, so they can be intelligible to the readers. It is essential, however, that the writer have a technical training, so he can cooperate with the engineer in obtaining the necessary information for his articles. The necessity of explaining the engineering details are eliminated to a large extent, and the engineer is not obliged to supply information which to him seems obvious.

The technical writer has also an important duty to perform for the world in connection with the engineer. Perhaps above all others, the engineer has contributed most to the material welfare of humanity. Within the last century he has practically revolutionized the living conditions of civilized people, but as yet the engineer does not occupy his proper place in the scheme of things. Why is he not a more conspicuous citizen? Why do we not have more of the benefit of his trained mind in our public affairs? The membership of the Sixty-Fifth Congress did not contain a single engineer in either the Upper or Lower House. It is indeed astonishing that in our country with its wonderful scienific and mechanical achievements, there stand out very few engineers or scientists whose voices are heard in our National councils, although it is highly probable that the engineer might indeed be a very valuable public servant.

Nothing but praise can be given the engineer for the value of his work, but he has the training that will enable him to serve the public in a greater degree still, if he will but come out of his hermitage and mingle with the open world. In this country there is very little spontaneity of recognition of the men of science. We differ from the older countries in that, although we quickly recognize what the engineer does, we are not inclined to exalt him into realms of distinction beyond his actual achievements. The technical writer will be performing a great public service by making men aware of the engineer and bringing him out of his isolation into his fullest obligations of citizenship.

The duties that logically fall within the field of the college-graduate writer are varied. We might classify them roughly as follows:

(a) Description of apparatus for the sales staff,

(b) Description of apparatus for the prospective customer so he shall recognize his need for such apparatus,

(c) Installation and operating information to the customer who has already purchased the apparatus,

(d) Information to customers for ordering repair and replacement parts for apparatus,

(e) Descriptions of apparatus installations and operating data for the technical and trade publications,

(f) Appropriate description of apparatus for newspapers,

(g) Articles for the various house organs maintained by companies. These will consist usually of magazines for manufacturing-of-works departments, for dealers, for export departments,

(h) Advertising copy for popular advertising media such as Saturday Evening Post, Literary Digest, Nation's Business, and newspapers,

(i) Advertising copy for technical and trade papers,

(j) Promotion letters for direct mail selling of such apparatus as can be merchandised direct.

In short, the duties of a technical writer are without end. The rapidly changing tasks which face him are always interesting and extremely fascinating. No one ever saw a technical writer suffering from ennui; he doesn't get a chance to get stale on one job, because new problems are constantly confronting him and the thrill of action is always his. There is real satisfaction in solving a difficult problem by virtue of the written word. The pen is a mighty weapon in these days of intensified training, and there are no limitations to the field of the technical writer. The social relations between the buyer and seller will influence a sale, but before the contract is definitely placed the thought that will count most will be the product itself, its efficiency, reliability, adaptability and strength, and investigation will disclose that in most cases some technical writer has recorded these things in so interesting, definite, and conclusive a way that he is entitled to a good share of credit for the final purchase.

The technical writer is constantly increasing and building up a vast store of knowledge for himself and he is not limiting himself to any one branch of the engineering profession. Specialization is essential and necessary in all lines of endeavor, but one should not limit the scope of his activities to the neglect of everything else that is going on around him. The technical writer obtains more than a smattering knowledge of the apparatus. Convincing articles cannot be written by one not familiar with his subject, and the writer fails in his appointed task if his presentation does not convince his readers. It is therefore necessary that he keep in constant communication with the engineers. He must study new inventions, perfections, and achievements in design and operation and develop an engineering appreciation that he may be properly qualified to present accurate engineering details. In this way the technical writer obtains a view of the work similar to that held by the officials of the organization, not an insight which permits of his engaging in research work, but a broad, comprehensive view of the industry, an essential requisite for management.

The salaries in the technical writing field are comparable to those in the engineering, and the results are much more quickly recognized, with the possibilities of advancement thereby enhanced. While serving his company to the best of his ability, the writer has a splendid opportunity at the same time for building up prestige for himself in his chosen profession. Through his articles he gradually becomes well-known, and in time finds himself in that enviable position of a recognized authority. In this comparatively virgin field, the chances of success are as great as they are unlimited, and with the added incentive that he is performing a public service through his educational articles, the college graduate entering the technical writing field is afforded exceptional opportunities.

AN INTERVIEW WITH HARRINGTON BEARD

By Albert W. Morse
Editor, The Minnesota Techno-Log

"I HAVE just come from a wonderfully interesting meeting at the Radisson Hotel, called by a group of men and women who have felt the impact of the world's need, and in connection with a plan of memorial for the service and the sacrifice of our boys in the World War. They desire to put emphasis on the work that still remains to be done, so that every one of us may make our real contribution to a real world fraternity.

HARRINGTON BEARD

"At this meeting J. Henry Scattergood of Philadelphia made a wonderful plea for unselfish world service that would include not only our own America, but also the needs of England and France and, yes, Germany, too. Our leaders are finding in this "strange and maddening maize of things," that to overcome the intense selfish materialism of our world, there must be a recognition of those things that contribute to the life of the Spirit, and, after all, 'life is more than meat and the body than raiment,' and he, who as a true patriot would serve his day and generation, must find in his own personal experience something more than money or comfort or pleasure, and life grows large and sweet as he gives of his best in the things of the spirit rather than in things material.

"So I come to meet you in the Men's Union and to tell something of the pictures, that we have placed here, to adorn these walls, and which are an addition to shelter, warmth and comfort, contributing to that larger and more beautiful life which we call "the life of the spirit." What then, does this Life of the Spirit mean? It means, does it not, the life which is a product of the soul, of hope and faith, imagination, joy and love, those emotions which find their finest expression in devotion to family, to country and to religion. So then, on these walls of the Men's Union we see first pictures of some of America's finest sculpture.

"The Minute Man from Concord, where Daniel French has memorialized the patriotism of the men at Acton as they met in the meadows of Concord, the Hessian soldiers sent over to quench their patriotic love of a country in which they might serve God according to the dictates of their own consciences.

"The Appeal to the Great Spirit," by Cyrus Dallin, the original in bronze standing in front of the Boston Art museum. Fine, was it not, that these men charged with the erection of a great art museum should choose a work of art to occupy the very central position in front of that institution. We see the faithful horse with his rider, who, resting for a moment, perhaps uncertain of the next step, finds that his resource comes, after all not from of his own instinct and knowledge, but from his Appeal to the Great Father of the Indian.

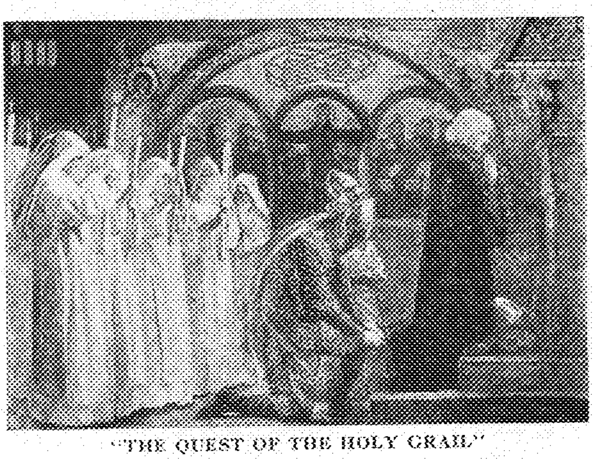
"At the end of this same room may be seen St. Gauden's two splendid military works, Sherman on his horse, lead by Victory, the original of which stands at the entrance of Central Park, New York, and the Shaw Memorial, situated opposite the State House on Boston Common, where this supreme artist has portrayed the young Colonel leading his colored troops as they "relinquish all in their service of the Republic."

"In this plan of pictorial decoration, on another wall, we see that there has been placed, the four principle decorations in the Hall of the Family, in the Library of Congress, painted by Charles Sprague Race, and these four are "Labor," where two youths are removing from the ground the stump of the tree as they prepare the ground for agriculture, representing that great blessing of Providence, Work; "Study," where two girls sitting under the trees, are working out together some problems of mathematics; "Recreation," in which we see that Mr. Pearce appreciates that "all work and no play makes Jack a dull boy," for here are two girls playing on instruments and dancing on the greensward. And, the fourth, "Religion," for in this group of pictures which ornament the Hall of the Family, our artist has recognized that after all, the children of the human family are "incurably religions" and under the trees are two arrayed in primitive garb, as before the crude altar which they have erected, on which they have placed the sacrificial fire, they kneel in prayer.

"Turning to the other wall, there can be seen the three pictures, the original of which are in the Appellate Court building in New York City, painted by H. O. Walker, Edward A. Simmons and Edwin R. Blashfield. In the center of this group, representing the phases of the law, we find "Wisdom" with her attendants, done by H. O. Walker. On the left, "Justice" with "Mercy," painted by Simmons. On the right, painted by Blashfield, "Power," who draws her sword in behalf of "Appeal," who kneels at the feet of "Power." In these three pictures, the visitor quickly appreciates the very foundations of government in a democracy. Only where such characteristics are obtained, can there by a true democracy!

"Next we find two panels of the

(Continued on page 18)



"THE QUEST OF THE HOLY GRAIL"

The
MINNESOTA TECHNO-LOG
University of Minnesota

A DIFFERENT aspect about campus life is apparent this fall, an atmosphere which affects old and new students alike. The reason for this change is found in the progress which evidences itself in the successful advancement of the University building program.

The library, one of the best in the country, is open to the students, affording complete accommodations for study in surroundings representing the finest of artistic interior decoration.

Football crowds will soon fill the new Memorial stadium, a magnificent structure which will stand many years as a monument to Minnesota spirit.

The electrical engineering building is equipped and ready for use by the returning students. Its radio towers are visible for miles, marking the newest of the engineering group of buildings.

Experiments have been conducted regularly in the new mines experimental building since its completion recently, making the University a center of activity in the mining industry.

Now the administration building is rapidly nearing the stage where it will house the executive offices of the University.

Behind all this progress there is one figure, the engineer. His is the creative mind which directs the planning and the actual construction work.

THE ENGINEER AND HIS BOOKS

ENGINEERS cannot overestimate the importance of business writing in their profession; the fact is becoming more and more apparent each day as technical graduates come into closer relationship with men in other walks of life. So the appearance of a thoroughly reliable and practical book on this subject is recognized as an important development.

T. H. Bailey Whipple, the author of "Principles of Business Writing," is qualified as are few other men, to write a book on this subject. Through his connection with the Westinghouse Electric and Manufacturing Co. as literary critic, he has acquired an intimate knowledge of the English language as it is used in the swirl of modern business. Mr. Whipple has written this book with this knowledge as a background, and there is worthwhile information in each paragraph.

The book is divided into five parts and an appendix. Part one contains the Introduction, which shows the inseparable connection of good English and industry. When the author asks, "Why do not the colleges teach their students the use of good English before attempting to teach them other subjects which are oftentimes beyond their grasp?" he asks a pertinent question. Students themselves realize this gap in the curriculum of engineering colleges.

Part two, dealing with the principles of Business Letter Writing, discusses in detail such subjects as "clearness," "conciseness," "completeness," "correctness," "courtesy," and "style."

Words and Phrases Often Misused, the subject of part three, constitute, perhaps, the most important section of the book. It is the fact that this material is exceedingly hard to find which makes it so valuable. Here may be found the mistakes which creep into language as it is used in the factories, shops, and offices alike, of the nation. These words and phrases constitute 95 per cent of the errors that correspondence supervisors must correct. Practically half of the book is devoted to this section.

Part four deals with report writing, and examples are cited to illustrate the points which the author makes. An article by F. H. Norton says something applicable to college students when it says, "As in any kind of writing, clearness is dependent on the three essentials, unity, coherence, and emphasis. If a report should cover too much space, no one will take the time to search for the particular part he wants, and any digression takes the mind away from the main thought."

The jobs which college graduates lose each year because their letters of application are not correctly written would undoubtedly be much fewer if this book were more widely read and followed. Human emotions affecting the writing of letters, such as "fear" and "anger" are analyzed, and letters themselves are analyzed in detail.

Let's Get Back to Fundamentals, the subject of appendix A, is a discussion of English and its importance. Appendix B contains suggestions to authors. One of the contributors to the book writes, "The scientific writer, above all others, should choose words that have precise meanings or to which precise meanings may be given." Appendix C is devoted to Questions and Answers on Business Writing, and by referring to this section, one may solve many of his writing problems.

The character of "Principles of Business Writing" may be indicated by saying that it helps to train good writers through the use of practical psychology rather than through the use of the rules of grammar and rhetoric.

GREATER UNIVERSITY CORPORATION

(Of the University of Minnesota)

Balance Sheet, July 31, 1924.

ASSETS

CASH:		
On hand	$ 125.00	
On deposit:		
Checking account	31,906.54	
Savings accounts	3,603.18	
Total cash		$ 35,634.72
INVESTMENTS—AT COST:		
United States Treasury 4¼'s 1927 (face value, $50,000)	$ 50,000.00	
United States Treasury 4¾'s 1927 (face value, $50,000)	50,468.75	
Preferred capital stock, Nicollet Hotel, Inc., (par value, $100)	93.00	
Total investments		100,561.75
ACCOUNT RECEIVABLE—UNIVERSITY OF MINNESOTA (athletic association for construction of team quarters)		33,000.00
PLEDGES RECEIVABLE:		
Alumni and public ($48,270.67 over 31 days past due)	$511,181.93	
Faculty and employes ($5,362.56 over 31 days past due)	61,573.21	
Students ($56,614.60 over 31 days past due)	606,163.46	
Total pledges receivable		$1,178,918.60
ACCRUED INTEREST ON INVESTMENTS		1,171.87
ADVANCES ON STADIUM (title to completed stadium, which will cost approximately $690,000.00, will vest in the University of Minnesota):		
Cost of land necessary to supplement site provided by the University of Minnesota	$ 80,508.00	
General Contract	349,991.10	
Architects and engineers	26,361.24	
Contractor's bond and builder's risk insurance	9,176.05	
Miscellaneous	54.77	
Total advances on stadium		466,091.16
OFFICE FURNITURE AND EQUIPMENT—Depreciated value		1,133.46
DEFERRED CHARGES—Unexpired portion of fidelity bond premiums		34.15
TOTAL		$1,816,545.71

LIABILITIES

CURRENT LIABILITIES:			
Accounts payable on estimates of July, 1924, stadium construction:			
General contract		$ 92,864.70	
Architects and engineers		1,910.67	
Unpaid expenses		53.50	
Total current liabilities			$ 94,828.87
CORPORATE SURPLUS—NET:			
Subscriptions—Net:			
Alumni and public	$ 963,661.11		
Faculty and employes	96,538.85		
Students	671,139.38		
Total	$1,731,339.34		
Less adjustments of conditional subscriptions, etc.	2,065.72	$1,729,273.62	
University of Minnesota:			
Appropriation to defray cost of constructing team quarters in stadium	$ 63,000.00		
For moving dirt into railroad cut	10,062.60	73,062.60	
Interest on investments and bank deposits		8,346.45	
Net profit on sales of investments		2,268.82	
Gross surplus		$1,812,951.49	
Deductions:			
Expenses:			
Campaign	$ 77,152.13		
Administrative	13,961.34		
Net loss on sales of office equipment	121.18		
Total deductions		91,234.65	
Corporate surplus—Net			1,721,716.84
TOTAL			$1,816,545.71

ALUMNI AND FACULTY PERSONAL NEWS

Alumni

F. A. Anderson, '08 E. E., is now one of the owners of the National Appliance Co. of Portland, Ore. They manufacture electrically heated laboratory apparatus, and sheet metal products.

C. M. Barrill, '23 E. E., is doing testing work for the General Electric Co. at their Schenectady plant. He has been making a study of short circuit calculations, and this fall he will commence the second year of an advanced engineering course in the Consulting Engineering Department. His address is 1 Willow Ave., Schenectady.

John H. Barr, '83 M., '88 M. E., is one of the officers of the Barr-Morse Corporation, Ithaca, N. Y.

Ross D. Bostwick, '23 Chem., is assistant superintendent of the Spokane Refining Co., Hillyard, Wash.

Allan C. Butterworth, '11 E. E., is now with the Montreal Mining Company at Hurley, Wis., and has been working on the installation of a great deal of mine equipment.

L. M. Case, '24 Mines, is working for the Oliver Mining Company.

Byron Curry, '23 C. E., is working on the Robert Street bridge, St. Paul, for the Fegles Construction Company.

Arthur Norman Dallimore, '08 C., has moved to 1215 Carterette Street, Pueblo, Colorado.

Grover W. Diamond, '12 C. E., is estimator for the St. Paul Foundry Co.

Lyle A. Dills, '21 C. E., is working as material inspector for the Minnesota Highway Department.

Harry C. Elliott, '19 M., engineer for the Packard Motor Car Co., of Detroit, Mich., has changed his address to 976 East Grand Blvd., Detroit.

L. A. Emerson, '11 E., is with the Joliet Township high school at Joliet, Ill., as their vocational director.

E. W. Engstrom, '23 E. E., is with the General Electric Company at Schenectady. He is in the high power transmitter section of the Radio Department.

Vincent H. Erwin, '13 E., '14 E. E., is now superintendent of steam generation for the Tennessee Electric Power Company, Guild, Tenn.

Piece P. Farber, '08 C. E., is no longer with the Louis F. Dow Company of St. Paul. He is one of the partners in the firm of Wiseman and Farber, engaged in the sale of steel building products at Danville, Va.

Julian Garzon, '24 C. E., is Inspecting pavements for the Highway Commission around Fairmount.

Harry J. Gee, '19 G., has recently taken a position as accountant with the J. K. Raglan & Co., of Minneapolis.

Marcus O. Giertsen, '12 C., and '13 C., is assistant bridge engineer with the Minnesota Highway Commission.

C. R. D. Jorgens, '12 C., '13 C. E., is now highway engineer of the Minnesota Highway Department at St. Cloud, Minn.

"Dusty" Kearney, '23 E., left for St. Cloud the other day to take charge of the sales department of the Northern States Power Company in that division.

The Ideal Electric and Mfg. Co. of Mansfield, Ohio, now claims three of our electrical graduates. O. E. Dunnum, '22 E., is one of the sales engineers. Clay W. Noel, '20 E., is a division engineer. Harold R. Goss, '20 E., is manager of the synchronous department.

Leonard T. Johnson, '10 E., formerly engineer for W. J. Rainey, Inc., is now assistant steam engineer for the Grasselli Chemical Company of Cleveland, Ohio.

I. C. McCoy, '11 E., is following the example of his former professor, Dr. Shepardson, and is now head of the department of electricity, Joliet Township high school, Joliet, Ill.

Norman S. McVean, '21 E., is now telephone equipment engineer with the New England Telephone and Telegraph Company, 30 Oliver street, Boston, Mass.

Lewis E. Merrill, '20 M., '21 M. E., is now in the mechanical engineering department, Minneapolis Steel and Machinery Co. He lives at 3124 Fifth Avenue South.

Mike Mitchell, '23 C., is now engineer with the W. B. Carter Company, Tulsa, Okla. He is assisting in the installation of a sewerage and water system in that city. He writes that he takes lunch daily with the millionaires of the city.

Arvin G. Olson, '22 E., formerly with the Commonwealth Edison Co., is now in the engineering department of the Public Service Co., 114 N. Oak Park Ave., Oak Park, Ill.

H. C. Rath, '23 E. E., is at the Fort Wayne Plant of the General Electric Company.

Ingwald A. Rosok, '03 E., was promoted to manager of the Bisbee Improvement Company, Bisbee, Ariz.

J. E. Searles, '99 G., writes us that his present address is 650 S. 9th East St., Salt Lake City, Utah.

Samuel J. Sutherland, '23 A. E., formerly assistant superintendent of the Minnesota Stadium, is now architect for Croft and Boerner at Ottumwa, Iowa.

Arthur G. Welin, '12 C., '13 C. E., is engineer for the L. P. Wolff Co., St. Paul, Minn.

Raymond J. Wolfangle, '17 C., is engineer for Ramsey County.

Faculty

Leon E. Arnal, professor of architectural design, who has been visiting his old home, Marseilles, France, is on his way home now and will be here to resume his duties when design classes start.

Prof. Paul Brinton of the School of Chemistry is going to do research work with the rare earth elements at the Sarbone in Paris.

John W. Dawson, formerly an instructor in architecture, is now with Omara and Hill, architects of Saint Louis. His place is taken by Donald C. Heath, '16 Arch., whose home address is 43 Dell Place, Minneapolis.

C. C. Fishburn, instructor in civil engineering, is leaving this year.

Prof. J. J. Flather, who has been in California on a furlough, is again officiating as the head of the department of mechanical engineering.

Among recent promotions is the advancement of R. W. French to the rank of associate professor of drawing and descriptive geometry.

F. C. Ganger, who lectured in architecture last year, is now in Tampa, Florida, where he is engaged in the construction of a new waterworks system.

Isaac W. Geiger is made associate professor of analytical chemistry.

J. Carl Kamplain is an instructor in the department of mathematics and mechanics.

Prof. William H. Kirchner, head of the department of drawing and descriptive geometry, has returned from Europe, where he spent a year's sabbatical leave.

F. C. Lang is made associate professor of highway engineering.

Prof. G. A. Maney of the civil engineering department has returned from Dallas, Texas, where he was engaged in concrete construction work.

Prof. George H. Montillion is leaving for the University of Michigan where he will do graduate work in chemical engineering.

Louis J. Schnell is an assistant in the department of electrical engineering. He received his Bachelor of Science degree in electrical engineering at the University of Colorado, and was an instructor in engineering mathematics there.

Prof. R. W. Siler of the department of mathematics and mechanics is leaving to study in Europe a year.

Hibbert M. Hill, '23 Civil, is a new instructor in that department.

George L. Tuve who instructed in mechanical engineering last year is to direct the mechanical laboratories of the University of Montana this winter during the absence of the former director. It is expected that Mr. Tuve will return in a year; he is on leave.

THE SHIP'S LOG

AMONG Professor Burton's prints that are on view in the Techno-Log office, is his first drypoint, "Rain in Venice." This work he prizes highly because of the fact that the copper plate was accidently destroyed, leaving only four of the prints in existence.

In a little talk with Professor Springer the other day, I learned that he has been preparing a list of subjects to be given out to seniors for original investigations. The subjects are all of a real practical nature. They will require some reading, construction, and testing, all of which is to be done by the student as he chooses. Credit will of course be given when a report is made of the results. Without a doubt, this is one of the finest ways of becoming acquainted with engineering procedure and of really learning facts.

There is a great deal being written about college life, which is the cause of much discussion. I refer to such novels as "Cap and Gown," "The Plastic Age" and "The Barb." The pictures these stories paint are undoubtedly true as far as they go, but they don't go far enough. The American university and college represent a cross section of life the same way as do any other gathering of people. And in such a group you will always find individuals similar to the ones pictured in these novels.

The library of the Department of Architecture, with which few students outside the department are acquainted, is full of many interesting volumes. Of special interest, I believe, are the restorations; the volumes containing the pictures of old, and for the most part, nearly demolished buildings which have been restored by a modern artist. In some cases all that the artist had to go upon was a rough plan of the building, left by the crumbling walls, and perhaps a few feet of wall left standing. The originals of these restorations are extremely large, some measuring as much as four by ten feet.

There are also many volumes containing the work of modern artists. I might mention a collection of reproductions from the work of the modern Italian school that is full of many beautiful and colorful things.—J. W. R.

Romance of Etchings

(Continued from page 6)

Limited production is a great factor; the fame and death of the artist are other important factors. If Rembrandt was working with us now, his prints would sell for a very few dollars, yet his proofs are selling as high as $25,000. Great etchers never receive high prices for their work; the profits go to those who sell their product after their death. A few great etchers in our own age, have, through modern advertising methods, been able to gain recognition and money; Frank Benson and McBey are the two outstanding examples of etchers who are reaping a little of the fruits of their labors.

Buying etchings is as romantic an occupation or hobby as buying the rarest of antiques or the most valuable of bonds. Great art produced in a nation is its endowment policy which is paid up after its commercial life is gone.

Federal Reserve Bank

(Continued from page 7)

there are 5,564 square feet of pipe coil radiation.

The remainder of the building is heated by direct radiation, totaling 11,555 square feet. The desired temperature throughout the building is maintained by thermostatic controllers. Adequate air washers, ventilators, and fans purify the air of the entire building, including the vaults.

Engineers' Bookstore

(Continued from page 10)

of Architecture, Civil and Mechanical, and Electrical Engineering, and the Schools of Business and Chemistry.

The Faculty Board members have been appointed, by custom, by the Dean of the College, and at the present time the Board has been fortunate in having men that were keenly interested in its welfare.

The bookstore has not only sought to better itself, but has reached out and tried to develop college spirit. The engineers' basket ball team was awarded M's last spring by the bookstore, in an effort to awaken interest in intramural athletics.

The faculty members of the 1924-25 board are: C. A. Mann (Chem.), J. H. Forsythe (Arch.), O. S. Zelner (Civil). The student members are: John A. Banovetz, E25 Civil, Russell E. Backstrom, E25 Mech, Arthur F. Christensen, E25 Elec., Stanley M. Heins, Bus.25, Ernest E. Jewett, C25 Chem., Dean W. Rankin, E25 Arch.

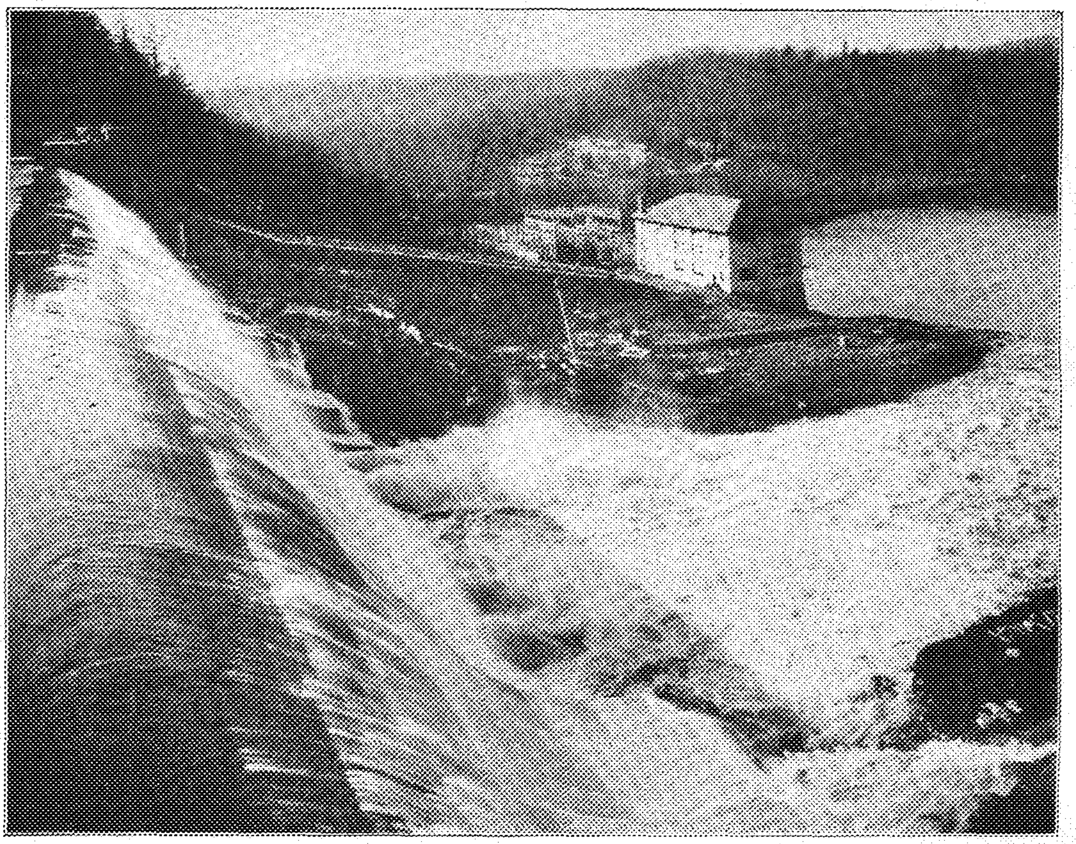
Harrington Beard

(Continued from page 14)

matchless series of paintings done by Edwin Austin Abbey for the Boston Public library, entitled "The Quest of the Holy Grail." These two pictures represent, first, the kneeling Galahad and Sir Bors and Sir Lancelot, two of the best knights of King Arthur's Round Table, who are placing on the heels of the reverend youth the golden spurs of knighthood, after he had spent a night of vigil in the nearby chapel; and, second, "Solomon's Ship," which has waited so long for the pure knight, Galahad, who with Sir Lancelot and Sir Percival sails for the sacred city of Sarrath, of which, because of his faithfulness and courage, Galahad is to become king. Two more of the pictures of this beautiful lounging room are copies of the stately mosaics which adorn the Reading Room of the Representatives in Congress in the Congressional Library, the one being "History" with her attendants "Mythology and Tradition," and the other "Law," with whom may be seen those who would on one side destroy and on the other, uphold "Justice."

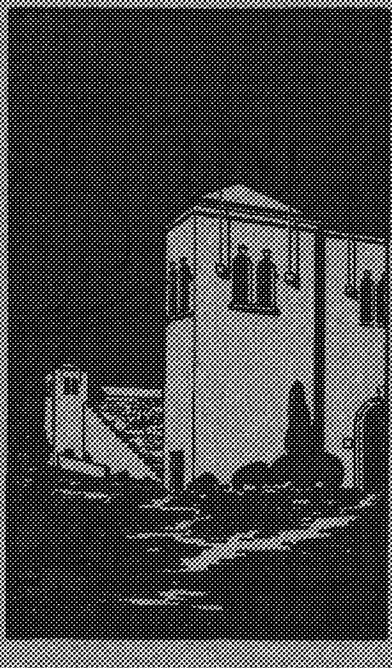
"The last group of pictures used are those done by Edward Simmons for the Criminal Court Room of New York City. On the one side are the Three Fates, "Clotho," "Lachesis" and "Atropos," and on the other those who represent the three ideas which are the very basis of a nation's life, "Liberty," "Equality" and "Fraternity."

"I have sought, therefore, to tell you briefly my thought about these splendid American works of art. These may appeal to you and to the next more or less differently from what they appeal to me, but after all we shall surely agree as we view these splendid productions, that they are Messages of the Spirit and, out of these portrayals we find the Ideas that truly and surely contribute to the Higher Life of the Spirit and therefore are contributing to the real cultural opportunities of this great University."



THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

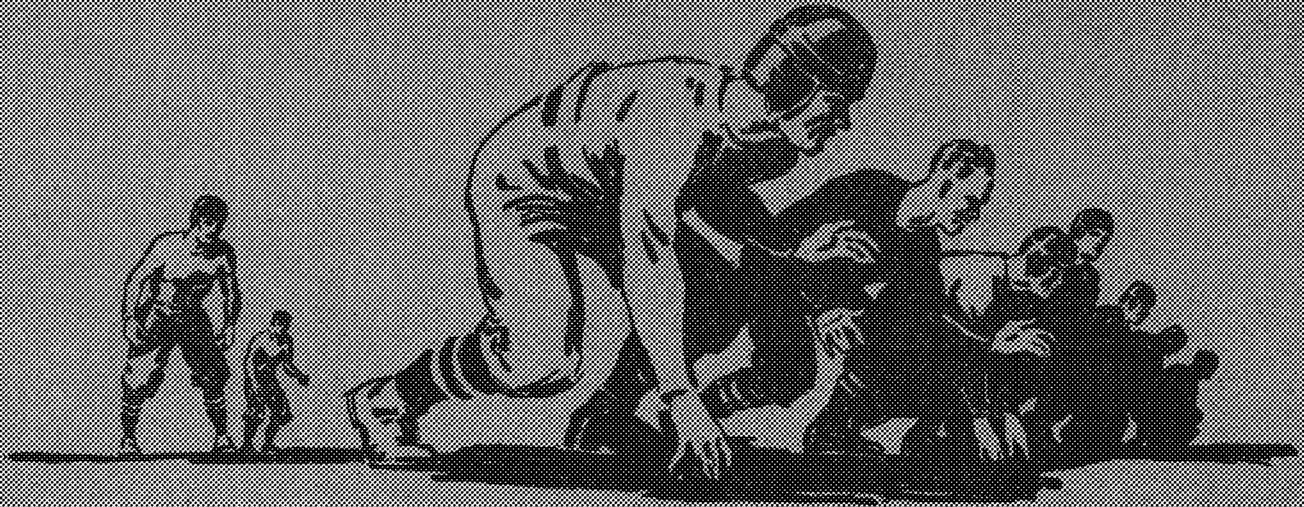


NOVEMBER
1 9 2 4

Volume V 25 CENTS A COPY Number 2

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES



What Makes Defense "Air-Tight"?

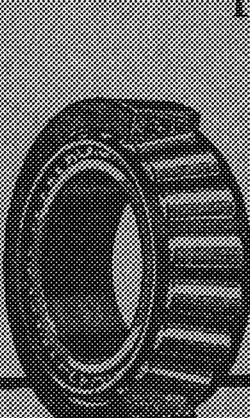
A team with fast, hard-tackling ends and a weak line can no more stop a straight attack, than heavy guards and tackles can break up open plays, when the ends are weak. An "air-tight" defense must stop plays both through the line and from the ends; it must withstand attack from every quarter, just as a good bearing must withstand all loads.

The bearings in the wheels of a motor car, for instance, have a vertical load upon them, represented by the weight of the car. This is termed "radial load". It corresponds in effect to a straight charge by backs upon a football line.

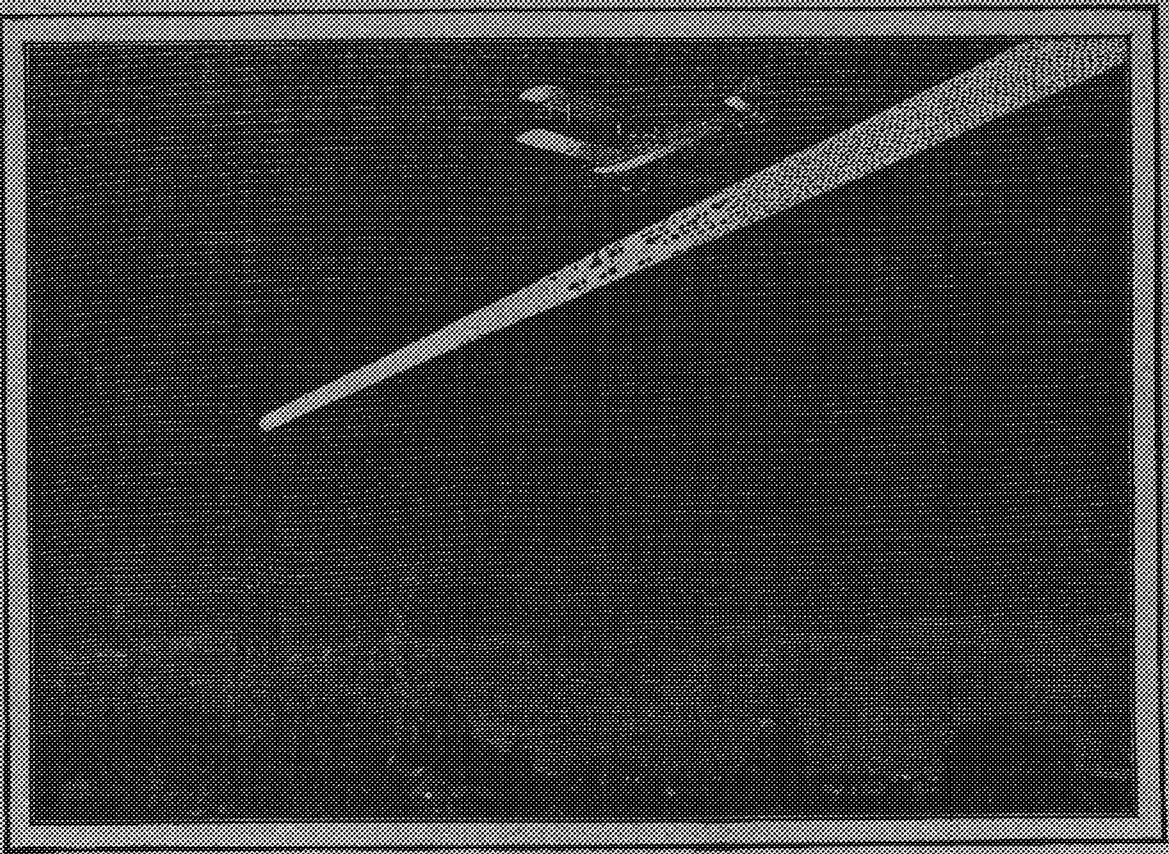
When the car sways, however, or when its course is sharply changed, a part of the weight of the car is thrown sidewise against the bearings in the wheels. This load is called "end thrust". It corresponds in effect to a diagonal attack upon a football line.

In actual operation, a wheel bearing must meet continuously both "radial load" and "end thrust"—must as it were, withstand attack through center, off tackle, or from the ends. Because of its *tapered* principle, a Timken Tapered Roller Bearing withstands, in one bearing, all these loads. It is upon this principle that the unquestioned leadership of Timken Bearings is founded—a leadership extending beyond the automotive field throughout industry generally.

The Timken Roller Bearing Company
CANTON, OHIO



TIMKEN
Tapered
ROLLER BEARINGS



Beacons of the sky

Between Cleveland and Rock Springs, Wyo., along the night route of the air mail service, tall beacons have been placed every twenty-five miles.

Revolving on great steel towers, General Electric searchlights, totaling 1,992,000,000 candle-power, blaze a path of light for the airplane pilot.

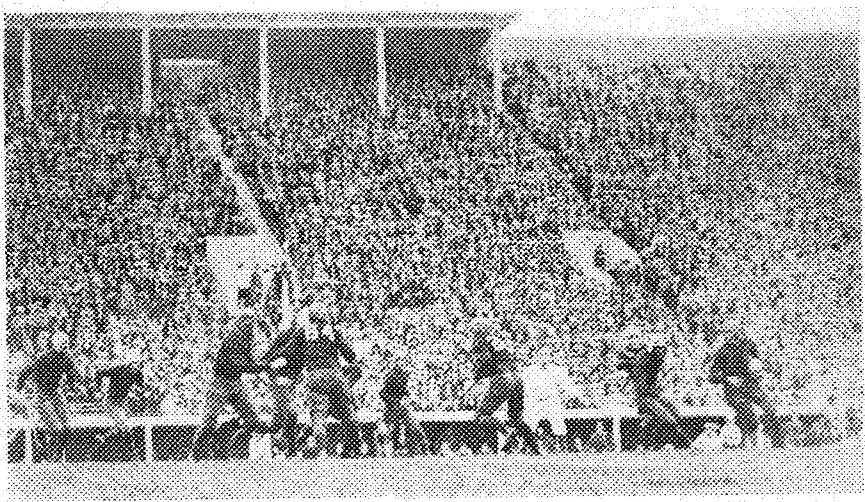
What the lighthouse is to the ocean navigator, these beacons are to the conquerors of the air.

This achievement has been made possible by engineers of the Illuminating Engineering Laboratories of the General Electric Company, working with officials of the Post Office Department. A startling achievement now will be a commonplace of life in the new America which you will inherit.

If you are interested to learn more about what electricity is doing, write for Reprint No. AR391 containing a complete set of these advertisements.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY SCHENECTADY, NEW YORK



THE FIRST GAME IN MINNESOTA'S MEMORIAL STADIUM

On October 4th, North Dakota held The Maroon and Gold to the lowest score in the history of gridiron contests between the two schools, 14 to 6.

The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

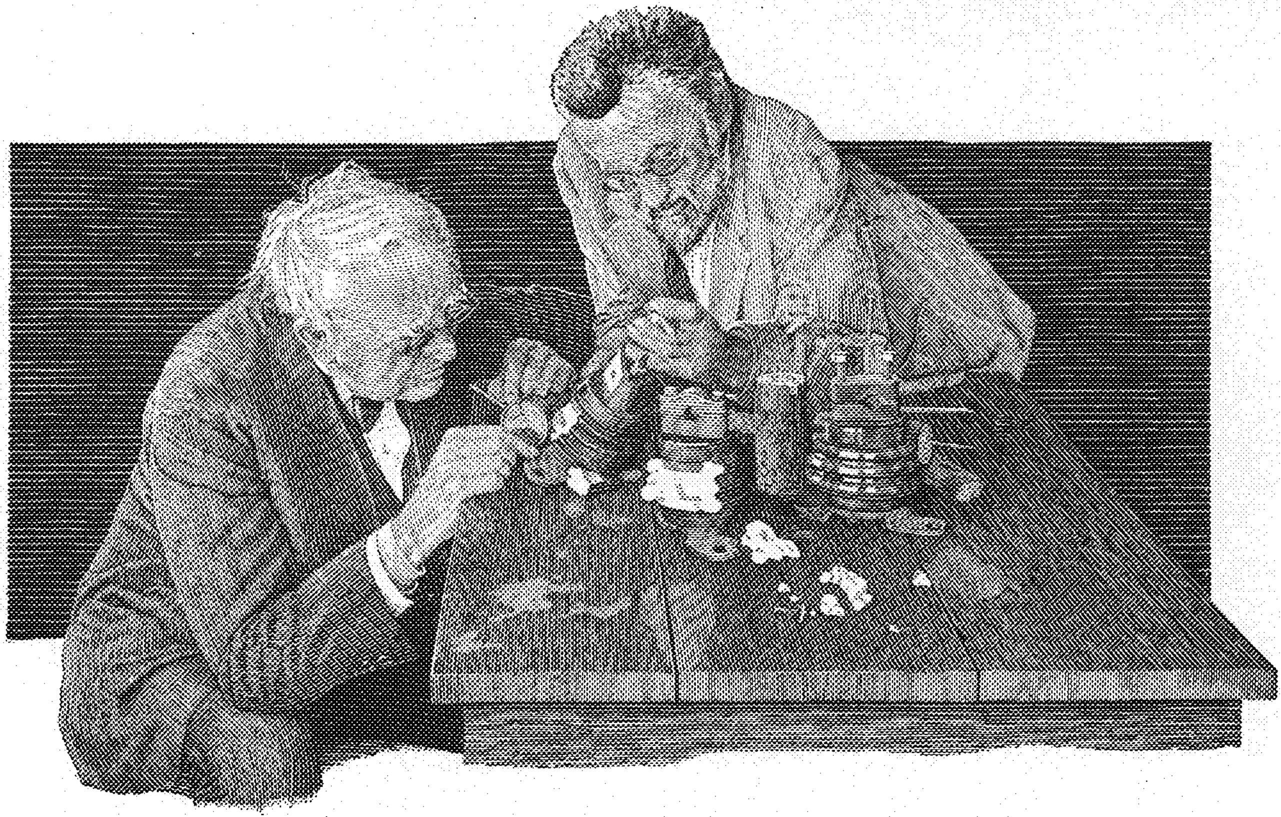
ALBERT W. MORSE, *Managing Editor* RICHARD W. JONES, *Business Manager*

VOLUME 5 NUMBER 2

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.



Thomas A. Edison and Charles P. Steinmetz in the Schenectady laboratories of the General Electric Company, where Dr. Steinmetz did his great work

Steinmetz

The spirit of Dr. Steinmetz kept his frail body alive. It clothed him with surpassing power; he tamed the lightning and discharged the first artificial thunderbolt.

Great honors came to him, yet he will be remembered not for what he received, but for what he gave. Humanity will share forever in the profit of his research. This is the reward of the scientist, this is enduring glory.

Emerson tells how the mass of men worry themselves into nameless graves, while now and then a great, unselfish soul forgets himself into immortality. One of the most inspiring influences in the life of a modern corporation is the selfless work of the scientists in the laboratories, which it provides for their research.

If you are interested to learn more about what electricity is doing, write for Reprint No. AR391 containing a complete set of these advertisements.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V | NOVEMBER, 1924 | Number 2

HISTORY OF ELECTRICAL DEPARTMENT

By George D. Shepardson

Head of Electrical Engineering Department

THE University of Minnesota "Catalogue for the year 1886-87 and Announcement for the year 1888" announced for the first time that the College of Mechanic Arts offered a course in electrical engineering. At that time, Cyrus Northrop, LL. D., was President of the University, William A. Pike, C. E., was "Professor of Engineering and in charge of Physics" and Director of the College of Mechanic Arts. Frederick S. Jones was "Instructor in Physics" and apparently de facto head of the new Department of Electrical Engineering. The student registration in the College of Mechanic Arts consisted of four juniors and fourteen "specials," the entire university then having 135 students of college grade, while sub-freshmen, "specials" and extension students raised the grand total to 546. In the spring of 1891, Mr. George D. Shepardson was called from Cornell University to become head of the department. Arriving in the summer of 1891, he taught for some time all of the courses in electrical engineering and also some sections in physics.

When the course in electrical engineering was first announced in 1887, the combined departments of physics and electrical engineering occupied five rooms on the first floor of the then new Mechanic Arts Building which had been erected in 1886 at a cost of $30,000.

In the summer of 1890, the new Physical and Chemical Laboratory Building (now the Minnesota Union) was completed at a cost of $107,148, and the combined departments of physics and electrical engineering occupied the east half, including 12,712 square feet, exclusive of halls and stairways. Five rooms in the building were assigned to the exclusive use of the electrical engineering department, and several other rooms were shared by the physics department.

The rapid growth in the number of students taking work in the departments of chemistry, physics and electrical engineering soon made the new building inadequate for the three departments, and in 1899 it was turned over to the chemists, the department of physics being housed temporarily in the north end of the then new armory, while the Physics building was being erected.

As early as 1892, preliminary plans were made for "U"-shaped engineering building to be built between the river and what is now the

GEORGE D. SHEPARDSON IN 1895

Publications building. This space being inadequate for the rapidly growing college, the site south of Pillsbury Hall and facing Church street was later assigned, and in 1899 the first unit was erected to house the shops of the mechanical engineering department. At this time the electrical department had been crowded out of its previous quarters in the building which was then being remodeled for the exclusive use of chemistry, and was scattered in four or five different buildings, a small room in the Armory serving as department office, the library being under the stairs in the main corridor of the Armory; classes were held in several buildings. Space that was intended for the blacksmith shop in the new shop building was temporarily designated for the electrical laboratory, three temporary galleries helping to supplement the inadequate floor space.

The Legislature of 1901 made an appropriation of $60,000 for building and equipment for the engineering college, this providing for small changes in the Mechanic Arts building, for adding class rooms and offices to the shop building, for the electric power plant, and for what was expected to be part of the electrical wing of the future Main Engineering building. In February, 1902, the electrical department began moving into the new Electrical building, which was 60 feet wide and 80 feet long, with two floors and partial basement, erected at a cost of $13,782.

By 1906, the growth of the college again made the quarters inadequate, and the crowded condition of the electrical laboratories was a large factor in securing from the Legislature of 1907 an appropriation of $250,000 to erect an engineering building and laboratory, it being expected that this would be used to complete the building of which the shop and part of the electrical laboratory units had already been constructed. However the same Legislature made an appropriation of $450,000 for extending the campus, thereby giving the University space required for building on the larger scale demanded by the rapidly increasing number of students. At this time, Dean Frederick S. Jones convinced the president and board of regents that "his college should not be in anybody's back yard" and the site for the Main Engineering building was then transferred to the New campus, thus abandoning the completion of the building which had been planned eight years before. The already congested condition in the electrical laboratory, which had been slightly relieved by excavating the basement and by adding a skylight, was a prominent feature in the argument for the appropriations for the Main Engineering building, but the funds could not adequately provide for the whole college, and the electrical department gave way, and waited, and waited.

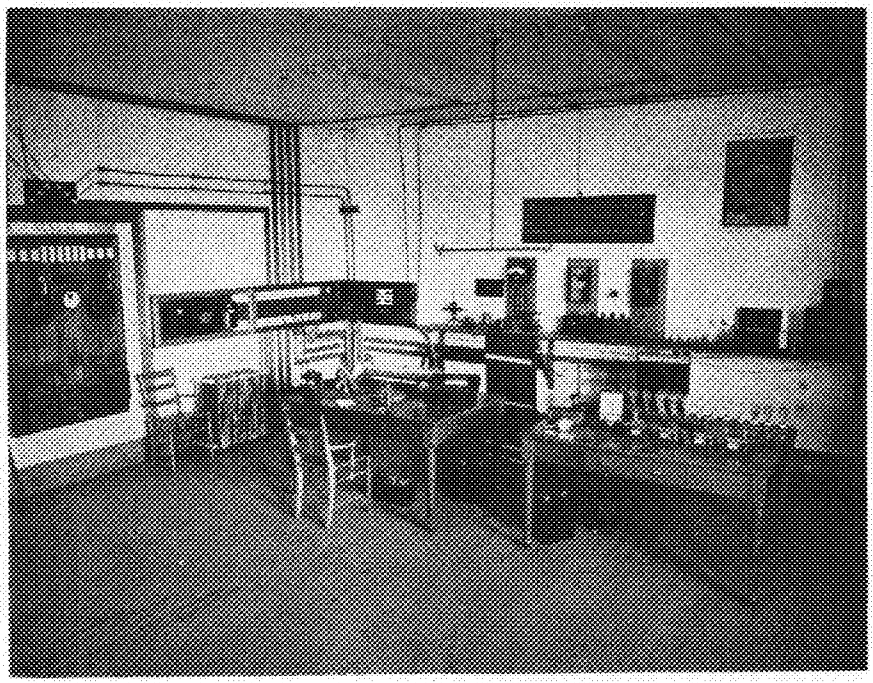
After many delays and much pleading, an appropriation of $375,000 was made in 1923 for the New Electrical building and its equipment. Ground was broken on Decoration Day, 1923, and the contractor turned over the building practically completed on May 8, 1924. Some classes were held in the building during the spring quarter of 1924, and all of the equipment was removed from the old building to the new during the summer.

The New Electrical building, which is directly north of the Main Engineering building, resembles the latter in general external finish, the walls being of red matt-faced brick trimmed with Bedford sandstone. It is 275 feet long, exclusive of outside steps, with width varying from 40 to 70 feet. There are four available floors, while the roof and two 90-foot towers are utilized for radio radiating and receiving antennae. The plans and construction are such that the building may later be extended northward to house the mechanical engineering department, the front then to correspond with the Main Engineering building.

The Electrical building consists essentially of an office and classroom portion facing Church street, and a laboratory portion extending toward Union street, the two being connected by a link designed both to detach noises and other vibrations and also to serve as a break to harmonize the somewhat ornamental Church street portion with the simpler laboratory portion. The electric machinery laboratory occupies the first and second floors of the laboratory portion, galleries on both sides providing facilities for computation and for lighter experimental work. The upper floor is devoted to communication laboratories. The lower floor houses the service machinery and battery, the shop, laboratories for introductory and for precise work, and a few research rooms.

Historical collections are being arranged to show the progress in various lines, such as lighting, communication, measuring equipment, dynamos and motors, batteries, wiring devices, heating and chemical effects, and lightning arresters.

Plans are being made for exhibit rooms. Various electrical products will be shown along with working exhibits illustrating how various results are obtained by the use of electricity. These will be so arranged that by pushing a button or by other simple action any visitor may put things in motion and see just how it is done. In one of the dark rooms will be installed exhibits showing right and wrong ways to apply light, and also showing various effects which may be produced by electric lights.



THE FIRST LABORATORY, 1893-1899, NOW LITTLE THEATER, MEN'S UNION

Lighting being one of the important uses of electricity, special attention has been given both to the general lighting of the building and also to certain special applications. Something like twenty-five different kinds of lighting equipment (luminaires) are used in as many different rooms to illustrate modern practice, while the illumination classroom has a number of distinct types of lighting controlled by separate circuits. Careful attention has been paid to details, such as lighting the blackboards, these being supplied with special luminaires and set on a small angle so that there is no glare from the windows.

The building is so constructed that almost any room may be used for various purposes, electric circuits being actually or potentially installed so that any room may be readily electrically connected with any other without any wires being exposed to view.

Close co-operation between the architect and the teaching staff has resulted in a building which is admirably adapted to its purposes and which is believed to make a distinct advance in electrical laboratory construction.

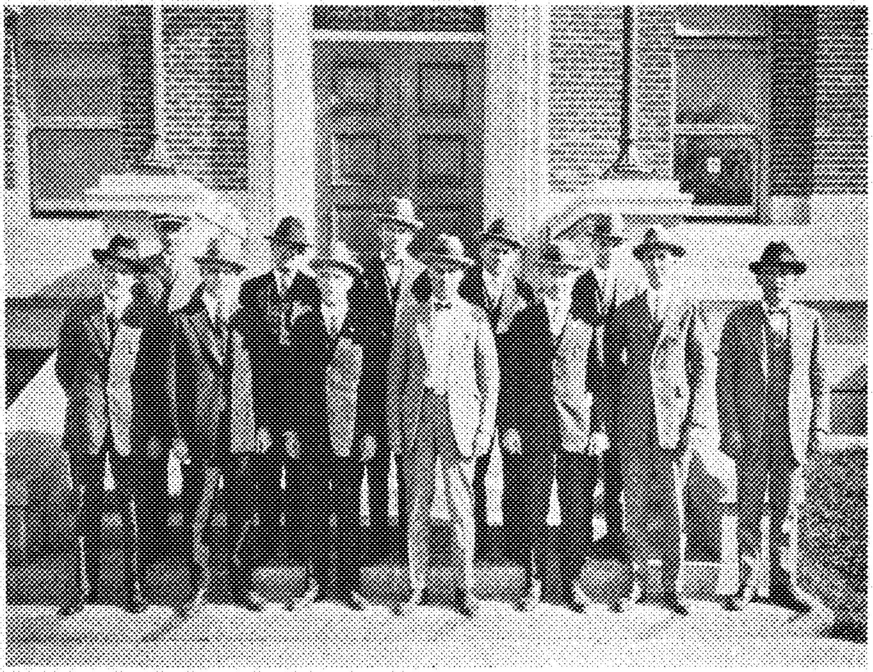
The University of Minnesota "Catalogue for the year 1887-88 and Announcement for the year 1888-89," making the first announcement of the establishment of a course in electrical engineering, stated on page 61.

"The University is supplied with a good and increasing collection of electrical test instruments, and has lately added a hundred-light dynamo, which, with its regulating apparatus and indicators is available for much practical work."

The next catalogue mentioned about 43 pieces of equipment for electrical engineering, a considerable portion of which were evidently used also by the physics department and of which three or four pieces remain in the electrical museum.

The catalogue for 1890-91 listed about 77 pieces of electrical equipment, most of it being quite as well suited for a physics laboratory as for electrical engineering.

The equipment has grown until the inventory now shows a total of 4,402 items valued at $76,340.27. These figures will be changed somewhat at the next inventory check, since a number of worn-out or otherwise obsolete articles were junked during the recent moving into the



THE PRESENT FACULTY. TOP ROW: L. J. SCHNELL, C. M. JANSKY JR. G. W. SWENSON, E. R. MARTIN, R. A. BRADEN. BOTTOM ROW: J. H. KUHLMAN, C. L. SAMPSON, G. D. SHEPARDSON, F. W. SPRINGER, W. T. RYAN, M. E. TODD, O. F. HEIDELBERGER

new building, and since new equipment is arriving.

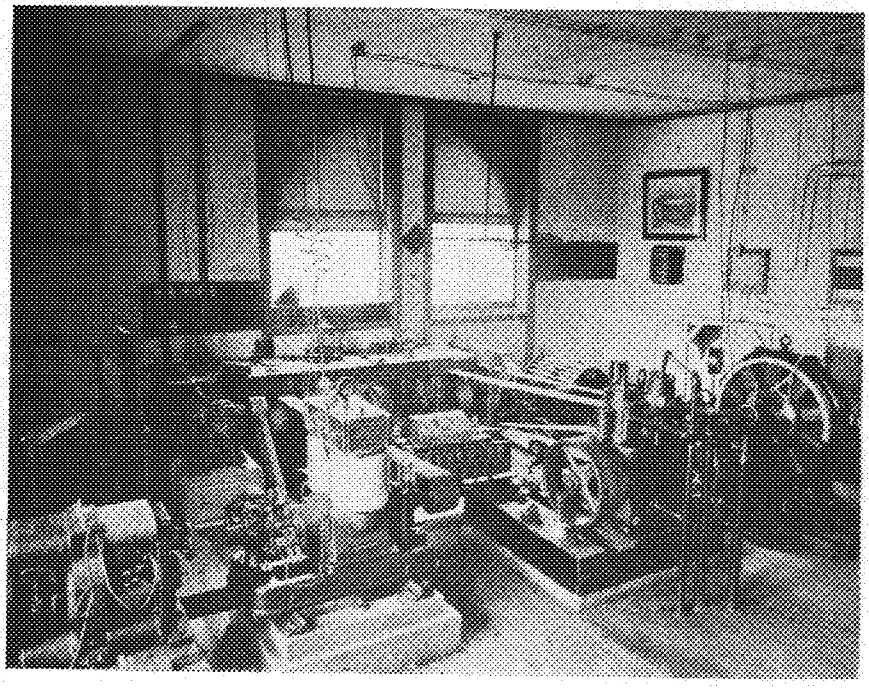
In addition to the more or less portable articles that are numbered and listed in the inventory of equipment, the teaching facilities should really include the $375,000 allotted for the new building, and its equipment, especially certain parts of the latter.

Besides the equipment usually installed in a modern building, such as heating plumbing, lighting, elevator, ventilation, furniture, window shades, etc., the Electrical building is provided with cranes for handling machinery, generating machinery, a storage battery for furnishing various kinds of electric power, switchboards for controlling and distributing the current, a comprehensive system of race-ways and circuits for electrically connecting various parts of the building, built-in work-benches, provisions for special lighting, radio towers, and a number of minor features that are really part of the building. These special features cost approximately $60,000, it being difficult to get exact figures because part of them were included in the architect's plans and were merged in the general contract for the building. A residue from the allotted $375,000 is being spent for new apparatus for teaching and research.

The laboratory equipment in a modern electrical building covers a wide range for various purposes. While the most conspicuous items are the various types of generators, motors and transformers, with their controlling, loading and measuring equipment, there are required standards for checking the instruments, a variety of equipment for demonstrating the laws which govern the flow of electricity in various kinds of circuits, and laws underlying the commercial applications of electricity. Special equipment is used in measuring light and its effects, several rooms being devoted to photometry and demonstrations of lighting. The field of electrical communication, whether by telegraph or telephone over wires, by radio, or by "wired wireless," is developing with almost incredible rapidity and calls for an almost unlimited amount and variety of equipment to keep within sight of achievements. As a single example, the startling developments in radio communication on short wave lengths using alternating currents at several million cycles per second, are challenging scientists and amateurs to strenuous activity to discover the phenomena and laws pertaining to this new field, one which seems to offer untold and even unimagined possibilities.

The present state of an art and its possible or probable future growth can best be understood by giving attention to the steps by which the present state has been reached. Therefore an important part of a scientific or engineering laboratory is its historical museum, showing the previous states of the art, some of the successful steps in development, and some of the causes for past failures. Minnesota has the beginning of a museum showing the development of electrical generators and motors and their controlling devices, wires and wiring supplies, lightning arresters, lighting devices and means of communication. With the better housing facilities now available, it is expected that both the historical mus-

(*Continued on page 28*)



LABORATORY, 1892-1899, MACHINERY DRIVEN BY WESTINGHOUSE ENGINE

CIVIL CAMP—A SUMMER ON CASS LAKE

By Harold C. E. Peterson
Member of the Senior Civil Class

THREE years of intense preparation; six weeks of magnificent anticipation; two hundred and forty odd miles of sleepless transportation; a curve in the road; and sight of sights, the few, the all too few, thousands of magnificent Norways, sole survivors in that region, of the woodsmen's axes, hove into view. Summer camp became a reality.

Plenty of work was waiting for us. Tents had to be pitched; floors had to be laid, or, for those of us who were so fortunate as to find the remains of one of last year's tent floors, repaired. Tables, shelf-stands, stools, and other supposed conveniences had to be contrived. (I say contrived, because it took all the ingenuity that any embryo engineer is ever supposed to possess to manage to filch the necessary materials from under the watchful eyes of camp mates and instructors). Instruments, drawing tables, lanterns, outboard motors, oars, and all the other appurtenances of a well regulated, thoroughly modern, surveying and railroad location camp had to be uncrated and stored in their proper places. The whole camp site had to be policed and completely cleared of all rubbish and relics left by thoughtless tourists who had occupied the spot during the previous nine or ten summers. Having been one of the camp policemen, the writer is in a position to know that it would take at least nine years to duplicate the pile of tin cans he buried "'neath the whisp'ring pines." And an up-to-date garbage disposal plant, more or less complete in several details, had to be constructed for the convenience of the cook and the consideration due our noses. Outside of this we had nothing to do except chop wood, fix the pump, build a dock, paint a boat, and eat. Thus endeth the first day.

Next morning—BANG!! BIF!! and a couple more BANGS!! Hartmann hollered "Bears!" Ward jumped for his gun! Bill Brose climbed under his cot, and Beese slumbered peacefully on. But it was only the cook's assistant giving the first call for breakfast. So we shivered into our clothes, looked at our watches, and then wanted to crawl back into bed until morning. It was 5:45. DEE-licious! I always thought that there was something wrong with the fellow who said, or rather sang, "It's nice to get up in the morning when the sun begins to shine." Now I *know* there was. But the first six weeks were really the only ones that were hard. After that we were used to it. Anyway, roll-call was at six, after which we were free to eat breakfast. Many were the arguments occasioned by this "before breakfast roll" in quest of a solution of the why and wherefore of it. The latest, and perhaps the best, was that it allowed the fellows to go to work immediately after breakfast, rather than forcing them to wait around for roll-call. Of course, this wasn't a logical solution, but it was an ambitious one.

After our first breakfast together, the serious work of camp began. Parties were formed, in most cases according to tents, and sent out to locate bench marks, established or re-establish triangulation points, and determine the positions of bases by triangulation points. At the same time one party was sent out to investigate the idiosyncrasies of an Invar tape by trying to measure a base line for a triangulation system. For the benefit of those who have not as yet been initiated into the mysteries surrounding an Invar tape, I might here explain that it has a very low coefficient of expansion, is very susceptible to kinking; has very faint and fine markings every five meters throughout its length and every tenth meter for a meter's length at one end, requires a constant measured pull of fifteen kilograms during use, and must be multiplied by constants determined by the U. S. Bureau of Weights and Measures. In spite of all these precautions, some very accurate results were obtained by the different parties during the summer.

The 1924 Civil Camp was novel in that it introduced into camp life the refining influence of feminine membership. It was with some trepidation that we awaited the arrival of the Misses Quinn and Knudsen, accompanied by Mrs. Quinn, for we did not know just what effect their presence might have upon camp life in general. But any fears we might have had were quickly dispelled, because the girls proved themselves to be mighty good sports, shirking no duties, and performing their work with an accuracy and speed which made many of the rest of us feel like freshmen S. L. A.'s.

Memory fails me when it comes to trying to remember just when it was that our party was first introduced to the basket lunch, but whenever it was soon enough. For

Have you ever been so hungry
That you felt like eating grass;
When a soup bone'd taste like porter-
house to you?
If you have, you'll know the feeling—
That delicious, luscious feeling—
That our gang had when the noon-
time whistle blew.

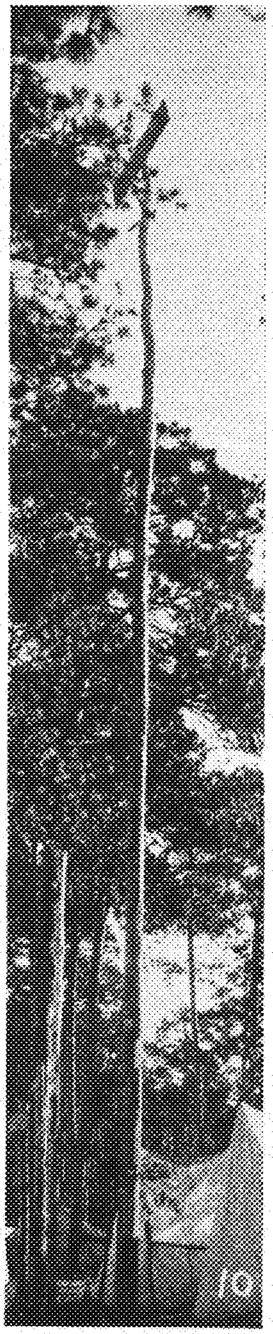
Oh! those lunches that we carried
In a basket on our arm—
As we toiled and progressed onward—
And protected from all harm.
What sensations they have brought us,
With what agonies they've wrought us,
As we've spied their meagre contents
And thrust in an eager palm.

Two sandwiches were there—
One a cheese and one a honey—
With a pickle, orange, doughnut, or
a pear.
And when we had had our fill—
(Laugh it off—there was room still)—
We would hie ourselves to town and
get a "square."

This was all right when we were close enough to town to run in during the noon hour, but it often happened that the noon hour would find us far out on the lake, perhaps on the north shore, sometimes on Star Island, and once in a while near Cuba. Then we would appreciate the appetite that Nature gave us in return for working and sleeping in the open air, and realizing that to waste food was a crime, we'd fight for the crumbs. Garvin Peterson often remarked, "Slip them to me, too, Rastus, them's good."

There are said to be only two ways of really getting acquainted with a man. One of these ways is forbidden us by the Eighteenth Amendment. The other way is to live with a man and work with him. This is the outstanding feature of the Civil Engineering camp. It fosters a spirit of brotherhood among the members of the class that it will take years to dispel. It gives the individual members a chance to absorb one another's ideas and ideals, to realize one another's ambitions and hopes, and to overlook each other's shortcomings and remember his better features. In short, summer camp, outside of all its practical features, is an education in the human side of life. We came to really know our instructors, not as professors and teachers, but as men. And that feature of camp, in itself, was worth the time and expense involved in getting to camp, and in staying there for the all-too-short six weeks.

One of the days, in particular, when we came closer, perhaps, than ever before to Professor Zelner, was the day we measured the flow of the Mississippi River just below the outlet from Cass Lake. In the morning we had rated the meter at the box factory in Cass Lake, while Professor Zelner unloaded logs from a flat-car (just for exercise) after instructing us in the methods to be used in our work. These methods consisted, simply enough, of attaching the meter to a stick and dragging it through currentless water at measured rates of speed and noting the revolutions of the blade. We were through just in time to arrive at the Mississippi River at noon, carrying our basket lunch and ingredients for making coffee. It was during this lunch hour that we came to know Professor Zelner better, for he talked with us (not to us, as is the general custom of instructors) on various and sundry topics mainly bearing on our attitude towards camp life. Professor Zelner's dog, Scotty, was an interested and interesting member of the party, chiefly through its antics with a crawfish. In the afternoon we continued our stream measurements, measuring the depth at ten foot intervals across the stream, measuring the velocity of the water between these points, and then computing the flow in cubic feet per second.



THE CLASS SYMBOL

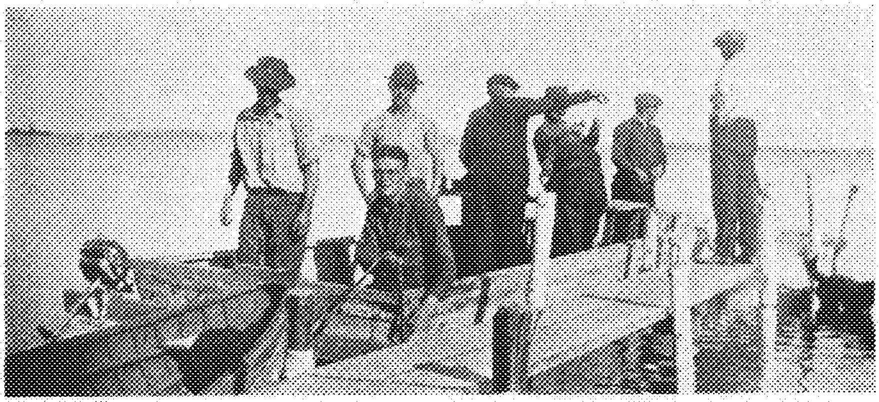
Another interesting feature was sounding the lake for depth. A party of eleven men would mount the good ship "Catamarand" (nicknamed "Cataram" by friend Eder B. Youngquist), which was a flat-bottomed barge resembling nothing so much as an oversized mortar box, fitted up with a table for drawing in the location of the points sounded, and run by a Johnson outboard motor. It was surprising how fast such a little motor could propel that barge around the lake. Two men alternated with the sounding rope, two read the sextants which located the position of the soundings by means of angles between signals located on land, one timed the readings, another ran the motor, three men plotted the readings with a three arm protractor and took notes, one man determined the course to be followed, and the eleventh man was the admiral. Readings were taken every minute and soundings every half minute. Contour lines were drawn in after returning to camp. The surprising thing about it all was how fast Cass Lake drops once it got started. Perhaps a hundred readings would be taken between three and four feet in depth, when without warning the next half minute sounding would require seventy-five or eighty feet of the rope to reach bottom. It was at the edge of these drop-offs where the big fish lay in wait for the little fish, and where the fishermen of the camp caught the big fish, or at least got their material for the stories of the fish that got away.

Reams of paper could be used up in writing of all the work that was covered in camp; of the cross-overs between the Soo Line and the Great Northern tracks; of the map that was made of the Great Northern Yards in Cass Lake with its almost innumerable frogs, turnouts, switchstands, and whatnots, each of which had to be located, and in the case of the frogs, measured to obtain the correct frog number. Pages might be written of the sorrows of leveling. More pages might be consumed in telling of the traverses which never seemed to close; of the hand-leveling which had to be rerun because the leveling party which preceeded it didn't come within ten feet of closing; and of the railroad location which included every phase of the work. But time forbids.

Yet the "shooting" of Polaris cannot be skipped over so lightly, for it was really remarkable how every night after five when parties had solemnly sworn that they had hit it the night before, the same smiling face of the North Star would again be seen. Even after every member of the class had had his chance, Polaris still shined brightly on. But the primary object of the attempted murder was attained, namely, the determination of the azimuth of a line between two triangulation stations. So Professor Cutler was satisfied, and future Civil camps can still take their shots at that star, and ease their consciences by reflecting that no one has reached it yet.

We have now reached the night life at camp, the time when many of the computations were made, though not nearly all of them, for it was necessary to spend many days in the office tent, also. It was at this time of the day when many of our consultations with the instructors were held, when the notes of the day were copied, and the day's reports turned in. And what an imposing stack of records quickly began to accumulate. No wonder Mr. Boone was kept checking and re-checking, copying and entering, sweating and swearing.

There was another side to the night life of camp, however, and it was in the subjects offered at this time that most of the "A's" of camp were received, or at least earned.



STARTING OUT IN THE CATAMARAND FOR SOUNDINGS

For some of the fellows put in a good deal of time on the subjects offered, subjects such as bridge, dancing at Wilton, and visits with girls at Bemidji. Most every night the cry was "Bemidji or bust" (sometimes changed to "Bemidji to bust") and nary a Saturday night passed but what roll was called at Wilton. It is even rumored that three of the boys, after all hope of obtaining a ride from camp had been abandoned, started for Wilton on foot and succeeded in arriving there. After spending what was said to have been an exceedingly pleasant evening dancing and conversing with the "Belles of Bemidji," they are said to have promoted a ride as far as Bemidji, where they were forced to spend the night. Further investigation disclosed the fact that these three inveterate dance hounds missed the morning bus and were forced to choose between waiting for the 1:50 A. M. train with a three mile walk to camp awaiting them, or starting out to walk the twenty miles to camp with the hope of doing some more promoting. How much truth there is in the story that they chose the latter course, and were successful in their pleas to a Bemidji lass who owned a car may never be known. However, be that as it may, they rode into camp escorted by three damsels one Sunday afternoon.

Two or three of the boys at camp raised beards. Needless to say—their time was spent before a mirror. But all prizes, including the silver plated razor strop, were "copped off" by John Ward, for he alone stuck it out and raised a beauty.

Other fellows spent their evenings and Sundays fishing, hazlenutting, or touring the country. Some of the latter went as far as International Falls, crossing into Canada, and coming back several days late with a story of throwing a piston through their engine head (one more Ford story, though this one possesses the element of truth, as any one who has ever had anything to do with a Ford can verify). Ask MacAndrews.

The last week of camp was a busy one. Work had to be cleaned up. The totem pole had to be carved and erected, and it stands now as a symbol of our class, above them all. Last year's class said it couldn't be done, but we did it, for our pole towers almost three times as high as theirs does. We will make no such rash statement, but the 1926 class has got something ahead of them.

And so the summer passed, each day different from the preceding, each filled to the brim with things destined to leave us wiser in the lore of surveying, wiser in the lessons to be learned from Nature, and far wiser in those things gained only by constant contact and association with our fellowmen, a summer, all too short, and perhaps never, for us, to come again. So sorrowfully, sadly, we bid the whispering Norways, silent sentinels of the camp ground, "Good-bye, though not, we hope, forever."

NESTLING AMONG THE MIGHTY NORWEGIAN PINES

"VIVE LA BAND"— A LOYAL ORGANIZATION

By Paul B. Nelson

"WE want music! we want music! we want music!" chanted the crowd as they surged down University avenue the night of the pep-fest. Suddenly a whistle was blown and at the next beat, "Cheer, cheer, the gang's all here" resounded through the night air. The crowd, quickening its step, caught up the tune. Again the foot-ball season had come to Minnesota.

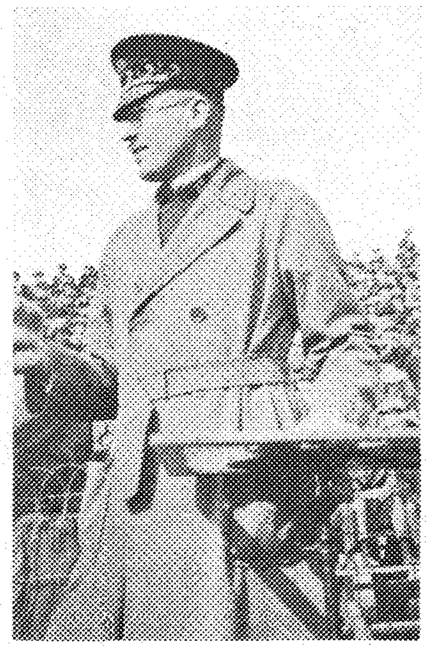
The University of Minnesota band back in 1919 was a small group composed of only thirty-five men; it was without uniforms or leadership, and lacked almost entirely any form of organization. At this time, however, a new man assumed control. Under the guidance of Michael M. Jalma, the band quickly took a more definite shape, and its subsequent growth has been very rapid. Its membership today is the largest in its history, averaging one hundred men a year.

The band is composed in reality of two separate and distinctly different groups, the concert and military division which number forty and sixty members, respectively. The military band is made up of those who have drill requirements to fulfill, and it is a branch of the R. O. T. C. In the concert band are men of advanced standing who have no military requirements. The scope of work differs very much, the concert division undertaking work of a more difficult character.

One reason for the band's development is the democratic principles upon which it is controlled. Each member has a vote in electing the officers, and these officers, in conjunction with the leader, who in turn co-operates with other faculty advisors, compose the governing staff. Each year an incentive is offered in the form of scholarships for which the advanced members and first-chair men are eligible. There are thirty-five of these paying a stipend of $35 yearly, and ten paying $15, making is possible for an exceptional member to receive as high as $50 annually in scholarships.

Gold honorary keys are awarded graduating members who have been with the band at least four years of their college course, and aside from the honor, the keys serve as a means of identification between fellow bandsmen. An alumni organization is being formed, and a reunion is to be staged on Homecoming day.

Very extensive plans are being perfected for the band's program this coming season. A tour of Northern Minnesota will take place during Christmas vacation, and the men will no doubt again appear at Twin City theatres as a concert attraction next spring. Concerts at other schools of the Big Ten are to be arranged. It is needless to mention the band's various campus activities. Imagine a football game or a parade with the band missing!



MICHAEL M. JALMA

Another innovation will be the establishment of a course in band directing. This will be a course in the School of Music and part of the regular curriculum. Several alumni band members have chosen this as their profession, and this occupation usually is a remunerative one.

The twilight concerts which have been given during spring quarters from the library steps are an enjoyable feature. The band is, however, hampered by the lack of a proper place in which to perform, resulting in only a comparatively few being able to hear to advantage. Plans are on foot at the present time for the erection of a band stand or "band shell" as it is properly called. This shell is to be built with its back in the shape of a parabolic reflector, enabling the sound to carry great distances. This could also be used for numerous other campus activities, such as the ceremonies of St. Patrick's day.

A band is ineffective without a competent leader. He must be a quick thinker and a strategist, besides possessing rare musical ability. We find all these qualities in Michael M. Jalma. "Mike" is one of the "old boys" who played with the band when they were students at Minnesota. He is the leader of the famous 151st Field Artillery band which won distinction both at home and abroad, and his bands have often played in conjunction with the Minneapolis Symphony Orchestra. Mr. Jalma's close cooperation with the members themselves is note-worthy.

Before concluding, we must not forget to mention an interesting important fact. Practically one half of the band's roll is composed of men from the technical colleges, including Dean Affleck, John Banovetz, Walter Barker, Albert Becker, Walter Dunke, Rudolph Eklund, John Geis, Paul Havens, James Holst, Bertram Hovey, Roy Irons, Theophil Jerabek, Clarence Johnson, Euan Johnson, Paul Jones, Ole Kristofferson, Joe Lushene, James McCully, Paul Nelson, James Redding, Barret Rogers, Michael Strecker, Niles Thompson, Clarence Thyberg.

An engineer is a man who has as his aim the better things in life, no matter how hard he must labor. It is therefore not peculiar that so great a number of engineers have ability along musical lines. An interest in music and things musical will prove to be a pleasing hobby and will tend to improve tastes and conversations.

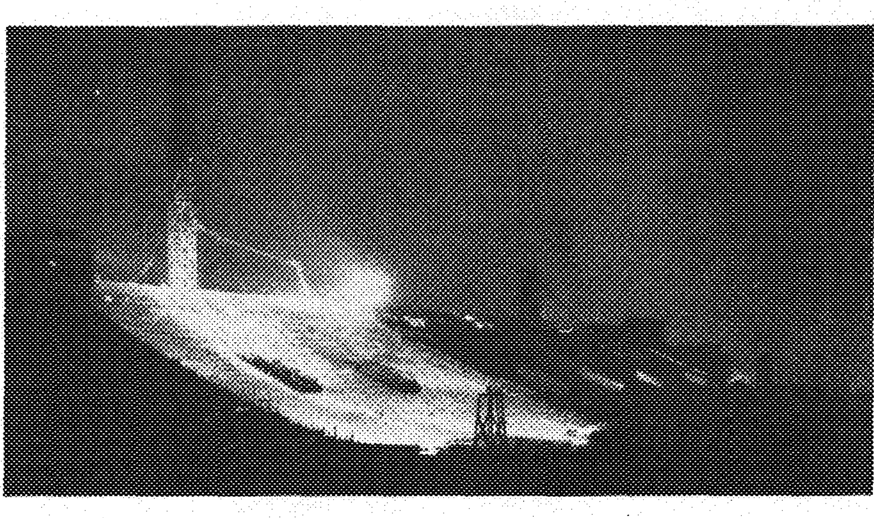
In its rapid rise to the front, the University of Minnesota band has assumed a part which is integral with the welfare of the school at large. It is a loyal rooter, always on the job, never asking recompense, but always there to do its "stuff" because it loves Minnesota. "Vive la Band!"

HOW MINNESOTA'S STADIUM WAS PLANNED

By James H. Forsythe
College of Engineering and Architecture

A STADIUM has for its principle purpose the provision of seats to which a small or a large number of spectators may find ready access and egress under absolute control, and from which each individual may secure the best possible view of the action taking place in the area enclosed by the seats. While there may be other purposes for the structure, these must be secondary to the primary purpose, and any arrangement for these purposes must be made after the primary problem has been solved. When, therefore, the Greater Minnesota Corporation decided to proceed with the building of the Memorial Stadium, it had to choose a site, fix the seating capacity and determine the general form of the structure before the architects and engineers could proceed with the design. The site, after consideration of various other possible ones, was chosen because of its accessibility to the University community, which could make many secondary uses of the structure, and on account of its convenient location with regard to the two cities. The seating capacity, 50,800, was fixed by the size of the site, the funds available for building and the very definite limitation imposed by the street access to the structure with the corresponding problem of automobile and street-car traffic.

The U-shaped plan, instead of the horseshoe, or the bowl plan, was selected partly because of the relation of the building to the straight lines of University Avenue, but principally because the Athletic Department very wisely wished to use the Stadium for track contests, as well as football, and consequently the 220-yard straight-away required an open end. This shape will also allow for future expansion. With these three limiting conditions decided, the design was developed in the office of Frederick M. Mann, Architect, by Mr. F. M. Mann, Mr. Roy C. Jones, Mr. Leon Arnal and Mr. J. H. Forsythe, four members of the teaching staff of the Department of Architecture of the University. They collaborated closely with the Osborne Engineering Company of Cleveland, who had been selected by the Corporation as engineers for the work. Before developing the design, visits were made to the stadia at Harvard, Yale, Princeton, Ohio, Illinois, Pennsylvania and Chicago, and observations made at those universities were of great assistance in solving the problem at Minnesota.



RUSHING THE EARLY CONSTRUCTION WITH THE AID OF FLOOD LIGHTS

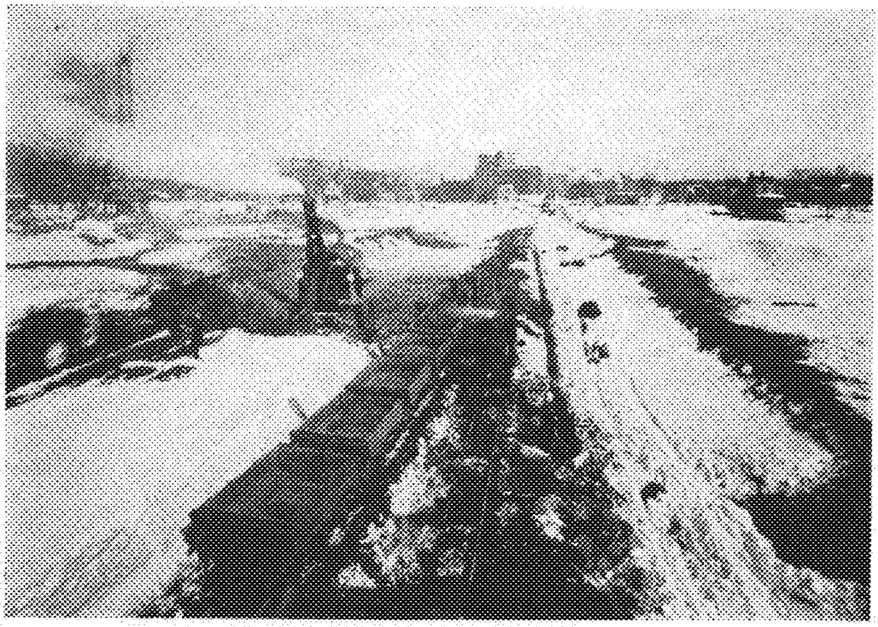
Circulation to and from the seats were considered first. There are necessary in a stadium, three public lines of circulation, two horizontal and one vertical, and minor independent lines to serve the team quarters.

One horizontal line must be outside of the line on which tickets are taken. The public sidewalks and streets serve in this instance, and the building was located at a minimum of 35 feet from the street curb lines to avoid congestion of foot traffic. One horizontal line must be within the stadium walls; in this instance it consists of a concourse 20 feet wide. The third line is a vertical one connecting the concourse directly with the seats. Spectators going to their seats must be divided into separate groups or sections on the seat bank and should reach a point well up on the bank so that the distribution above and below the portal opening in the bank should be nearly equal.

Since stairways or even complicated ramps are very unsatisfactory for circulation, it was decided to sink the field level about seven feet below the surrounding street and concourse level, in order to bring the portals as high up on the seat bank as possible. From the inner line of the concourse concrete ramps which have a rise of about one foot in seven pass through the seat bank at portals sixteen feet four inches above the field level. These portals are connected on the stand horizontally by an aisle or promenade three feet six inches wide. Adjacent to each portal is one vertical aisle three feet wide. The number of sections and portals was determined by an actual study of conditions in other stadia and theatres. From data thus collected it was decided that the stands could be completely emptied in eight minutes by 30 five-foot portals, each serving a section of from 1,500 to 1,800 seats.

Sixty-two rows of seats were required to secure the required seating capacity. The promenade is on the twenty-fourth seat level.

The next problem was that of ticket taking and the control of the spectators between the outer and inner lines of the horizontal circulation. As far as the regular spacing of units would permit, the street wall of the stadium was pierced opposite the ramps by arched openings eight feet in width. The dif-



A MONTH AFTER THE CONTRACT WAS LET — SNOW ON APRIL 5

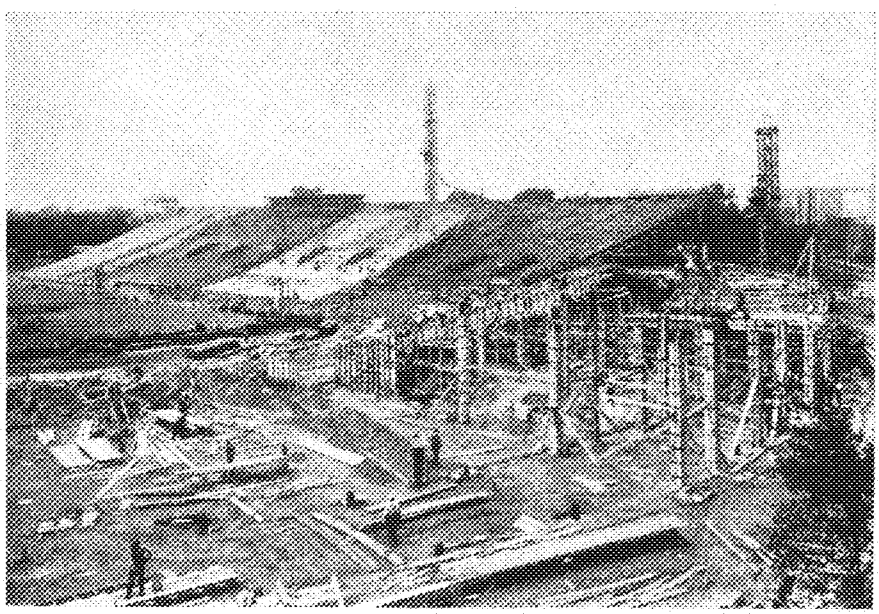
ference in diameter between the outer wall and the inner line of portals on the curved end made necessary the use of 36 openings in the outer wall as against 30 portal openings. This difference in number, however, is very advantageous in emptying the concourse quickly. The tickets are taken by two ticket takers who stand back to back at removable railings in the center of each opening. These railings are set in metal sleeves flush with the concrete sills at each opening. Since the openings are closed by sliding doors, the railings can be set up completely before the doors are opened and can be removed after the game is started and placed at the side of the openings so as to clear the doorways for exit. This is a new feature in stadium design.

Direct access from the concourse to the level of the field is provided by a processional entrance thirteen and a half feet in width on the major axis of the field with a wide opening in the outer wall on Oak St. This entrance can be used for a marching column, for pageants or for any other purpose where it is undesirable to go first to the stands and then to the field.

To give the best possible view of the field to each spectator, it is necessary that the vertical section of the stands be a curved one. The curve was determined theoretically by assuming a definite point at the corner of the playing field, a definite distance between the seats, a definite vertical rise for each seat and a point on the stand. From these assumptions, a parabolic curve was developed, which for purposes of simplicity in construction was reduced eight chords by a compromise cut-and-try method. The lowest seat rise was made six inches, and the highest seat rise thirteen inches. The distance back to back of seats was put at 26 inches, which is neither the minimum nor the maximum in other structures. Each spectator now occupies a space twenty-six by eighteen inches. The actual seats are made of three strips of redwood one and five eighths by three inches with chamfered edges. The strips are set one-eighth of an inch apart and are fastened to redwood blocks of bracket type by bronze screws. The blocks in turn are fastened to the concrete seat deck by bolts screwed into metal inserts placed in the concrete while it was being poured. The method of fastening these blocks to the concrete obviates the difficulties which have been found in other stadia where attempts were made to insert bolts in the concrete while it was being placed or to fasten metal brackets to the concrete after it had set, with resulting difficulty in bringing seats and supports into line.

The team quarters are located at the west end of the stands, and are more complete in their appointments than any which were seen at other stadia.

The home team at the west end of the north stand has a locker room twenty-eight by eighty-two feet, a shower room twenty-eight and a half by twenty feet, a toilet room twelve by seventeen, a training room twenty-one by twenty-seven feet, an equipment room twenty by thirty-six feet, a coaches room seventeen by twenty and one half feet, and an office twenty-one by twenty-five feet. These units, with the exception of the office and the coaches room, are all located on the field level, and communicate directly with it through doors in the west wall of the stand. From the locker room, access is had by means of a tunnel under the stands to a dugout opposite the 50-yd. line of the playing field. This dugout, a unique feature, gives shelter and protection to players who otherwise would be forced to sit on the side lines on the ground or on low benches. In the south stand there is a similar ar-



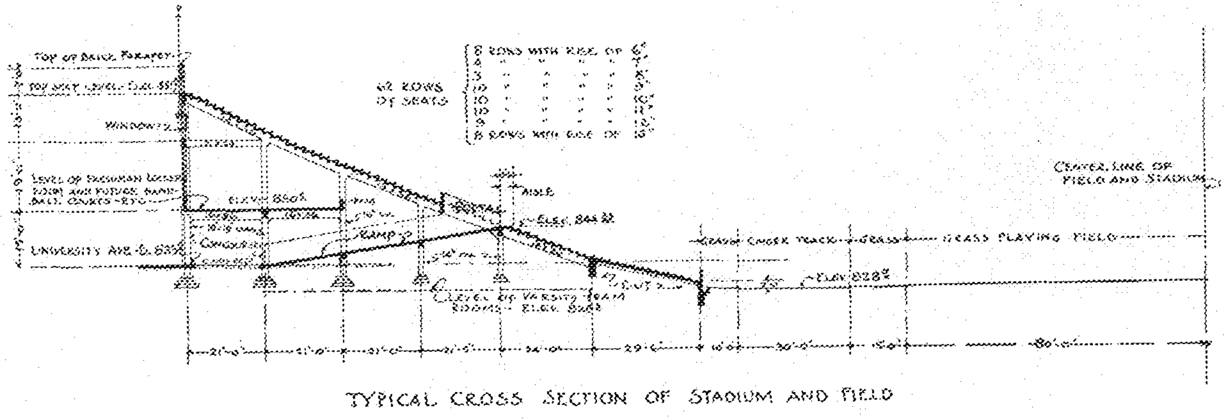
SHOWING THE WORK IN DIFFERENT STAGES ON JUNE 1 rangement of locker rooms, though smaller in size—the main locker room being but thirty-one by forty-six feet, and the shower room twenty-one by nineteen feet, with minor rooms for offices, supplies and toilets. Over the concourse at the west ends of both the north and south stands are groups of rooms for the use of either the freshmen or visiting teams or track athletes. Each group consists of a lecture room thirty-two feet square, a locker room thirty-two by one-hundred-and-five feet, a toilet room seventeen by thirty-two feet, and a shower room twenty-two by thirty-two feet. A nine-foot connecting corridor is reached by a stairway located in the tower at the end of the stands. It was felt that the location of the stadium so close to the main campus would make advisable arrangements for the use of the space under the stands for various athletic and training purposes in addition to those having to do with varsity football and track, but attempts to use this space in other stadia were not completely successful because of the division of the space into unsatisfactory units by the circulation ramps and stairways to the stands. The resulting areas were small, isolated, hard to heat, and hard to control. In the Minnesota stadium, no attempt has been made to use the space on the level with the concourse and the ramps, except that the floor of the concourse has been made of cinders and will be used as an indoor running track. The rest of the area is closed off by tile walls six feet high that follow the inside line of the concourse and enclose the ramps. However, constructional girders have been located 15 feet above the concourse level and on these can be built a concrete slab forty to fifty feet wide the entire length of the stands—which is over 1,500 feet. (See cross section.) About 200 linear feet or 800 sq. ft. of this slab have already been built at the west ends of both north and south stands for the freshmen locker rooms. When this slab is completed the athletic association will have from 50,000 to 60,000 sq. ft. of floor area, well lighted, easily heated and to which access can be had only from the stairways in the towers at the ends of the stands. The small windows high up in the outer wall will furnish ample light and ventilation for the area, and the clear width is such that the area can be subdivided into hand ball courts, squash courts, raquet courts, or gymnasia. This feature is an innovation in stadium design.

After all the various conditions bearing on the general problem had been formulated and the dimensions of the areas necessary to meet the conditions determined, consideration was given to the constructional system that would support the seat deck, the outer walls, etc. Note particularly that the constructional system was not developed until after all the problems had been carefully studied and tentatively solved. After careful study of the advantages and disadvantages of steel frame and concrete, the engineers and architects decided that the construction should be of reinforced concrete throughout, and that brick and stone work of the same kind as that used on the newer University buildings should be used on all the exposed portions of the stand except the actual seat deck. A column spacing of approximately 21 feet in each direction was found to be the most practical and the structure in general is carried on reinforced concrete columns fourteen to eighteen inches square resting on mass footings from six to seven feet square. These columns in turn carry girders three feet in depth. The risers of the seat deck are reinforced and act as beams carried by the girders. The technichal description of the reinforcing would be too involved to be of interest in this article.

Fifty of the seat rows are carried on this framed reinforced concrete construction. The other 12 rows, those closest to the field, rest directly on the ground and are made of concrete, reinforced by wire mesh and light rods. The ground on which these 12 rows rest is not filled ground but the edge of the original cut made when the field was excavated seven feet below the surrounding street level. Ten expansion joints of the sliding type are carried vertically through the stands. There are two horizontal joints—one at the horizontal aisle on the portal line, the other between the concrete frame and the seats that rest directly on the ground. The brick walls are carried by the concrete frame.

The concrete used throughout varies in the proportions of mix, although in general it approximates 1, 2, 4. The variation is due to the fact that the concrete specification described very accurately the grading of the aggregates and the proportion of water to cement. When the aggregates did not contain the

(Continued on page 32)



TYPICAL CROSS SECTION OF STADIUM AND FIELD

AUDIO-FREQUENCY AMPLIFICATION

By Kenefick Robertson*
Electrical Editor of the Techno-Log

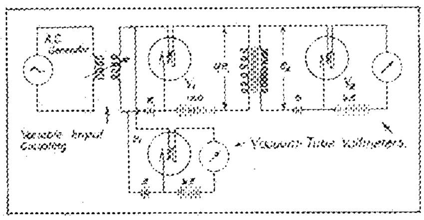
THE VOLTAGE amplification produced by a vacuum-tube amplifier is the ratio of the output voltage to the input voltage. This is the ratio of e_2 to e_1 shown fig. 1. The voltage amplification can be expressed by the equation A equals e_2 divided by e_1. In order to obtain the amplification then the problem resolves itself into one of measuring the input and output voltages to a fair degree of accuracy. This is difficult because the voltages are small, and only feeble currents can be drawn without affecting the condition of the test to a point of uselessness.

The amplification of a transformer-coupled amplifier may be expressed as the product of the amplification factor of the vacuum tube and the voltage transformation ratio of the coupling or amplifying transformer. This can be expressed as equal to the product of mu and k where mu is the amplification of the tube and k the transformation ratio of the transformer. The factor mu is practically the same for all adjustments of plate and grid battery voltages on a given tube. It does not change with the frequency of the alternating voltage. Most tubes used with coupling transformers have amplification factors lying between 5 and 8.

In contrast to the constantness of the amplification factor, the voltage transformation ratio of the coupling transformer varies with the vacuum tube, with the type of tube, and with the frequency of the impressed voltage.

From the fact that the amplification and the voltage transformation ratio bear a constant relation to each other, it follows that the most important characteristics of an amplifier, the amount of amplification and the uniformity at different frequencies can be expressed equally well in terms of either the amplification (A) or the voltage transformation ratio (k). Conversely, the characteristics of the transformer can be expressed in terms of its voltage ratio, or in terms of the amplification it gives when used with a given tube.

Transformation ratio, as the term is used here, means the ratio of the voltage across the terminals of the secondary winding to the voltage impressed on the primary winding and the plate resistance of the vacuum tube in series. The foregoing equation depends upon two fundamental principles of vacuum tube operation. The first is that an alternating e. m. f. between the grid and filament gives rise to plate current equal to that produced by an e. m. f. mu times e_1 acting in series with the plate resistance. The second is that the portion of the plate circuit within the tube has resistance.



VOLTAGE RATIO MEASUREMENT

Measurements in a recent test of the plate resistance of amplifier tubes varied 5,000 ohms for the larger (VT-2) to 500,000 ohms on the smaller (209A) tubes.

Because the plate resistance is constant at all frequencies while the reactance of the primary of a transformer varies with the frequency, the amplification of a transformer used with a tube or by itself could only be measured with the tube connected in the usual manner. In order to obtain accurate measurements of either amplification or transformation ratio, it was desirable to connect the secondary of the transformer to the filament and grid of a vacuum-tube in order to have a capacity load equivalent to that obtained in all actual circuits.

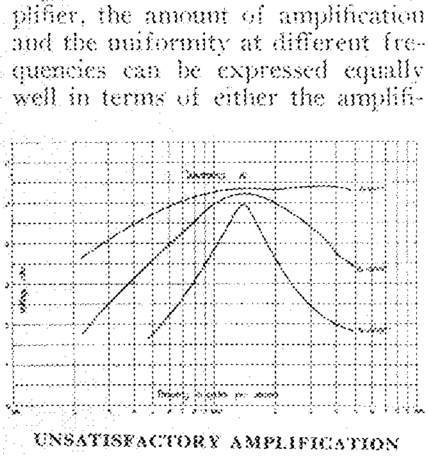
Amplification to be expected with a given tube was best measured with the tube and transformer connected together, and the input and output voltages of the system measured. However, if the plate resistance best adapted for use with a given transformer is to be determined, the tube can be removed and a variable resistance inserted in the plate circuit.

Tests were made to select the transformer best suited for work with a Western electric "type J" vacuum-tube and a 120 volt plate battery. The grid battery voltage was adjusted to obtain a minimum of distortion due to the relation of grid voltage and plate current being non-linear. A plate resistance of about 12,000 ohms satisfied this requirement. Because of the many interdependent factors, the transformer best suited for distortionless amplification with one set of battery voltages might not be at all satisfactory with another.

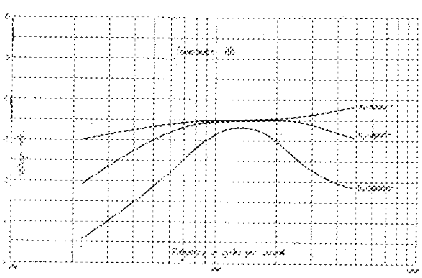
Voltage measurements were made by impressing the e. m. f. on the grid of a vacuum-tube and measuring the corresponding plate current. The voltage at the input of the system was maintained constant in order to expel errors that might occur in the transformation ratio at different electrical pressures. The impressed alternating voltage was made by a vacuum-tube generator and varied in frequency from 150 to 4,800 cycles per second. The relation between frequency and the amplification was plotted for all the transformers tested.

For measurement of the ratio of input voltage to the primary of a transformer (in series with a non-inductive resistance) and the secondary or output voltage the circuit were similar to the one used to measure the amplification ratio. The voltage was generated by a vacuum-tube and impressed on the primary of the transformer and a non-inductive resistance variable between the lowest limit of plate resistance to 100,000 ohms. Voltages were meas-

(Continued on page 32)



UNSATISFACTORY AMPLIFICATION



UNIFORM AMPLIFICATION

The
MINNESOTA TECHNO-LOG
University of Minnesota

A MORE thorough and farther-reaching engineering education in the colleges of the United States, surely a thing worth striving for, is the goal of the Carnegie Corporation in offering to finance an investigation of present conditions.

The Corporation resolved in October last year, "That the sum of $108,000 be, and it hereby is, set aside for the purpose of making possible a study of engineering education under the direction of the Society for the Promotion of Engineering Education: that of this sum the following amounts be, and they hereby are, made available to the Society for the Promotion of Engineering Education: $24,000 during the present fiscal year; $12,000 during the fiscal year 1924 with the understanding that if, in the judgement of the Executive Committee, substantial progress shall have been made in this study by January 1, 1925, the balance of the $108,000 will be made available to the Society as follows: $24,000 additional during the fiscal year 1924; $48,000 during the fiscal year 1925."

A little over a year has passed.

William E. Wickenden, assistant vice-president of the American Telephone and Telegraph Co., has acted in the capacity of Director of Investigations. He has been assisted by councilors from the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining and Metallurgical Engineers and the Mining and Metallurgical Society of America.

Data has been compiled concerning the ancestry and inclinations of college freshmen, and the attitude of alumni toward the professions. Through this work, the committeemen expect to locate the weaknesses of engineering education, and to be able to suggest effective measures to eliminate them.

The energy spent, however great it may have been, has produced results, and these results should go a long way toward advancing the profession of engineering to a higher level through the application of better methods of teaching in the colleges of the country.

FOR the Greater Minnesota Technology, the institution which today is being constructed in mortar and brick, and which tomorrow will send into the world men recognized as the leaders of industry; for this The Minnesota Techno-Log stands, and to this end the staff devotes its thought and energy, always keeping foremost the welfare of the University.

"FOR the enlightenment of the youth of this land and for the benefit of the state—— ——." With these words, Hon. Fred B. Snyder, president of the Board of Regents, turned over the new electrical building to the University.

It was at the dedication banquet of the building on November 1, 1924, Homecoming day. Alumni who had graduated as far back as 1892 were there, gathered to commemorate the founding of the electrical department and to dedicate its new home. Dean Frederick S. Jones of Yale College, formerly the dean of engineering at the University and the first instructor of electricity on the campus, made the principal address. Truly noteworthy in the history of the University, was this occasion; it marked an epoch of the College of Engineering and Architecture.

Fostering, as it does, the advancement of the engineering profession, the college reflects its progress; and this characteristic is most clearly evident in the electrical department.

The practical development of electricity is a thing of the comparatively recent past. Although electric current was first available as far back as 1790, it has been within the short span of a lifetime that this mysterious force has become an important factor in industry. Men still actively engaged in widening its scope have seen the telephone develop from a mere toy to the greatest factor in communication; they have seen the radio develop into a household necessity. It is significant to note the importance of college laboratories in this progress, for here are applied the fundamental theories which determine the more spectacular accomplishments of electrical engineering.

How, then, can the state benefit from its investment in the new electrical engineering building? What does the future hold for this great industry? According to P. O. Davis of the Alabama Polytechnic institute, there are today before men in the electrical engineering industry seven conceptions, seven definite expectations:

"1. They look forward to the eventual complete utilization of the water power of the country;

"2. They believe that some day great super-power systems will line the land, carrying energy from the falling waters and huge central station plants to the stations that serve all cities;

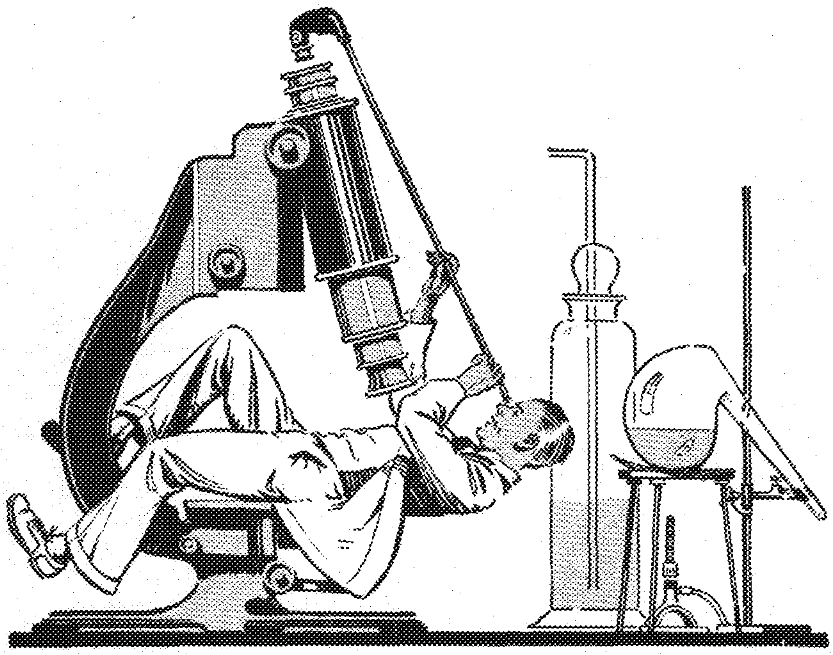
"3. They count on the complete motorization of all industries, so that whenever a wheel turns in a mill or on a railway, its power will be electric;

"4. They are certain that electricity will become indispensible in bringing about chemical and physical actions, in a field in which it is now making great headway;

"5. They know that the complete electrification of the home, through the use of electric appliances, is but a matter for natural development, and that the use of electrical conveniences in the store and office will increase inevitably in full proportion;

"6. They are confident that soon practically every customer will own a share of the business he is helping to develop, through the purchase of securities, and that thereby the vision for the best development of this great enterprise that affects every community and individual will be successfully carried out;

"7. They anticipate the electrification of agriculture."



NEWS FROM THE ENGINEERING CAMPUS

LIBRARIES ARE CONSOLIDATED

IN accordance with the recently adopted University library policy to center all the departmental libraries of the College of Engineering and Architecture in the main engineering building, a consolidation was made this fall of the electrical and mechanical libraries which have previously been kept in the department buildings. This is a branch of the University library and contains about 20,000 books. A working collection of architectural books is kept in the architectural reading room on the third floor for convenient use by students who may be studying design in the adjoining drafting rooms.

The library is equipped with reference books, including the best engineering hand-books, and is especially rich in files of periodicals, American and foreign, relating to engineering, architecture and allied subjects.

It receives about one hundred and eighty current periodicals, about seventy publications of learned societies and institutions, and twenty five scientific publications of engineering experiment stations. The Minnesota Techo-Log donates copies of publications of the twenty one members of the "Engineering College Magazine, Associated."

Within the last few years, the library has been enriched by gifts from the library of the Engineers' Club of Minneapolis and about six hundred books and many valuable pamphlets from the library of the late Dr. Henry Turner Eddy.

Publications of the United States patent office, including Specifications and Drawings, 1871-1905, the Official Gazette, 1872-date, annual reports, 1845-date, are now kept in the new University library building. They are shelved with the U. S. government documents.

The Dewey decimal system of classification is used. A dictionary card catalog is kept, and duplicates of all its cards are filed in the catalog of the main University library.

Room 13, the basement room under the main reading room, is used as a study room, by students wishing to work and study together. Quiet conversation is permitted here.

The library is open from 8:30 a. m. to 10:00 p. m. on week days. It is closed Sundays and during the hour of University convocations.

MINES SOCIETY MEETS

The School of Mines Society, an all-mines organization, held its annual election earlier than usual at a special meeting. The Society's officers are as follows: Carl Scheid, '25, president; Tom Andrews, '26, vice-president; Mark Thomasson, '26, secretary-treasurer; Paul Deringer, '27, athletic manager.

Russel Poole was appointed to fill a vacancy as Mines representative in the Knights of the Northern Star. Peter Deutscher, who had held the position, failed to return to school this fall.

9XI ON THE AIR AGAIN

The University radio station, 9XI, is coming into the limelight this year along with the new building. This is true in at least a scientific if not a popular way. A new aerial has been erected, the laboratory is at last a workhouse, watches are kept, data recorded, and considerable research is being accomplished.

About five men are doing research on problems pertaining to radio this year and the department expects some very valuable results. A large percentage of the resources of the department are being spent in the development of short wave transmission, a field which is new and seems to offer large possibilities. Along with the research in these fields the operators are collecting data on actual transmission, and communication with the Atlantic and Pacific coasts is established at will by the night operators. The force of operators is the largest in the history of the station, and numbers over a dozen men. They are under chief operator W. C. Hilgedick, a junior who operated the set of a Great Lakes steamer last summer.

The classes in radio are larger than ever, which is due in part to the large number of men enrolled in the advanced R. O. T. C. class.

STADIUM SEATS 50,800

For two years, speculation has been rife concerning the seating capacity of Minnesota's Memorial stadium. To be exact there are 18 miles of seats in the great "U." And in that 18 miles, which is folded back on itself 62 times, there is room for 50,800 people without crowding.

Minnesota's Stadium compares favorably in capacity with the Yale bowl with its 75,000 seats and California with 75,000, which are the largest in the country. Illinois just dedicated her stadium with its 70,000 seats. Ohio's can accommodate 60,000. Wisconsin and Iowa sell tickets for 35,000 and 25,000 respectfully.

$6,000 IN PRIZES OFFERED

The American Chemical Society has announced a prize essay contest to be held among undergraduate students of the colleges and universities of the United States.

This contest, similar to one held every year among the high and secondary schools of America, is made possible by the generosity of Mr. and Mrs. Francis P. Gowan. There are six prizes, of $1,000 each, which will be awarded to undergraduate students for the best essays on one of the subjects stipulated in the rules.

It is not required that students be enrolled in courses of chemistry to participate in this contest. A special knowledge of chemistry is not required of entrants as the purpose is to create generally a live interest and appreciation of the subject and a realization of its importance to our national life.

Essays must be the original work of the contestants, and only persons who have satisfied college entrance requirements, who are enrolled in such an institution and who are continuing work of a collegiate grade are eligible to enter this contest.

Rules governing the contest are as follows:

1. A contestant may submit only one essay.

2. Essays must not exceed 5,000 words. Any exceeding 5,000 words will not be considered by the judges of the contest.

3. Essays must be confined to one of the following subjects:

a. The Relation of Chemistry to Health and Disease.

b. The Relation of Chemistry to the Enrichment of Life.

d. The Relation of Chemistry to Agriculture or Forestry.

4. The Relation of Chemistry to National Defense.

e. The Relation of Chemistry to the Home.

f. The Relation of Chemistry to the Development of an Industry or a Resource of the United States.

4. Essays must be legibly written in ink or (preferably) typewritten, double-spaced, have wide margins and be on one side only of paper 8½x11 in. Each essay must bear the name, home address, and name and address of the school of the contestant. The sheets must be numbered consecutively and securely fastened together.

5. All direct quotations must be enclosed in quotation marks.

6. All essays must be in the hands of the Secretary of the Committee on Prize Essays of the American Chemical Society, 85 Beaver Street, New York City, not later than March 1, 1925.

7. From the essays submitted, the best three on each of the six subjects will be selected by a committee organized by the Division of Chemistry and Chemical Technology, National Research Council, Washington, D. C. The authors of the resulting eighteen essays will then be asked to write under supervision and without access to references on a subject to be announced at the time of writing, but not before. This subject will be one designed to bring out the knowledge of the contestant of the role played by chemistry in world affairs, and will require a thorough familiarity with the general subject. The contestants will be allowed three hours in which to write these essays, which will then be forwarded to a special committee of judges accompanied by the supervisor's affidavit to the effect that the work was done in accordance with these rules. From the essays so submitted the winners of the six prizes of $1,000 each will be selected and announcement made as promptly as possible.

8. The university and college contest will be considered a national contest and all matters pertaining to it will be referred directly to the Committee on Prize Essays of the American Chemical Society, which will be assisted by designated individuals and committees.

9. Full rights to publish any essays submitted are reserved by the American Chemical Society.

FROSH ARCHITECTS FETED

Upperclassmen of the Architectural department were hosts at the annual freshmen get-together and welcome on the night of October 16, held in the studios on the fourth floor of the main engineering building, Walter Kendall, president of the Architectural Society, had charge of the general arrangements and presided over the meeting. Professor F. M. Mann, head of the department, was the principal speaker of the evening, explaining the workings of the department and the different prizes offered each year for students work, announcing also the prize winners of the past few years. Between talks a little playlet was given by Dorothy Brink and Oswald Stageberg. Leon Arnal, professor of design, gave an interesting talk which was, of course, appreciated most by those who have received design criticism from him. A light lunch was served. Fifty freshmen are enrolled this year.

SIGNAL CORPS OUTLOOK

The year 1924-25 sees the Signal Corps Unit of the Reserve Officers' Training Corps getting under way with what looks to be exceptionally bright prospects. With thirteen seniors taking the work of the second year Advanced Course and twenty juniors having signified their desire to obtain commissions in the reserve, the two upper classes are very well represented. The present second-year advanced class attended the R. O. T. C. camp at Camp Custer, Michigan, this past summer, and it is predicted that the juniors next summer will uphold the high record of Minnesota.

The sophomore section has in it sixty men, the majority of whom are interested in military work, and out of whom ought to come an advanced class at least the equal of any of preceding years. The freshman unit, though an unknown quantity as yet due to the short time we have had the men for instruction, is exceptionally strong numerically, having one hundred forty members. Judging from the results obtained to date, it is going to be equally as strong in quality.

A number of changes have been made in the work, especially that of the Advanced Course. The military and college work of this course has been so laid out that the members take a college elective and two hours' military work per week both years, for which college credits are given toward graduation (nine in the junior year and twelve in the senior year).

It is predicted that this arrangement will work out better for the student in a scholastic way and at the same time enable him to obtain that constant military training throughout his entire college career, which is so necessary to his becoming a well-instructed and competent member of The Officers' Reserve Corps. Beginning this year, more emphasis is being put upon "Command and Leadership," and every effort will be made to bring out these qualities in the man, which after all are absolutely essential to the making of a good officer, and which go a long way toward a successful career in civil life.

Captain J. T. Watson, Jr., has been ordered by the War Department to Camp Alfred Vail, N. J., to pursue a course of instruction in the Signal School. He has been replaced here by Captain W. B. Persons who comes from duty aboard the government "Cableship Dellwood" which constitutes the repair and upkeep section of the Washington-Alaska Cable system, the government communication link connecting the states with this country's northernmost territory.

MINERS ELECT OFFICERS

In the School of Mines, elections of officers have the interest of the entire college. This year was no exception. The Freshmen, in picking their men, chose Russel Taylor president, Howard Kyler vice president, John Folliot secretary-treasurer, and Donald Booth representative on the Freshman Commission. In the Sophomore class, Paul Deringer was elected president, Russel Poole vice president, and Ted Erck secretary-treasurer. The Juniors showed their appreciation of Elliot Griffith's work by re-electing him president. Tom Andrews was elected vice-president and Everett Van Dazee secretary-treasurer of the Juniors.

ALUMNI AND FACULTY PERSONAL NEWS

Alumni

ARCHITECTS

Milton L. Anderson, '21, and Miss Glynda Mildred Grove were married July 30th in Los Angeles, where they will reside at 661 Shatto Street.

E. F. C. Backstrom is with Larry Bakken, '22, in the Northwest Lumbermen's Association, Minneapolis.

Wallace C. Bonsall, '24, and Donald T. Graf, '22, entered Harvard this fall as postgraduates.

On Sept. 27th, Donald Campbell, Ex '22, sailed from New York for from four to six months in Europe.

Stacy, Minnesota, was the home of Miss Verna Lois Baxter, who on July 3 became the bride of Donald H. Ellison, Ex '20. The Ellison home is 2517 Emerson Ave. S., Minneapolis.

Ralph M. Hammett, '19, who won the annual traveling fellowship last year at Harvard, is "somewhere" en route to Europe via the Orient.

After nearly a year in Europe with his father, William H. Kirchner, '22, is back in Minneapolis again.

Richard F. McGee, '23, has gone back to teach at Stout Institute, Menomonie, Wis. He advises that he now has a son and heir.

"Izzy" Silverman, '23, sends his greetings from Bozeman, where he is instructing in Montana State College of the University of Montana.

CHEMISTS

George H. Stone, '10, has recently entered the "state of matrimonial happiness" by taking a bride. He married Miss Mary Benjamin of Northfield, Minn., who was instructing in the high school at Brainerd. Mr. Stone is a foreman in the tie treating plant of the Northern Pacific Railway Co., Brainerd. They are now on their honeymoon.

William T. Morin, '22, Ch. E. '23, is in San Francisco, Calif., as a technical salesman for the Pacific Abrasive Supply Co. His address is 318 Mission St.

Clifford E. Peterson, '23, is doing chemical work for the William O. Goodrich Linseed Oil Refineries. He is living at 2314 Herbert St., Milwaukee, Wis.

Winslow S. Anderson, M. S. (Ch) '23, has entered the teaching profession, and is an instructor in chemistry at North Carolina State College.

Norman S. Cassel, '23, is employed by the Proctor and Gamble Company in Cincinnati, Ohio.

CIVILS

Herbert Liese, '24, is estimating for the Foley Brothers Contracting Co. of St. Paul. "Herb" says he likes his work very well. He is living at 519 10th Ave. S. E., Minneapolis.

Louis R. Bevan, '24, is working for the board of park commissioners of Minneapolis.

Walter E. Wilson, '24, is demonstrating his ability by holding the position of assistant city engineer of Duluth, Minn.

Edwin T. Bergquist, '24, is inspector of bridges for the state highway department at Moorhead, Minn. "Ed" is attending night school at Moorhead normal.

Arthur Tews, '24, is with the state highway department, and is at Lake City, Minn.

Loyd L. H. Peterson, '24, is in the efficiency department of the Northern States Power Co., St. Cloud, Minn.

E. Ruben Grant, '24, is employed by the bridge department of the Missouri state highway department, and is living at Jefferson City.

John Schlenk, '23, is working on the dam and power plant project of the Phoenix Utility Company at Little Falls, Minn. Address his mail to box 127.

Philip L. Bergquist, '24, is in the operating department of the Great Northern Railway Company, St. Paul.

Julian (Spike) Garzon, '24, who was alumni editor of the Techno-Log last year, is working for the state highway department in the southern part of the state, contrary to an item in the October Techno-Log.

ELECTRICALS

Dean M. Barnes, '21, is in the engineering department of the Associated Telephone Co. of Long Beach, California. Address his mail to box 1635, Compton, California.

Selmer Ellefson, '16, who formerly traveled for the Minneapolis office of the General Electric Company, is now power engineer of the Northwestern Public Service Company of Huron, South Dakota.

Irving H. Marshman, '24, is taking the student training course with the General Electric Company, Schenectady, N. Y.

Jozef J. Kater, '24, is employed in the radio department of the General Electric Company at Schenectady, N. Y.

William Edwards Brewster, '12, lives in Cleveland, Ohio, and can be reached at 1658 Union Trust Building.

Norman S. McVean, '21, is working for the New England Telephone and Telegraph Company at 50 Oliver St., Boston, Mass.

J. Roscoe Furber, '24, Manley B. Monsen, and Warren E. Carlson, of the same class, are taking the student training course given by the Northern States Power Company of Minneapolis.

Alfred B. Greene, '24, who was all-senior president last year, is still confined to his bed at the Glen Lake sanatorium, after having suffered a breakdown last spring. "Al" is going to show his friends that "one can not keep a good man down." He would like to hear from some more of his friends.

Hugo Schlenk, '18, was married on September to Miss Gretchen Munch, also a former Minnesota student. They are living at 1370 Fairmont Ave., St. Paul. Mr. Schlenk is the manager of gas production at the St. Paul Gas Light Co.

Archibald T. Miller, '24, is taking post graduate work at Cornell, where he expects to get a degree in mechanical engineering next June.

Frederick R. Kapple, '24, is taking the student course of the Northwestern Bell Telephone Company of Minneapolis. He is living at 1227 Fourth St. S. E.

Lysk W. Morton, and Laurence C. Warren, '24, are taking the student training course at the General Electric Company at Schenectady.

Robert T. McCullough, '23, is a field engineer for the Long Island Lighting Co. His address is 119 4th Ave., Bay Shore, N. Y.

Walter F. Kannenberg, '23, living at 230 Thomas St., St. Paul, is engineer for the Northwestern Bell Telephone Co. in Minneapolis.

John G. Lewis, '24, has been around the department regularly during the past month. He came back to do some special work for the department of electrical engineering, and has been in Prof. Springer's office. The next field Lewis expects to enter is the General Electric test course at Schenectady. The third of November, the day on which Lewis report at his new school, is also election day, and consequently he is wondering how to matriculate in New York and vote in Minnesota. It's safe to say that this is one problem the engineers don't have to graph and hand in for the next time. Lewis was president of Eta Kappa Nu, honorary fraternity in electrical engineering, last year.

MECHANICALS

Harley R. Langman, '24, is in charge of the flake soap packing department of the Proctor and Gamble Mfg. Company at Kansas City. He was recently transferred there from the Ivorydale plant in Cincinnati, Ohio.

Charles R. Blodgett, '24, is designer and general trouble man of the mechanical equipment for the manufacture of soap at the Ivorydale plant of Proctor and Gamble. Rumor has it that Charles is the proud papa of a son which arrived in September.

Paul M. Boyd, '24, had a "high" position, literally speaking, during summer vacation, as he was manager of the Curtiss field at St. Paul. He is now taking post graduate work at Massachusetts Institute of Technology.

Frank A. Morris and Donald Earl, '24, are taking post graduate work at Minnesota.

William I. Darmody, '24, is with the Northern Fire Apparatus Company of Minneapolis doing test work on pumps and other equipment of a similar nature.

Stuart V. Willson, '24, is with the Minneapolis General Electric Co. in Minneapolis.

Edwin E. Koehler, '24, and John ("Dinty") Moore, '24, are in St. Louis, Mo., selling safety insurance for

workman protection in manufacturing plants.

Stanley B. Tuttle, '24, is with the Fulton Engine Company of St. Louis, Mo., designing and assisting the chief engineer.

Stewart Collis, '24, is with the Northern States Power Co. at St. Paul.

George Barry, '24, is combustion engineer for the Northern States Power Co. at Sioux Falls, South Dakota.

Loyd P. Groebel, and Kenneth Ross, '24, are taking a test course at the General Electric Co. in Schenectady, N. Y.

Frank Kiesner, '24, is with the American Radiator Company in Buffalo, N. Y., as salesman.

George Rathburn, '24, is with the Northern States Power Co. at Winona, Minn.

Harry Woolman and Russel Hiers, '24, have entered the services of the U. S. Radiator Co., the former having his headquarters at Cincinnati, Ohio, and the latter at New Haven, Conn.

That he is rapidly climbing the ladder of success is indicated by the record Edward Stauffacher, '24, has made since graduation. "Ed" is now an engineer for the Empire Oil Companies, and is very enthusiastic about his work. Soon after his graduation, he entered the service of this company and was assigned to test some two hundred oil pumps for steam economies and fluid efficiency at several of their fields. He has been successful in his work and expects to be located permanently at the refineries at Tulsa. "Ed" writes, "The Empire Companies offer a very good opportunity to the Mechanical Engineer. They much prefer men from the northern and eastern universities. I can honestly state that a graduate of the mechanical engineering department of the University of Minnesota has a decided advantage over the graduates of most of the other schools."

MINERS

F. J. Curran, '24, is a metallurgist for the Arrowhead Steel Products Co., Minneapolis, Minn.

L. M. Case, '24, is in the employ of the Oliver Mining Co. at Chisholm, Minn., as a miner.

J. H. Nelmark, '24, is located at Chisholm, where he is working as a mining engineer for the Oliver Mining Co.

J. L. Stewart, '24, is performing geological work for the N. P. R. R. somewhere in the United States.

A. T. Anderson, '24, is a miner for the Picandis-Mather Mining Co., Elcor, Minn.

Luis De Uribe Echeharria, '24, is with the New England Oil Co. down in Venezuela.

A. J. Scheid, '23, is an electric furnace man at the Maynard Steel Casting Co., Milwaukee, Wis.

G. M. Moga, '22, is roaming the hills up in Canada, where the north begins, as a prospector.

B. C. Hutchinson, '24, is at Crosby, Minnesota, as a mining engineer for H. I. Pearl Allied Engineers.

C. O. Lee, '24, is helping to improve the roads by his engineering for the state highway department at Wadena, Minn.

Henry La Tendresse, and John Middleton, '23, are in the wilds of Belgian Congo, Africa, prospecting for the "sparkling stones." Mail addressed to Forminiere, Mission Butler, Amadi, Congo Belge, should reach them.

N. Dudley Kean, '24, is at Taconite, Minnesota, as pit engineer for the Oliver Iron Mining Company.

FACULTY

Hibbard Hill, 1923 Civil, has returned to fill the vacancy left by the absence of Mr. Brevik in the civil department. Mr. Hill has been with the United States Coast and Geodetic Survey since his graduation, working both on triangulation in the Northern Rockies and on a precise traverse in the Lac LaCroix region of Minnesota. The latter was run over the ice.

The annual radio conference of the Department of Commerce was called by Secretary Hoover last month, and, as in previous years since its establishment, Prof. C. M. Jansky was a member of the national body. The conference is held in Washington and lasts for one week. The purpose of the group, which is composed of noted scientists in the radio field, is to make recommendations to the department of commerce on the rules and regulations governing the transmission of intelligence by radio in the United States.

After a year's leave of absence, Prof. G. A. Maney has returned to continue his instruction in the design of reinforced concrete structures. During this interval Prof. Maney designed the Physicians' and Surgeons' building at Fort Worth, Texas, and also supervised its construction. This building, constructed in the form of a perfect cross, is reputed to be the largest reinforced concrete building in the world.

Mr. John H. Moffett of the mechanical department attended the convention of the American Foundrymen's Association. The convention was held in Milwaukee from October 11 to 16. Mr. Moffett was misinformed regarding the date of the meeting. He left too late and so missed some of the interesting features of the gathering.

Mr. R. E. Montanna, Asst. Prof. in Chemical Engineering, is a new member of the faculty. Professor Montanna comes to Minnesota from eastern universities. After graduating from Syracuse University in 1916 with a degree of B. S. in chemistry, he worked for six years in various chemical manufacturing concerns in the East. In 1922 he went to Yale as instructor in chemical engineering, and in the spring of 1924 he was given his Ph. D. degree.

In speaking of Minnesota, he says, "I have been here such a short time that I have not as yet formed any definite opinion about this University. However, if first impressions mean anything, I feel that I am going to like Minnesota immensely. One thing has struck me; I noticed an article in The Minnesota Daily in which the writer stated that if Minnesota continued to develop at its present rate, it would compare favorably with colleges in the East in ten years. From what I have seen of Eastern Colleges, I might say that Minnesota compares very favorably with them now. Your stadium ranks on a par with any in the East. I wish, though, that some system could be developed whereby spectators could be informed of the exact location of the ball on the field. It is nearly impossible for one sitting at the far end of the field to judge the location of the ball when it is at the other end of the field."

Prof. Montanna hopes in the near future to continue his research work on the chemistry of cellulose.

Mr. R. D. Morrill of the University of Maine has been secured as an instructor in mechanical engineering. He will assist Professor Shoop in steam engineering laboratory. Mr. Morrill has spent a number of years doing power plant work in the East. Later he will have charge of classes in these subjects. Mr. Morrill drove his Cadillac from Vermont to Minneapolis, a distance of 1,800 miles, in the record time of five days. Most of the driving was done at night when the traffic policemen were off the job. Mr. Morrill's record almost equals some of Professor Shipley's daring week-end dashes to his summer camp.

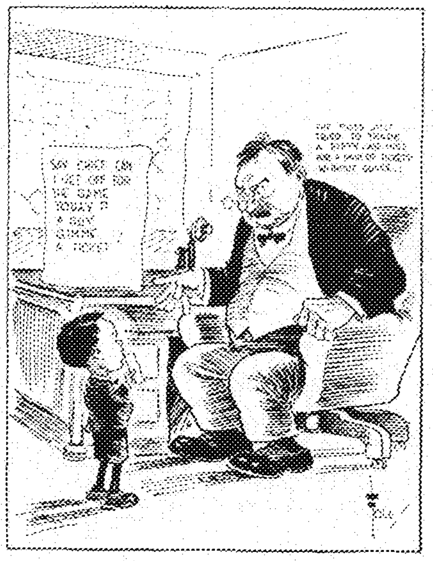
George D. Shepardson, C. M. Jansky and George W. Swenson of the electrical department were guests of the American Telegraph and Telephone Co. at a national conference on communication engineering education held in New York last summer. Faculty members of the 18 most prominent engineering schools in the country, together with officials of the A. T. & T., composed the convention body. The Minnesota men report that much good was accomplished. The subject of research took a large part of the time. Besides sponsering the convention, the company presented standard sets of instruments to each of the universities to enable students to do more efficient research work in the field of telephony.

Telephone survey work for the Bureau of Standards helped to fill the vacation months of George W. Swenson, instructor in communication. Mr. Swenson drove through to Washington with his wife and family in his car, and he reports the trip as being most enjoyable. The department of which Mr. Swenson was a member is making a survey of the telephones in the hospitals, schools, and district offices of the Veterans' Bureau. The nature of the work permitted him to visit several of the large Eastern cities.

DESIGN PROBLEMS PENDING

Design assignments awaiting judgment and being worked on are as follows: Grade I, "A Memorial Tablet" (short problem); Grade II, "An Open Air Restaurant" (short problem), "A Formal Garden Stairway" (esquisse-esquisse), "A Central Library" (long problem); Grade III, "A Presbyterian Church" (long problem) and "A Fireplace for a Private Office" (esquisse-esquisse).

GEAR STRIPPINGS



ROOM FOR THE BOSS, TOO

Now with 50,000 people at the football game there will be 25,000 blankets spread over the redwood. Allowing 42 square feet to a blanket the grand area of all the blankets if they were laid side by side would be 2.41 acres, or more than enough to cover the playing field twice.

TO BE SPECIFIC

Geese is a heavy-set bird with a head on one side and a tail on the other. His feet is set so far back on his running gear that they nearly miss his body. Some geese is ganders and has a curl on his tail. Ganders don't lay or set. They just eat, loaf and go swimming. If I had to be a geese I would rather be a gander. Geese do not give milk, but give eggs, but for me, give me liberty or give me death.—*Capper's Weekly.*

WHAT IS IT?

By means of pedaled attachment, a fulcrumed lever converts a vertical reciprocating motion into a circular movement. The principle of the machine is a huge disc which revolves in a vertical plane. Power is applied through the axis of the disc and work is done on the periphery. The hardest substance by mere impact is reduced to any shape.

It's a grindstone.

—r. p. m.

Electrical Department

(Continued from page 7)

eum and the exhibition of modern electrical appliances will steadily grow.

As previously noted, the first teacher of electrical engineering at the University of Minnesota was F. S. Jones, later aided by a student-assistant, E. P. Burch. Professor Shepardson was the only electrical instructor for some time after 1891, the staff gradually growing in consequence of the increasing demand until now there are three professors, three assistant professors, two instructors, four graduate fellows and assistants, an equipment man, a mechanician, a clerk and several part-time student assistants.

G. H. Morse was added as a part-time scholar in 1894, being succeeded in 1896 by F. W. Springer as a student assistant, the latter gradually advancing until in 1907 he was made a full professor. Mr. Springer has been virtual director of the electrical laboratory for a number of years and deserves credit for many of the excellent features in the new building.

W. T. Ryan was appointed an instructor in December, 1906, advancing to a full professorship in 1922. He has specialized in electric power and central stations. In addition to his teaching responsibilities at the University, Professor Ryan has charge of making valuations of electric power utilities for the Minnesota Tax Commission.

W. J. Finke, a student assistant in 1909-1910, was an instructor from 1910 to 1912, being succeeded by H. M. Turner, who specialized in transient phenomena and in radio, resigning in 1919 to go to Yale. He being followed by C. M. Jansky, Jr, who has taken an active part in the advancement of radio communication.

E. A. Reid instructed in the laboratory from 1916 to 1918, resigning to take a position at the University of Illinois. E. R. Martin came in 1916, specializing in lighting and in electric railways. A. H. Abbott instructed for part of the war period in 1918-19. G. W. Swenson came in 1919 from the S. A. T. C. of war-time fame, and has since been specializing in wire-conducted communication. M. E. Todd, who has had several years' experience in teaching, was secured as an instructor in 1920, specializ-

ing in electrical measurements. J. H. Kuhlman was appointed an instructor in 1920, teaching electrical design.

A number of well-known engineers have given valued service as non-resident lecturers. These include E. P. Burch, C. L. Pillsbury, Frederick Dustin and P. G. Downton. Many others have given one or more lectures.

Teaching fellowships and assistantships have been established from time to time since 1920, such positions having been filled by H. C. Forbes, L. C. Larson, E. C. Manderfeld, R. J. Heidelberger, R. A. Braden, O. Heidelberger, C. L. Sampson and L. J. Schnell.

Other men, though listed as members of other departments, have conducted courses in or very closely allied to electrical engineering. Special mention is due to the late Dr. H. T. Eddy, who for a number of years conducted the classes in alternating current theory, and to R. R. Herrmann and H. C. T. Eggers who have courses in mathematics and in drawing bearing especially on electrical problems.

From the small beginnings, the classes have grown almost continuously. Since the war the upper classes have increased rapidly, the graduates numbering 23 in 1919, 32 in 1920, 38 in 1921, 41 in 1922, 50 in 1923, 64 in 1924. This year there are 81 juniors, 65 seniors and six graduate students in the electrical engineering course. There is a slight falling off in the number of freshmen and sophomores, perhaps partly due to the improving business conditions and partly to the growth of the junior colleges which are sending increasing numbers to enter as juniors, and which also are probably helping divert some of the incapables who otherwise might swell the lower classes and be unable to progress. The electrical engineering department gives instruction not only to electrical engineering students, but also to seniors in civil, mechanical, chemical and mining engineering and in architecture. There are also a number of night classes conducted for the University Extension Division. The graduates from the electrical engineering course, beginning with the class of 2 in 1891 and including the class of 64 in 1924, aggregate 600 men, most of whom have continued in some phase of engineering activity.

Minnesota Stadium

(Continued from page 14)

proper proportions of fine and course material, a greater amount of cement had to be placed in that particular batch. The result is, that the concrete throughout the stadium shows a uniformity of strength that is remarkable. This uniformity of strength was checked by means of cylinders taken regularly throughout the building operation. These were tested in the experimental engineering laboratories by Professor Lagaard and uniformly showed a compressive strength above 2,000 pounds per square inch. It was found advisable to add about five per cent of lime by weight to the mix in order to make the finishing of the concrete on the stands easier and to prevent the separation of the aggregates during pouring. The concrete was placed from a tower about 100 feet high on the street side of the stadium. This tower was built on a platform which carried also the complete mixing plant. The platform itself was placed on rollers on a track of wooden beams and as each section was poured the tower platform and mixing plant was moved to the new section.

It was necessary to make careful provision for the removal of the water which would fall upon the stands during a heavy rain. The principal drainage from the stands is a concrete gutter 12 inches wide located in front of the lower wall separating the first row of seats from the field. This gutter is connected with a 21-inch sewer emptying into the trunk line sewer on Oak Street. The water which may come down the portals and ramps either from rain or from melting snow is carried off through gratings in the foot of the ramps. These gratings cover a gutter which communicates with the sandy soil under the stand. Naturally the amount of water that is taken care of in these locations is small. No waterproofing material was used in the concrete that makes up the deck and there has not been any leakage of water through the deck into the areas underneath the stand, even during the torrential rains of the past summer.

Many minor but interesting problems were presented during the design and construction of the stadium. Iron flagpoles for pennants to give a festive air to the stadium were attached to the outer wall by means of stone corbels and metal rings. These flagpoles are about 17 feet in height, are completely rigged and surmounted by gold plated metal balls.

Request was made for a press stand to seat about 125 men. This is in the south stand and is provided with redwood seats and backs, long writing tables, telegraph instruments, storage space for typewriters, papers, etc. There is also a small toilet room at the back of the stand. In a corresponding location on the north stand is a covered stand for 250 people, to be used for scouts, visiting officials, or other persons to whom the athletic association may issue complementary tickets. In this stand is a glassed-in broadcasting station. Ample electric connections are made at various points on the stand for the attaching of floodlights and a large electric box is buried in the ground at the curved end of the field so that attachment can be made for lights on a stage or platform that may be temporarily located there in case of the use of the curved end of the stand for theatrical performances, open air meetings, or the many other uses for which this curved end can be put at times other than during the football season.

The contract was awarded on March 4, 1924, and it was absolutely necessary that the stands be finished in time for the fall season. The provision of a removable tower for placing the concrete has already been mentioned. The use of a railway steam shovel and light dump carts on a narrow gage track for the removal of material to the depth of seven feet under the field area saved considerable time in this portion of the work and gave the University an early opportunity to start the making of the playing field. The concrete of the last section was poured about 40 days in advance of the date set in the original schedule. A movable scaffold was used for placing the brick of the outer wall. Form lumber was cut by a small saw mill that was moved around the stands.

Mention must be made of the very efficient work done by Mr. Elwell, president superintendent of the architects and engineers, and his two assistants, Mr. Sutherland and Mr. Loftus, both recent graduates of the College of Engineering and Architecture.

Audio-Frequency

(Continued from page 15)

ured by vacuum-tube voltmeters. The voltage was somewhat larger in these measurements. The limit of the permissible alternating voltage is such that the positive peak of the alternating voltage reduces the fixed negative voltage to zero. Measurements were easier and the results nearer perfect at the higher voltage. Curves were plotted between the frequency and the transformation ratio.

The circuits used in the measurements of both the amplification ratio and the transformation ratio differ from actual service circuits in that there was not an inductive load in the plate circuit of the vacuum-tube connected to the secondary of the transformer. Such a load would produce regeneration which would reduce the effective resistance of the grid circuit. However, the final analysis of this error shows it to be very small and on the side of safety, or it reduces the amplification. The test circuit for the voltage ratio alters actual conditions in that no current corresponding to that of a plate circuit flows through its primary. The result of this change is to alter the inductance of the primary of the transformer. Measurements of this inductance both with and without a primary current showed the error to be negligible.

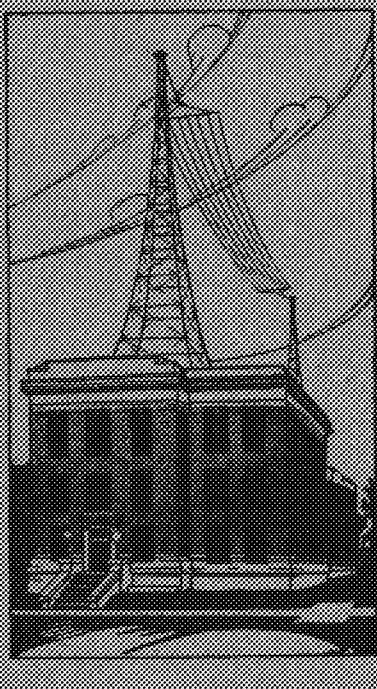
Analysis of the curves of all the tests gives some valuable information. One fact given by the experiments is that one transformer may give better results when used with a certain tube adjusted for a certain plate resistance than another transformer, but that at another adjustment of the plate resistance the reverse is true. Thus it can be seen that the transformer should be selected to work with the plate circuit resistance that is most easily obtainable with a given connection of instruments.

In general it may be said that a transformer built with large windings on a large iron core has high primary inductance and is most suitable for use with a small amplifying tube using a reasonable low plate battery voltage and small plate current, while a transformer built with smaller inductance in the primary would function best under conditions opposite to those of the first transformer. Power tubes could be used under such conditions.

*From Research by R. A. Braden.

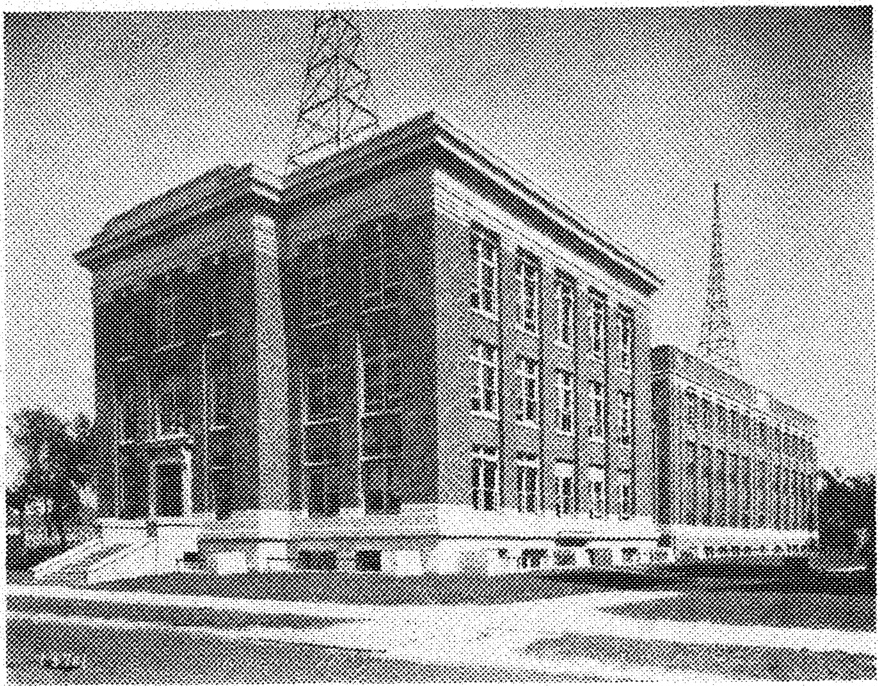
THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS



DECEMBER
1 9 2 4

Volume V 25 CENTS A COPY Number 3
MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED
PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES



THE NEW HOME OF THE ELECTRICAL ENGINEERING DEPARTMENT.

The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

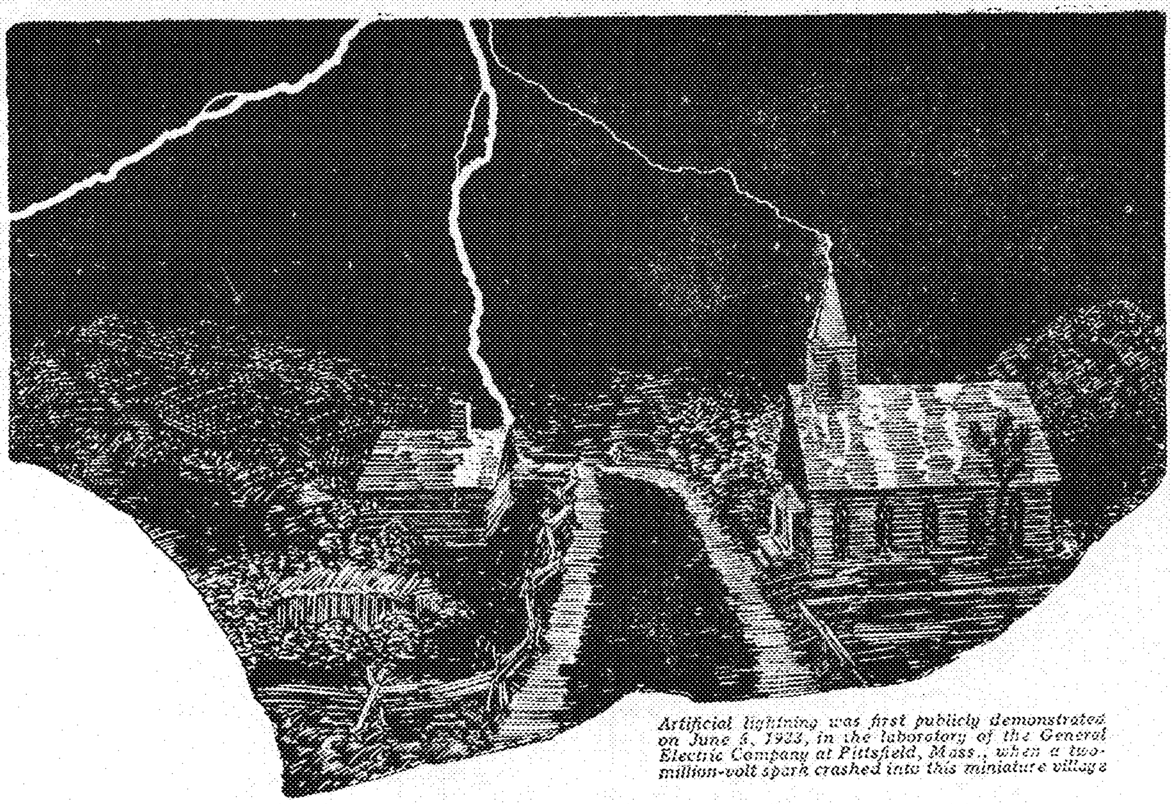
ALBERT W. MORSE, *Managing Editor* — RICHARD W. JONES, *Business Manager*

VOLUME 5 — NUMBER 3

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.



Artificial lightning was first publicly demonstrated on June 5, 1923, in the laboratory of the General Electric Company at Pittsfield, Mass., when a two-million-volt spark crashed into this miniature village

What's the use of artificial lightning?

Experiments like these are particularly thrilling and important to young men and women, who will live in an age when electricity will perform most of life's hardest tasks. Know what the research laboratories of the General Electric Company are doing; they are a telescope through which you can see the future!

If you are interested to learn more about what electricity is doing, write for Reprint No. AR391 containing a complete set of these advertisements.

It is mainly experimental, aiding General Electric scientists to solve high power transmission problems. Many such experiments yield no immediate return.

But in the long run this work is practical and important. It is part of the study which must go on unceasingly if this powerful force, Electricity, is to be fully tamed and enlisted in your service.

95-941DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V | DECEMBER, 1924 | Number 3

ALPHA TAU OMEGA MOVES INTO NEW HOME

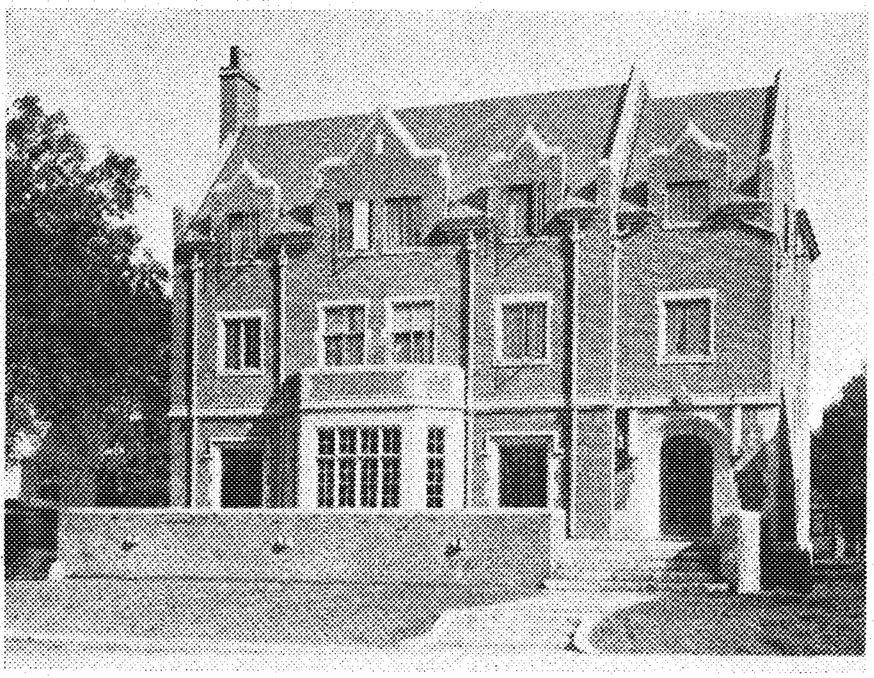
By W. O. French

Member of the Senior Mechanical Class

THE new Minnesota home of Alpha Tau Omega is at 1821 University avenue southeast. This site was selected only after full consideration of other possible locations. The Cass Gilbert plan, when eventually realized, might enhance the value of the region south of Washington avenue and east of the Campus as sites for the academic fraternities. A year ago, the trend of the geographical center of the campus was southward, and it still is, and had the Memorial Stadium been placed on the river flats, as was for a time considered, this tendency would have been more marked. The decision to build the stadium on University avenue, however, gave Fraternity Row a new lease on life. The center of athletics has such a strong influence in determining the center of interest of the University that even the ultimate realization of the Cass Gibert plan, with the consequent shifting of the geographical center, will not cause the center of interest to move appreciably; and it is this center of interest that fraternities, with their varied membership, desire to be near.

The general architectural type of the building is a modified English Tudor design. It is a large three-story house, substantial, and yet not massive. The exterior is a red and brown mixture of Harvard brick, with a Bedford stone trim. A fifteen-foot terrace extends across the full width of the house in front. At the east end of the terrace is an imposing stone arch door with the crest of the fraternity carved above, and flanked by stone ornamentation. A hand-wrought lightning fixture of the wall-bracket type is at each side of the door.

Two French doors, one on either side of a large bay, also open to the terrace. The bay terminates at the second floor in a balcony. The slope of the roof, the ridge of which extends parallel to the front of the house, is frequently broken by a series of dormers. The chimney is on the west end of the house, and that part of it extending above the ridge harmonizes with the Tudor design. The roof is laid with composition slate-gray shingles.



Of English Tudor Design; Substantial, and yet not Massive; An Addition to Fraternity Row

From the standpoint of interior arrangement, the house contains many features original in fraternity-home construction. On the first floor is the entrance and stair hall, a lounge, a library, a coat room, and a guest room with closet and lavatory.

By placing the main entrance at one side, it was possible to extend the main lounge nearly across the entire front of the house. This feature gives an excellent floor space to accommodate dances and other social functions. This is augmented by the library, which is connected with the lounge by a large Bedford stone archway. A similar archway forms the entrance to the lounge from the hall. The French doors and the bay add beauty to the room and admit ample light during the day. The wide expanse of pane area was delicately varied by introducing several panes of matched glass, some of which are tinted. A large fireplace, trimmed with Bedford stone, opposite the hall archway, lends an air of coziness by its warm glow on cold winter evenings. Plastered cement beams remove the monotony of the otherwise flat ceiling. Lighting is effected by means of several wall-bracket lights and three chandeliers. These are of hand-wrought iron. The walls are of rough plaster, dashed and troweled. The side walls are old ivory stippled and blended with orange and blue. Near the ceiling, the stippling fades out and the ceiling is a clear ivory. This feature gives an impression of a higher room and enhances the cheerfulness of it. The floor of this room and of the entire first floor, is terrazzo. A mixture of buff, black, and a little white, bonded with gray cement, was used. A dark mixture of the same composition was used for borders and bases, and was separated from the lighter areas by an inlay of marble.

The library is a somewhat smaller room to the rear. The walls and ceiling of the library are of rough, float-finish plaster, cream-colored and blended. All woodwork in the first floor is of oak. The library contains bookcases built into the wall on either side of the window. They extend nearly to the ceiling.

The walls, floor, and ceiling of the hall are finished the same as those of the other rooms on this floor. A bronze memorial tablet, bearing the names of those members of the chapter who served in the World War is set in the wall. The stairway to the second floor is built against the outside wall. Treads are of terrazzo and the risers are oak. A hand rail of oak borne by wrought-iron posts gives a stately appearance to the stairs. The lower steps flare slightly outward in graceful curves.

At one side of the stair-way the hall continues to the guest room, and a coat room and the basement stairway open from the hall to the left and right, respectively.

The guest room is reserved for the use of parents and friends who desire to stay overnight. It is so arranged that it can be used as a woman's retiring room in the event of a party, and the private lavatory and adjacent coat room add to its utility.

The basement is a new departure in that it contains several of the main rooms of the house. Coming from the first floor, one first enters a lobby from which there are three arch-ways opening to the dining-room at the rear. Along the south wall of the lobby is a door leading to a coat room for the use of members living in the city. A lavatory opens from one end of the coat room. Farther along on the south wall is the entrance to the chapter room, which is directly under the terrace. A storeroom can also be reached from the lobby, and beyond it is the boiler room and the coal bunkers.

Normally the dining room can care for forty persons, although a hundred can be seated if necessary by using narrow banquet tables and placing them in the lobby as well as the dining room. The kitchen, connected to the dining room through a butler's pantry, is compact, and yet has ample facilities for serving a large number of persons. Commodious cupboard space is installed in the kitchen proper, and additional cupboards, together with the china closets, are in the butler's pantry. Two sinks, one in the kitchen and one in the pantry, are additional conveniences.

One of the most interesting rooms in the house is the chapter room. From the lobby, a heavy oak door with wrought iron hinges and lock bars the way. For the present, though, we will be permitted to pass this barrier. From the lobby, an anteroom, paved with rough cobblestones, leads to the chapel proper. Yes, chapel is an appropriate word. Patterned after the chapels of old English castles, with pews, pulpit, chancellery, and pipe organ, it can be called nothing else. The ceiling is trussed with heavy beams, and the floor is of cement with a large Maltese cross worked in with gold and black in the center. There are no windows so artificial ventilation is provided.

The lobby, dining room and basement stairway have red, master mix cement floors and bases. The walls and ceiling are a float finish plaster, Stonekote tinted. This finish has been found to be extremely satisfactory in several places in and about the Twin Cities.

On the second and third floors are the study rooms and dormitories. The dormitory system is used, as it appears to offer greater opportunities for privacy to the occupants during study hours. There are two dormitories on the third floor, and one on the second, and each accommodate eight men. Each study room is designed to accommodate two men, with room for two desks, two dressers, and several chairs, and each man has a closet with double shelves. There are eleven of these rooms.

In addition to the dormitory and study rooms, the second floor houses the chapter office and the servants' quarters, consisting of two bedrooms and a bath.

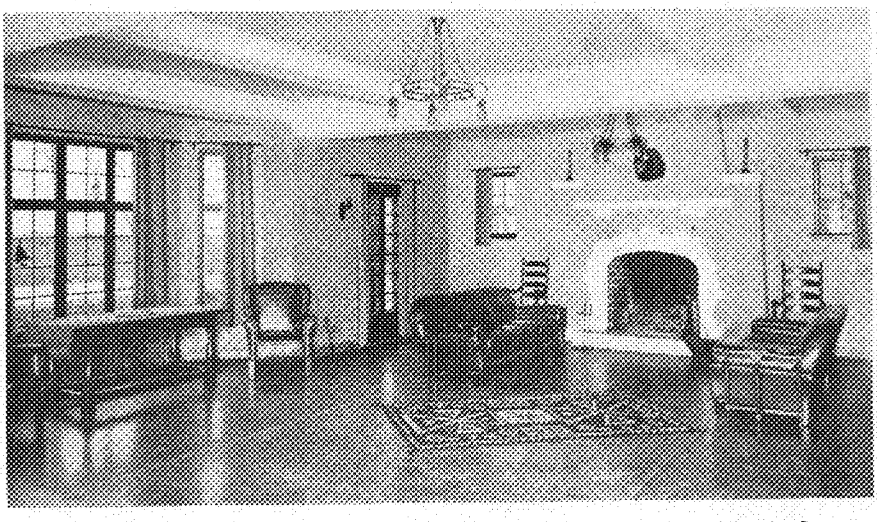
Each of the sleeping floors is provided with suitable linen closets, and there is a large bath room on each floor. Bath rooms and lavatories throughout the house have porcelain-enamelled fixtures, enamelled walls and ceilings, and white terrazzo floors.

The woodwork on all floors but the first is birch, with a brown stain. The second floor slab is concrete and the third, maple. The ceiling and walls of the upper floors are of float-finish plaster. Windows throughout the house have crittal steel casements and frames. Each window is made up of several panes, and opens outward. Inside screens are used.

The house is virtually fireproof, with poured concrete foundations, hollow tile and brick-veneered walls, and concrete floor slabs. It was necessary, under the building laws, to provide a fire-escape. This was done by building a concrete stairway, enclosed with hollow tile and brick veneer on the exposed sides, on the back of the house. This stairway reaches all floors and connects directly with the kitchen and servants' quarters, so is convenient for service.

The heating system uses steam at pressures up to six pounds, although two pounds is normal. A Peerless steel tubular boiler supplies the steam to a one-pipe overhead heating system having direct radiation. A steam heating system reduces the number and size of the radiators to a minimum and was therefore felt to be most desirable. A one-pipe system when properly designed is as efficient as any other, and in addition does away with objectionable piping and unsightly radiator connections. Provision has been made to install oil burners in the boiler if it seems desirable in the future.

Although not completely furnished, the house is even now attractive. As in the designing of the house, the fur-



The Fireplace Adds a Touch of Cheer to the Atmosphere of Comfort Found in the Lounge

The Entrance Hall, Showing the World War Memorial and Entrance to Guest Room

niture and draperies were selected with a view of combining the utmost of durability and utility with beauty. Fortunately this was accomplished. The lounge is furnished with several club-type chairs and davenports upholstered with Spanish leather. Several walnut taborets, davenport tables, and chairs of William and Mary design add their beauty to the room. In one corner is a grand piano of parlor size; it also is of walnut to harmonize with the rest of the room. Flanking one of the archways in this room are two stately, wrought-iron floor lamps.

The library is furnished with heavy, mission-type, quarter-sawed oak furniture. Adorning the walls of these two rooms are various pictures, tapestries, and trophies of the chase that were given to the chapter by alumni. Sport trophies, won by the undergraduates in interfraternity competitions, are placed in one of the deep-set windows of the library. Curtains of these rooms are sun-fast, Roman striped and are arranged to be drawn to one side easily.

The hall windows are curtained with a blue silk. A small console is placed under the memorial tablet, flanked by two straight-back, cane-seated chairs. The guest room is finished simply with a gray-enamelled wicker set, and a bird's-eye maple dressing table and bench. The curtains are cretonne, and two delicate etchings by S. Chatwood Burton adorn the walls.

Ground was broken for the house on Homecoming day, 1923, after the Iowa-Minnesota football game. The occasion was marked by an elaborate ceremony attended by active and alumni members of the fraternity. Excavation continued rapidly, and the foundations were poured before the weather became cold enough to interfere. By the time the first floor slab was poured, however, which was toward the latter part of January, 1924, is was deemed advisable to suspend operations until spring. This was done, and construction ceased until March. With the arrival of warmer weather, the contractors resumed their work, and by June the roof was laid.

The interior finishing prolonged the construction period another two months, however. In laying the terrazzo floors, considerable time was required for the various operations of mixing, pouring, setting, grinding and polishing. This in turn held up the finishing of the walls on the first floor, although the decorators had time to complete the finishing in the rest of the house while waiting. It might be of interest to know that the terrazzo floors have fulfilled all expectations. They were decided upon with some trepidition, but have proved to be desirable in every way. They not only add much to the decorative effect of the first floor, but keep a polish well and afford an excellent surface for dancing.

Plumbing and wiring was of course installed during the time the rest of the construction was in progress, and the various fixtures in the two systems were in place at soon as the walls and floors were finished.

As it has been mentioned elsewhere in this article, the lighting fixtures on the first floor are of wrought iron. One of the members of the active chapter had taken advantage of the facilities of his father's boiler and manufacturing works to fashion them during his spare moments of the summer vacation, and the work he turned out is in every way in keeping with the design of the house. In addition to the chandelier and wall-brackets, he also made two beautiful floor lamps of wrought iron and made the latch and hinges for the Chapter room door.

The building contract called for completion of the house in time to allow for its preparation for occupancy by the time the school year of 1924-25 commenced, and in spite of the month lost due to cold weather this provision was carried out to the letter.

The house was designed by a group of alumni of the Fraternity. They are Messrs. William Dorr, Arthur Bohnen, William Smiley, and Milton Latta.

A Corner in the Lounge; The Floor is Terrazzo, a Mixture of Buff, Black and White

STATE HIGHWAY CULVERTS INSPECTED

By Henry B. Kenny, C. E.
Former Highway Engineer, State of Florida

I HAVE just recently completed one of the most unusual surveys which I believe has ever been made by a civil engineer.

It was an inspection of culvert structures, covering 3,800 miles of highways in the State of Minnesota. In our party were A. J. Sheldon, chief metallurgist of the American Rolling Mill Company, and R. E. Bergford, assistant testing engineer of the Minnesota Highway department. We inspected all types of culverts from the extreme southeastern section of Minnesota, north to the Canadian line. It covered a period of four to five weeks of intensive study and observation of the different types of culverts now in use in the Northwest.

I can truthfully say that I learned more about culverts on this trip of 3,800 miles than I have in all my 12 years of practical experience in highway work throughout the United States and Canada. I also have had some serious upsets regarding previous opinion of the best materials to use for culvert purposes.

In the mind of an engineer, the first thought is that concrete is superior to any other known material when a permanent structure is required. With this idea in mind, I will discuss first, our findings regarding concrete culvert structures and their ability to stand up under severe climatic conditions.

In the pre-cast type of concrete structure, known under Minnesota Highway specifications as P-1 and P-3, we found defects in quite large numbers. In most cases the primary defect which had developed in this type of culvert was faulting. In other words, the section had been forced apart and had permitted the earth to filter in, reducing the culvert area to a considerable extent. Note figure 1, showing this defect. Opinions of the party differed somewhat as to the direct causes to which we might attribute this faulting, and it could be the result of several causes. We could attribute it to poor installation, heaving of the soil causing the sections to separate, or to improper gradient. I believe it was due to hydraulic action and that it is impossible to overcome this faulting in pre-cast concrete structures where we have to contend with expansion and contraction brought about by frost action in the extreme climatic conditions of the Northwest. Several engineers of prominence have concurred with me in this opinion.

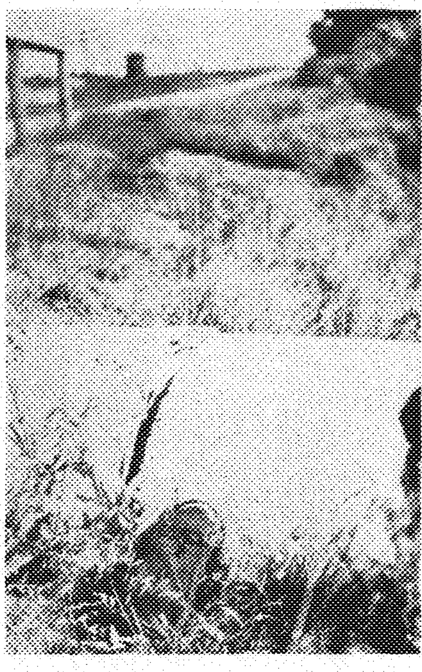


Figure 1. Faulting of Pre-Cast Concrete

In many instances the end sections had become detached and had fallen away from the main body of the culvert, which tended to obstruct the outlet and inlet, reducing the length of the pipe and setting up a new area of erosion which would ultimately undermine the succeeding sections.

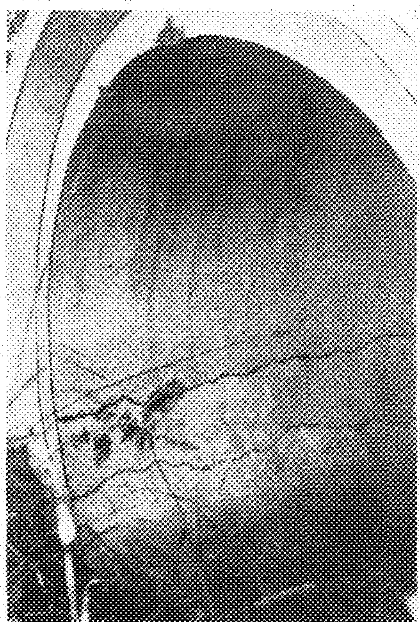


Figure 2. Erosion from Longitudinal Cracks

In many cases, we found longitudinal cracks. Some of these were large enough to permit erosion of the soil, and such erosion, of course, tended to block the waterway to a considerable degree. See figure 2. These cracks were due entirely to hydraulic action or to pressure of the soil surrounding the body of the structure.

Bear in mind that I am not citing isolated instances of these defects, but am summing up what we found in the majority of cases upon examination of the pre-cast type of culvert, and the photographs shown with this article are representative of the many embodied in the complete report.

In drawing my conclusions as to these more important effects, I say that an improvement in construction might remedy the faulting to some extent, or possibly greater care in the laying should be exercised. A more careful checking of the human element might possibly tend to circumvent the very disastrous result which the investigation indicated as being obtained by the pre-cast type of structure.

I understand that grouting between sections is recommended, but this will not remedy the difficulty of faulting where we have to contend with extreme climatic conditions which cause heaving of the soil. In other words, I do not believe that it is humanly possible to keep pre-cast pipe sections in perfect alignment where we have to contend with the heavy frost actions which take place in the soil of Minnesota.

We found some interesting monolithic or box-type concrete culverts of both the older type and of the newer design.

Figure 3 shows a large crack in a monolithic structure. I was indeed surprised to note how many instances we found cracks in this supposedly permanent type. Most of these cracks were found, of course, in the older style design, for it would not be possible for them to develop in the short space of time in which the new method of installation has been in use. While the results of the new type of construction are problematical, it is hoped that the difficulty in cracking will be overcome. However, it is reasonable to suppose that such defects may develop at a later period, basing one's opinion upon the conditions which have tended to cause these cracks in the older type of structure.

Figure 3. Cracking of Monolithic Structure

Opinions of the party differed somewhat as to the direct causes of these cracks, but indications were that hydraulic action, or in other words expansion and contraction of the concrete and the pressure of the soil, had tended to cause the defects. Of course, in some instances we could attribute the cracking to faulty installation which could also be attributed to poor concrete, such as improper mixture or poor aggregate. No doubt in many instances the gravel may have contained too much organic matter which would, of course, cause an eventual weakness of the structure. Such defects in construction and the use of poor materials are expected to be reckoned with wherever we have the human element to contend with.

In drawing my conclusions on this part of our survey of monolithic structures, I believe that benefit could be derived through more rigid and carefully drawn specifications, and more thorough and direct inspections on the part of the engineers while the culvert is under construction. However, no matter how well constructed or how closely drawn the specifications may be, we still have natural forces to contend with, and the action of natural forces is an unknown factor and may be the means of developing a failure in the monolithic structure under the extreme climatic conditions that such a structure is subjected to in Minnesota. This opinion is drawn from the hydraulic action on concrete in other structures as well as culverts, and is based on past experience as well as the thought that man has never successfully resisted the forces of nature.

In certain sections of the state where alkali predominates in the soil, we found that the alkaline action had been a very destructive force on concrete culverts. In quite a number of cases, this action had been so pronounced that practically the entire floor of the culvert had been eaten away, exposing the reinforcement. This is shown in figure 4. In many other cases which came under our observation, the alkali had completely disintegrated different parts of the culvert, and in some spots the concrete could be easily removed with the hands, coming away in a dry powdery form.

Analysis of the alkaline waters in which several of these defective structures were found show the following:

Calcium Chloride	4.50 per cent
Magnesium Chloride	11.20 per cent
Magnesium Sulphate	3.90 per cent
Sodium Sulphate	80.40 per cent

Space will not permit me to discuss fully my findings as to the action of alkali on concrete culvert structures, but I refer the reader to an interesting article on this subject in the June issue of Public Roads. This publication is issued by the United States Department of Agriculture, and the subject matter of the article is Volume Change and Measure of Alkali Action, by Dalton G. Miller, Sr., drainage engineer, United States Bureau of Public Roads. It is a scientific and complete investigation of the affect of alkali upon concrete measured by changes in length.

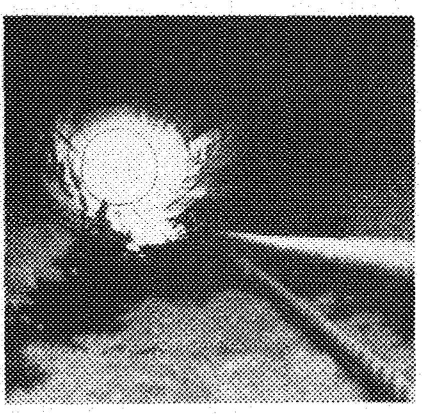


Figure 4. Concrete Disintegrated by Alkali

Corrugated metal culverts are recognized by highway departments all over the United States as standard for culvert structures, and are also being adopted by a great many of the large railroad companies. We found numerous installations of this type, and I was impressed by our discovery of corrugated metal's ability to stand up when used for culvert purposes.

I want to admit to you, before going into the details regarding our findings of the corrugated metal culvert, that as an engineer I went into this investigation with the preconceived idea that a metal culvert could not be considered as a thoroughly permanent structure. This idea was imbedded through the course of training which I had received during my schooling, as well as from the lack of text books regarding corrugated metal when used for drainage purposes. I think we engineers will have to admit that unless we come into direct contact with corrugated metal culvert installations, we have inadequate means of obtaining accurate knowledge regarding their efficiency, other than drawing upon hearsay or upon the experience in the actual installation of this particular type of culvert.

Note figure 5 of a corrugated metal installation, installed 16 years ago. The culvert shown in this photograph was manufactured from a 98.84 per cent pure iron, with a two ounce zinc coating. This culvert was found to be in perfect condition without any signs of deterioration or indications of rust or corrosion. In fact the zinc galvanizing was still intact. We examined many pure iron culvert installations and failed to find one instance where a pure iron corrugated culvert had failed.

We inspected these installations under severe conditions. In one instance, a farmer told the investigating committee that the culvert we were examining in an alkaline section had been in the ground for 18 or 19 years. In this particular instance some of the galvanizing had been removed, but no destructive corrosion had set in, and the basic metal was in practically perfect condition. The majority of pure iron culverts inspected also were in perfect alignment, showing no deflection due to weight of fill or hydraulic action.

I have made up a set of percentage figures, based upon our investigation

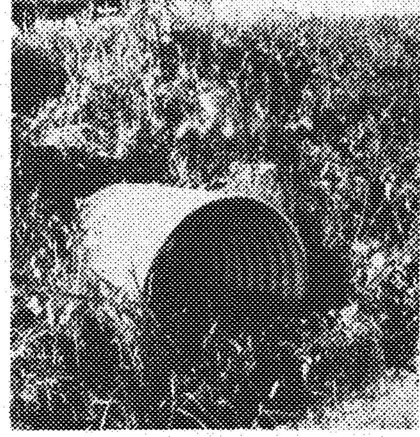


Figure 5. Metal Culvert Used 16 Years

of the different types of culvert structures, but space will not permit its being printed in this publication. However, figures shown in the tables indicate that over 90 per cent of the pre-cast structures examined showed defects, while in corrugated pure iron culverts only 1.05 per cent really showed any substantial defects. A similar set of deductions can be drawn upon the monolithic type, although it is not possible to indicate the total sum of structures which we examined, for in this case sufficient field notes were not taken. I would assume from my own opinion that we thoroughly examined sixty-five monolithic structures, and the majority showed some defects.

Concluding, I believe that the corrugated metal culvert, when manufactured from a pure iron metal, is going to be the successful installation of the future.

This investigation has convinced me that Mr. Caudle, assistant engineer of structures of the International Great Northern Railway, was entirely correct when he stated in California recently that "The flexibility of the pipe which will care for the uneven settlement of pressure on any part of it, the elimination of the danger of uncoupling the joints and the probable life of 25 to 30 years or longer, leads me to the conclusion that corrugated pure iron pipe is superior in every detail and much more economical than either cast iron pipe or reinforced concrete pipe for small waterways."

This inspection trip brought home very forcibly the fact that Minnesotans may well be proud of their good roads and their highway department.

Usually, an inspection journey of this character would be characterized by travel over some of the worst roads imaginable. But that is not the case in Minnesota.

Here is a state known internationally for its roadways. And yet it has less than 500 miles of paved highways, and spends less upon the development of its highway system than any other state.

However, it has over 100,000 miles of well graveled roadways, and these are kept in excellent condition at all times.

The system under which Minnesota operates, known throughout the civilized world as the "Babcock System," was inaugurated in 1905. At that time, C. M. Babcock, then a merchant in Elk River, Minn., formed an association of merchants and farmers in that city for the purpose of stimulating the construction of good roads in that vicinity. The results procured by this association were so remarkable that they attracted statewide attention, and led to the later appointment of Mr. Babcock as state highway commissioner.

Prior to this time, through the joint efforts of Mr. Babcock and the late Robert C. Dunn, then state senator, and afterwards state auditor, an act creating a "State Aid Roadway Fund" was passed, and by the terms of this act three commissioners were empowered to carry out its provisions.

However in 1921, this portion of the administration of the act being found somewhat cumbersome, the commission was abolished and all authority was centered in a single commissioner, Mr. Babcock being appointed to this post. As a matter of fact, he had always been the guiding genius of Minnesota roadways, to such an extent that he has become known as the "father of the Minnesota roadway system."

It is largely due to Mr. Babcock's genius and to the admirable law framed at his instance that Minnesota has accomplished such exceptional results in highway construction and maintenance.

In 1921, when Mr. Babcock was made sole commissioner of state highways, this department was small. However, he had the basis of exceptional service in the state highway act, under the terms of which the wealthier counties of Minnesota were compelled to aid the poorer ones in roadway construction and maintenance, and he utilized this advantage to the fullest possible degree.

His first act was to establish a proper system of roadway maintenance. This had for its purpose prompt service, especially to the poorer sections of the state, and in order to insure this he recruited a force of approximately 1,000 highway patrolmen in and near these several districts where roadway maintenance was undertaken.

The first task to which the department addressed itself was to make all existing roads passable, and then reasonably travelable. As a result, within ninety days from the day of his appointment as sole commissioner, over five million dollars' worth of construction work had been begun.

Within the four-year period from that time to this, a unified system of Minnesota roads—all of them good, although relatively few of what is called the "most modern" type—had been practically completed, and all this under the direction of a man holding a $6,000 a year job—not in politics.

But then, no modern miracle of this nature could have been brought about under a political regime, and that is probably one of the main reasons why Minnesota has produced such a miracle.

In one year, Commissioner Babcock succeeded in constructing 4,000 miles of rural boulevard. Within two years, he had a comprehensive modern highway system of over 7,000 miles which included over 400 miles of modern pavement. And while accomplishing all of these record-breaking performances, he consistently reduced the cost of road building to the taxpayers.

Today, tourists traveling through the Northwest solace themselves, when encountering stretches of bad roads in nearby states, with the remark, "Wait until you get to Minnesota, and you will find good roads, not only in spots, but everywhere."

And that is true. And it is known far and wide to such a degree that one of the leading officials of the Soviet government in Russia recently, while talking to an American, remarked that he had heard so much of the good roads in Minnesota that he desired above all things to obtain additional and complete information regarding the Babcock plan.

Speaking before a group of Minneapolis business men, a representative of the Belgian government told his auditors that the fame of Minnesota's roads had penetrated to his own country, and that, upon coming to the state and seeing its famous highways, he was prepared to return and corroborate all of the good reports he had heard regarding them.

Not long ago, a group of Norwegian and Swedish engineers came to Minnesota especially to inspect its roads and obtain information regarding them and the method of their construction.

These are only a few instances showing the remarkable fame achieved in a short time by a man who, without prior experience, applied common sense and businesslike methods to the problems of road construction, and who had foresight and acumen enough to disregard red tape and establish precedent, when that was necessary, and to employ the best engineering brains available to aid him.

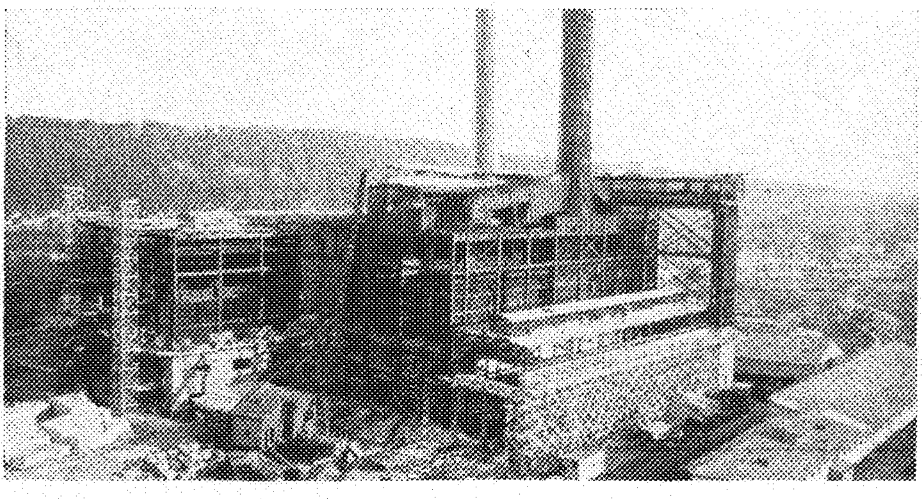
The journey was replete with interesting incidents, to which I would like to refer but am forbidden by space requirements.

HIGH BRIDGE PLANT BUILT IN ST. PAUL

By Carl M. Glidden

Former Techno-Log Advertising Manager

ERECTION in St. Paul of the High Bridge steam power station of the Northern States Power Company indicates a steady growth of central station business and assures greater continuity of service to towns and cities of the Northwest. It is on the north bank of the Mississippi near the point where the High bridge crosses the river. This place was particularly well chosen from a distribution standpoint, because current is sent out in several directions to the southern power loop through Faribault, to and from Wisconsin and both ways into the 110,000-volt power loop about the Twin Cities. Its proximity to the river for water and to the railroads for coal are another advantage.



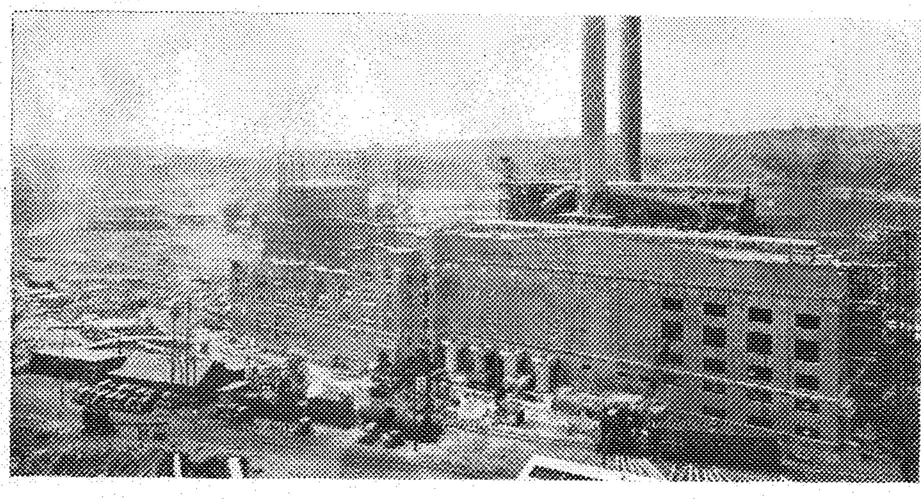
Picture Taken from High Bridge About July 15; Boilers are Shown Directly Beneath Stacks

The property contains 55 acres which a year and a half ago was a marshy tract in the river bottom, and which has been transformed into one of the most efficient generating stations in the country by the use of 6,900 tons of steel and 40,000 tons of concrete. The structure itself is 404 feet long by 275 feet wide, and its foundations extend 35 feet below the low-water stage of the river. It presents a red brick exterior finished with cut stone. The electrical galleries, which are six stories high, have been constructed to take care of one-half of the ultimate capacity of the station and are located midway of the building on the south side.

The central section of the building houses two 30,000 kilowatt generators, their condensers and all the pumps for the station, with the equipment for each unit entirely separate. The closed type of air washer has been used. The oil for lubrication of all bearings is kept clean by circulation through a continuous-type filer.

The pump room occupies the north side of the first floor, and all its equipment is easily reached by the 5-ton crane which covers this bay, and by the 100-ton crane which travels over the entire section. The condenser pumps require 300 horsepower to operate and are rated at 41,000 gallons per minute. Here, where 300,000 pounds of steam are condensed each hour, an electric resistance device is installed which immediately indicates condenser leakage. With the information supplied by this instrument, the introduction of excessive raw water into the boilers can be eliminated at the first opportunity. Without such a device, leakage of this nature is not evident until it has reached an excessive stage. The total water required for steam, condensing and cooling at a maximum load is 118,000,000 gallons per day, which is roughly 1½ times the amount used by St. Paul and Minneapolis combined. This fact explains the necessity of building the plant close to an adequate water supply. Three travelling screens on the river bank filter the water. The machine shop is on the same level as the turbine room, which allows the crane to move material easily.

The building has been designed so that there is sufficient light at all working points. Full skylights span the roofs of the turbine, boiler and coal handling wings, and walls of grey brick and white tile are an aid. The most modern design of artificial lighting has been provided, and the supply for this comes from a motor generator set with a storage battery floated on the line, thus insuring light at all times.



On August 2, With Operating Galleries on Extreme Left and Main Offices on Extreme Right

The third section extends beyond the main station to the east and is six stories high. Here are housed the officers, cafeteria, locker rooms with shower baths, warehouse, repair shops in one end; reactors, oil circuit breakers, 13,200 volt busses and reactors, station transformer banks are in the other.

Station economy has been taken care of in the design and arrangement of equipment in such a way that continuity of service has in no way been sacrificed in the attainment of high efficiencies. On the contrary, no piece of apparatus has been able to justify its incorporation in the plant layout unless it has been proven successful and is entirely out of the experimental stage.

Storage capacity is provided for 175,000 tons of coal. Five miles of tracks and the latest coal handling equipment will facilitate the handling. The coal is brought into the coal handling wing of the station by rail and dumped into bins under the tracks. Below these there are two apron conveyors which feed the coal into interchangeable crushers. Two bucket conveyors then elevate the coal up and over the boiler room to belt conveyors, which deposit it in the hoppers above the motor driven stokers. This carrier equipment is capable of handling 240 tons an hour.

There are eight boilers of 1877 brake horse power each, equipped with underfeed stokers and clinker grinders of ample volume to quickly develop full capacity so that proper combustion can take place without excessive temperature and smoke. This results in lower stoker and furnace maintenance costs, as well as higher combustion efficiency. Controls for the boilers are unified and so arranged that sufficient boiler capacity to furnish steam for the operation of one 30,000 kilowatt unit is within easy control of one man. The grinders are used for the first time in the Northwest. Each boiler has an individual motor driven force draft fan. By using a radiant and convection superheater, the steam is delivered to the mains at a pressure of 300 pounds and at the temperature of 700 deg. Fahrenheit. This superheat is a highly desirable quality and allows for turbine water rates of less than ten pounds per kilowatt-hour. The station heat balance is maintained by bleeding steam from the turbine and by the use of steam and motor driven auxiliaries. Ashes are dumped direct to cars below the grates. Two steel stacks 25 feet in diameter, extend from 100 feet above the ground to a height of 285 feet.

ENGINEERS' BOOKSTORE PAYS MEMBERS NEARLY $17,000

By Dean W. Rankin
Chairman of the Board, Engineers' Bookstore

HERE are the figures! The amount paid out to members of the bookstore since its organization in the spring of 1920 is $16,809.61. The dividends paid out annually have increased from $2,460 at the end of the first year to $5,900 at the end of the fourth year. This figure divided among 1,090 members gave an average dividend of $5.43.

Now you may get some idea of what the bookstore is doing for its members. It is turning back each year to them an amount greater than that of the $5 deposit. The store has been able to do this because of the confidence placed in it by the student body. It is not by any accident that the sales for the past four years have exceeded $200,000; this is explained by genuine service given to engineering students and by management during these years by men keenly interested in the store's welfare.

The bookstore is not a part of the University, nor has it sprung up over night. As far back as 1914 the Engineering Student Council attempted to purchase books and supplies through the University purchasing department in an effort to save money for the student body which at that time amounted to about 400. Later on, in the fall of 1915, the Student council was able to purchase books through the Minnesota "Co-op" at 15 per cent off list prices. It can be readily seen that with such a plan it was rather cumbersome to take care of over 200 upper classmen, and accounts were seldom closed satisfactorily. During that period, there were many freshmen who were not helped because of the difficulty in ordering. The first-year men at the present time, however, are greatly benefited by their membership.

The plan just mentioned worked fairly satisfactorily until the fall of 1919, when greater enrollment added increased difficulties to handling the needs of the students. The Association of Engineering Students, which was the forerunner of what is now the Technical Commission, was fully aware of the problem before them. Data was gathered from schools in different parts of the country in order to more intelligently face the problem, and Howard Jacobson, the present manager of the bookstore, then president of the association, was one of those who were instrumental in forming plans for the organization of the store. The first board of directors was elected by the association in May, 1920, and was organized under an amendment to the by-laws of the association. Mr. Jacobson was appointed as manager June 1, 1920.

The faculty members of the 1924-25 board are: C. A. Mann (Chem.), J. H. Forsythe (Arch.), O. S. Zelner (Civil), appointed by Dean Leland. The student members are: John A. Banovetz, E25 Civil, Russell E. Backstrom, E25 Mech., Arthur F. Christensen, E25 Elec., Stanley M. Heins, Bus.25, Ernest E. Jewett, C25 Chem., Dean W. Rankin, E25 Arch.

Statement of May 31, 1924

RESOURCES		
Cash	$ 359.42	
Bank	2162.42	
Cert. of Deposit	5000.00	
Total Cash		7521.84
Accts. Receivable	70.00	
Office Equipment	378.00	
Office Furniture	5.00	
Store Furniture	66.00	
Total Fixed Assets		519.00
Rental Outfits Caps and Gowns		1100.00
Mdse. Inventory		7762.40
		17,067.51
LIABILITIES		
1921 Dividend	77.55	
1922 Dividend	143.22	
1923 Dividend	276.67	
1924 Dividend, payable Oct. 1, 1924	5781.32	
Total Dividend Unpaid		6278.76
Vouchers Payable		963.46
Deposits Caps & Gowns		95.00
Membership		5870.00
Surplus		3860.29
		$17,067.51
INCOME FROM SALES		
Net Sales		$56,085.41
Cost of Sales		42,198.00
Profit from Sales		13,887.41
Interest Received		204.98
Gross Profit		14,092.39
Operating Expense		
Salaries	5,544.96	
Supplies	290.53	
Advertising	292.43	
Other Expense	495.06	
Total Operating Exp.	6,622.98	
Fixed Charges	213.40	
		6,836.38
Profit for Distribution		$7,256.01

ARTILLERYMEN TRAIN AT FORT MONROE

By Herman F. Beseler

Member of the Senior Mechanical Class

ONE night last June, fifteen embryo reserve officers of the Coast Artillery Corps boarded the "rattlers" to begin a long trip to the Fort Monroe, Virginia, R. O. T. C. summer training camp.

The journey to Washington was a rather quiet one, that is, quiet for the passengers at the other end of the train. We had been on the train only a short time before there was a well organized attempt to make a little harmony.

"Steve" Stevens assumed command of the group when we arrived in Washington and proceeded to show us around the city to the best of his "inability." He was unable to understand the Southerner's brogue when inquiring directions and soon "bawled up the detail" (speaking in military terms). We then rebelled from his fatherly guidance and proceeded to see the town by the "majority rule" plan. We spent the day around Washington and managed to get away in the evening without any of our bunch having been persuaded to buy the Washington monument.

The trip to Fort Monroe was made on a boat down the Potomac river through Chesapeake Bay, and the pleasant evening spent on the historic Potomac will be long remembered. Early the next morning the boat arrived at Old Point, where the fort is located, and our journey was ended.

An army truck met us at the wharf and we all climbed onto it, some of us finding it necessary to hang on by our teeth, it seemed. At the R. O. T. C. camp we were greeted by several other University of Minnesota fellows who had successfully negotiated the hazardous trip over the mountains in a four wheel no-brake excuse for an automobile. The necessary procedures such as the physical examination and issue of equipment were soon over, and the next task was the pleasant one of getting acquainted with the two hundred and fifty fellows from other schools.

The second day we were in camp we heard a rumor that there was a summer resort and amusement beach across the bay, so that evening about ten of us from Minnesota set out to investigate the truth of the matter. We boarded a small passenger ferry and were out in the bay only a few minutes before a terrific storm broke loose with all its fury. The waves rolling in from the sea grew bigger and bigger and tossed our little boat about like an egg shell. The incessant flashes of lightning piercing the blackness of the night presented a scene to us that we shall never forget. The pitching of the boat, combined with the terrific wind, made it difficult to stand on the upper deck, but we managed to cling to our seats, or the rail, or whatever object bobbed up next, till we were safely tied to the wharf. The first attempt to tie up at the dock was unsuccessful, and it seemed that the wind and waves would send the boat crashing into it. After the boat had been tied, a few passengers managed to scramble over the tossing gang plank, but the rest were compelled to stay aboard until the angry waters had subsided somewhat. The few passengers who got off at first found it necessary to lie down flat on the dock and brace themselves against the piles because the wind was so terrific that the danger of being blown into the water was great. We spent a couple of hours at Ocean View beach, and then returned to camp again on the same ferry, the water being comparatively calm by that time.

"Carry Me Back to Old Virginy" Recalls Pleasant Memories to These Reserve Students Who Returned to the University this Fall After Winning Athletic and Military Honors

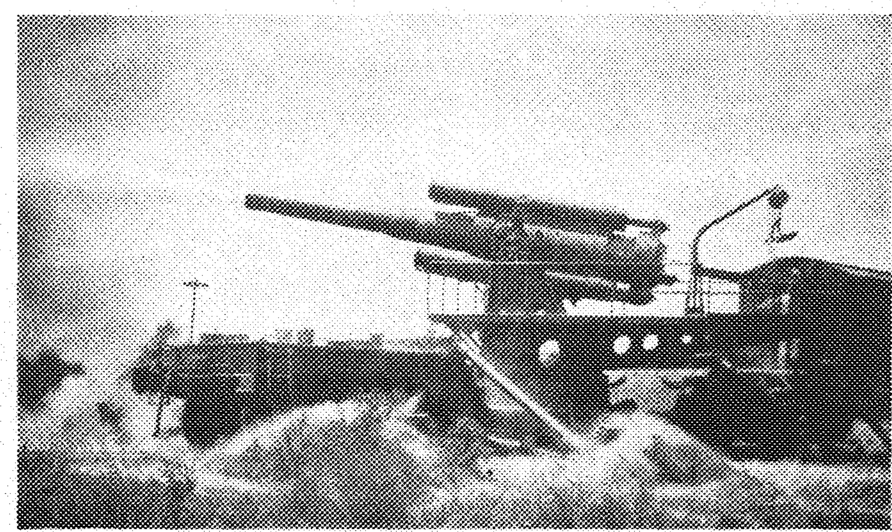
The first week at camp was devoted to rifle and pistol practise, and it may be truthfully said that the Minnesota bunch can be congratulated for the number who received qualification medals for marksmanship. Some time was devoted also to machine gunnery.

After a week's practise with dummy shells and dummy powder bags, we began to lay down a veritable barrage of gun fire into Chesapeake Bay. Nearly every type of gun at the fort was fired; the twelve inch mortars, the ten-inch disappearing rifle, the French 75mm. and 155mm. field guns, the three inch anti-aircraft rifles, and the fifty caliber machine gun. To one who has never seen a big gun fired, this course presented no small amount of interest and excitement. Incidently it might be mentioned that, as far as our marksmanship with the big guns was concerned, a man would have been as safe on the target as on the tug that pulled it.

The fifth week was spent at Fort Eustis, fifteen miles inland from Fort Monroe, where nearly all the railway-mounted guns owned by the U. S. are kept. While at Fort Eustis, our battery, "C," emplaced and fired the eight inch railway-mounted rifle, while the other two batteries worked with the twelve inch mortars.

The few days remaining of the summer's camp were spent on the field at Fort Monroe. The students participated in athletic efficiency tests and competitive infantry drill.

While the regular course of instruction was in itself very interesting, numerous activities made camp life enjoyable. Being located as we were in the heart of historical and aristocratic old Virginia, many places of interest were easily accessible. Three trips of especial interest were enjoyed: to the Navy Yards at Norfolk, to Yorktown of Revolutionary War fame, and to Jamestown, where the first permanent English colony was established. At Yorktown, a couple of round cannon balls which were shot during the siege of the town may be seen still imbedded in the brick walls of the old General Nelson mansion.



Battery "C" Men From Minnesota Firing An 8-Inch Railway-Mounted Rifle at Fort Eustis

A small, square brick structure greets the stranger in Yorktown today, as it did over two hundred years ago. The building was erected in 1715, and was the first customs house in the country. Also, as an observing fellow remarked, just across the street from it is the "First National Bank."

Williamsburg is historically perhaps the most interesting village in the country, and it is only a short distance from Fort Eustis. The second oldest college in the country, William and Mary College, is situated there. Phi Beta Kappa was founded at that institution in 1776.

A field meet, baseball games, and tennis matches furnished competition among the batteries; baseball, of course, created the most excitement. Battery "C" won the tennis championship, due largely to the efforts of Arndt Duvall, who won the individual championship.

Outdoor sports received the most attention, but the indoor "sports" were not neglected. An opportunity was given us once every week to star on our field of glory, the waxed ballroom floor, at a dance given in the attractive ballroom of the Coast Artillery School building. Each dance was a good one, due to the efforts of the camp hostess, Mrs. Mc. Nickel, who was a real mother to the whole R. O. T. C. Contrary to an accepted military axiom, it may be said that on those occasions, the greater the number of "misses," the greater the number of "hits."

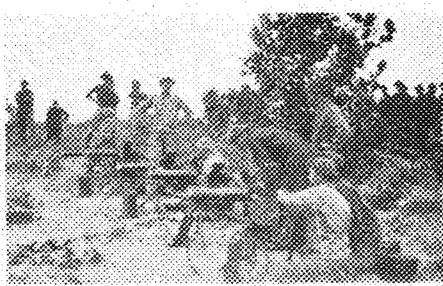
Buckroe Beach, a famous summer resort, is up the beach about three miles from Fort Monroe, and it was nightly the rendezvous for many R. O. T. C. men. "Phil" Hartmann is generally conceded to be the best authority on how to spend the evening at Buckroe, get a ride back to camp in some "dame's" sedan, and then successfully evade the officer who makes the bed check.

Practical jokers can be found in any crowd, and the Monroe camp was no exception to the rule. Perhaps the most difficult problem experienced by any fellow was that of finding his cot after coming home from a dance or date. One sometimes had to climb about the rafters to collect sufficient parts of his cot and bedding on which to sleep the rest of the night.

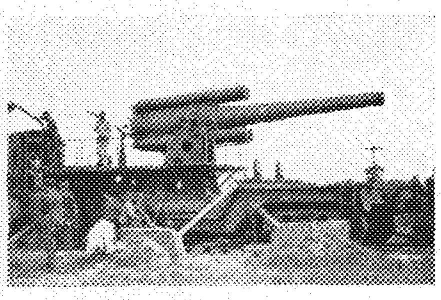
Preparedness is the motto of the army, it is said, and the boys were no slackers in some respects. Frequently a gang would mobilize and start a fire drill. Each man would run to one of the hand pumps and in a few minutes the streams of water shooting out of the windows made the barracks look like a New York city fire boat in action. As there never was a real fire, and practice was essential, it often became necessary for the rival upper and lower floor inhabitants to wage a water fight. And no matter how drenched their clothes became, their spirits were not dampened until some officer had mustered up enough courage to brave the spray and restore peace and order again.

On July 30, the camp was over. Most of the fellows who drove cars down discovered that with a little coaxing their abused machines would still give an occasional wheeze, so they climbed in with their luggage, and all of Uncle Sam's they could get away with, and started homeward. Many of the fellows took the ocean trip to New York City, and from there, a few continued northward to Montreal, and returned to Minnesota via the Great Lakes. The sentimental old song, "Carry me back to Old Virginy," recalls pleasant memories.

The Range, Where Herman Beseler Excels



Pouring Lead From Machine Guns



Ready to Fire the 8-Inch Rifle

O. M. LELAND — ENGINEER AND EDUCATOR

By M. Alden Countryman

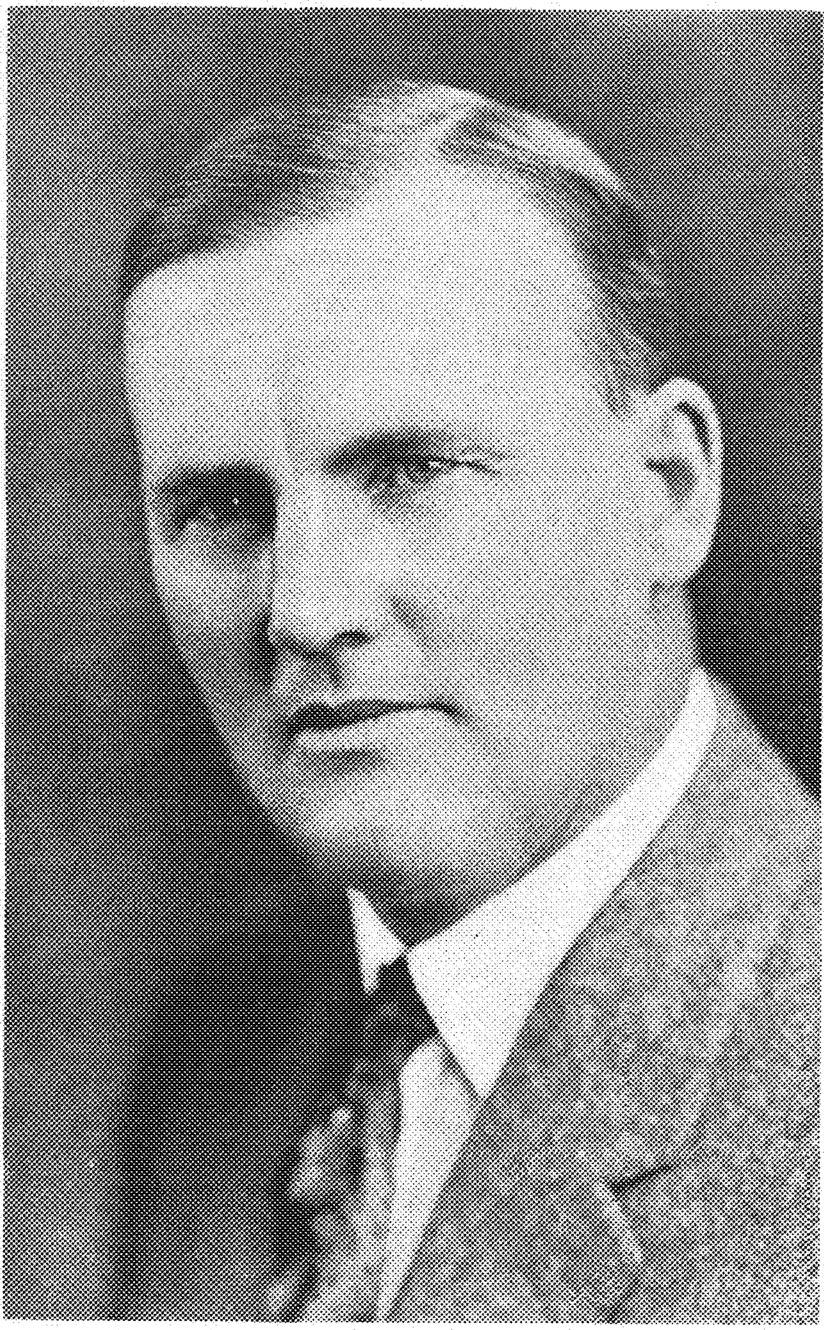
Member of the Senior Electrical Class

ORA MINER LELAND, dean of the College of Engineering and Architecture and the School of Chemistry at the University of Minnesota, was born at Grand Haven, Michigan, June 28, 1876. He came from an English family which settled in America in 1652.

He received his professional degree of civil engineer from the University of Michigan in 1920, having taken graduate work in structural engineering. His preliminary work was at the same institution, where he graduated with the class of 1900. While he was attending the Michigan engineering school, he specialized in geodesy and practical astronomy.

His professional work as a civil engineer has extended from the tropical regions of the Panama Canal zone and Porto Rico to the ice-coated international boundary between Alaska and Canada. In addition to his widely varied activities on the North American continent, he served as captain, major, and lieutenant-colonel with the A. E. F. in France, Belgium, and Germany during the World War.

Prior to his graduation from the University of Michigan, he served as chief clerk and draftsman for the United States Surveyor General of Florida, where Mr. Leland had headquarters at Tallahassee. After graduation he again entered government service, first with the Coast and Geodetic Survey, and then in the General Land office in Washington, examining surveys.



Ora Miner Leland

At Cornell University Mr. Leland became a civil engineering instructor in the fall of 1903 and he was connected with the teaching staff at Cornell continuously until 1920, when he came to Minnesota to head the College of Engineering and Architecture and the School of Chemistry.

Exploration of virgin territory, with its accompanying hardships and loneliness, occupied his summer vacations for several years while he had charge of the demarcation of various sections of the boundary between Canada and Alaska, our northernmost possession. In the winter he maintained an office in Ithaca, New York, in connection with this work.

Chief Justice White of the United States supreme court in 1911 appointed Mr. Leland a member of the arbitration commission which settled the Costa Rica-Panama boundary dispute. Again in 1921 he was appointed by Chief Justice Taft to a commission on the same boundary question.

In 1920 he engaged in professional practice in the service of J. G. White Engineering Corporation of New York City, in the capacity of engineering supervisor.

His war record is as outstanding and patriotic as his government connections in time of peace. When the United States entered the conflict in April, 1917, he joined the Corps of Engineers and held the rank of division engineer with the 78th division in France, and later with the 89th Division in Belgium and Germany. After serving his country both in peace and in war he stands ready for an emergency as colonel of engineers in the organized reserve.

At Minnesota Dean Leland guides the destinies of over 1,000 students.

SEARCHING FOR COPPER AND ADVENTURE

By Alva J. Haley

Member of the Senior Mines Class

LEAVING Minneapolis at 2:30 p. m. on the Chicago Great Western, Friday, May 16, the mines class of 1925 started on the trip upon which our hearts had been set for many a month, under the supervision of professor P. Christianson, E. H. Comstock, and W. H. Parker of the departments of metallurgy, mine plant, and mining, respectively.

Arrangements had been made by the faculty to have a "private" tourist sleeper, which was hooked on the back of the train most of the time until we reached El Paso. A bridge game progressed far into the first night and probably disturbed the balance of the party which vainly sought Morpheus. This was soon forgotten, especially by the offenders, on reaching Kansas City the next morning, where our meanderings up town soon became tiresome and we were glad to get back on our car, attached to the westbound Santa Fe, and embarked for La Junta, Colorado, and points north. On this part of the journey the time was spent largely in the bowling game, which "Vic" Mann and "Beanie" Larpenteur invented.

Arriving all safe and sound in Colorado Springs Sunday morning, the crowd split, most of us hiring a Pierce Arrow touring car and driving around to see the sights, including the Seven Falls, Garden of the Gods, the Cave of the Winds, and Pikes Peak.

The next morning we were loaded into cars headed for the Pikes View coal mine. After obtaining much information at this place, we motored back to town, had lunch, and hiked out to the Golden Cycle Mill. Here we followed gold-bearing ore through the processes of milling and cyanidation. Most of us were seeing a mill of this type for the first time.

Our train left that evening for El Paso, via Alburquerque, New Mexico. This was the dullest part of the trip. We arrived in El Paso Wednesday morning and went out to the Consolidated Kansas City smelter in the afternoon. This handles both copper and lead ores, the metallurgy of which are somewhat similar.

Since Cuidad Jaurz was just across the river, it was only natural that we should spend the time from right after dinner until 9 p. m., the limit, in this most beautiful (?) of Mexico's cities. The next morning the group left on the Southern Pacific for Cachise, Arizona, leaving "Shorty" Sherman and Al Haley to go direct to Bisbee on the El Paso and Southwestern. According to those who went on the Southern Pacific, they were transferred to Studebaker stage coaches at Cochise, and made a tiresome journey south to Bisbee. Since the whole drive was through the desert, the season late May, and the day clear, the thermometer rose to 110° in the shade (but where, oh where was the shade?), the enforced layover for a couple of hours in McNeil was anything but their idea of a pleasant time. The stage arrived in Bisbee late that afternoon, where the weather was much nicer. From the next morning on, our work began in dead earnest.

Parker Lidnholm Jensen Comstock
Hennen Larpenteur Ruhnke Mann
Scheid Olson Sherman Haley Sodoma Kendrick

In Bisbee we saw the Diesel power plant in the Copper Queen branch of the Phelps Dodge Corporation, the new Copper Queen concentrator, the power plants of the Junction mine (the largest of the Calumet and Arizona's holdings), and the Sacramento mine owned by the Copper Queen.

About this time the miners and metallurgists were divided into separate groups and we continued our respective work independent of each other. The metallurgists, after visiting the Shattuck mill at Bisbee and spending a couple of more days at the Copper Queen Concentrator, left for Douglas, where they studied the intricacies of the Copper Queen smelters. The miners spent most of the remaining time under ground at the Junction and Sacramento mines. We were treated with courtesy at these mines and it is hoped that the succeeding classes of the School of Mines can have the opportunities which we had on this last trip. The superintendent, Mr. Whitley, and the assistant superintendent, Mr. Rait, of the Calumet and Arizona mines are Minnesota graduates.

On completion of our field work, the party broke up. "Shorty" Sherman, "Don" Ruhnke, Lloyd Kendrick and "Stan" Olson returned to Minnesota; "Beanie" Larpenteur found work in a lumber mill in Bend, Oregon; "Bill" Jensen left for Coeur d'Alene; Harry Winters went to the Nevada mint; "Chuck" Scheid left for Milwaukee, where he was employed in a steel mill; "Ed" Hennen and "Vic" Mann stayed in Bisbee to work in the mines; and "Joe" Sodona and "Al" Haley went to Butte. These various destinations were all reached via Los Angeles, San Francisco, Portland, Seattle, and Vancouver, ending one of the most valuable parts of our curriculum.

The
MINNESOTA TECHNO-LOG
University of Minnesota

ALBERT W. MORSE, MANAGING EDITOR

Herman F. Beseler - - - - - Alumni Editor
Clyde W. Lighter - - - - - Architectural Editor
James M. Sutherland - - - - - Chemical Editor
Harold C. E. Peterson - - - - - Civil Editor
Kenefick Robertson - - - - - Electrical Editor
Leonard Kleinfeld - - - - - Mechanical Editor
Thomas F. Andrews - - - - - Mines Editor
Russell S. Grant - - - - - Humor Editor

Special Writers

Marshall H. Coolidge, Jr., Alva J. Haley, Philip F. Hartman, Joseph E. Meagher, Carl C. Nelson, Paul B. Nelson.

Assistants

Erling A. Amundsen, Willard H. Nordenson.

RICHARD W. JONES, BUSINESS MANAGER

Norman R. Moore - - - - - Advertising Manager
Marvin C. Rogers - - - - - Circulation Manager

Assistants

A. S. Bull, A. L. Christensen, G. M. Lange.

Faculty Advisers

Prof. A. S. Cutler, Prof. C. A. Mann.

For the Greater Minnesota Technology, the institution which today is being constructed in mortar and brick, and which tomorrow will send into the world men recognized as the leaders of industry; for this The Minnesota Techno-Log stands, and to this end the staff devotes its thought and energy, always keeping foremost the welfare of the University.

ONE hundred years have passed since the founding of the first college providing education along engineering lines. Stephen Van Rensselaer established in 1824 at Troy, New York, Rensselaer Polytechnic Institute with the aim to apply science to "agriculture, domestic economy, the arts and manufacture."

Although agriculture was the most important study in the opinion of Mr. Rensselaer, engineering subjects were not neglected in the curriculum. Courses in surveying and hydrostatics were introduced in 1825, and in 1826 general engineering and civil engineering were established as regular courses of study. Mining engineering was later taught. In 1826 the civil engineering course was extended from three to four years, and mechanical engineering was introduced. So it can be said that Rensselaer Poytechnic Institute was essentially as complete in its curriculum at the time of the Civil War as any technical college is today.

The influence of Rensselaer Poytechnic Institute has been apparent in other engineering colleges. In the East this is evident from the fact that the first courses of study established at the Massachusetts Institute of Technology were nearly identical to those at Rensselaer the same year.

Alumni of Rensselaer have held professorships at the universities of Arizona, Colorado, Iowa, Louisiana, Minnesota, Missouri, Texas, West Virginia and Wisconsin.

Stephen Van Rensselaer was indeed the Father of Engineering Education.

AN INVENTORY of The Minnesota Techno-Log at the close of the fall quarter, 1924-1925, discloses several developments which the managing editor believes are indicative of a certain amount of progress.

The dream of years past, an adequate and convenient office, was realized early in the summer, when the faculty of the electrical department granted an urgent request for the use of a room in the new building. This relief came only after a comprehensive survey had been made of the entire main campus. Room 37, the office, is in the front part of the basement, and the almost constant stream of students passing past the door makes possible a closer contact with the student body than could be maintained when four flights of stairs had to be negotiated before reaching the former office on the top floor of the main engineering building.

Two additions have been made to the office equipment. One, that of an old roll top desk, is important from the historical standpoint as well as from that of utility. This desk was the "original" one, as far as it is possible to determine, as it was used by the staff of the old Minnesota Engineer. Its many pigeon holes again contain copy for the technical magazine of the engineering colleges, and the venerable piece of furniture appears to be glad that it once more is associated with campus journalism. Then there is a table sufficiently large to accommodate the multitude of budding authors who deluge the managing editor with interesting articles.

Upon examining the magazine itself, several changes are at once evident. It is worth noting, for instance, that there was an October number this fall, the first one in the history of the magazine, and that it appeared on the campus before October first. In fact it was the first student publication on the campus this fall. The body stock of the Techno-Log is without equal in any other similar publication in the country; it reproduces halftones and type with maximum beauty and clearness, a fact remarked upon by several advertisers. The use of colored ink in adding a touch of red is a refinement which makes the Techno-Log distinctive. A new cover design, conceived by Minnesota students in the department of architecture, makes possible a two-color cover with a new campus sketch each month. The cover stock is worthy of note, since it is a change from the paper formerly used.

The erroneous idea that a magazine office should be littered with waste paper, an idea which many persons seem to have, is not true in the Techno-Log office. The managing editor believes that the neatness of the office is reflected in the work of the staff, and an effort is continually made to have the room orderly. An aid in this work is the collection of etchings belonging to S. Chatwood Burton which hangs on the walls. Professor Burton has kindly loaned these pieces of art to the Techno-Log, and the admiration of them shown by visitors is a source of pride for the staff.

In recognition of their interest and actual assistance in the development of the Techno-Log this fall, the managing editor wishes to thank Dean O. M. Leland of the College of Engineering and Architecture, Prof. F. W. Springer of the department of electrical engineering, and Clarence W. Teal, managing editor of the magazine last year.

NEWS FROM THE ENGINEERING CAMPUS

REPRESENTED IN ATHLETICS

DURING the past year, many students from the technical college have been prominent in the various branches of athletics. Those on the football team were Roger Wheeler, Chem. '26, regular end, Everett Van Duzee, Mines '22, substitute half back, and Conrad Cooper, Mech. '26, regular center. Van Duzee was not in any conference game, but the playing of Cooper and Wheeler was a feature of many contests. Captain-elect Ascher, before changing courses, was enrolled in the engineering college.

Several members of the swimming team are engineers. Hugo Hanft, Elec. '25, was last year's captain; Horace Nutting, Civil '25, Hamilton Craig, Civil '25, and Harold Bud, Civil '25, are other engineers on the team. Bud won the fancy diving contest last year, and was a runner up in tryouts for the Olympics. The captain of last year's cross-country team was Arthur Jacobson, Elec. '25. Roy Schuck, Civil '25, is another high-point man on the squad.

"Clem" Tunnell, Elec. '25, is captain of this year's wrestling team. Conrad Cooper, formerly heavyweight champion boxer, and Earl Spokely, Civil '27, are other men competing for the wrestling team. Kapplin, freshman engineer, is on the wrestling and boxing teams.

"Cy" Pesek, Arch. '25, and "Black" Rasey, Arch. '26, were mainstays on last year's basketball quintet. Rasey also won his letter in baseball last spring, and had the highest batting average on the squad.

Percy Flotin, Civil '26, promises to make a strong bid for the hockey team. "Porky" was kept out of the game by injuries last season.

Clifford Anderson, Civil '26, will be student football manager next fall.

Kenneth Wells, Mech. '26, is under "Doc" Cook as assistant ticket manager.

YOUNG WINS ART PRIZE

At a recent exhibition of paintings at the Minneapolis Institute of Art, Elmer E. Young, instructor in freehand drawing in the department of architecture, was awarded second place. His title was "Across the Bay," and this was one of several sketches submitted by him.

The Institute Bulletin for October says, "'Across the Bay,' one of a group of water colors by Elmer E. Young, was awarded second prize. Lively, though restrained in color, it is marked contrast to the soberness of many of the canvasses and proves the artist's appreciation of the water-color medium in making the freshness and transparency of the pigment count to the fullest degree." Mr. Young was awarded second prize last year also.

Work submitted is that of Minnesota artists and much enthusiasm in the exhibition is created each year. Sculptoring as well as painting in oil and water-color is submitted.

SENIOR MINERS ELECT

The election of the senior class officers in the School of Mines took place some time after the other class elections with the following results: Bernard Larpenteur, president; Carl Scheid, vice-president; "Joe" Sodoma, secretary; Edward Hennen, treasurer.

MINERS-CHEMISTS, 6-2

Miners and chemists engaged in their annual gridiron combat on Nov. 1, resulting in a victory for the miners.

Neither team had had any practice prior to the game, and but few men were in condition. At the start, the miners were in possession of the ball, but after a first down they were forced to punt. Neither team was able to gain, and it was during this quarter that Deringer, miner half back, was severely injured.

The second quarter was a repetition of the first, with the exception of the last five minutes when Erck fumbled behind the chemist's goal and gave them their only count of the day.

After the half, the miners came back. The line began to hold and the backfield interference improved. Before many minutes of play, Walsh, quarterback, plunged through and placed the ball behind the chemists' goal. The kick for an additional point failed.

During the remainder of the game, neither team was able to increase its standing. The game ended with the score: miners, 6; chemists, 2.

LEWIS TO MANAGE SHOW

Berkley R. Lewis, senior engineer, was named manager of the electrical show, to be given by the A. I. E. E. sometime during the spring quarter, at the first meeting of the Minnesota student branch this fall, Oct. 29. In addition to appointing Lewis as manager, Raymond W. Keller, chairman, named Niles Thompson to the executive board, to consist of the manager and officers of the student branch. Henry Reed is secretary and Clement Tunell treasurer of the branch.

Talks were given by professor Shepardson, Springer and Ryan, stressing the coordination of the student branch in securing instructive entertainment for the student body.

Arthur L. Christensen was appointed by Keller to head a committee to conduct a prize contest among the student members of the Institute to stimulate interest in scientific writing. This committee includes Allen H. Wurzbach and Carl C. Nelson, who are working on the rules to govern the contest. They have also secured funds with which to reward the successful competitors.

Movies were shown at the meeting depicting the erection of a large central station by Stone and Webster of Boston.

DESIGN AWARDS MADE

Some interesting work has been produced in design this fall under professors Arnal, Jones and Rhobertson, criticising grades III, II and I respectively. Some of the problems are still unjudged, but the following awards have been made:

Grade III. First Long Problem ("A Presbyterian Church"). Mentions: Alwin Rigg, Edwin Krafft, Edwin Melander, Walter Kendall. Credits: Everett Peterson, Rabel Rosenberg, Gordon Lumm, Reuben Lantz, George Freeberg, Reolino McCann, Peter Bross.

First Esquisse-Esquisse ("A Fireplace in a Bank Director's Room"). Credits: Dorothy Brink, Peter Bross. Con-credits: Walter Kendall. First Short Problem ("A Private Hospital"). Unjudged.

Second Esquisse-Esquisse ("An Orphanage"). Unjudged.

Interior Decorating. First problem ("Elizabethan Furniture").

Credits: Helen Parker, Mary Slocumb, Rhoda Cote, Dorothy Mann, Verna Smith.

Second problem ("An Elizabethan Stairway"). Mentions: Mary Slocumb, Rhoda Cote. Credits: Dorothy Mann, Helen Parker. Con-credit: Verna Smith.

Esquisse-Esquisse ("A Theatre Curtain"). Credit: Mary Slocumb. Con-credit: Rhoda Cote.

Grade II. First Short Problem ("An Open Air Restaurant"). Mentions: Alvin Jansma, Gustave Naslund, Clyde Lighter. Credits: Paul Havens, Martin Ekstrand, Dewey Gerlach, Arnold Melius. Con-credits: Da Yu Doon, Gerald Kronick, Robert Porter.

First Esquisse-Esquisse ("A Stairway in a Formal Garden"). Credit: Gerald Kronick. Con-credit: Alvin Jansma, Gus Naslund.

Second Esquisse-Esquisse ("A Mail Order Store"). Unjudged.

First Long Problem ("A Public Library for a Large City"). Mentions: Gerald Kronick, Cyde Lighter. Credits: Martin Ekstrand, Alvin Jansma, Oswald Stageberg, Da Yu Doon, Paul Havens, Gustave Naslund, Dewey Gerlach, Herman Frenzel. Con-credit: Arnold Melius.

Grade I. First Short Problem ("A Memorial Tablet"). Mentions: Oswald Stageberg, Grace Cameron, Fritz Elfstrom, William Edwards.

First Esquisse-Esquisse ("A Flagpole"). Credit: John Ramey.

First Long Problem ("A Gateway to a Botanical Garden"). Unjudged.

PAUL DERINGER HURT

The miners' victory over the chemists in the football game Nov. 1, was marred by the injury of Paul Deringer, the miners' manager and halfback. Deringer, in stopping a man, received the chemist's knee in his abdomen and was forced to leave the field. Paul went immediately to the trainer in the armory where he collapsed. He was sent to the University health service and later in the day to the St. Barnabas hospital.

Deringer's injuries were internal, and seemed of such a serious nature as to require an operation to save his life. The operation was not performed, however, and Paul's fighting spirit pulled him through. At present, Deringer is back in school and feeling as well as ever. He is president of the sophomore miners and is a member of Theta Tau and Kappa Sigma fraternities.

MEASUREMENTS, NEW COURSE

For the first time in several years, a course in electrical engineering measurements will be offered to juniors and seniors during the winter quarter. The course is being arranged by professors Springer and Todd.

Emphasis will be put on the principles of direct reading wattmeters, voltmeters, and ammeters, and the measurements of resistance, inductance, and capacity by comparison and bridge methods. The work to be given is expected to be typical of the kind of problems met by engineers in practice and the methods best adopted for their solution.

The department does not expect to detract from the value of the precision measurements course offered by the physics department, but intends to cover the subject of measurements from the standpoint of the electrical engineer.

M. E. QUARTERS ENLARGED

It became evident last year that the construction of a new mechanical engineering building would be delayed for an indefinite period. Immediately steps were taken to combine the abandoned electrical and the mechanical buildings into a unit which can now temporarily serve the mechanical department. The old electrical building will be called the "Power Plant Laboratory."

Many hurried conferences were held because it was imperative that the alterations be made without delay. Professor Shipley and his colleagues drew up the following plan, which has been followed. A temporary, covered passageway constructed of wood and sheet metal links the two buildings. It extends from the shipping platform of the old electrical building directly across to the mechanical building. This passage provides access to the locker rooms, which are located in the basement of the electrical building. Here there are 380 steel lockers, enough wash-basins to accommodate sixty students at one time, showers and lavatories. All the washrooms and toilets in the mechanical building have been discarded.

The main laboratory in the old electrical building has been converted into my room for machine design. Which classes use this room will depend upon the registration. The remainder of the electrical building may be used for lecture rooms and offices, and several instructors have moved into the remodeled structure.

Modifications in the mechanical building are few but effective. An opening has been made through the wall between the machine shop and the lecture room adjoining it. Into this room have been moved the toolmaking machines which represent the best of the machine shop's equipment. This annex will now be used only by the mechanics and the three or four students who make tools and dies.

Upstairs an alteration similar to that below has been made. There is an opening through the wall between the pattern shop and the drafting room on the south side of the building, and through here two rows of joiner's benches extend into the drafting room, providing accommodation for forty students at bench work. This eliminates the old system under which the class had to be divided into sections, one half operating the lathes with the other half working at the benches. A student can now always have a bench, and whenever a piece requires lathe work, there is a machine available.

LARPENTEUR HEADS SENIORS

Bernard Larpenteur, recently elected president of the senior miners, was chosen all-senior president in a close election. Larpenteur, by reason of his new office, was required to resign from the All-University council. He is a member of Theta Tau, Chi Delta Xi, and Alpha Pi Omega (honorary mining) fraternities.

MARTENIS HEADS A. S. M. E.

A purely business meeting of the Minnesota student branch of the A. S. M. E. was held Nov. 8, at which many matters of importance to the branch were presented for discussion and vote.

Because of the press of business, no outside speakers were scheduled for the meeting. As our meetings are closely tied up with seminar, papers to be read at meetings are not prepared by the members.

Prof. J. V. Martenis was unanimously elected honorary member for this college year. Professor Martenis has long been a member of the Minneapolis active chapter, and has shown an interest in the student branch. He is at the head of the mechanical engineering employment bureau, and is successful in finding employment for graduates.

Through the kindness of the Minneapolis active chapter, the Minnesota student branch has an additional prize of $50.00. This prize is offered for the best technical paper on some mechanical engineering subject. The conditions governing this prize are liberal and have the purpose of stimulating interest. Competition for this prize is limited to members of the Minnesota student branch only.

The annual Briggs prize of $50 for the best paper, and $25 for the second paper on the subject of Foundry Practice has created some interest. This paper is open to all engineering sophomores.

The national headquarters of the A. S. M. E. offers a prize of $150 for the best paper on "The Influence of the Locomotive on the Unity of Our Country." Full information governing the conditions of these prizes is posted in the mechanical engineering building.

The Minnesota student branch's new club room came up for discussion. A room committee consisting of three was appointed with Parke Robinson as chairman. The room has been re-decorated, and supplies a long felt need in this department.

A resolution of thanks to the Minneapolis active chapter was drawn up in appreciation of the prize offered by them for the best mechanical engineering paper.

CLASS OFFICERS ELECTED

The class of 1925 elections resulted as follows: William Brose, president; Dwight Burns, vice-president; John Banovetz, secretary; Harry MacAndrews, treasurer; Edward I. Quinn, athletic manager.

Officers selected by the Class of 1926 for the coming year are: Percy Flotin, president; Robert Beveridge, vice-president; Kenneth Ferguson, secretary; "Jack" Carmen, treasurer; Kenneth Foster, athletic manager.

ELECTRICALS HONORED

Carl C. Nelson, Joseph E. Meagher and Lewis E. Peterson, senior engineers, and Hilder W. Bergman, Winfred C. Hilgedick, and Albert A. Lee, junior engineers, were initiated Dec. 4 into Eta Kappa Nu, honorary electrical engineering traternity. The exercises were held in the Leamington hotel. Henry Reed, '25, is president of the group.

HALEY ON COUNCIL

Alva Haley, senior miner, succeeds Bernard Larpenteur as mines representative on the All-University Council. As Haley was the only man to circulate a petition, his choice was unanimous, and the election was unnecessary. He is a member of Theta Tau, professional engineering fraternity.

MINERS IN R. O. T. C.

Four of the junior miners have broken a precedent which was almost a tradition. They have joined the advanced infantry R. O. T. C. They are the first miners to take the advanced course since 1922, when there was one man enrolled. Athough the work is added to an already crowded schedule, the men are very much interested, and intend to stick it out.

4TH OSCILLOGRAPH SET UP

The Westinghouse oscillograph which was recently put into service in the electrical laboratories came on an order placed by the electrical department three years ago. Although the instrument arrived last spring, it was not unpacked or set up until this fall after the department had finished moving into the new building.

The oscillograph combines many important advantages over older machines. It is provided with a large number of accessories, so that photographs of electricity may be taken from all angles.

Quantity production of oscillographs is not a common industry, judging from the price of the instrument. Its cost was $1800.

BURTON TEACHES FINE ARTS

Three new studios have been arranged on the fourth floor of the main engineering building for art classes taught by Prof. S. Chatwood Burton in stage design, painting, and sculpture.

At present the department of architecture offers courses in freehand drawing, painting, sculpture, and stage design.

Work in stage craft consists in part of designing to scale complete stage sets and properties for different types of plays. Sets for Shakespearean plays have received special attention this quarter. According to Professor Burton, the class will advance throughout the year and design sets for Grecian, Roman, French and modern American plays. Special attention is paid to lighting effects. The model designs are tested at the University for imperfections in the arrangements of lights. Methods of perfecting the acoustics of theatres are also studied. The class includes about 15 dramatic students.

Among the proposed courses which are to be given by Professor Burton are advanced drawing, sculpture, illustration, print making, and mural decorating.

"We desire to expand the realm of fine arts at Minnesota so that every interested student will be benefited by at least one course," Professor Burton said in commenting on the changes in courses. "We hope later to arrange work in commercial art for those who are interested."

Work to be covered in the course in mural decorating will include wall coverings of domes, friezes, spandrels, and lunettes. The course in prints and etchings will include wood cuts, dry points, engravings, and aqua tints, and it will be the first time such a course has been offered at any western school.

MUSIC, MELTED ARCHITECTURE

A bit of explanation may be appropriate at this time of the year to new students on the campus and to some old ones. The main engineering building is in no way connected with the department of music, regardless of the fact that melodious strains may be heard wafting down from the upper floors at night. It is only the junior and senior designers getting inspiration for their work.

Goethe, the German poet and prose writer, once said that architecture was frozen music. Those who know the likes and dislikes of design students will go him one better by saying that music is melted architecture. If you think this is not true, go up to the drafting rooms almost any night to see the process of melting music into architecture.

At night time, much of the best work is done in the drafting rooms. The reason for this is hard to determine, but it may be simply the effect of the night air; or, perhaps it is because there is no one watching over the work, eliminating the mental strain of being seen doing the wrong thing.

Occasionally, however, the singing may be abruptly interrupted by a night class instructor coming in to see "what is trump" or "who held that full house."

DRIPPINGS FROM THE OIL CAN

Boston, Philadelphia, New York, and Chicago

Little Penelope Socrates,
A Boston maid of four,
Wide opened her eyes on Christmas morn
And looked the landscape o'er.

"What is't inflates my *bas de bleue?*"
She asked with dignity.
"'Tis Ibsen in the original,
Oh, joy beyond degree!"

Miss May Cadwallader Rittenhouse,
Of Philadelphia town,
Awoke, as much as they ever do there,
And watched the snow come down.

"Well, I'm glad that Christmas has come again,"
You might have heard her say,
"For my family is one day older
Than it was last Christmas day."

It was Christmas in giddy Gotham,
And Miss Irene De Jones,
Awoke at noon and yawned and yawned
And stretched her languid bones.

"Well, I'm sorry that it's Christmas;
Papa at home will stay,
For 'change is closed, and he won't make
A single cent all day."

Oh, windily yawned the Christmas
In the city of the Lake,
And Miss Anabel Wabash Breezy
Was instantly awake.

"Ah! what's that in my stocking?
Well, in two jiffs I'll know!"
And she drew forth a grand piano
From away down in the toe.

* *

Economics for Engineers

Lecturer—"Now, when a person is deaf, his sight is more acute, for the law of compensation will work itself out."

Student (thoughtfully)—"I have often noticed myself that when a man has a short leg the other is somewhat longer."

* *

Originality Required

"Adam must have had a tough time," said the office boy. "When he first picked up Eve, he couldn't say, Haven't I met you somewhere before?"

But We Call It Coal

Certain savages in Polynesia cook their food over redhot pieces of rock. So does our cook.

* *

Professor Erickson's Slogan

"Up and atom."

* *

Bismuth!

A little boy asked his father, a confirmed dyspeptic, "Dad, did Moses suffer with indigestion?"

"I'm sure I don't know," snapped his father, whose temper was rather soured by his infirmity.

"Well, I think he must have had it, for our teacher told us Sunday that God gave him two tablets."

* *

Proof

Most motorists trust in God. You can tell that by the way they drive.

* *

The First of Its Kind

How times have changed since ages old,
When Adam lived alone;
The first broadcasting station
Was made of a single bone.

* *

No Chance to Survive

A Toronto doctor declares that motoring kills worry. So, of course, does any other kind of death.

* *

Because

I sit upon the mountain top,
I breathe the summer air,
I sit upon the mountain top—
Because—I have no chair.

A sweet girl sits beside me,
The reason is implied,
The sweet girl sits beside me—
Because—I'm by her side.

I ask her if she loves me
Better than all her beaux;
I ask her if she loves me—
Because—I know she knows.

She says she will not let me go,
And as I rise to go,
She says she will not tell me—
Because—she knows I know.

Oh! Please now leave us quickly,
Do not hesitate or pause;
Oh! Please now leave us quickly!
Because—well—just because.

Read This and Weep

I woke to look upon a face,
Silent, white, and cold,
Oh, friend, the agony I felt
Can never quite be told.
We'd lived together but a year,
Too soon it seems to see
Those gentle hands outstretched and still,
That toiled so hard for me.
My waking thoughts had been of one
Who now to sleep had dropped,
'Twas hard to realize, oh friend,
My Ingersoll had stopped.

* *

Fireproof.

Coal has been used for building purposes in a Welch town. This is believed by many housing experts to be the greatest achievement in non-inflammable construction reached so far.

* *

Answer to Correspondent

"No, Mabel, the cost of a shingle and its upkeep should not be charged under roofing expenses."

* *

Ain't It So?

At sight of girls with eyes like stars,
Our heart it jumps and skips,
But girls with eyes like quarter-moons
Should keep them in eclipse.

* *

Naturally

Sea-sick passengers are never interested in permanent waves.

* *

Hiawatha Up-To-Date

By the shore of Cuticura,
By the Sparkling Noxage Water,
Lived the Prophylactic Chiclet, Danderine.
She was loved by Instant Postum,
Son of Sunkist and Victrola,
The rulers of the tribe of Coca-Cola.
Through the Tanlac strolled the lovers,
Through the Shredded Wheat they wandered,
"My lovely little Chiclet," gurgled Postum,
"No Pyrene can quench the fire,
Nor can Aspirin still the heartache,
Oh my Prest-O-Lite desire, Danderine."

ALUMNI AND FACULTY PERSONAL NEWS

ALUMNI ASSOCIATION

Louis W. Tannehill, '16 architectural, was elected vice-president of the Minnesota Alumni Association of Southern California at the recent election of officers for the coming year. Other engineers in the club are: Alfred Bachrach, '08 electrical; Joseph H. Pengilly, '11 electrical; and Clayton T. Gibbs, '18 electrical.

ARCHITECTS

M. J. Anderson, '19, has charge of the University extension work in architecture at Duluth. His address is 2701 W. 4th St.

Paul Damberg, '21, is engaged in Architectural work on the range. His address is 710 Jones St., Eveleth, Minn.

Reuben F. Damberg, '21, is continuing in the practical study of architecture as architectures' representative on a group of municipal buildings at Virginia, Minn.

Myron Dasset, '17, has been in Europe for five years, where he has been studying at the Ecole Beaux Arts, Paris. He was married this summer in Paris to Miss Mildred Charlaine Jamison of Hollywood.

Stanley W. Hahn, '22, holds the position of project manager with the firm of John Russell Pope, architect. The office of the firm is at 542 5th Ave., New York City.

Ralph Hammett, '18, is traveling in Europe as the result of his winning of the Nelson Robinson Junior Traveling Scholarship in architecture which is a Harvard scholarship. When last heard from, he was in southern China. Mail addressed care of American Academy, Rome, Italy, should reach him.

Ed Loye, '20, and Don Campbell, ex. '22, are traveling in Europe.

CHEMISTS

Ross D. Bostwick, '23, is the assistant to the superintendent in the Spokane Refining Company of Spokane, Washington. Mr. Bostwick resides at 503 Diamond Ave., Hillyard, Wash.

A fellowship in chemistry has been awarded to Ruth Elmquist, '23, by the Dupont Powder Company, allowing her to study in France for one year. Miss Elmquist will be accompanied by Esther Bauer, who completed her master's degree in science last July. They will study abroad under the direction of Paul Brinton, professor of analytical chemistry. Professor Brinton was Miss Elmquist's advisor. He is spending the year on sabbatical leave.

R. W. Krantz, '24, received an engineering experimental station fellowship and is now spending his time doing chemical engineering research work at the University.

Irvin Lavine, '24, put his chemistry books on the shelf for a while and is now managing one of the Kimball shoe stores of Minneapolis. Mr. Lavine expects to come back to the University next year and take up graduate work.

Cecil Mayo, '24, is an assistant superintendent in a by-product department of the Armour Packing Company of St. Paul.

Karl F. Paul, '24, is a cadet chemical engineer with the Empire Gas Company of Bartlesville, Oklahoma. A. O. Fuhrman, '24, is with the same company in the same capacity.

Charles Johnston and A. G. Zima, both of the class of '24, are taking post graduate work at the University.

Betty Sullivan, '22, has been sent by the Russell-Miller Flour Mills to Paris where she will study the chemistry of flour at the Sorbonne. After a year at the Sorbonne, Miss Sullivan will continue her research in Denmark, where scientific milling of wheat is done.

CIVILS

H. A. Barber, '21, is the heading engineer with the Southern California Edison Co. Mr. Barber's address at present is Camp 62, Big Creek, California.

George C. Bestor, '24, is a junior engineer with the Empire Gas and Fuel Co., Bartlesville, Oklahoma.

Ole M. Bolme, '10, is a structural engineer with the Robins Conveying Belt Co., 15 Park Row, New York City.

Julian Garzon, '24, who was with the Minnesota Highway Department until recently, has accepted a position with the Northern States Power Company. Mr. Garzon's work will consist of computing and mapping in conjunction with the hydrographic investigations of the Mississippi River now being conducted by that company. His present address is: Field Office, Northern States Power Co., Monticello, Minn.

Leslie L. Halladay, '21, is a civil engineer for the Board of Park Commissioners of Minneapolis.

Carl C. Hanke, '20, is an assistant engineer with the Sanitary District of Chicago. Mr. Hanke resides at 1357 Greenleaf Ave., Chicago.

The manager of the Bond Department of the Transportation Brotherhood's National Bank of Minneapolis is George S. Houston, '02.

John C. Hustad, '15, is the secretary and treasurer of the Hustad Co., 176 South 9th St., Minneapolis, consulting engineers.

The June alumni issue of the Techno-Log stated that Ralph E. Johnston, '16, was employed by the Kalman Steel Company. A letter has been received from that company stating that Mr. Johnston died about a year ago.

For special risk insurance, consult Lawrence W. King, '09, who is in that department of the St. Paul Fire and Marine Insurance Company, 111 West 5th St., St. Paul, Minn.

Andrew A. McCree, '08, is a partner in the firm of McCree and Company, 315 Hackney Bldg., St. Paul. The firm does engineering and contracting work.

George A. Meskal, '23, was married on Nov. 26th to Miss Nora Raabolle of Minneapolis.

Glenn Nelson, '23, was in the Twin Cities for a few weeks recently to visit with friends. He is in the Municipal Engineering Department of the city of Los Angeles, California.

Arthur O. Olsen, '10, is the sales engineer for the Redfield Brick and Tile Company of Redfield, Iowa.

The manager of the local branch of the Nordyke and Marmon Auto Co. at Indianapolis, Ind., is Harold Leon Peterson, '16. His address is 11th and Meridian Streets, Indianapolis.

Charles N. Robertson, '08, is the highway engineer of Brown County, Minn.

Theodore S. Thompson, '24, is inspector for the Minnesota Highway Department. When last heard from, Mr. Thompson was at Gaylord, Minn.

Another Minnesota graduate working for the Highway Department is Claudius A. Thompson, '22, who is the resident engineer at Barnesville, Minn.

The chief engineer of the Eastern Massachusetts Street Railway Co., is Frank B. Walker, '97. Mr. Walker's address is 1 Beacon St., Boston, Mass.

Donald W. Webster, '14, is an assistant construction engineer with the State Highway Department.

ELECTRICALS

Frank A. Anderson, '08, is a part owner of the National Appliance Co. of Portland, Oregon, manufacturers of electrically heated laboratory apparatus, machine, and sheet metal products. His address is 1322 Wisteria Avenue, Portland.

The president and general manager of the Kase Electric Co. of Minneapolis is Irving E. Aske, '20. The firm address is 3161 Hiawatha Ave., Minneapolis.

Vernon M. Babcock, '23, has been transferred from the Milwaukee plant of the Cutler-Hammer Manufacturing Company to the Detroit office. John M. Newman, '23, is working for the company at the Milwaukee plant.

The chief engineer of the American Light and Traction Co., 120 Broadway, New York City, is Walter C. Beckford, '09.

Irvin L. Boyum, '17, is switchboard engineer at the Westinghouse Electric and Mfg. Co. at 2303 Kennedy St. NE., Minneapolis.

Philip Carlson, '19, and Basil Maine, '21, have joined the Chile Exploration company and have been stationed for several months at Chuquicamata, Chile, South America, where they are doing electrical engineering.

Gerald F. Case, '23, is with the Oliver Mining Company at Chisholm.

Wendell P. Chapman, '14, is the division engineer for the Minnesota highway department. The office is at 1246 University Ave., St. Paul.

Edward J. Cheney, '04, heads the firm of E. J. Cheney, with its office at 61 Broadway, New York City. Mr. Cheney is a consulting engineer.

Irwin M. Ellestad, '22, E.E. '23, is with the Northwestern Bell Telephone Co. at 420 3rd Ave. So., Minneapolis, as interference engineer.

Henry C. Forbes, '22, holds the position of assistant chief engineer of the

Colonial Radio Corporation. The address of the firm is East Ave. and 10th St., Long Island City, N. Y.

Clayton T. Gibbs, '18, is an electrical engineer for the firm of Holmes and Sanborn, 912 Black Bldg., Los Angeles, California.

Harold R. Goss, '20, has risen from the ranks and is now manager of the synchronous department of the Ideal Electric and Manufacturing Co., of Mansfield, Ohio. Orney E. Dunnam, of the class of '22, is sales engineer at the same concern, and Clay W. Noel, '20, is the divisional engineer.

David Grimes, '19, visited the University this fall. He is vice-president of the Grimes Radio Engineering Company of New York City, and is a national authority on radio. He is interested at present in broadcasting with short wave lengths, and predicts that the short wave length will open a new field in broadcasting, allow for more stations, and will carry farther with less power than the longer wave lengths used at present by the large stations. He said that the disadvantage of short wave lengths is their inability to reach certain "dead" spots, such as steel buildings.

Another Minnesota man has heard the call of California. Arnold B. Hendrickson, '22, is a petroleum engineer in the Petroleum and Gas Dept. of the California State Bureau of Mines.

Leonard T. Johnson, '16, is no longer with the W. J. Rainey Corporation, but is now assistant steam engineer for the Grasselli Chemical Company of Cleveland, Ohio. His address is now 1250 N. Lockwood Ave., E. Cleveland, Ohio.

Ludvig C. Larson, '21, is instructing in the electrical department of the University of Wisconsin.

Ralph W. Liddle, '21, is editor-in-chief of the "Edison Round Table," the organ of the Commonwealth Edison Company of Chicago, Ill. Henry F. Drost, '22, is with the same company as an engineer.

The engineer of plans in the Minnesota Highway department is Clarence W. Lilly, '17. The office address is 1246 University Ave., St. Paul.

Percival E. Love, '21, holds the position of assistant engineer with the Pacific Gas and Electric Co., 445 Sutter St., San Francisco, California.

The head of the department of electricity of Joliet Township High School is Ira Clark McCoy, '11. He has recently changed his address to 1501 N. Raynor Ave., Joliet.

The assistant electrical engineer of the Minnesota Power and Light Company at Duluth is John E. Magnuson, '22.

The address of Norman S. McVean, '21, telephone equipment engineer for the New England Telephone and Telegraph Co., is 30 Oliver St., and not 50 Oliver St. as stated in the last issue of the Techno-Log.

Arnim G. Olson, '22, is in the engineering dept. of the Public Service Co. at 114 N. Oak Ave., Oak Park, Ill. Mr. Olson resides at 213 So. Euclid Ave., Oak Park.

Albert E. Peterson, '19, is with the Commonwealth Edison Company of Chicago. His address is 3417 W. Adams St., Chicago.

J. W. Pierson, '19, is employed by

the Commonwealth Edison Company as boiler room engineer at the Crawford Station plant. This station is mentioned by engineering magazines as being the latest word in power plant development. A steam pressure of 550 pounds can be used, and one boiler in a line is a reheat boiler.

Ingwald A. Rosok, '03, became manager of the Bisbee Improvement Company of Bisbee, Arizona, 2 years ago and still has that position.

Clarence Teal, '24, editor of the Techno-Log last year, is taking the students training course offered by the Northern States Power Company of Minneapolis. Mr. Teal was prominent in several activities while at the University, but is especially remembered for the work he did for the Techno-Log and the Arabs, the engineers' dramatic organization. During his senior year, Mr. Teal was elected a member of the Grey Friars, honorary senior society. He lives at 1010 E. 19th St., Minneapolis.

Of the twelve men taking the ten months course at the Northern States Power Company, eleven of them are members of the class of '24. Those taking the sales course are: John Roscoe Furber, Lloyd I. Pelley, Hilding O. Magney, Frazer A. McGregor, and Lyle McLeeland. Manley Munsen, Torarin E. Lobeck, Benj. C. Treka, and Warren E. Carlson are taking the course in generation, while in the sales department there is Leonard E. Mabbot and Stuart V. Wilson, M. E. '24, who was prominent in campus affairs, athletics, and also a member of Grey Friars

MECHANICALS

Henry B. Avery, '98, is in the sales department of the Elwood Myers Co. The firm has its office at 511 Globe Building, Minneapolis.

John H. Barr, '83, M. E. '88, formerly with the Remington Typewriter Co., is now with the Barr-Morse Corporation of Itacha, N. Y.

A letter was recently received from Major Richard F. Cox, '08, of the Coast Artillery Corps, U. S. Army. Major Cox left the Philippines last January, and since March has been stationed at Fort McPherson, Georgia, in the office of the Commanding General of the Fourth Coast Artillery District.

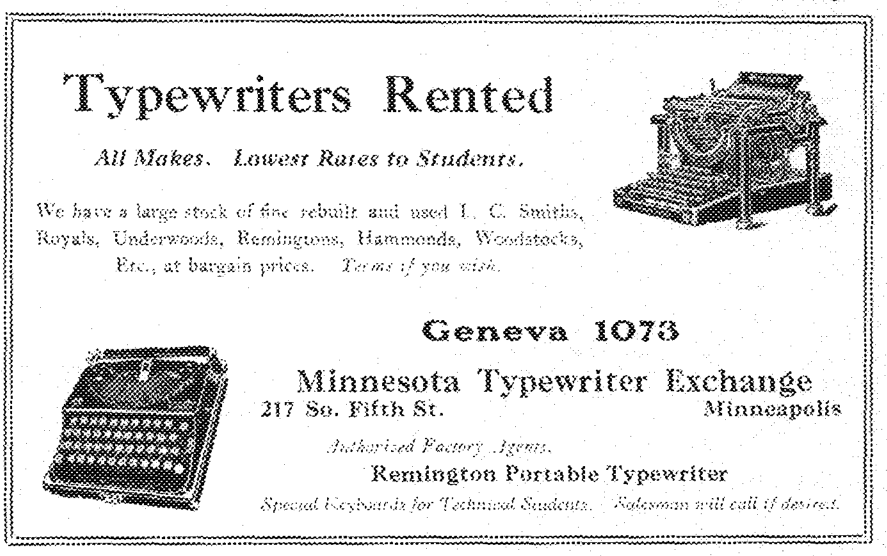
Eugene C. Crane, '13, has a position with the Bartlett and Snow Co., of Cleveland, Ohio, as superintendent of construction.

Verne Curtis, '22, is engaged in sales work for the Cutler-Hammer Manufacturing Company, of Milwaukee, Wisconsin. The Firm manufactures electric controlling devices.

Harry C. Elliot, '19, is an engineer for the Packard Motor Car Company at Detroit. Mr. Elliot no longer lives at 5372 Iroquois Ave., as stated in the June issue of the Techno-Log, but has moved to 976 East Grand Boulevard, Detroit.

In the faculty of the University of West Virginia, Morgantown, Va., is James H. Gill, '92, who is the professor of machine construction.

Alex W. Luce, '23, has forsaken the ranks of engineers to become assistant boys' secretary of the Omaha, Nebra-



ska, Young Men's Christian Association.

The manager of the Portland, Oregon, branch of the Lidgerwood Mfg. Co. of New York City, is J. M. Meany, '07. His home address is 686 East 15th St., Portland, Oregon.

Melvin Ovestrud, '14, is the works manager of the Twin City Forge and Foundry Company plant at Stillwater, Minn.

Clayton M. Reasoner, '20, former instructor in metallurgy at the University, died in June following an operation for appendicitis. Mr. Reasoner was about to receive his doctor's degree from the University. He was a member of Tau Beta Pi, honorary engineering fraternity, and was employed in the engineering department of the Pillsbury Flour Mills.

P. W. Rhame, '20, is superintendent of inspection at the A. C. Spark Plug Company at Flint, Michigan.

Andrew Saltwick, '24, has accepted a position with the Milwaukee Railroad as special apprentice at the company's headquarters in Belford, Indiana.

Clarence Q. Swenson, '17, M. E. '20, is in the sales department of the firm of Alfred O. Blaich Co., 555 Beaufait, Detroit, Mich.

Duane L. Taylor, '17, has been with the U. S. Navy since 1918, having been stationed on the U. S. S. Idaho the last three years. During the last two years he was in charge of the boiler room on that ship. Mr. Taylor recently visited the University while on his way to Columbia University, where he will take up post graduate work under the direction of the Navy Department. He holds a commission as a naval officer. In 1921 he was married to Miss Carrie Hauser, A. '19. They have one son, Duane, Jr., two years old.

MINERS

Howard C. Conheim, '23, is at present at Tulsa, Oklahoma, doing oil geology work.

Lyndon L. Foley, '18, married Margaret Cray, daughter of Mr. and Mrs. A. J. Cray of Lime Springs, Iowa, at the home of the bride on Nov. 29. Mr. Foley is a member of Theta Tau, professional engineering fraternity. Albert W. Morse, Elec. '26, fraternity brother of Mr. Foley, attended him as best man. Mrs. Foley is a graduate of the Principia Junior College of St. Louis and of the University of Wisconsin. Mr. Foley has had experience in the oil fields of Trinidad and the United States, and is at present engaged in geology work in Independence, Kansas.

Arthur Forsyth, '23, is with the Bethlehem Steel Corporation at Bethlehem, Pa.

C. J. Knutson, '24, is an instrument man with the Northern Pacific Railway Co. at Glendive, Montana.

William J. Nichols is married and lives in Toole, Utah, according to a letter written by F. J. Hamernik of Kellog, with whom Mr. Nichols once worked.

Stanley G. Olson, '24, left recently to take a position as junior engineer with the U. S. Steel Co. at Kennecott, Alaska. Mr. Olson will do engineering and geological work.

News from Here and There

PURDUE HAS NEW ELECTRICAL BUILDING

Purdue University is building a new electrical engineering building, and the first unit was completed last summer. This now houses all the equipment of the electrical laboratories, and is one of four units which will eventually compose a building 180 by 220 feet.

* * *

COLUMBIA ABOLISHES SIX-YEAR COURSES

A step which many engineers believe to be one backward instead of forward was taken recently at Columbia when the six-year courses in chemical, civil, mechanical and mining engineering were abolished, and four-year courses in these departments substituted. They lead to a bachelor's degree, with an additional year for the engineer's degree. It is generally felt that the six-year men were better trained.

* * *

CHICAGO BUILDS MUNICIPAL STADIUM

Armour Institute of Technology enjoys the use of a stadium built by the South Park commissioners for the city. Freedom from the "stadium drives" which are so customary in Big Ten schools must have been unique, although contributors do have an equally unique feeling of satisfaction.

* * *

MANUFACTURERS ENTERTAINED AT WISCONSIN

The college of engineering at the University of Wisconsin on Nov. 8 entertained 31 Milwaukee men prominent in engineering activities, including representatives of manufacturing and public utility organizations. As a part of the program, the laboratories and shops of the college were opened for inspection by the visitors.

* * *

IOWA DEVELOPS LOUD SPEAKER

The electrical engineering department at the State University of Iowa has developed a loud speaker which amplifies hundreds of times the voice customarily heard in conversation. This is accomplished by the use of four tubes, with an equal number of transformers and rheostats. Several storage batteries and about a hundred dry cells furnish the current.

* * *

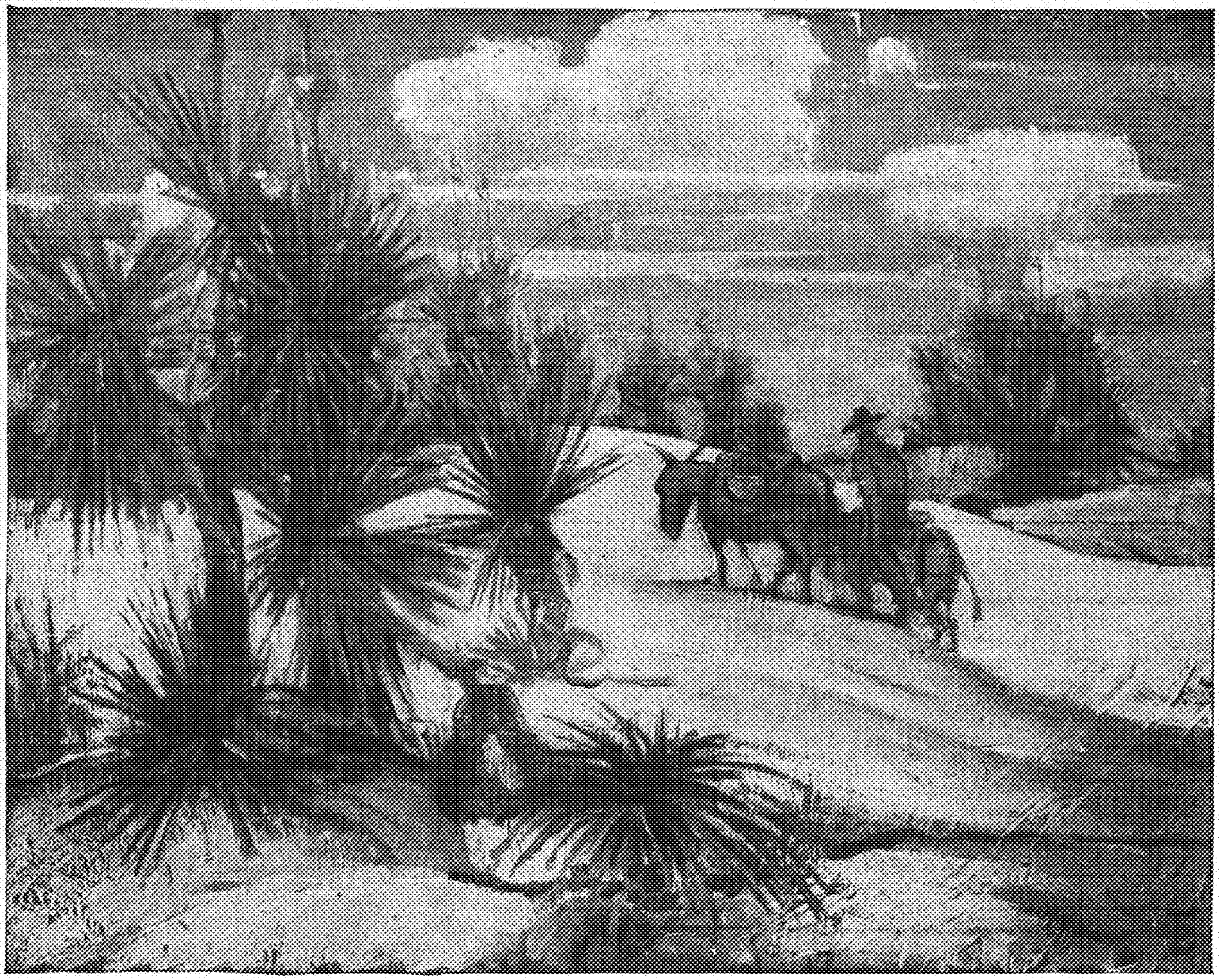
GEORGIA TECH HAS CERAMICS BUILDING

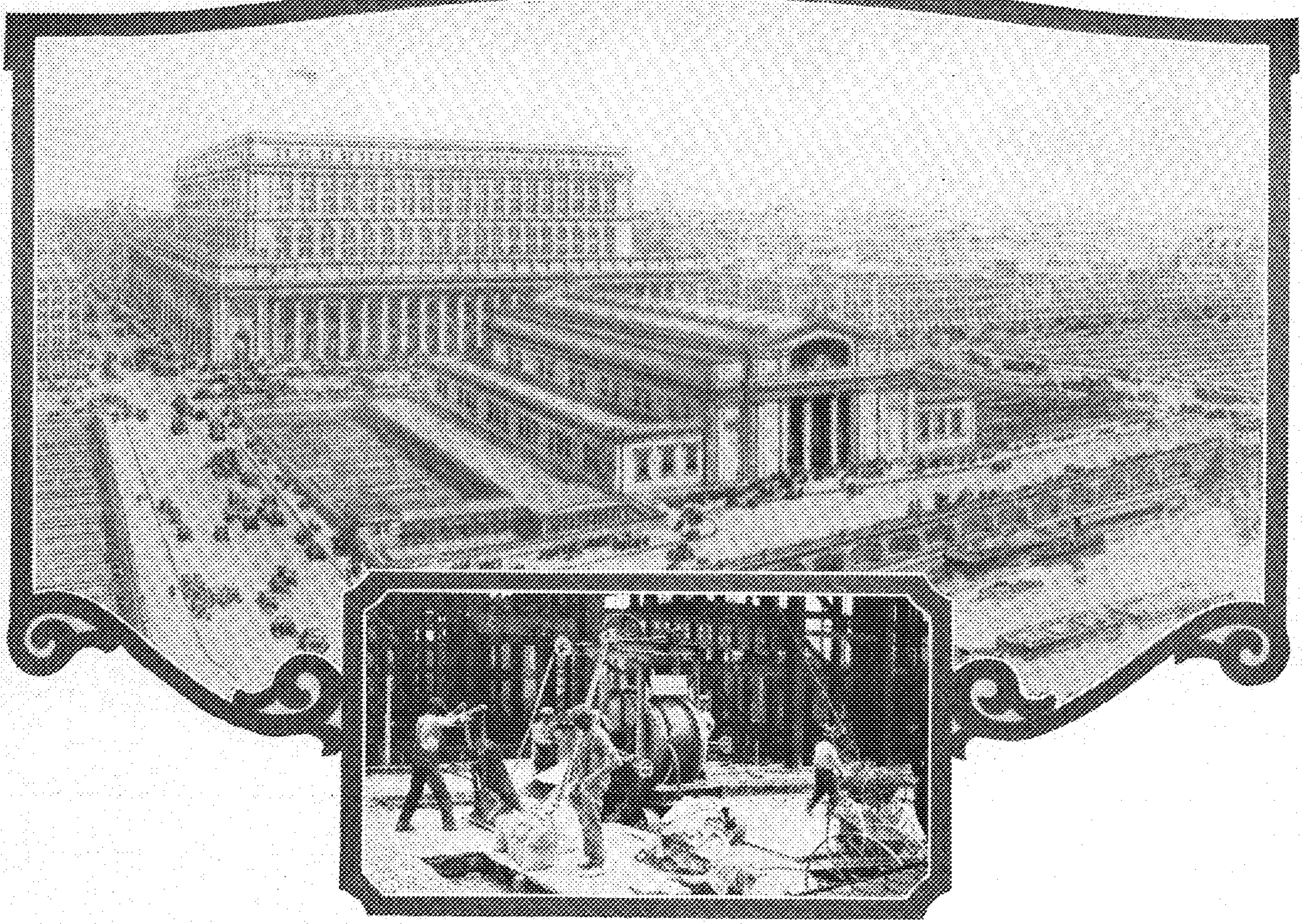
The ceramics course established this year at Georgia Tech as a result of numerous requests is the only one in the South, and it has proven so satisfactory that a building intended primarily for this department is nearly completed. It is a story and a half high, and contains six rooms, providing an office, a library, a class room, a testing laboratory, a clay room and a kiln room.

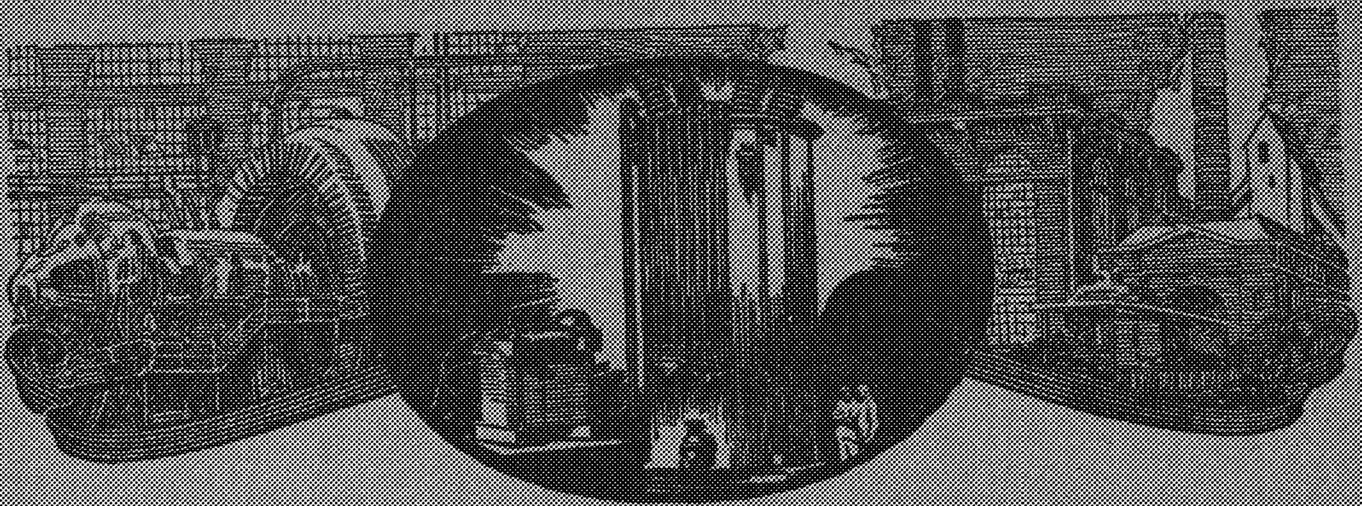
* * *

FOREIGN CRUISE OFFERED IN NAVAL COURSE

Students at George Washington University who enroll in the Naval Reserve Officers' Training course established there this year through the cooperation of the federal navy department may take a summer cruise to foreign countries as a part of their regular work. They are enrolled as midshipmen, and are to be commissioned as ensigns upon completion of their course.







A Toy—a Tool

THE first twenty days in December witnessed a big event in one man's life. They saw a toy grow into a tool—one of the most useful in all history.

On December 1st, 1885 there was brought to George Westinghouse, at Pittsburgh, an uncommercial "secondary generator"—a scientific toy. Westinghouse and associates lived with it day and night, and by December 20, 1885, in a flash of genius, had completed the essential conceptions of the modern transformer. Thus in twenty days they paved the way for alternating current, and the electrical era of the twentieth century.

Here was a brilliant engineering feat—a feat that through the years has been a particular inspiration to a specialized group of "design engineers" within the Westinghouse organization. These men are electrical and mechanical engineers who are attracted not merely by an engineering problem—but by the technical difficulties of "licking" that problem to narrow and exact practical limits.

These men work continuously with both sides of an equation. On one side are the needs of a customer. For the other side must be developed apparatus which exactly meets those needs. The apparatus may range from a complete system of electrification for a railroad to a new type of curling iron.

Engineering extends a welcoming hand to men qualified for designing. Many of the most constructive services of Westinghouse have been made possible by their leadership.

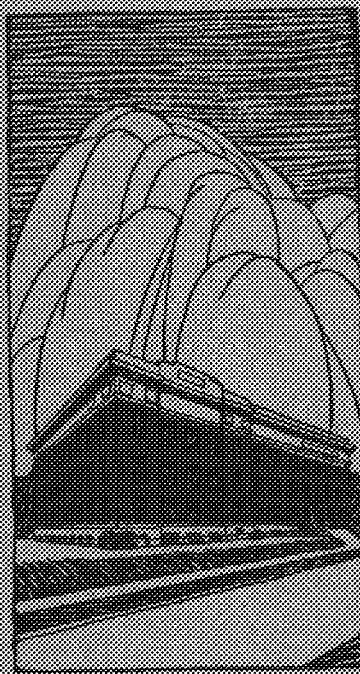
Westinghouse

ACHIEVEMENT & OPPORTUNITY

WESTINGHOUSE ELECTRIC

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS



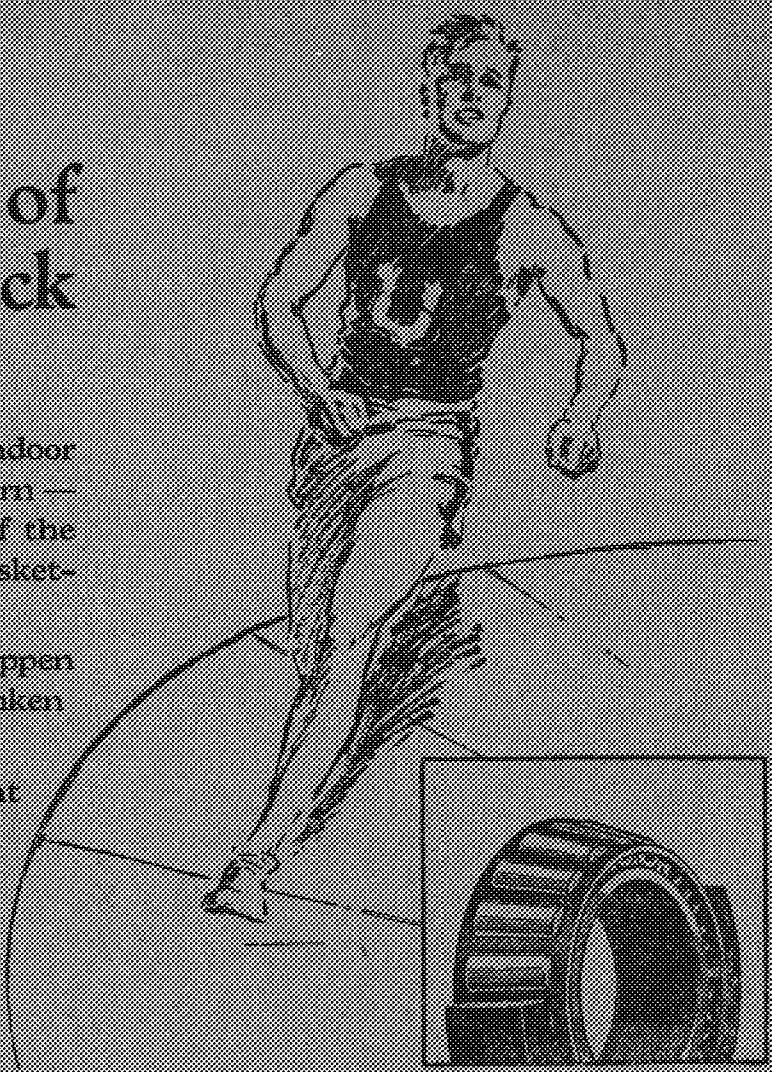
JANUARY
1 9 2 5

Volume V 25 CENTS A COPY Number 4

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES

So the Turns of an Indoor Track are Banked



DOWN the stretch of an indoor track, then 'round the turn—what would happen to a runner if the turn were perfectly level, like a basket-ball floor?

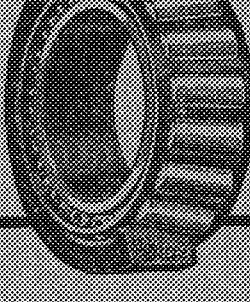
The same thing that would happen to a Timken Bearing if the Timken Bearing were not *tapered.*

When you sharply turn the front wheels of a moving motor car, for example, the same thing happens as when a runner dashes round the turn of a track. The front wheels direct the car around the turn. Momentum, however, tends to throw it sidewise—in the same direction that it previously was traveling. The result is a heavy side load or "end thrust" on the bearings in the front wheels.

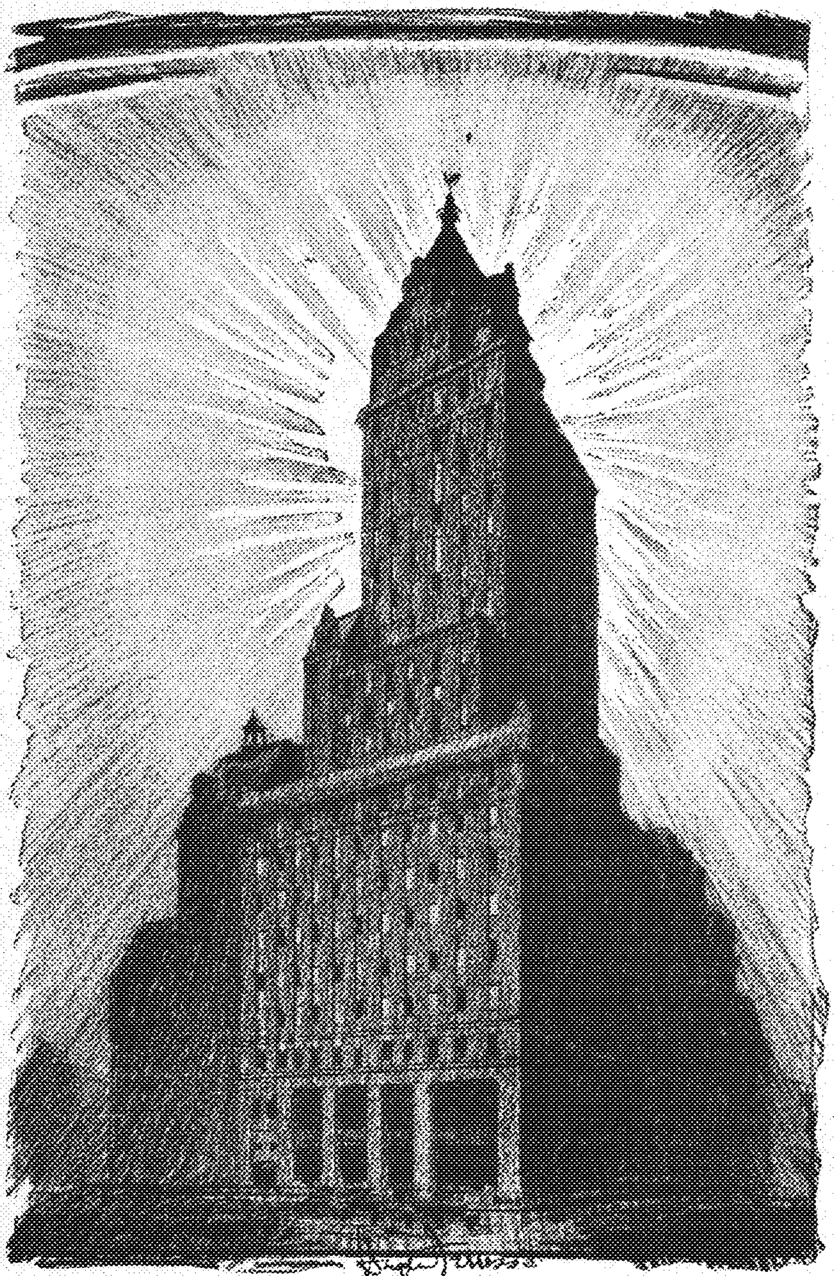
The bank of the track keeps a runner from feeling the effect of side-swing as he rounds a curve. A similar device—the taper—enables a Timken Bearing easily to withstand "end thrust" from any source.

In bearings that are not tapered, heavy "end thrust" must be cared for by a separate "thrust" bearing. A Timken Tapered Roller Bearing withstands heavy "thrust loads," as well as all other loads, with equal effectiveness.

THE TIMKEN ROLLER BEARING COMPANY
CANTON, OHIO



TIMKEN
Tapered
ROLLER BEARINGS



The Heckscher Building
New York City

WARREN & WETMORE
Architects

© O. E. CO.

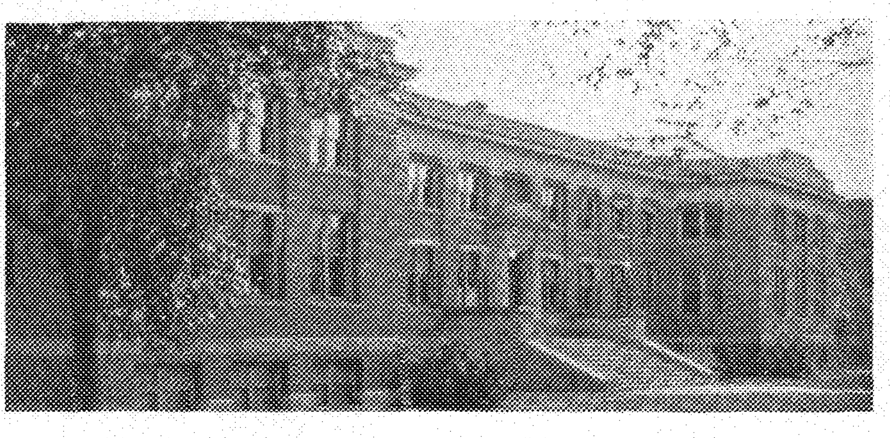
Architecture—Today and Tomorrow

THE great buildings of today, designed in masses which rear rugged, mounting profiles into the sky, foretell even greater and more massive structures for the next half century. Always a close co-ordination of architecture and engineering, of design and construction, the architecture of the future will find architect and engineer working ever more closely together.

Certainly modern invention—modern engineering skill and organization, will prove more than equal to the demands of the architecture of the future.

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



EXPERIMENTAL SHOPS OF THE COLLEGE OF ENGINEERING

The MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

HERMAN F. BESELER AND KENEPICK ROBERTSON, *Managing Editors*
RICHARD W. JONES, *Business Manager*

VOLUME 5 NUMBER 4

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V JANUARY, 1925 Number 4

IMPRESSIONS OF SPAIN—ITS ART, PEOPLE

By S. Chatwood Burton

College of Engineering and Architecture

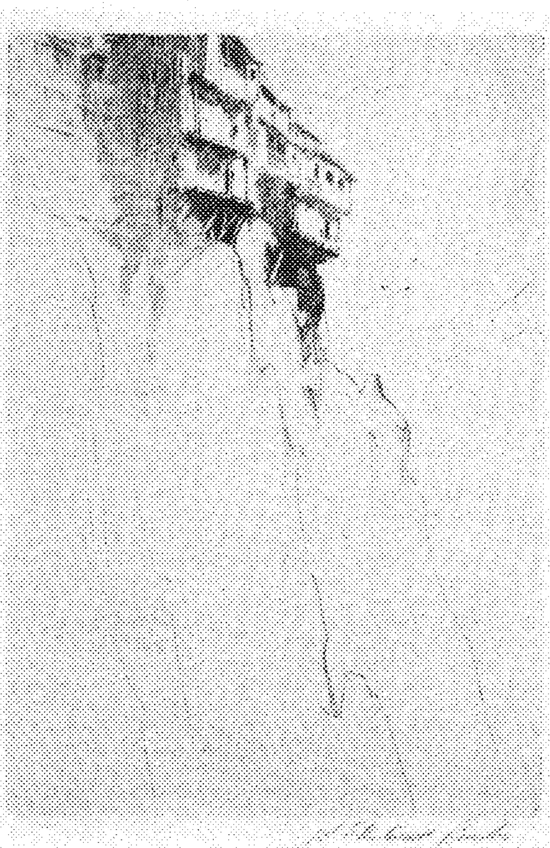
Reprinted from The Western Architect

ENTERING Spain as one goes into an unknown country, to make discoveries without preconceived ideas or the help of a Baedeker, was the writer's privilege. With this attitude of mind he covered more than 3,000 miles in that wonderful land of contrasts and there received his first impressions of its architecture, its art, and its people. He can now say with Cram, "Never was a country so lied about or so misjudged by contemporary intelligence."

Many architetcts have been led to consider Spanish architecture in the same manner that they approach the study of the Rococo style. Artists have, in general, formed their conception of Spanish art from Spanish masterpieces outside of Spain. The world at large, when it thinks of Spain, pictures priests, down-trodden people, bull-fighting, dark-eyed beauties, oranges and sunlight.

Strange as it may seem it is possible to find in this country examples of architecture as beautiful in proportion and modulation of planes as those found in Italy, France, or England; but it is impossible to obtain a thorough understanding of Spanish art without visiting the most important galleries and churches throughout Spain. The people of this land are far from being down-trodden or cruel; on the contrary, they are entirely confident of their superiority, and this assurance makes them one of the kindest and most generous people in the world. In certain Spanish towns feminine beauty is so rare that the only thing left for one to do is to talk about it. And as for sunny Spain—it is possible to freeze within its borders, even in the Month of May.

Spain, like lands situated near rivers whose banks overflow and leave behind valuable deposits, has been flooded by different civilizations from the North, South and East, and these tides have left behind interesting architectural deposits which await our

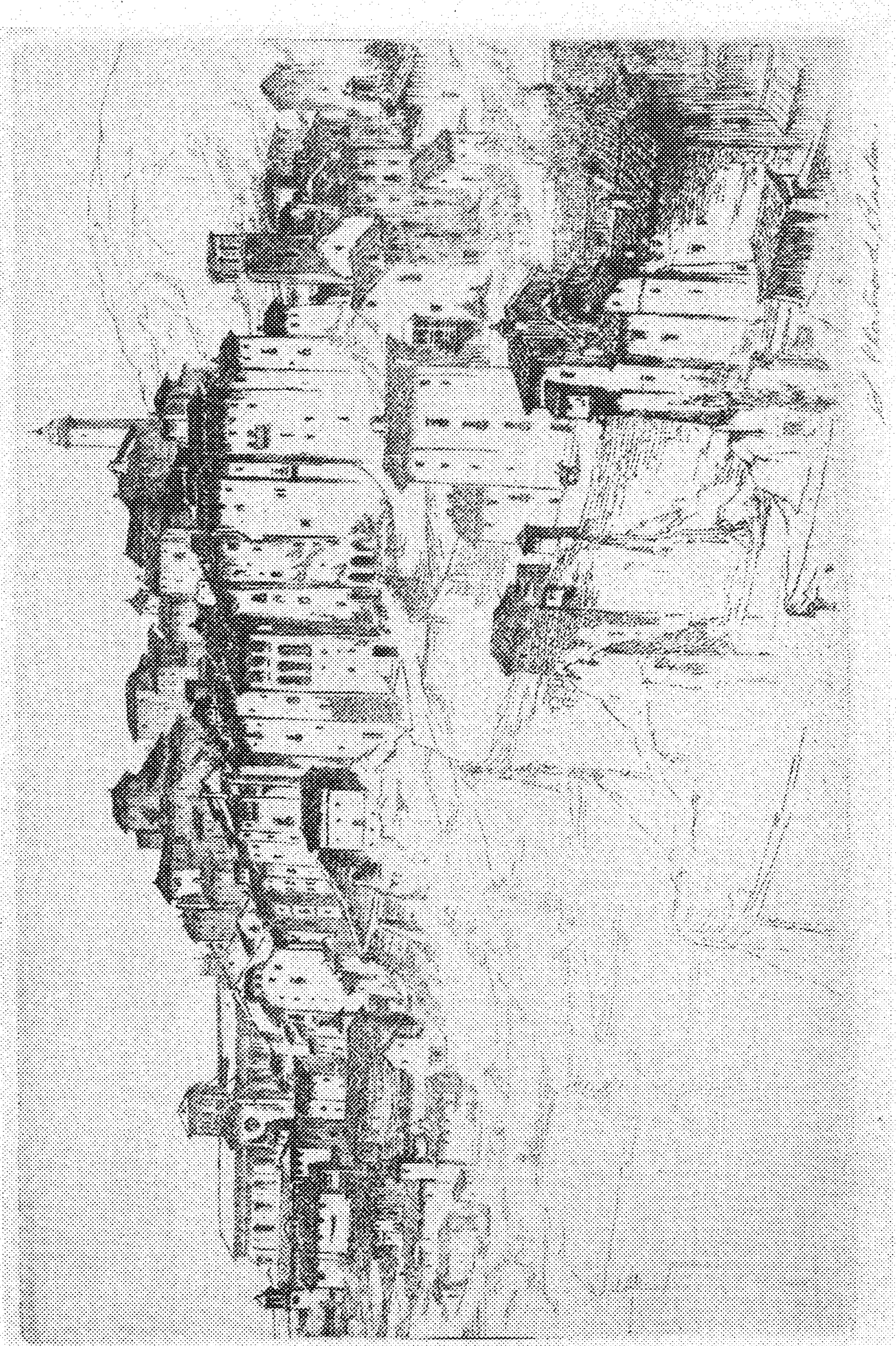


The Cliff Dwellers, Cuenca, Spain

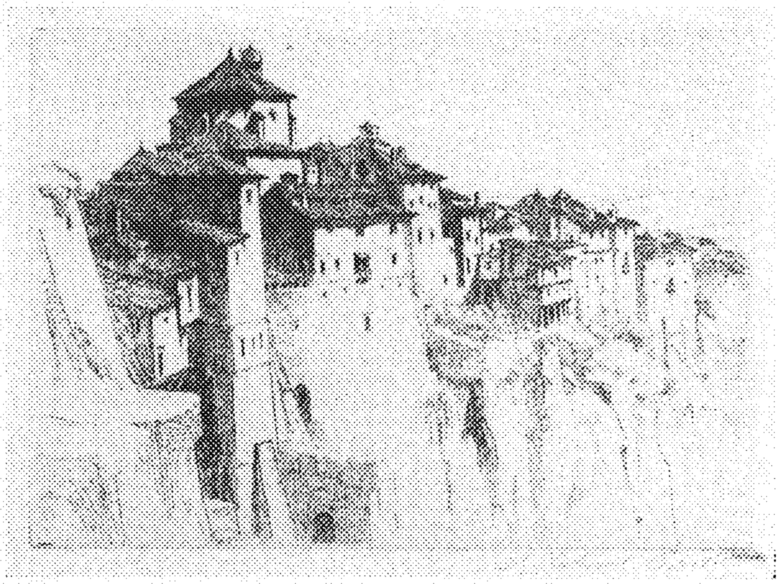
inspection and from which we will profit. The next wave to spread over Spain will be made up of architects and artists from America—and the rear guard which always follows in its wake. This flood will meditate on the remains of the Greek, Carthaginian, Roman, Moorish and Medieval builders, and it will find that these architectural deposits, while maintaining their own individuality, were adjusted and modified to this land of extensive plains, rugged cliffs and climbing hills. On its return to America, this flood will be to our architecture what the gulf stream is to Europe. Warmth and life will be added which will save it from a stylistic death and make of it a living, vital, pulsating, homogeneous whole.

Spanish architecture is expressive of freedom, joy, exuberance and richness, qualities possessed by the Spaniard. It naturally took centuries to develop, and was helped by his acquaintance with the many styles which had invaded Spain, and the crowds of skilled craftsmen within its borders. There is in Spanish architectural work, a harmonious union with the elements of the landscape, to be noted in the location of many of the Spanish cities, such as Segovia, Toledo, Ronda and Cuenca. They are situated high above the surrounding country, on hills, and look out over the unmeasurable expanse of plains to the gleaming purple of the distant mountains, while at their feet run the shining rivers which reflect their majesty and beauty.

At Nevers, in France, builders harmonize the roofs with the slope of the land. Here in Spain harmonies are produced by walls which melt at their base into the summits of rocks and hills. The structures of these cities and towns grow from and are not simply put onto, the top of the land. They emerge blossom-like out of the grimness of the stern hilltops as does a white corolla from the top of a cactus. From the distance they appear as a shining crown, spired roundabout, which rests on the stately head of a giant. To see the sinking sun cast its halo over one of these cities or towns, first in a hazy sheet of pale gold, gradually deepening to a pulsing orange, which flashes into shades of fire streaked with ruby shadows; to see the quivering scarlet poise silent a moment behind the aged embattlements and then sink quietly into the mysterious greens of evening



CUENCA, FROM ACROSS THE HUECAR, SPAIN



Upper Town, Cuenca, Spain

—this is so wonderful that even the stars hesitate spellbound to gaze thereon.

The best impressions of a few Spanish towns, like the women of a Moorish harem, are frequently to be seen only from a distance. Upon close approach, the high walls and narrow streets shut off the view, and one may enter a street at the base of the town, wind one's way completely to the top where the Moorish castle stands, without finding a single break from which to obtain a good vista. For this reason the most satisfying views of some towns are those from the surrounding hills or plains—where one can delight in the uninterrupted continuity of the structure and the hills which they crown, or the curious harmony of the varied towers, walls and turrets silhouetted against the liquid blue of the noonday sky.

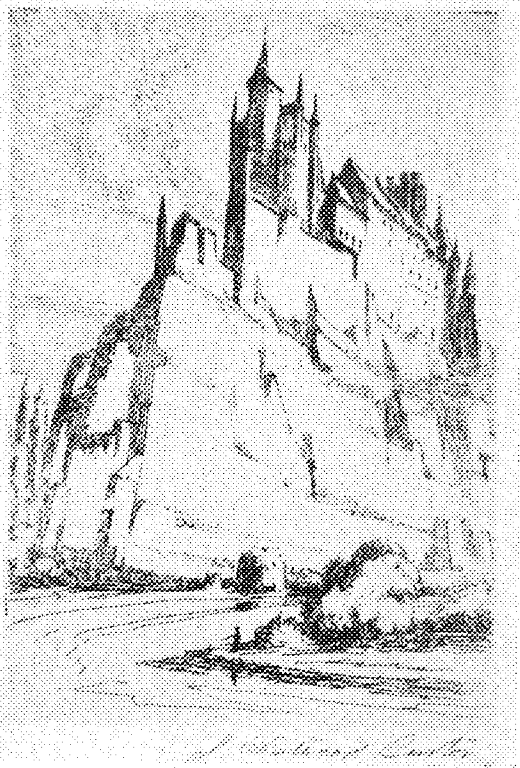
Other towns are out-door architectural laboratories where great Roman buildings or aqueducts, Gothic churches or cathedrals, stand side by side with Renaissance structures or the remains of Moorish castles—to say nothing of unusual dwellings with charming patios containing Greek and Roman statues, unique well-heads, and a display of exquisite craftsmanship in their very intricate specimens of iron work, balconies and columns.

The dominant types of architecture find their greatest expression in the monasteries, cathedrals and churches which have naturally played a most important role in molding Spanish life and character. It is interesting to see how the early churches in Spain reflect ecclesiastical conservatism with a natural leaning towards novelty in both structure and ornament. There is always a solidity of construction, a majestic solemnity and broad effect of the proportion, together with a certain simplicity and severity, which are characteristic of Romanesque ideals. For examples of Spanish Romanesque one may visit San Isidore at Leon, San Millan at Segovia, and San Pedro at Avila. At an early date Spain began to develop the Gothic style, and was encouraged in this by the Cistercian order, which introduced the Burgundian type of building, which can best be studied at the church of Las Huelgas near Burgos.

Important examples of Spanish Gothic are the cathedral at Salamanca, the one at Tarragona, San Miguel at Palencia, San Vincente at Avila. One of the first and finest examples of thirteenth century Gothic to be erected in Spain was the Cathedral at Burgos. One can study in this church the harmonious record of all the variations which this style underwent in three centuries. With its delicate, dream-like turrets and spires it is truly both a beautiful and interesting structure, springing from a distance like white lace out of the brown and barren waste of the northern plateau.

In the fourteenth and fifteenth centuries, the more strictly national features disappeared from the architecture, and an air of cosmopolitanism was brought about by a wealth of color and form introduced by means of sculptured flower and foliage, complicated tracery and delicately modelled profiles. The windows in all the churches for the most part are smaller than those of the northern countries, since sunlight is more abundant. As it filters through the delicate rose window of Toledo cathedral in late afternoon, caressing the tiled floors and carven altars with long fingers of iridescent prismatic color, one has the same subtle impression of unconscious harmony and the quieting satisfaction of beauty, that the Moors succeeded in producing in their palaces.

In the cathedrals of Cordoba and Seville, the Capilla Mayor is situated in the middle of the church. Therefore the only places left for the congregation are the arms of the transept, and the focal point is in the center; whereas in France and England the culminating point of the interior was always at the east end of the church. As a result, the interiors of Gothic cathedrals do not appear as spacious as the exteriors would lead



The Alcazar, Segovia, Spain

one to expect. Since the fifteenth century the choir has been placed in the nave of the church, instead of, as formerly, at the east end, and it is decorated with an inconceivable wealth of sculpture.

In Catalonia, in order to attain spaciousness and a feeling of simplicity, the naves were gradually made wider until finally the aisles disappeared and were represented merely by a series of separate chapels, as in the cathedral at Gerona. Sometimes the effort for spaciousness took the shape of octagonal additions to the choir, as in the Chapel of Santiago at Toledo, and in the Condestable at Burgos.

The Gothic period ended in Spain with cathedrals worthy of a great style. One of the last ones built was in the sixteenth century during the early dawn of the Renaissance, at Segovia, where the round arch and straight cut forms of the Romanesque architecture had deeply rooted themselves. The church gives a somewhat strange and hybrid, but altogether harmonious, impression. Juan Gil de Ontanon, its architect, had already built the new cathedral at Salamanca, and in Segovia he seized the opportunity to refine and perfect his early design. Some fifty years were passed in its construction, and Juan's son, Rodrigo, assisted in its completion. The splendid Gothic cloisters were built by Juan Campero of stone carried from the old cloisters near the Alcazar. Golden brown, shining with yellow tints, it has sober dignity and a mild austerity. The principles of the cathedral are Gothic, although the crossing is crowned with a round cimborio topped by a dome very Renaissance in feeling.

Though the towers and walls of Spanish cities may have sunk into a deep, impotent slumber, not so the churches. The more one sees of their fiestas and processions, the more one is impressed with the keen activity and colorful life of the present day Spanish church. The superb monuments of architecture here, are not like their distant cousins, for the use and pleasure of tourists and strolling travelers. The devoutness of the Spanish women increases with their age, and they exert a powerful influence on the nation in this respect. When one sees the whole populace assembling to view the Easter processions, he feels himself transported to the age of mystery and miracle plays. Time has produced but little difference in the attitude of the people and priests, or in the nature of the festival. The week preceding Easter is spent in many elaborate celebrations, which reach their culmination in a magnificent procession of the Brotherhoods of the city. At Seville they carry on platforms, profusely adorned statues of the saints, and are followed by bands of musicians. At the head of the procession march the Romans followed by other members of the Brotherhood, all bearing candles.

At Lorca, the procession takes the form of a review of Old and New Testament characters. Roman soldiers leading Christ to be crucified; Simon carrying the cross; Pilate, the apostles, Moses, Solomon, Nebuchadnezzar and others are there. The climax is the figure of the Virgin—beautifully attired and sitting on a platform carried by about twenty men. The embroidering of the sumptuous costumes worn by these characters is the yearly task of six different groups of women.

In Spain the church is alive, not only the church, but the cloisters, the plaza mayor and the public fountain, are inseparable from life. It is in the church that the important climaxes in the pageantry of life from the cradle to the grave are staged. In the cloisters the leaders of the church talk and smoke with their friends between masses, or the young people play games; here the procession assembles before going into the city. The Plaza mayor on market days is almost as colorful as the ritual of the church. Its effects are not so carefully studied, yet it sparkles with vitality, color, amusement, variety, barter and mirth. However, the most animated place in Spain is the public fountain which evidently takes the place of our women's clubs. It is much more primitive, but none the less fascinating to the traveler.

There are a few lifeless places in Spain which have a rare beauty; they remind one of the figure of a certain carved recumbent bishop which is a part of a wonderful tomb in the hospital at Toledo. The Bishop's face is so perfectly carved that one is led to exclaim, "In death there is a new beauty not less sublime than that which accompanies life." Abbeys which have weathered more than 1000 years are lovely, yet desolate. Spain has untold numbers of these wonderful, forsaken abbeys, perched high among jagged rocks, deeply hidden in leafy dells, or enclosed behind high walls. One can find them among the mountains of Galicia or in the wide valleys of Aragon. The Benedictine generally chose the most rugged granite mountain side for the site for his abbey, while the Cistercian preferred the fertile river valley. Those in search of the Carthusian abbeys may look on the lonely peaks. One should not leave Spain without seeing S. S. Creus in Catalonio. It is one of the most enchanting places in Spain, built by the conquering Kings of Aragon, who were inheritors, in Italy, of both Greek and Saracen. It is here that all styles are used, yet they produce a most harmonious and delightful composite.

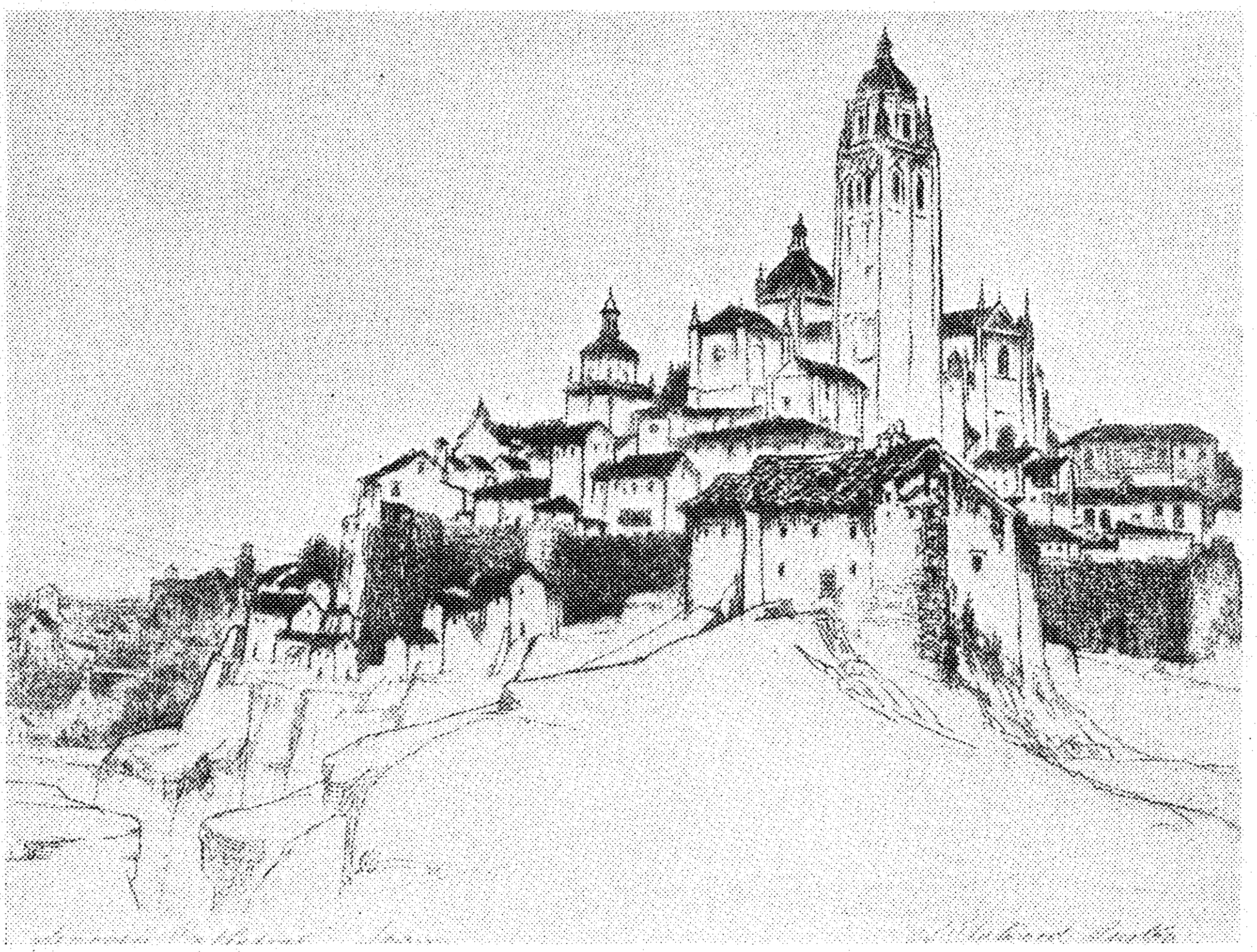
A few buildings in Spain are cold and uninteresting, but in no sense are they representative of the people. The Escorial is one—built by Herrera under the command of Philip II. This was built in an unsympathetic period forced upon the Spaniards by a passionless monarch. It is prisonlike in its severity, and produced a strong vital reaction against the Palladian classic which resulted in a colorful extravagance reminding one of the Barocco. The interior of the Cartuja, in Granada, is the other extreme of the frigid Escorial.

But this occasional severity and coldness never occur in the Spaniard's homes. Instead, the dwellings reflect the Moorish sensitiveness to beauty which here seems to find its fullest expression. It is posible that from their eastern rulers the Spaniards received their remarkable craftsman's understanding of the right balance between plain and decorated spaces, and their subtle means of giving nobility and richness to the rooms or patios in which they live. Without self-consciousness, the Spaniards' work always grew out of the wholesome requirements of the case and out of local conditions. They made a house to live in and its plan and construction were based upon the oriental type of dwelling with a patio—the walls acting as frames for home and garden furnishings and as a harmonious background for its human inhabitants.

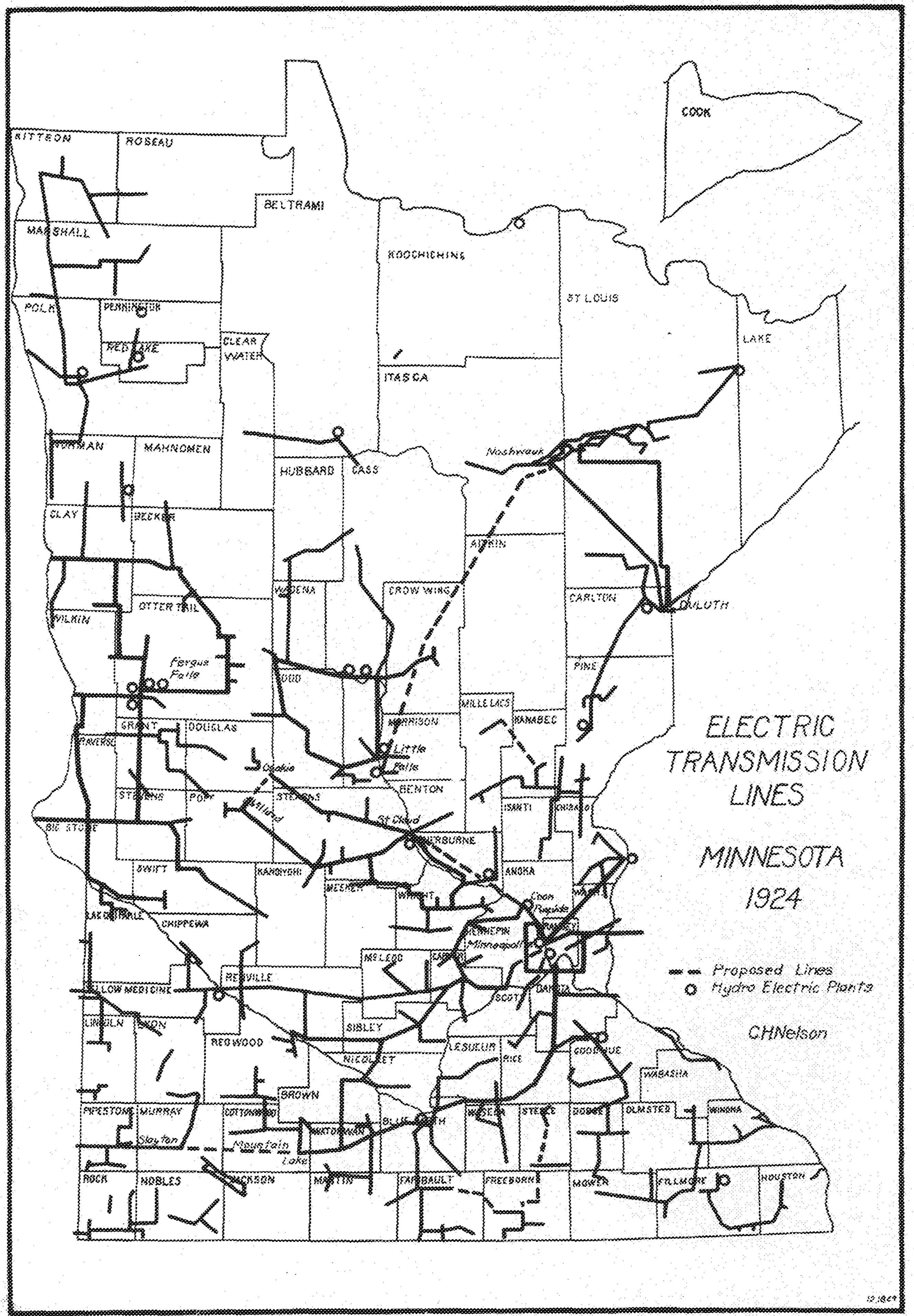
In passing through the rooms of a beautiful Spanish home one senses an atmosphere of the richest color, much as one may sense flowers in a garden at night. Upon rousing to discover the sources of this stimulation, one gradually becomes aware of honey-comb and inlaid ceilings, lustrous tiles, carved plaster, wrought-metal lanterns, latticed bay windows, intricate panelling, corbelled cornices; great spaces of plain, plastered wall with blazing accents of color or carving perfectly placed, damask and velvet hangings, carved doors of wood and panelled shutters, superb in their originality and pictorial quality; upholstery of tapestry or Cordovan leather, blue and scarlet velvet chests, with steel, brass, or gilded iron fittings, and elaborate cabinets. The balance maintained between white-washed walls, tiled floors, painted ceilings, and the strong, rich furniture arranged along the wall, is distinguished and refreshing.

It brings back to the mind thoughts of the Moorish civilization in Spain. There have been great cities in Spain —Cordoba with its million people, and with mosques, baths, bazaars, universities, palaces and pleasure gardens taken from Arabian nights; ceilings of cedar set with ivory and mother-of-pearl, walls sheeted with shining tiles, couch hangings of gold embroidered stuffs, marble courts with fountains and pools of water courses, flowers everywhere, with orange orchards, vineyards and cypress groves. And amidst it all a Moorish chivalry in splendid vestments and damascened armor from Toledo; music, love-making, learning, and fighting; all the while that the rest of Europe was sunk in the Dark Ages before the dawn of the true medievalism!

At sundown on the rockbound coast of Morocco a stately figure stands, facing Spain and dreaming of the days when his nation set forth to convert the world to the glory of his faith. He hears the sound of victory mingled with the battle cry of Allah. Onward the glittering victorious armies march to the north, bearing on high the Crescent which everywhere replaced the Cross. After battle, there were sacred mosques to be erected, and cities to be turned into splendors of magnificence which rivaled the luxurious visions of the Arabian nights. As queen of all this glory was Cordoba, the greatest jewel to be set in the triumphant crown of Allah. With Damascus and Bagdad in the far Orient, it formed the trinity of Moorish conception.



The Cathedral at Segovia, Spain


ELECTRIC
TRANSMISSION
LINES
MINNESOTA
1924
Proposed Lines
Hydro Electric Plants
CHNelson
COOK
ROSEAU
BELTRAMI
KOOCHICHING
ST LOUIS
LAKE
POLK
RED LAKE
ITASCA
MAHNOMEN
HUBBARD
CASS
Nashwauk
CLAY
BECKER
AITKIN
CARLTON
DULUTH
WADENA
CROW WING
WILKIN
OTTER TAIL
Fergus Falls
PINE
MILLE LACS
KANABEC
GRANT
DOUGLAS
MORRISON
Little Falls
BENTON
STEVENS
POPE
ISANTI
BIG STONE
St Cloud
SWIFT
KANDIYOHI
ANOKA
Coon Rapids
CHIPPEWA
HENNEPIN
Minneapolis
RENVILLE
MC LEOD
SCOTT
DAKOTA
SIBLEY
REDWOOD
NICOLLET
LESUEUR
RICE
GOODHUE
WABASHA
BROWN
PIPESTONE
MURRAY
WASECA
STEELE
DODGE
OLMSTED
WINONA
Slayton
Mountain Lake
ROCK
NOBLES
JACKSON
MARTIN
FARIBAULT
FREEBORN
MOWER
FILLMORE
HOUSTON

MINNESOTA'S ELECTRIC POWER INDUSTRY

By Clarence H. Nelson
Member of the Senior Electrical Class

THE first dynamo was brought to Minnesota in 1880, installed at Lake View near Stillwater, and later moved to Cloquet, where it furnished light for a lumber mill. The first alternator was installed at Mankato in 1887. The first transmission line in the state was built from St. Paul to Apple River, Wisconsin, in 1895.

The electrical development in the state was slow until about 1912. The first installations were small D. C. plants, usually built in conjunction with the village water works. Most of these were run by steam engines and used only for a few hours a day. The growth of the village and the increasing demand for lights soon overloaded the equipment. Then came the period of change from carbon lights to mazda lights which gave the D. C. machines a little longer period of usefulness. When the time came for the village or private plants could add to the plant, several plans could be used. Some added small units to the existing plants, a few remodeled their plants to A. C. systems of greater capacity, and the others sold out to corporate utilities.

The many corporations that came into existence for the development of the industry soon bought up these small, overloaded plants. Large stations were built using steam and water for power. Transmission lines were built from the stations to the neighboring towns. Day and night service, electricity for power purposes, and increased dependability, made the new system popular and forced the companies to expand very rapidly. The men in charge of the larger companies soon saw that their advancement was best assured by uniting the companies into one system. When this was done, the first step was taken toward a definite power development for the state. Until 1915 very little interconnecting on a large scale had taken place, but during the next five years the companies in the southern half of Minnesota were brought together by the Byllesby Engineering and Management Corporation. The united system was called the Northern States Power Company.

The west central, central and northeastern parts of the state were served by eight different power companies. These were developing as fast as they could without any cooperation between each other. Indeed, on the Mesaba Iron Range there was keen competition as to who was to have the business. A glance at the map will show the lines of two companies occupying the same field. These rival lines were not connected until after 1920.

In 1922 and 1923 the Minnesota Power and Light Company bought the Great Northern, the Minnesota Utilities, General Light and Power, and Cuyuna Range power companies. Interconnections were made between the first three systems, which increased their capacity and did away with the wasteful, inefficient duplication of electric service. This corporation bought up the Little Falls company in 1924. During the summer of 1924 they started building a dam at Royalton and a 110,000 volt transmission line to Nashwauk. The general location of this is shown by the dotted line between the Iron Range and Little Falls. This company serves ninety towns over 970 miles of line, with voltage ranging from 110,000 to 22,000.

The Northern States Power Company has a 110,000 volt loop around the Twin Cities and a 110,000 volt transmission line to Wisota, Wisconsin. A 60,000 volt loop connects nearly all of its main generating stations. This loop extends southwest to Watonwan County and from this the company feeds out into other lines at voltages ranging from 22,000 to 6,600. In August, 1924, the St. Cloud Public Service Company became part of the Northern States Power Company. Immediately steps were taken to insure constant adequate service for that division. The dotted lines between Villard and Osakis, and St. Cloud and Coon Rapids, show the proposed improvements. These will prevent an interruption of service such as happened in the early part of 1922, when line trouble caused a number of towns to be dark. Another tie proposed by the company is that between Mountain Lake and Slayton. In all, this company energizes about 1,900 miles of line and supplies 165 towns with service.

The west central part of the state is well served by the Ottertail Power Company. Two 40,000 volt loops feed out from the hydro and steam plants at Fergus Falls. The loops feed out to other lines at 12,000 and 6,600 volts. Eighty towns are supplied with service over 650 miles of high line.

Five hundred and twenty towns of the state are furnished service from Corporate Utilities and 5,000 miles of transmission line are needed to connect them to the stations supplying the power. There are 0.062 miles of high line per square mile of area in Minnesota, while in Illinois there are 0.112 miles per square mile, nearly two times as much as we have.

Through the effort of the University of Minnesota, the power companies of the state, and the manufacturers of electrical equipment, a study is being made of the farm service connection. Many farmers have availed themselves of electric power and through this study it is hoped that many more can be connected.

In 1915 there were one hundred and forty-seven towns having isolated plants either municipally or privately owned. Ninety-two municipalities owned stations with a total capacity of 16,830 K. W. Fifty-five towns had privately owned plants with a capacity of 13,628 K. W. The power companies' total capacity was 86,825 K. W. The total for the state was then 117,290 K. W. Most of the isolated plants were small and furnished D. C.; a few supplied A. C. It is interesting to note that three plants were using 133 cycle units.

At the end of 1923 there were fifty-four municipal plants with a total capacity of 24,000 K. W. The nineteen privately owned isolated plants had 2,335 K. W. capacity, while the power companies had increased their power to 364,600 K. W. The state total was then 391,000 K. W., an increase of 330 per cent over 1915. This gives Minnesota 0.164 K. W. per capita, which is not far behind Illinois, with 0.187 K. W. per capita. The municipal plants decreased in number, but increased in K. W., being nearly doubled in capacity per plant. The privately owned plants decreased in number and capacity. This seems to indicate that the private owners were less willing to rebuild and keep going than the villages. Also some of the large privately owned plants were used for power stations for newly formed corporations.

Minnesota is called the Land of

10,000 Lakes. When a country is level enough to have so many lakes, the hydro power must suffer. According to the forestry department we have 450,000 available horse power. This value depends of course on the amount of rainfall, for after an extended period of low rainfall the available power will be lowered to about 300,000 horse power.

There are at the present time twenty-six dams in the state used for generating electric power commercially. The heads vary from 10 feet to 375 feet. The total electric capacity is about 200,000 K. W. The amount of power in dams under different heads is tabulated below.

Number of Dams	Heads ft.	Per cent of total Water Power
12	20-10	5.34
8	40-21	46.2
3	60-41	3.72
3	375-61	39.4

Five and thirty-four one-hundredths per cent of the power is installed in plants where data relative to the heads could not be obtained. These are small municipal and private plants. From these figures it is seen that 56.88% of the power is under 40 foot head.

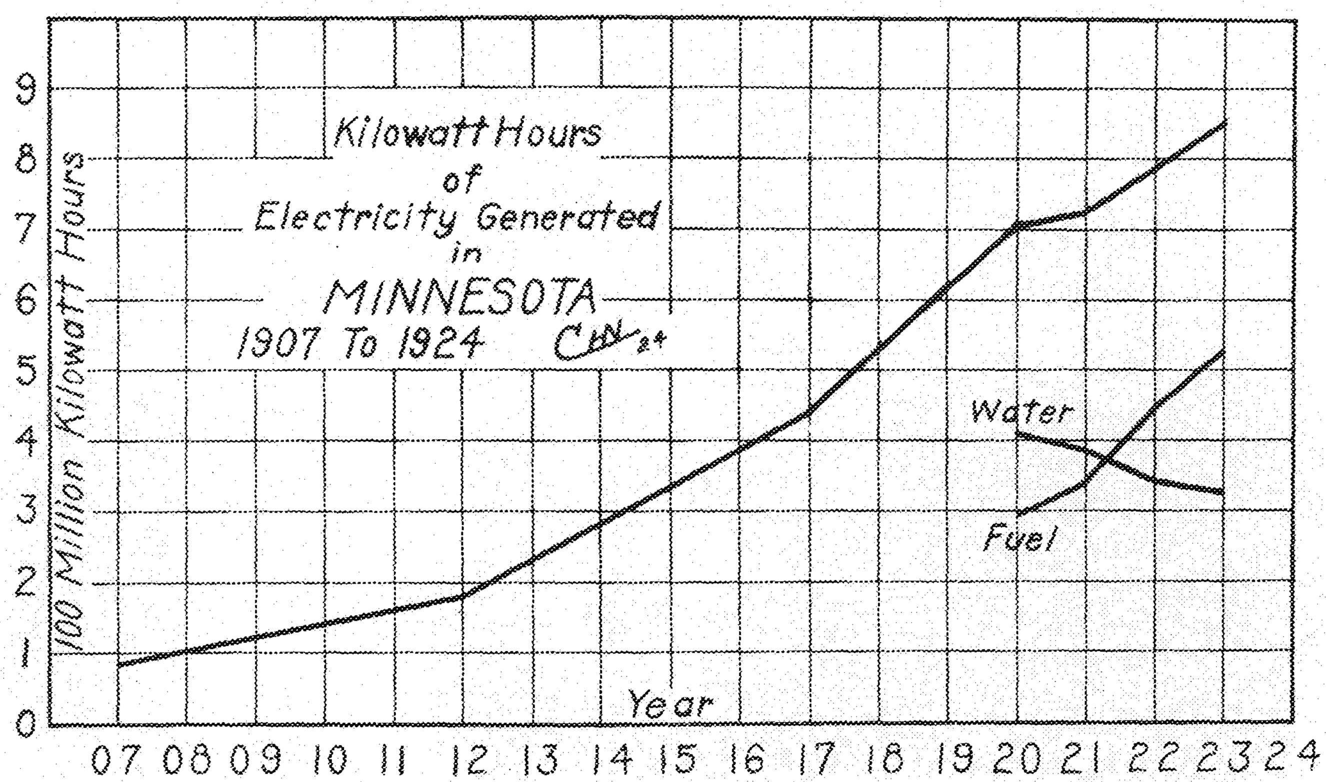
Several large steam stations furnish most of the remainder of the installed power. Three new stations have recently been built in the Twin Cities.

Figure one shows the increase in K. W. H. generated in the state from 1907 to the end of 1923. The rapid rise after 1912 shows effectively how the industry developed. The K. W. H. per capita in 1915 was 152 and in 1923 it was 345, an increase of 225%. The drop in the curve at 1921 shows the effect of the general economic depression on the utility business. The figures for K. W. H. generated by fuels and water are available from 1920. The K. W. H. generated by water has decreased every year as shown on the curve, Figure 1, although new plants have been built. The decrease has been due to complications of rainfall and drainage. The steam generated energy passed the hydroelectric generation between 1921-22 and with the new steam plants in operation the quantitative lead of the thermal plants is assured. It is interesting to note that in 1923, 5.9 million K. W. H. were generated by using wood as fuel.

What the future development will be cannot be forecasted without a much more intensive study of conditions in this and neighboring states. A study of this kind cannot be confined to one state alone, for the electric utility business cannot be restricted by state boundaries. The north central power division of the N. E. L. A. Power Survey includes the states of North and South Dakota and Minnesota. At the present time this territory is being surveyed to make possible improvements that will serve the people as they demand and yet not duplicate equipment. The N. E. L. A. urges the power companies to include interconnections in their improvement programs.

Such interconnections can best be made when the companies adopt standard voltages as well as frequency. Interconnecting the various companies of the state will make toward better utilization of the natural resources that we have.

Material for this article has been obtained from the Electrical World, McGraw Central Station Handbook, Northern States Power Company literature, N. E. L. A. and Geological Survey reports. I appreciate also the valuable suggestions made by Mr. R. B. Sleight.



MODERN PRESS USED BY THE TRIBUNE

By Maurice Munger

Member of the Sophomore Mechanical Class

THE PRESSES on which the Minneapolis Tribune is printed are shown to advantage in the three illustrations accompanying this article.

The frame is of cast iron, and rests on a foundation entirely separate from that of the building. In the first figure is pictured one of the four units which complete the battery. It consists of a folder and three decks of cylinders.

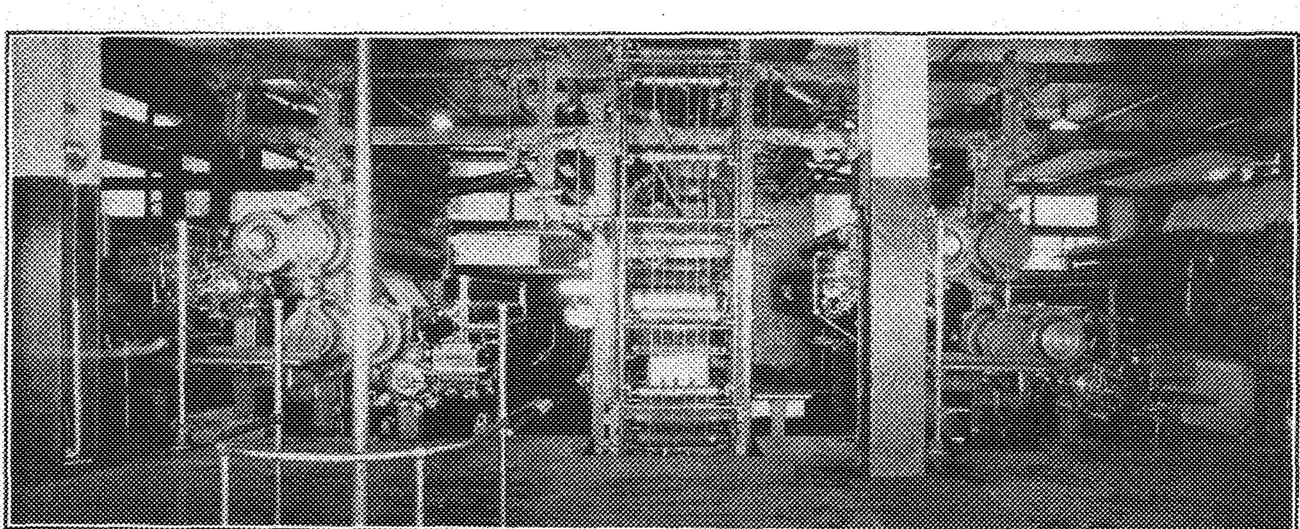
A deck, so called, is made up of two sets of impressions and plate cylinders, the ink distributing system and the rollers carrying the sheet along through the press. In figure 1 the deck at the left is clearly shown. The cylinder at the lower right is the plate cylinder of the lower pair, and the plate cylinder of the upper pair, which prints the other side, is at the left. There are eight plates on each cylinder, where they are held by straps which fit over the bevelled edges. A plate, which prints a complete page, is 1-16 of an inch thick from the inside surface to the face of the type. When two papers are printed at every revolution of the cylinder, the plates are put on the press in duplicate, there being two for page one, two for page two and so on. With duplicate plates, the capacity of each unit is a tweny-four page paper, but the folders can be adjusted to retain the first twenty-four pages and insert the next twenty-four inside, producing a forty-eight page paper. In order to do this, a single plate is put on for each page, and the run is said to be "collect." A yielding blanket of felt and rubber five twenty-fourths of an inch thick is placed on the lower impression cylinder, which is directly below the upper one, to allow for slight inequalities in the surface of the plate.

To print the twenty-four page paper spoken of above, forty-eight plates are used, the plate for each page being duplicated, so two papers are printed for every revolution of the cylinders. To print a forty-eight page paper, the folder can be so adjusted as to place the second of these papers inside the first, making a four-section paper with twelve pages in each. For such a paper, the plates are of course not duplicated.

By means of clutches on the drive shaft, decks may be engaged with or freed from the driving motors of which there are four. Any of or all the four folders may be operated as a unit with from one to three decks of cylinders. Folders one, two and four may be used with four decks each, number one and number three with five and number two with six decks.

Ink is fed from a central tank to the valves which control the amount supplied to each column of the paper. These valves are contained in iron boxes which may be found at the upper left and lower right on each deck. A tube leads from each of these control valves to a place opposite its column, above a composition drip roller. This roller, which is 8 inches in diameter, transfers the ink to a steel one about fourteen inches in diameter, upon the surface of which the ink is distributed by a smaller composition roller. A third composition roller, also a smaller one, transfers the ink from the first steel roller to a second one of the same size, upon which three small distributing rollers and two eight inch rollers, "form" rollers, run. These likewise run against the face of the plates and keep the type inked. To secure a more even distribution of the ink, the small distributing rollers and the first steel roller are moved back and forth lengthwise by a cam on the end of the second steel roller.

Figure 2 shows the reels, located directly below the press, which hold the paper as it is being used; there is a reel for each deck of cylinders. Each reel has spindles for three rolls of paper, and the arms of these spindles can be moved to any position on the length of the shaft, so that a full, three-quarter or half width roll may be used, depending upon the number of pages in the edition. The arms of the deck can be rotated in either direction from



One of the four units, consisting of a folder and three decks of cylinders, which complete the battery of presses.

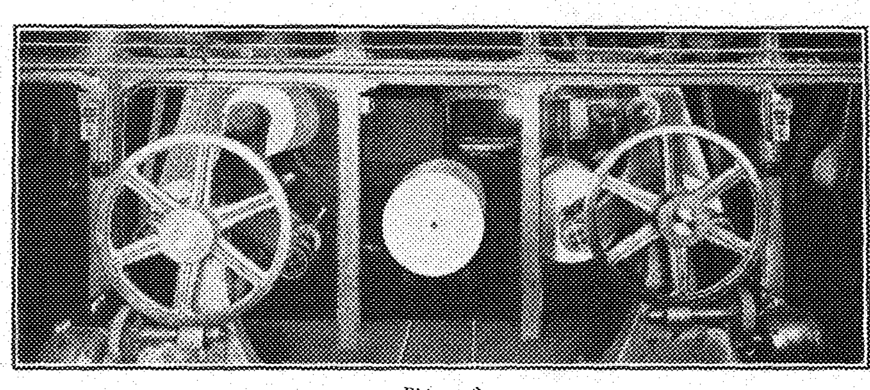


Figure 2
The reels shown above, hold the paper and are located directly below the press. There is one reel for each deck of cylinders.

the small, square control boxes which appear on the sides of the posts. In filling the reel with paper, one of the three pairs of arms is moved into position so that the spindles are at the height of the core of a roll of paper as it rests on the truck.

The paper comes in rolls of four, three and two page widths, so by using the right number of decks and the proper widths of rolls, papers with any even number of pages up to ninety-six may be printed. For example, a twenty-four page paper is printed by using three decks with full width rolls of paper in all of them.

To prevent the roll from "running wild," a certain amount of tension must be kept to hold the sheet of paper back; this is accomplished by the tension belts in figure 3. These belts are driven two per cent slower than the surface speed of the plate on the plate cylinder. A perpendicular from the point of suspension of these belts would fall nearer the central shaft of the reel than the position occupied by the spindle, when its arms are horizontal. Since the bars on which the lower pulley is mounted are free to swing on the driving shaft, the force with which the belt is held against the roll of paper can be controlled by rotating the reel. The greatest advantage of this type of reel is that paper can be put in while the press is running. A sticky glue is spread on the new sheet and when one roll has been used up, the press is stopped just long enough to bring the new roll into position, rub the old sheet against the glue on the new roll, and break the last of the old sheet off beyond the "paster."

From the roll the paper passes up over a roller which is held up by a spring at each end which prevent resulting jerks from breaking the sheet in case the rolls of paper are sometimes not perfectly round, leaving the spring roller, the sheet goes under a solidly mounted roller up through the floor and between the impression cylinder and the plate, where it receives the ink. From the upper impression, it goes over a drag roller which is driven at a slightly greater surface speed than the plate so that slack is taken up. The sheets form as many decks as are being used and are brought to the folder by a system of rollers which support and direct the moving paper.

As the sheet goes into the folder, it is split down the middle by a slitter, a sharpened disk. Each half, forming a section of the completed paper, comes down over a V-shaped plate called "the former" and between two rollers which fold it in the middle. This is the fold at the back of the finished paper. From "the former" the paper goes into the rotary part of the folder where the individual newspapers are separated and the sections are put together. The completed paper drops into a conveyor belt and is taken to the carrier, an arrangement of coiled springs running on rollers which carries the paper up to the mailing room.

The presses are driven by four 120 horsepower motors, one to each unit. Each press also has a 10 horsepower starting motor which engages cogs on the main shaft through a reduction gear. These motors are shown in figure 3. Two of the conrol boxes are shown here also. Left to right the top buttons are "On," "Stop," "Off;" below are "Ink" and "Reset" and at the bottom "On" and "Safe."

Before the press can be moved at all, the "Reset" button must be pushed, and several red lights go on automatically. Then the "On" button closes the circuit of the starting motor. If the "On" button is held down, the motor driven rheostat operates to speed up the press by starting the large motor, and centrifugal force disengages the cogs of the small motor, allowing it to stop. The "Stop" button breaks the power circuit to the motor and causes the energy of the rotating machine to be used in operating the motor as a dynamo, supplying current to the electric brakes on the ends of the impression cylinders which are shown in the first illustration. The "Off" button merely reverses the action of the "On" button. When the "Safe" button is in, the press cannot be operated until the "On" has been pressed to release it.

The presses are designed to run at 300 revolutions per minute, the speed at which the paper moves at the rate of 13 1-3 miles per hour. Under test one of the four presses developed 340 R. P. M., but the usual speed under operating conditions is about 270.

Figure 3
The two motors, one 120 H. P. and one 10 H. P. operate the press. The smaller motor is used to engage the gears on the main shaft.

VALUE OF MATHEMATICS IN ENGINEERING

By John A. Banovetz
Member of the Senior Civil Class

WHAT is an engineer? We say that there are manufacturing engineers, transportation engineers, and administration engineers. An engineer is a manager, and an inventor or plotter; one who designs and executes a project in an efficient and economic manner. A common definition is: an individual who can do for $1 that which anybody else can do for $2.

When the young graduate engineer steps into the practical field of engineering he finds conditions somewhat different from those which he had expected; for we must remember that a college course does not develop an engineer but enables his development to have a good start. He must stick with the bunch and make a place for himself. Results show that at the end of fifteen years the majority of graduates are still engaged in that particular branch of engineering for which they were trained; but after twenty-five years the larger proportion are under other than strictly engineering fields, with positions such as managers and superintendents of large industries. The general tendency today is to place the management of a concern in the hands of a technically trained graduate instead of an after-dinner speaker.

In order to prepare a student for the large variety of positions he may hold, what should his curriculum contain? It is obvious that to become an engineer one must have training in the technical courses pertaining to one special branch of engineering. Today there is an increasing need of English in the engineering curriculum. It will enable the engineer to write a more intelligent and concise report. A knowledge of good English will aid an Engineer to make a speech convincing.

Mathematics is the fundamental basis for most engineering subjects. Prof. B. L. Newkirk in his address before the Society for the Promotion of Engineering Education said, "Educated common sense and clear logical thinking constitutes the science of mathematics in its applications to engineering problems." The student, if he has not a comprehensive knowledge of elementary mathematics, is not capable of mastering the theories and laws which constitute the scientific basis of engineering work. Mathematics is as essential to the engineer as anatomy is to the surgeon and the basic laws are to the lawyer; for the engineer is continually working with mathematical problems.

There are a number of the so-called practical engineers who, in the estimation of the technically trained man are considered nothing more than handbook engineers. This sort of an engineer will go to the handbook for all his formulae and solutions to problems. Many times he does not fully understand the formulae, nor does he appreciate its significance. Usually he knows nothing about its derivation. When a problem arises he turns to his handbook, selects a formula, puts in his known quantities, and by arithmetic obtains the answer. The trouble with this method is that he may select the improper formula or assume the incorrect coefficients. Since he does not know the real basis of his formula he is not certain that the solution is correct. Again he may not know the assumptions made in the derivation of the formula itself. If he happens to choose the correct formula he can consider himself lucky, if not the result may be very costly.

A course in mathematics should accomplish two important things: first, it should produce a stimulating and lasting effect upon the mind of the student, a general training for his brain; and second, it should give the student the ability to properly interpret mathematical language and to accurately and skillfully use it. One must have two objects in mind to successfully study the science of mathematics; namely, the mental discipline it affords by giving a thorough knowledge of principles, and the ability of applying these principles to the solution of practical problems. The second is very important in later life, being a great factor in determining one's future success.

The teacher of mathematics must possess an interest in his subject in order to have the student derive the most benefit from it. By arousing a craving for mathematics in the student, the teacher can often produce a stimulating effect on the mind. This is sometimes produced by giving concrete examples showing where and how these apparently theoretical principles have direct application to engineering problems. These illustrations provide the missing link in connecting pure mathematics and practical engineering. If the course is given in too abstract a manner, it will be uninteresting to the beginner and he will fail to get its significance. On the other hand if the course should happen to be too concrete the student will fail to get the fundamental principles and will use the science as a common ordinary tool instead of a valuable instrument.

Most engineering colleges require three units of High School mathematics as a part of the entrance requirements. These units consist of one and a half year of Algebra, one year of Plane Geometry, and a half year of Solid Geometry. If a student enters the University of Minnesota without these units he must complete the course without credit before taking any college mathematics.

The majority of engineering schools require three years of mathematics in the engineering courses. In the freshman year the mathematics required are College Algebra, Trigonometry, and Analytical Geometry. College Algebra generally consists of factions and negative exponents, surds and imaginaries, logarithms, variables, graphical representation, simultaneous linear equations, quardratic equations, progressions, binomial theorem, series, and undetermined coefficients. Here the Freshman gets his introduction to college mathematics. If he can pass this course with a fair grade he can consider himself capable of pursuing the remaining mathematical courses. This is also the place where the Freshman may meet his Waterloo. To succeed as a student he must expend untiring effort in his work or he is liable to fall by the wayside. Trigonometry is considered much easier than Algebra, however, and it is very important that a thorough knowledge of it is obtained. Analytical Geometry is absolutely necessary in any good mathematical curriculum.

During the Sophomore year the student studies the Calculus, and possibly some Mechanics. The Calculus is the most valuable knowledge of mathematics that the engineer can possess. No one subject is as powerful and general in its applications. Many of the problems in it are simplified into standard formula. In fact a large portion of our most important formulae are derived through the aid of the Calculus. One often hears an engineer say that he uses

Algebra and Trigonometry a good deal but never the Calculus. This type of engineer has not the proper grasp of the Calculus and because of his lack of confidence hesitates to use it; instead he resorts to more simple methods, many of which give him only approximate results. To be sure of himself, he will often alter his result to have a factor of safety. This is poor engineering, for he may spend money needlessly in adding unnecessary strength or endurance to his project, or he may be so far in the wrong that the additional safety factor is not sufficient to compensate for the error. This man may be a good engineer without the Calculus, but he would be a better engineer with it.

Mechanics is a course that relates theoretical mathematics to practical problems. It may be considered as a special course in physics. It is divided into three classes: Statics, Kinematics, and Kinetics. Here the student begins to see the importance and applications of his previous courses.

In the junior year Mechanics is completed and additional practical mathematical courses are required or offered as electives. These courses include Hydraulics, Hydraulic Measurements, Strength of Materials, and Materials of Construction. Laboratory courses are given in connection with the theory. There is also offered in the third and fourth years advanced mathematics such as the Theory of Least Squares, Differential Equations, and Dynamics.

AN OLD-TIMER LAUDS HIS UNIVERSITY

By James J. Garvey

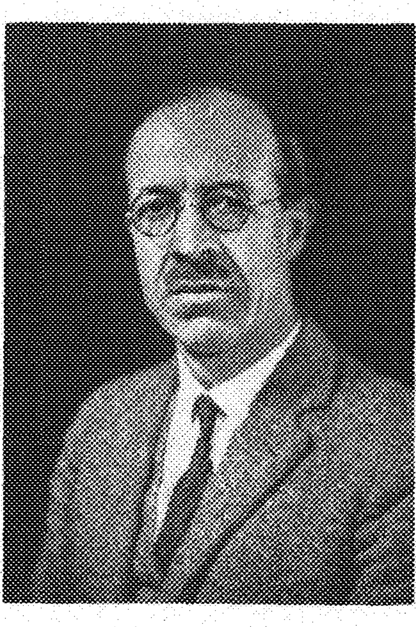
Western Electric Company

Too often those of us who have never had the opportunity of returning to the Campus after a long absence feel that the elation of the old graduate is a sudden rush of former undergraduate enthusiasm without any real reason. Even the present day undergraduate can not realize what it means to come back and see the strides that are being made by the old University—the great work it is doing to make its sons really qualified to take their places in the technical and business activities of the nation. Take my own case for example, and I believe my industrial experience has given me a good opportunity to judge whether the enthusiasm of the old Minnesota graduate is really justified.

For several years my work in one of the largest manufacturing organizations of the country has kept me in intimate touch with all of the larger and more progressive universities and colleges of the Middle Western and Southwestern districts of the country. Imagine my feelings, therefore, when I recently came back to the University and as an old football fan I became elated when I saw the new stadium! As a thorough believer in the undergraduate life of the University I got a feeling of snug satisfaction in noting the many recent improvements around the Campus. The railroad cut has disappeared and the Administration building is rapidly nearing completion. The new library is in full operation and the quadrangle dreamed of for so many years is gradually taking form.

What caused me to literally swell with pride was the new electrical engineering building which has recently been completed, and which seems to me to be as nearly perfect for the purpose for which it was designed as anything that exists at any university. The building, I believe, and remember I am basing my opinion on the observations I have made in years of contact with all of the better known universities of the Middle West, is not surpassed by any of the Middle Western technical colleges of today.

Too often I have found that an en-



James J. Garvey

gineering laboratory was more or less an animated junk heap; collections of disorganized departments, poor equipment and arrangements that the management of any modern and efficient manufacturing organization would not tolerate for a moment. The old-timers who are coming back these days are delighted that Minnesota has passed through this stage and has reasons to be proud of its present set-up. I believe the "old bunch" that used to make the anvil ring in the forge shop in the old engineering building that is used as the University Post Office today, and at that time contained all of the shops, drafting rooms, engineering laboratories, and some of the lecture rooms of the department, will feel as proud as I did at my recent visit.

The general appearance and arrangement of equipment at any engineering college is one that always impresses the casual visitor from the industries with either its efficiency, or lack of efficiency, as the case may be. It is a fairly accurate gauge of the quality of work done by the student body and one that is given very careful consideration by industries when they are in the field for technical graduates.

After a thorough inspection of the arrangements of its lecture room and laboratories, its possibilities for expansion to meet the needs of the department in its future growth, I feel that I must express my personal appreciation to the faculty and to all others who have been instrumental in bringing about such a decided improvement—and I am certain that the undergraduate students who now have this enlarged opportunity have a feeling of pride and gratitude even greater than mine.

I must not close without reminding you that this increased opportunity for more thorough works brings a decided increase of responsibility upon the student body and unless you, individually, by more conscientious effort and closer application, fit yourselves to render greater service to the state and to all industry at large, the efforts of the men who have made this change possible and the money invested will to a large degree have been wasted. But, knowing the quality and high moral standing of the sons of Minnesota as I do, I am certain that the investment will return a high rate of interest in all of the affairs of the state and nation wherever a Minnesota engineer may be found.

The
MINNESOTA TECHNO-LOG
University of Minnesota

For the Greater Minnesota Technology, the institution which today is being constructed in mortar and brick, and which tomorrow will send into the world men recognized as the leaders of industry; for this THE MINNESOTA TECHNO-LOG stands, and to this end the staff devotes its thought and energy, always keeping foremost the welfare of the University.

IT is a pleasure to introduce Herman F. Beseler and Kenefick Robertson as managing editors of THE MINNESOTA TECHNO-LOG.

They have worked faithfully in the interest of the magazine. As alumni editor during the first part of the year, Mr. Beseler kept the alumni in touch with their University. Last year he was an alumni correspondent.

Kenefick Robertson is finishing a journalistic career of distinguished service to his University. In his sophomore year, he was engineering editor of *The Minnesota Daily*, and he has served consecutively as special writer, electrical editor, and associate editor of THE MINNESOTA TECHNO-LOG.

I believe that they will maintain the present high standard of the magazine. —ALBERT W. MORSE.

FOR three months the College of Engineering and Architecture and the Schools of Chemistry and Mines have been given the best student magazine published in our association. The editorial style and general make-up of the publication have been exceptionally pleasing. All honor for the creditable showing of THE TECHNO-LOG is due to Albert W. Morse, ex-managing editor. Mr. Morse was forced to resign early this quarter because of scholastic difficulties.

To us who take over the managing editor's desk the task of maintaining the present high standard of the TECHNO-LOG seems almost unsurmountable. We will do our best. —HERMAN F. BESELER,
KENEFICK ROBERTSON.

PRIZES are offered annually to the students of the technical colleges by various organizations or individuals for essays covering a wide range of subjects. Each year these essay contests are almost totally ignored. As an illustration of that might be mentioned the Briggs Foundry Essay Contest of last year. Although only five essays are necessary under the conditions given by Mr. Briggs for the awarding of the fifty and twenty-five dollar prizes, the prizes were not given last year because an insufficient number of essays were submitted. The same thing has happened to the Briggs contest and to other contests many times. Engineering students speak, and rightfully so, of the spirit in the Engineering College—how every worthy movement is loyally supported by every Engineer even at a sacrifice of time or pleasure. Yet, when contests which offer prizes totaling several hundred dollars are ignored, it would seem to indicate that something is wrong in the Engineering College. To the student who is a bit hard pressed financially, and there are many of us in that condition, the essay contests offer at least a partial solution of the above named difficulty. But the financial renumeration should not be the only incentive to enter an essay contest. Should a student spend much of his spare time on an essay contest and fail to win a prize, his efforts shall not have been in vain. We are here, theoretically at least, to obtain an education. Just because a subject has been delved into or an essay written that is not required in the classroom does not mean that the time spent in that manner has been wasted. The fact that there may be many competing for some particular prize should not discourage one from competing also. Many students give up, others postpone writing until it is too late, but the fellow who wins is the fellow who puts conscientious effort into his paper and "sticks it out!"

—H. F. B.

POWER development in Minnesota, a subject in which every Minnesota engineer is or should be interested, is excellently outlined in this issue by Mr. Clarence H. Nelson, senior in the department of electrical engineering. A glance at the map of the transmission lines of the state accompanying the article shows that Minnesota is now endowed with a system of transmission lines that should be a great economic asset to the state. The Twin City and Southern power loops are of particular note. Interconnection of the hydro-electric plants within a radius of a hundred miles or more of the Twin Cities, and the huge steam-driven plants of the metropolitan area insure adequate power for Minneapolis and Saint Paul for several years' normal growth. More important, however, is the fact that most of the present loops are arranged to allow of an almost unlimited expansion without duplication of apparatus such as has occurred in the iron range district.

What is true of interconnection in the southern part of the state is also true of the electric loops west and north of the Twin Cities. Well arranged main lines energized at high voltages provide a steady flow of energy to substations serving small towns and villages. In advent of the predicted development of the use of electric power in agriculture these lines and substations will prove invaluable in keeping down the costs of rural electrification.

Truly, Minnesota is adequately prepared to meet any increase in electric power the future may demand.

—K. R.

NEWS FROM THE ENGINEERING CAMPUS

PARCEL, MANEY WRITE TEXT

John Ira Parcel and George Alfred Maney, Professors of Structural Engineering, have collaborated in the writing of a textbook on "Indeterminate Stresses." Previous publications on this subject have been merely treatises usually beyond the understanding of all but the most learned, and therefore far from suitable for use as text books.

In the book of Professors Parcel and Maney, however, main emphasis has been laid upon the principles of the subject and upon the methods of attack, and a special effort has been made to show the essential unity of the subject. It treats of the fundamental theory of statically indeterminate stress analysis in so far as this theory has become embodied in the science of structural engineering. The chapter headings are as follows:

1. Introduction.
2. Deflections.
3. General Theory of Statically Indeterminate Stresses.
4. Special Methods of Analysis.
5. The Continuous Girder.
6. The Rigid Frame.
7. The Elastic Arch.
8. Secondary Stresses.

The final proof reading of the book has been completed and the first copies will be in the hands of instructors in the various technical schools for study and approval before spring so that the book may be used as a text next fall. It will be published by Wiley and Sons under the title of "An Elementary Treatise on Statically Indeterminate Stresses."

SHEPARDSON CONTEST JUDGE

Professor G. D. Shepardson was a member of the International Jury which met in New York City during the Christmas holidays to decide winners of the Home Lighting Contest essays. The Grand Prize was an electrical home valued at $15,000. Other prizes included ten college scholarships. This contest provoked such interest that it is planned to have a similar one among the employees of the various electrical concerns throughout the United States.

Professor Shepardson also spent three days in Washington, D. C., at a meeting of the American Association for Advancement of Science.

TAU BETA PI

Ora M. Leland, Dean of the College of Engineering and of the School of Chemistry, was made an honorary member of Tau Beta Pi at a banquet held at the Elk's club January 7, 1925. In addition to the initiation of Dean Leland 12 seniors and one junior were taken into the society.

George M. Cornell welcomed the initiates for the chapter. Hugo H. Hanft, senior electrical, responded for the new members of the society.

The initiates are:

Junior—
Henry Bullard.

Seniors—
George Nelson.
Frank Nichol.
Russell E. Backstrom.
Peter P. Bross.
Walter S. Olson.
Alvin M. Edmunds.
Anthony D. Martino.
Roland W. Holmes.
Sidney A. Parsons.
Hugo H. Hanft.
Edward L. Hill.
Lewis E. Peterson.

RADIO STATION 9XI ACTIVE

Work on use of short waves has progressed recently. J. P. Barton has designed a special low reading wavemeter for use between 10 and 30 meters. The calibration of this instrument is very accurate, having a reading six times closer than one of similar nature in use at the Bureau of Standards.

The broadcasting of standard frequency waves will start soon. Minnesota will be the third institution in the United States to do this, Leland Stanford and the Bureau of Standards being the others. Several new low loss receivers have been built which give remarkable results. Very good daylight range is being obtained with the transmitter. Communication with Washington and Texas has been accomplished with the sun shining at both places. A new vertical cage antenna has been erected, which should increase the range considerably. A staff of 14 operators makes a nightly watch possible.

MINERS PLANNING SHINDIG

Plans are being made for the Miner's Annual "Shindig," which will take place February 11, the day before Lincoln's birthday. Paul Deringer, the Sophomore class president, has charge of general arrangements and promises a real party with a few new ideas as to the details. In previous years the dance has been largely patronized by the technical colleges and no deviation will be made this year from the precedent.

SENIORS LOOK FOR JOBS

Up until about three years ago the senior mechanical engineering class experienced much difficulty in locating positions prior to their time of graduation. Thereupon it was suggested that a project should be started in an attempt to remedy this difficulty; this project was to be known as the Senior Mechanical Employment Bureau. One man was appointed who wrote to the larger industrial concerns of the country informing them of the desirability of hiring technical graduates. The majority of replies were very favorable, most of the concerns expressing the opinion that they preferred to put new employees in a special training course rather than to let them step into a position immediately upon their appointment.

As a result of these letters a large number of seniors found positions with which they were very pleased. Because of the success of the system it was continued, the mass of accumulated correspondence being passed on to the incoming senior class. The unfavorable and hopeless letters were culled out and destroyed. The favorable concerns were again circularized with the same success as before.

The advantages of a system such as this are at least twofold. Firstly, it develops a situation where men can be favorably placed in positions befitting their desires and inclinations. Secondly, it gives some member of the class, that is, the one who is acting as chairman of the Bureau, an opportunity to develop initiative and to carry through a worthy program.

Professor J. V. Martenis is one of the original sponsors of this movement. Professor Martenis is constantly in touch with the graduates of this department and he has been very instrumental in locating many men in good positions. In connection with this work he has come to the conclusion that the technical man is much more in demand than the man who desires to make his way without the asset of a college education.

Dean Leland has subscribed to the bulletin of the Engineering Societies Employment Service. Any student who is affiliated with any engineering society under this bulletin can avail himself of this service.

TRUMP HEADS AERONAUTS

A course in general aero-dynamics is being offered this quarter. Minnesota is one of the few schools in the United States where a similar course is a part of the elective curriculum. The course deals only with the fundamentals underlying operation of aircraft, and serves to give the student a general idea of the subject. Charles Boehnlein is instructor and there is an enrollment of 12. Plans are under foot for construction of a wind tunnel, where working models can be tried out.

The Aero-Engineer's Club meets regularly. W. A. Kidder of Curtis North-West Aeroplane company gave a talk at the meeting of Jan. 14 on aerial photography. Frederic Trump, M. E. '27, is the president of the club.

MATH PROF CONTRIBUTES

The Electrical World for December 27, 1924, contained an article on "Power Factor Rate Clauses" by Professor R. R. Herman, of the department of Mathematics and Mechanics. It deals with the effect of power factor on transformers and regulators, and the resulting effect on operating expense. A rate is advocated to take care of demand and energy changes.

Professor Hermann is a graduate of Minnesota, class of '13, and was at one time the editor of The Minnesota Engineer, predecessor of the Techno-Log. He is now with the Northern States Power Company, doing part time work in the sales department.

PROF PARKER SHOWS TEST

Mr. Parker's first hour class in mining took an hour from their regular work last week, in order to get an idea of some of the business of the department of metallography. Mr. Dowdell of that department, showed the men the types of furnaces used in heat treating and the curves expressing the state of the metal at different temperatures. In illustrating a change point in the course of heating, a wire was suspended between two points and an electric current passed through it. The wire, when heating, expanded some, checked itself, and then expanded. On cooling, the wire contracted. As the change point was reached, it glowed with the suddenly liberated heat and expanded again, only to check itself and shrink back to its normal size.

What is known as a Metcalf test bar was shown. This is a bar of steel which has been notched every inch or so, heated so that one end was almost melting while the other end was cold, quenched quickly to preserve the structure, and then broken at the notches. Every fracture showed a marked difference in the size of the crystals. A section was selected which was thought to have the proper size of grain and ground and polished. By arranging the piece in a metallographic microscope, a view of the structure enlarged several thousand times was obtained. Mr. Dowdell explained the relation of the various structures to hardness, carbon content, and the heating curves. In addition to the rather technical microscopic apparatus, the department has two very practical machines for testing the hardness of steels. Mr. Parker remarked that each shovel put out by one company is tested in one of the type machines shown.

The miners were interested in the demonstrations in more than a theoretical way because of the careful and scientific heat treatment which must be given to rock drills. The metallurgists in the School of Mines take a complete course in metallography.

PI TAU SIGMA

Four junior mechanical engineers were initiated into Pi Tau Sigma at a banquet held in the Elk's club January 15, 1925. Rollin W. Holmes acted as toastmaster. E. L. Ludvigson welcomed the new men into the fraternity, and George W. Mork responded for the initiates. Prof. J. V. Martenis also addressed the meeting.

The initiates are:
George W. Mork,
Clifford Comfort,
Harold Rollin,
Carl Fornfeist.

JANSKY TO HARTFORD

Prof. Jansky will attend a Board of Directors meeting of the American Radio Relay League to be held at Hartford, Connecticut, early in February.

PARTY PLANNED BY BROSE

Plans are being made under the able direction of William Brose for a "get-together" of the gang from last summer's Civil Camp. Since the committee appointed by Mr. Brose, with Roland Schmidt as chairman, has not as yet reported, nothing definite has yet been decided outside of the fact that the date will be shortly after mid-quarter examinations.

Various plans were suggested at the meeting held on January 15: plans varying from a theater party in full summer regalia followed by a banquet downtown, to a party in the Engineering Auditorium with suitable entertainment. However, whatever is decided upon it will undoubtedly be a plenty "hot" party.

RELAY LEAGUE CONVENES

The Dakota division of The American Radio Relay League, held its first annual convention at the University of Minnesota, Nov. 28 and 29. Over 200 radio enthusiasts from the Northwest gathered at one of the most successful district conclaves ever held in the country. Through the courtesy of Ora M. Leland, dean of the College of Engineering and Architecture, the use of the electrical building was granted to the league for its meetings.

The central attraction of the affair was the presence of Donald Mix, radio operator on the recent McMillan polar expedition. Several prominent radio engineers from the East were present, as well as officers of the relay league. The program for the first day included the calibration of wave meters from standards at the University station (9XI), technical talks and a sight-seeing tour around the Twin Cities. At a banquet in the evening at the Nicollet hotel, Mr. Mix was the principle speaker, and the entire program was broadcasted from WCCO.

On the last day there were illustrated talks and discussions, closing with an initiation of the delegates into "Wouff Houng," secret radio society.

A. T. & T. GIVES INSTRUMENTS

Valuable precision instruments for work in communication engineering have recently been added to the telephone and telegraph laboratories. These instruments are the gift of the American Telephone and Telegraph Company to the department. The company presented similar sets of instruments to 17 other selected engineering schools throughout the country.

All the apparatus in the group given the school here consists of measuring instruments with accessories and a standard oscillator. The oscillator generates alternating voltages between the frequency of 100 and 50,000 cycles per second, and is equipped with four power tubes which give rather uniform potentials at all frequencies. A calibration curve with the machine makes it possible to set the instrument at any frequency within its range by simply adjusting dials and switches. The department believes that the oscillator will enable much interesting work to be accomplished in the laboratories that heretofore has been impossible because of lack of equipment.

An amplifier-voltmeter-ammeter which accurately measures alternating potentials from 10 to 0.001 volts and currents from 10 to 0.01 milliamperes is included in the group. Its frequency range is that of the voice, namely 200 to 3,000 cycles per second. Anyone who has tried to obtain the current in a telephone receiver with the usual laboratory instruments realizes at once the value of this instrument.

An artificial line 200 miles long and a precision impedance bridge with a range of 560 millihenries inductance is included in the list of new apparatus.

MOORMAN WINNER REPORTS

Every spring the senior class is given a design problem in competition for the Moorman prize, which is one of the many offered for design competition, and is made possible by Mr. A. Moorman of the firm of A. Moorman and Co., St. Paul. The prize consists of domestic travel visiting points of interest to architectural students. Most of the universities having departments similar to ours are also visited and inspected.

Each fall someone from the spring class takes the coveted trip which the first prize gives.

When the student returns to the cities in the fall after the trip, he gives a report of his travels before the students of the department and members of the faculty and friends.

Last spring the prize went to Herbert Magoon, and on the night of November 20, he gave a detailed report, illustrated by several photographs thrown on the screen, most of which he took himself.

Probably the most interesting edifice described and illustrated was that of the unfinished Cathedral of St. John the Divine in New York city. While only the choir and trancept are already constructed, one can get an idea of the magnificence of the completed structure. It will surpass in size and will rival in beauty of detail and design the great Gothic structures of France and England. An idea of the size of the whole when completed may be gained by considering the fact that each one of the chapels around the choir is a good sized church in itself. The design for this cathedral was done by the old firm of Cram Goodhue and Ferguson of New York city.

Speeches were made by Mr. A. Moorman, donor of the prize, and by Prof. F. M. Mann, head of the department. Mr. Moorman gave a detailed explanation of the traveling prize; what it consists of and how it come about. He also expressed his desire to see a foreign-travel competition prize offered here in the near future. Professor Mann's talk consisted of an explanation of the various prizes offered during the year, dwelling especially on the Moorman prize. He also announced the winners of the prizes offered by the American Institute of Architects and by the faculty for last year.

The three speakers were introduced by Walter Kendall, president of the Architectural Society, who arranged the report as a special meeting of the society. Regardless of the approaching date for rendur in several grades of design, the students turned out en masse.

Several interesting pencil sketches of objects along the way were on display on the walls of the third floor hall. The objects sketched were interesting, and the work was well done regardless of the fact that Mr. Magoon was pressed for time occasionally when he was making a sketch. Some of them had to be finished from memory.

Before starting on his study-travel this fall, Mr. Magoon spent the summer months in Chicago, with a firm of architects there. From there he went to New York city to go into the offices of the firm of Cram and Ferguson.

ELEVATOR GUARD DEVISED

The safety shields on the bottom of the sliding gates of the elevator in the electrical building were devised by Prof. F. W. Springer in order to eliminate all chances for the occurence of accidents to careless or inexperienced passengers.

A strip of heavy canvas forms the basis of the guard. The strip is fastened to each upright member of the folding gates on the elevator, which are similar to the usual gates. As the elevator is in the laboratories, with a gate on each side, the danger was greater than in other installations. A patent has been applied for.

This is an example of the saving a trained engineer can give to society in preventing loss of life and limb.

HOYT ADDRESSES MINERS

The School of Mines Society at its first meeting of the year was addressed by Dr. Hoyt of the General Electric Company, Schenectady, N. Y. Dr. Hoyt is a graduate of the School of Mines, and is engaged in metallographic research. In his talk at the School of Mines, he explained the field of research as distinguished from those of development and design. To bring out his point he used his own work, the study of the metallic crystal for use in electric lights, as an example. Dr. Hoyt pointed out the reason why companies like the General Electric are willing to spend thousands of dollars on pure research, and in concluding emphasized the fact that a student should get all he possibly can out of every course. The miners considered the hour well spent.

D. C. SOURCE IS ASSURED

A dependable source of direct current is now assured all the laboratories in the new electrical building from the overhauled storage battery in the basement. The battery was brought over from the old building last spring but has only recently been repaired and charged.

The Exide storage battery company, builder of the original cells, have been in charge of placing the battery in the new building. Although new material have been used where needed, the battery is fundamentally the same as when it was in the old building.

DAILY PICKS EDITORS

Russell E. Backstrom, senior mechanical engineer, was recently appointed news editor for the Engineering College by The Minnesota Daily. The appointment came as the result of a tryout period started last quarter. At the same time The Daily appointed John McKee and Everett Van Duzee news editors from the Schools of Chemistry and Mines respectively. The three men have been responsible for all the news in The Daily from the technical campus this quarter. The men have been prominent in other school activities. Van Duzee was on the football squad this fall.

MECHANICALS HOLD SMOKER

The A. S. M. E. held its annual sophomore smoker last month. There was a large turnout of sophomores, all of whom joined heartily in the fun. The program was varied. Professor Mann, Kirk, and Shoop gave valuable talks interspersed with the customary humor necessary for such an occasion. This was followed by a one reel comedy also calculated to augment the informal nature of the gathering. Then followed the usual comestibles: cider and doughnuts.

The surprise feature of the evening's entertainment was the appearance of Stan Stanley, an exponent of physical culture. Mr. Stanley has been on the vaudeville stage for several years demonstrating his specialties of muscle control and dislocation of the various joints of his body. Mr. Stanley's program included many novel and entertaining feats, such as stopping the circulation of the blood in his arms, throwing his hip bones out of joint, and increasing his height several inches. As a closing feature, Mr. Stanley allowed six of the strongest men present to apply various wrestling holds on his body. Although all these men held him at the same time he broke away from them in eight minutes. Mr. Stanley weighs but 142 pounds.

RADIO STATION DEVELOPED

The past month has seen many developments in the newy re-established radio station (9XI). Complete schedules have been made, and a watch is kept each night, far into the morning. Operators are on duty every noon also.

The set now in use is a specially designed one for short waves; it uses a 250-watt radiation tube and puts about six-tenths of an ampere into the antenna on a working wave of 80 meters. Good results have been obtained: reports are received every day from stations on both coasts. Communication was established one night recently with a station in the interior of Mexico, and distances up to 500 miles are consistently covered in daylight.

Several important features are being worked out. James P. Barton is working on a transmitter which operates on the extremely short wave length of four meters. Louis J. Schnell wil soon have in operation a 500-watt standard frequency transmitter which will send signals of standard wave lengths, working in conjunction with similar sets at the bureau of standards and at Leland Stanford Junior University. Several low-loss receivers of novel design have been recently developed.

Railway emergency relief work schedules are being develop by "Win" C. Hilgedick, chief operator. This promises to be an important phase of work, as it provides for communication for railways when the line wires are down on account of storms.

The operators of the station are "Win" C. Hilgedick (9AUA), W. J. Zeidlik (9CDV), G. W. Larson (9DSW), C. W. Thyberg (9DVN), L. J. McKesson (9BTT), L. J. Schnell (9CPU), G. W. Volkenant (9IG), H. J. Boyce (9QE), V. M. Cousins (9ABU), C. J. Johnson (9CHC), L. V. Berkner (9AWM), and Paul B. Nelson (9BLV).

A. S. M. E. MEETS

On Saturday, December 13, 1924, the A. S. M. E. held its last business meeting prior to the close of the quarter. The important feature of the meeting was Professor Shipley's report of the A. S. M. E. convention in New York. Professor Shipley represented both the Student Branch and the Minneapolis Section at the convention. He belated the fact that, due to the pressure of other things, the program did not allow the Student Branch representatives enough time for the presentation of their reports.

Professor Martenis made a suggestion that the National Branch of the Society should be asked to assist in sending Student Branch representatives to the Society's conventions, rather than have this duty performed by some one not directly connected with the Student Branch.

IOWA TRANSIT QUOTES

"Electric Transmission Cables" by R. E. Burlingame appeared in the November issue of The Transit of the State University of Iowa. The article appeared in the TECHNO-LOG in May, 1923. The fact that The Transit reprinted the article without illustrations and without removing the local references in the article speaks well for Mr. Burlingame's talent. Burlingame has had much experience with the Northern States Power Company as station operator and at present does part time work for the electrical department. He is a senior and a member of Kappa Eta Kappa, professional electrical engineering fraternity.

FIRE NOZZLES TESTED

Research on the discharge of water from fire nozzles of different sizes and working at different pressures for the Fire Underwriters Association of Chicago is being accomplished under Professor J. J. Jones by Henry Reed and Don Cameron, senior electrical engineers. "The last scientific investigation on the discharge characteristics of fire nozzles was done in 1890," Mr. Reed said recently. In addition to determining the actual discharge of water the experimenters are determining the coefficients of the nozzles. Mr. Reed is president of Eta Kappa Nu, honorary fraternity of electrical engineering. He is also a member of Tau Beta Pi and Triangle. Don Cameron is a member of Triangle.

BURTON ON ART JURY

Professor S. Chatwood Burton was one of five men on the jury of the Chicago Etchers' Society, which recently met in Chicago to judge art from all parts of the world. The jury of which Mr. Burton was a member, chose about 300 etchings from a group of over 1,000 which were submitted by artists to hang in the Chicago Art Institute next month. Professor Burton contributed to the October issue of the TECHNO-LOG on The Romance and Technique of Etchings. In the current number is a reprint of an article he contributed to the September Western Architect. Both articles are profusely illustrated by cuts of Mr. Burton's work.

Several of his etchings are on exhibit in the TECHNO-LOG office, where anyone interested in them may see them at any time.

ARABS HELP MASQUERS

John E. Davidson, senior architectural engineer, is production manager for "Kismet," an oriental play to be given January 30 and 31. He is assisted by a number of the Arab technical staff in his stage work and also by students who wish to joint the Arabs' technical department. The Arabs also furnished the stage force for "Captain Applejack," which the Masquers gave last quarter. "By helping the other dramatic clubs of the campus the Arabs hope to build up a large stage force of experienced and capable men," Davidson said recently. Richard W. Jones, president of the club, has arranged for many of the electrical effects of the Masquers' play.

In addition to furnishing the so-called "stage hands," the Arabs have done considerable set designing for "Kismet." Gerald Kronick, senior architect, has designed and made most of the scenery for this week's show. He has been assisted by Theodore J. Prichard, author of the musical comedy, which the Arabs will stage in the spring quarter.

The facial make-up force of the Masquers has had the assistance of Oswald Stageberg, Arabs' production manager, and Carl Wise, former art director. The prelude and inter-act music will be furnished by the Arabs' Theater Orchestra under the direction of Folmar Bjerre, senior mechanical. Bjerre was formerly a member of the University Symphony Orchestra. Paul S. Salstrom, junior electrical, is pianist for the orchestra. Harry J. Winslow, senior electrical, is first violinist. Practices are held weekly.

MARSHMAN ON RADIO PROGRAM

A short talk, "A Testman's Opinion of Testmen," given by A. E. Marshman, University of Minnesota, will be one of the features of the International Intercollegiate Night on the air program, which will be broadcast by WGY, Schenectady, the General Electric broadcasting station, direct from the Edison Club Hall of that city, on the night of Saturday, January 31. Minnesota songs and cheers, by Minnesota alumni, will go on the air on the same program.

Other features of the evening will include the songs and cheers of many other colleges and universities; songs by the British Empire group, consisting of college men from New Zealand, Australia, South Africa, India, Canada, and the British Isles; a burlesque skit presented by Massachusetts Institute of Technology alumni; musical selections by the Edison Club string orchestra, composed entirely of college graduates; instrumental and vocal solo numbers rendered by former college men now in the employ of the General Electric Company; native songs by a quartet of graduates of the Royal Polytechnic Institute of Sweden; native music played by Chinese engineers, and group singing by all those participating in the entertainment, as well as one or more short talks.

This program, which will constitute the entire evening's entertainment from WGY, will go on the air at 7:30 P. M. More than 500 college men will participate in it, and at least 45 colleges and universities in this country and abroad, will be represented.

While collegiate numbers will comprise a large portion of the program there will be numerous classical solo numbers. Many of the men on the program were prominent in musical circles while in college, having been members of their glee and musical clubs.

CHI EPSILON

Three juniors and one senior were initiated into Chi Epsilon, honorary fraternity in civil engineering, at a banquet held in the Leamington hotel recently. The toastmaster of the evening was P. T. Bergquist. John A. Banovetz spoke for the local unit and the response for the initiates was given by T. P. Young, junior.

Short talks were made by Frank M. Warren and Frederic Bass, head of the department.

The initiates are:

Russell Morse,
T. P. Young,
C. R. Lund,
L. W. Newbauer.

RYAN ELECTED HEAD

Professor W. E. Ryan, of the department of electrical engineering, was made president of the Minnesota Federation of Architectural and Engineering Societies at a session of the federation in the Curtis hotel, January 23.

Max Toltz, retiring president of the group, asked at the meeting that the group make arrangements to induce the legislature to build a $100,000 highways laboratory at the University. He said that the expenditure would be of vast benefit to the state. Mr. Toltz is the senior member of Toltz, King and Day, engineering firm in Saint Paul.

HEINS DIRECTS ART

The Gopher art work this year is under the direction of Harold H. Heins, electrical. Mr. Heins has a large staff of assistants working under him and he recently said that the art work of the annual was nearly completed. The book this year will feature considerable art work by campus and Minnesota artists. Heins has drawn two of the cover plates for the TECHNO-LOG this year. The impressive sketch of the Mines building on the cover of this issue is a product of his brush.

BESELER SCORES 100

Making a perfect score firing at the target from the kneeling position is one of the accomplishments of Herman F. Beseler, senior mechanical this quarter. Beseler is captain of the rifle team and a captain in the Coast Artillery unit of the R. O. T. C. He was recently made a managing editor of the TECHNO-LOG.

HANFT LEADS Y DRIVE

Hugo H. Hanft, senior electrical engineer, directed the $4,000 student campaign held on the University campus last week. Hanft directed 150 workers during the intensive three-day drive for funds. Allen Wurzbach, engineering vice president of the "Y," was also active in the campaign for money and friends. Bernard J. Larpenteur, senior miner and president of the senior class, was a division official.

Hanft and Wurzbach recently contributed to The Y's Page, a news letter that appears occasionally on the campus.

MENDOTA BRIDGE VISITED

The junior and senior classes in mining made an inspection trip to the Mendota bridge, now under construction across the Minnesota river at Fort Snelling. The trip was made on two afternoons with the transportation furnished by the men with cars. Professor Parker was in charge. Aside from the general interest in the engineering work of the bridge construction, the miners were especially interested in the sinking of the concrete caissons, because there have been a number of mine shafts sunk in this manner.

DRIPPINGS FROM THE OIL CAN

Relations

"Mother, does the young man next door have a godfather?" "Not that I know of, dear." "Well, that's funny. Last night I heard him having an argument with somebody and he kept on saying, 'My godfather.'"

* *

Dark and Heavy

"Does yo' take this woman for thy lawfully wedded wife?" asked the negro clergyman, glancing at the diminutive, bow-legged bridegroom who stood beside 210 pounds of feminine assurance.

"Ah takes nothin!" responded the bridegroom gloomily. "Ah's bein' tooked."

* *

Holiday Business

Oh hum! Every dog has his day, but it's the dog with the sore tail who has his "week-end."

* *

Sore Necks

Mary had a little calf—
It was a shame to hide,
So Mary bought a little skirt
With a slit up on the side.

* *

Things Come His Way

We understand that the editor has burst forth into dramatics. In the recent presentation of that soul-stirring, heart-rending drama, The *Spitfire*, he took the part of the cuspidor.

* *

Vegetable Courtship

A potato went out on a mash,
And sought an onion bed;
"That's pie for me," observed the squash,
And all the beets turned red.

"Go away," the onion weepingly cried,
"Your love I cannot be;
The pumpkin is your lawful bride,
You cantaloupe with me."

"Oh, spare me a cress," the tuber prayed,
"My cherry-ished bride you'll be;
You are the only weeping maid
That's current now with me."

And as the wily tuber spoke,
He grasped the bashful prize,
And giving her an artichoke,
Devoured her with his eyes.

Drilled in Thrift

Ole Olson has been working as an engine wiper, and his boss, a thrifty man, had been coaching him for promotion to fireman with such advice as:

"Now, Ole, don't waste a drop of oil—that costs money. And don't waste the waste, either—that's getting expensive, too."

When Ole went up to be questioned on his eligibility for an engineman he was asked:

"Suppose you are on your engine on a single track. You go around a curve, and see rushing toward you an express. What would you do?"

To which Ole replied:

"I grab the oil can; I grab the waste and I yump."

* *

Hydrogen Peroxide

We owe a great deal to chemistry; for instance, we owe a great many of our blondes—.

* *

The Light that Lies, etc.

There was a light in her blue, blue eyes as he waited breathlessly for her answer—a light that was meant for him alone. He puffed nervously at his cigar—but it had gone out. There fell a silence—a silence pregnant with the communion of two vibrant souls. He fumbled for a match and then—then—

He lit his cigar by the light in her eyes.

* *

Making Love by Radio

My love dances on your aerial. It's high frequency oscillations are interpreted by your grid, and leak back into the tubes of my heart to be amplified so as to pulsate your diaphragm. The coils of your affection react enabling you to condense my sentiments, eliminating the unwanted signals of those who interfere with the reception of my never failing transmission. You are my pretty positive, and I your negative. Shall we switch on? Then let's!

* *

When the Leaves Come Tumbling Down

Professor—"Can you give me an example of a commercial appliance used in ancient times?"

Student—"Yes, sir, the loose-leaf system used in the Garden of Eden."

Worse Yet

"Ma," said a youngster, "there's a man in the kitchen hugging and kissing the hired girl." When his mother started for the kitchen he shouted, "April fool! It's only pa."

* *

"Hot" Literature

A girl at a public library inquired if "The Red Boat" was in.

"I don't think we have it," she was told.

"Oh, excuse me," said the girl. "I made a mistake. The title is 'The Scarlet Launch.'"

After a search the library assistant reported that no book with that title was listed in the card catalog.

"But I'm sure you have the book," the girl insisted. Suddenly she opened her handbag and produced a slip of paper on which something was written. Then she blushed. "Oh, I beg your pardon," she said. "It's 'The Ruby Yacht,' by a man named Omar."

* *

Kinda Mushy

Leonard—"Why is a cherry like a kiss?"

George—"Haven't the least idea."

Leonard—"Because both have a little 'pit' in them."

* *

Forensics

"He made an unusually good after-dinner speech." "What did he say?" "He said, 'Waiter, give me the check.'"

* *

A "Clothes" Call

A weary-looking tramp weekly tapped on the back door of a suburban residence.

"Lady," he said. "I am not a regular tramp. Until a few weeks ago I had a good hand laundry, but it failed me, and since then I've hardly had enough to eat."

"That is bad," responded the good woman as she began to give the man some food. "How did the laundry come to fail you?"

"She got tired of working and went home to her mother," was the reply.

* *

Not "Waisting" Time

"Hi, gimme a handful of waste!" I howled.
I was under the car to grease it.
But Jim had an armful of waist in the car,
And wasn't disposed to release it.

ALUMNI AND FACULTY PERSONAL NEWS

ARCHITECTS

Charles H. Hinman, '24, is drafting for the firm of C. W. and Geo. L. Rapp, of 190 N. State Street, Chicago, Ill. Mr. Hinman resides at 1636 W. Congress St., Chicago.

Sam Sutherland, '23, writes that he has found the night life of Ottumwa, Iowa, so lively that he saved enough money to buy a Ford roadster with which he intends to drive up to the Twin Cities once in a while.

Otto C. Person, '24, a former business manager of "Techno-Log," is with the city planning commission of Duluth. Mr. Person's address is 1310 E. Third Street, Duluth.

Albin R. Melander, Arch '21, who is in business in Duluth with the firm of Starein and Melander, is at present traveling in Europe. For the benefit of his many friends The Techno-Log presents here copies of letters addressed to Stanley A. Smith, head of the department of Architecture at Washington State College, Pullman, Wash.

Mr. Smith was formerly head of the architectural department at North Dakota, where Melander worked with him in the position now held by Edward O. Holien, '23. Mr. Melander's letters to Mr. Smith follow:

Carcassonne, Oct. 26, 1924.

Dear Friend Smith:

Tonight we leave for Marseilles, where we will stay only long enough to get our mail and then leave for Nice. From Nice we go to Genoa, Naples, Florence and Rome, arriving in Rome about the 20th of November. We will stay in Rome until the first part of December, when we will leave for La Havre, boarding the S. S. France for New York.

I arrived in England the 20th day of September, spent about ten days in England, then over to France. Went to Chester, Oxford, Broadway, Canterbury, London and then to Dover. Chester, as you know, has a very fine Gothic cathedral and also possesses some wonderful timbered houses. Oxford, for its Gothic ecclesiastical architecture; Broadway, a small town near Windsor, has some real interesting domestic architecture. It (Broadway) is a very tiny place and rather hard to reach, but I am glad I took the extra time necessary to get there in order to see some of the old English type of houses (stone construction, sort of Tudor style, some with straw thatched roofs). Canterbury, for its cathedral, London, for pretty much of everything. Didn't care very much for London.

Spent about a week in Belgium, visiting Ostend, Bruges, and other cities. Many of the concrete fortifications used in the trench warfare by the Germans are still to be seen. Most of Belgium has been about completely built up. Bruges gave me a great kick! The brick work was extremely interesting. In some instances they did everything that we would not do with brick. Much molded brick was used, forming interesting tracery work and panels.

At Paris I was met by Olsen, the man that won the Stewardson, and who, as you remember, did some work on the Practice House drawings. We remained at Paris about eight days, then started our trip through the chateau district and into northern France where we are today. Spent about five days visiting eight chateaux. Tours, Blois, Amboise, Chenonceaux, Langais, Azay-le-Rideau and Chaumont among those visited. Catherine de Medici must have been a terrible female. The Chateaux at Chaumont and Langais were furnished and occupied, the others were only used for exhibition purposes.

Leaving the chateau district, we went to Poitiers, Perigueux, La Roche, Cahors and Toulouse. We saw several excellent Romanesque arches, and other buildings influenced by the Romanesque. The further south we journeyed, the more we noticed the Italian and Spanish influences, especially in the flatter roofs, more sunlight and less cold, wet weather. Spent four days at Toulouse, where Olsen spent four months at the Ecole des Beaux Arts, after leaving the trenches. Wonderful brick work, a clear looking, prosperous city of 250,000.

Haven't done very much sketching, as the weather has been rather disagreeable. We hope to do more sketching and water color work, (I need all I can get), when we get to Italy.

I decided rather quickly this summer that I would come here at this time. Gave up the idea several times, only to finally decide to take the trip. Mr. Starein, my partner, was very anxious to have me go. If he was willing to shoulder the work in the office I could see no good reason why I should not go. Here I am hoping to get as much out of it as it is possible for an embryo like myself to absorb in a couple of months.

I have seen so many different things lately that I am rather confused with the whole trip. When we get to Italy we will travel slower, giving me more opportunity to give things more than just a gleaning look.

Is Eddie Holien and Beeman with you this year? Haven't heard from any of the fellows for quite some time.

Best wishes to yourself, Mrs. Smith and Margaret.

—Albin Reinhold Melander.

American Express Co., 11 Rue Street, Paris, France.

A few weeks later letters were received on the campus from both Melander and Ralph W. Hammett, '19, who were together at the time of writing from the American Academy in Rome, where Hammett is studying, following a trip through the Orient. A few weeks ago Wm. M. Ingemann, another classmate of Hammett's sailed for Europe for a six months' trip, studying architecture.

CHEMICAL

Edmund Backe, '24, is doing chemical engineering research work for the Waldorf Paper Products Co. of St. Paul, Minn. The firm address is: Hampden Pillsbury and Myrtle, St. Paul.

Miles A. Dahlen, '24, is an assistant in organic chemistry in the Minnesota School of Chemistry.

H. W. Glenn, '24, is at Cloquet, Minn., with the Northwestern Paper Company.

CIVIL

Byron Curry, '23, has been with the Fegles Construction Company for the past year. He has been working on the new Robert Street bridge in St. Paul since he became connected with that firm. Mr. Curry informs us that L. M. Mitchell, '23, is with the W. B. Carter Company, general contractors, of Tulsa, Oklahoma, and is serving that firm in the capacity of superintendent of construction on two sewage disposal plants just being completed.

At their third monthly meeting of the season on December 13, members of the civil engineering class of 1911 had the pleasure of talking over old times with C. A. Johnson, now of Denver, Colo. Dinner at the St. Paul Athletic Club was followed by a show. The following were present: C. A. Johnson of Denver; M. J. Hoffman and L. M. Roth of St. Paul; F. C. Boerner, E. B. Croft, E. H. Enger, I. Kvitrud, P. A. Laurence, E. J. Miller, G. A. Maney, S. J. Siverson, M. E. Swedberg, and A. C. Walby of Minneapolis.

Any member of the class coming to the cities will have a party "spread" for him if he will notify one of the local members in advance.

F. E. Downing, '04, is with the Cherokee Coal and Iron Company of Gadsden, Alabama. His address is: 629 South Fifth Street.

John Joseph Schlenk, '23, is with the Phoenix Utility Company of 71 Broadway, New York City.

George A. Morse, '14, is also in the sunny south, residing in Babson Park, Florida.

Frank Roos, '24 has resigned his position with the State Highway Department to accept a position with the Twin City Rapid Transit Company in the traffic department. Mr. Roos has moved into the position made vacant by the promotion of Peter Skurdalsvold, '15.

Word comes through John Lief Sverdrup, '21, bridge engineer for the highway department of the state of Missouri, that E. R. Grant, '24, is making splendid progress in the bridge department and that he is now working on one of the large bridges over the Missouri River. Mail written to him can be addressed care of the Highway Engineering Department of the State of Missouri, Jefferson City.

Swan P. Berg, '23, and "Pete" Larson are engaged in the construction of ore docks at Ashland, Wisconsin, for the Soo Line Railway.

ELECTRICALS

Edgar W. Christiansen, '19, is with the N. W. Bell Telephone Company at Omaha, Nebr.

Gilbert Cooley, '22, serves as assistant electrical superintendent for the Northern States Power Co., 76 W. 3rd St., Saint Paul, Minn.

Martin Cornelius, '06, is in the employ of the W. E. & M. Co., East Pittsburgh, Pa., as an electrical engineer.

A letter received from Lloyd A. Elmer, '21, states that he and E. C. Manderfeld, '21, are in the engineering department of the Western Electric Co. in New York City. Elmer's address is 477 Marlborough Road, Brooklyn, N. Y.

Charles F. Englin, '06, is located at Stillwater, Minn., where he is sales and credit manager for the Connolly Shoe Co.

George Fairbanks, '23, is at Eau Claire, Wisconsin, in the sales department of the Northern States Power Co. Until recently he was in the employ of the Minneapolis General Electric Co.

Fred R. Grant, '09, is an engineer with the General Electric Company at Schenectady, N. Y.

David Grimes, '19, of David Grimes, Inc., is in the radio manufacturing business. The firm address is Strand Theatre Building, New York.

Dart H. Lyford, '11, is sales manager for the Southwestern Engineering Corporation, 1221 Hollingsworth Building, Los Angeles, Calif.

A. L. Malmstrom, '17, is in the distribution department of the Detroit Edison Company, 2000 Second Ave., Detroit, Mich.

Louis W. McKeehan, '08, serves as a research physicist for the Western Electric Co., 463 West St., New York City.

Ralph H. Meserve, '23, is engineer with the St. Paul Gas Light Company, St. Paul, Minn.

Harry W. Mowry, '06, is in New York City with Western Electric as installation engineer. The address is 268 West 36th St., New York City.

C. Hugo Nelson, '10, of C. Hugo Nelson Company, wholesale lumber, is located at 1029 Drexel Building, Philadelphia, Penn.

John M. Newman, '23, is at Milwaukee, Wis., as engineer in the Cutler Hammer Plant.

Arthur P. Peterson, '19, is field representative for the Association of Electagists, Room 602, 15th West 37th Street, New York City.

Ray R. Phelps, '10, is owner of the Motor Inn Garage, 5th and Oak Sts., Kelso, Wash.

George J. Schottler, '23, is in the U. S. Patent Office at Washington, D. C., as junior patent examiner.

Donald C. Smith, '18, is an engineer with the A. T. & T. Co., 195 Broadway, New York City.

Laurence A. Stenger, '06, is employed by the Great Western Sugar Company, of Denver, Colo., as a research engineer.

Ray R. Sweet, '21, is chief engineer for Washburn-Crosby Company's Gold Medal radio station WCCO.

MECHANICALS

Charles G. Simms, '24, is a cadet engineer with the Wisconsin Public Service Corporation at Oshkosh, Wis.

Philip G. Swanson, '23, is in the employ of the Chicago Pneumatic Tool Company as a salesman. The firm address is 5th Ave. and 5th St. So., Minneapolis, Minn.

Harry C. Cook is manager of the Red Wing Iron Works at Red Wing, Minn.

Clarence Q. Swenson, '20, is Superintendent of the Detroit Heating Company, 50 W. Euclid Ave., Detroit, Mich.

Arthur C. Hubbell, '15, is Superintendent of the American Can Co., 7443 Paxton Ave., Chicago, Ill.

Irving N. Eustis, '18, is Assistant Engineer of the Fairmont Railway Motors Co., 203 North Ave., Fairmont, Minn.

Edward I. Andersen, '19, is Assistant to Works Manager, Westinghouse Electric and Manufacturing Co., Hotel Liberty, Attica, New York.

MINERS

Charles F. Jackson, '07, has been enjoying some unusual experiences, according to a letter received from him by Dean Appleby of the School of Mines. Mr. Jackson is superintendent of the Cyprus Mines Corporation in Skouriotissa, Nicosia, Cyprus. Ancient and modern civilization jostle elbows in the streets of Cyprus. On one hand primitive methods are much in evidence, while on the other may be seen the progress made by modern civilization. Mr. Jackson writes that mine fires are fought by digging out white hot rock from the bottom of the shaft 1,000 feet deep, that the mud brick monastery that he lives in, centuries old, is provided with modern plumbing, and that traveling is done by either camel or Ford. Mr. Jackson's letter reads in part:

"The early history of this mine is all legendary and obscure. It was worked by the Phoenicians prior to 600 or 700 B. C., and later by the Romans during the period of occupation, 107 B. C. to 395 B. C. It has probably not been worked since until this company began operations in 1914. In our present operations, we frequently encounter ancient workings, some of which are filled with waste, which is now as hard as the original rock. Other ancient workings are still open, and we find pieces of mine timber which, shut off from air, are in an almost perfect state of preservation. There are slag dumps on the surface near the mine. The low copper content, and chemical composition shows that these early metallurgists possessed considerable skill.

"The difficulties of mining here in Cyprus are more than ordinary. The natives have been shepherds and farmers for hundreds of years and had no knowledge of mining. It has been a slow process for the past ten years training them for underground work. I am told that when they first started to work here, they put a ladder up to an olive tree, and had the prospective miners climb around in the tree for days at a time before they gained sufficient courage to work in a shaft.

"The island itself is extremely interesting; it has figured prominently in history. It has always been governed by some great power, the Persians, Phoenicians, Egyptians, Greeks, Romans, Turks, and now it is in the hands of England. One may travel in Cyprus on foot, by donkey, camel, carriage, or automobile. The summers are hot, much like those of Arizona and New Mexico. The English residents nearly all go to Mt. Troodos for the summer; Mt. Troodos is the Mt. Olympus of Greek mythology."

Alexander M. Gow, '23, an instructor in the School of Mines, was married on December 20th to Miss Margaret E. Barlow of Winona, Minn. They are at home at the Riverside Apartments, 512 Delaware St., Minneapolis, Minn.

DRIPPINGS

WILD WEST

"And a horse ran away with my brother and he wasn't out for two months."

"That's nothin'. My brother ran away with a horse and he wasn't out for five years."

* *

BEFORE COLLEGE

On his tour of the district an inspector of schools came to a class of girls. He wrote upon the blackboard, LXXX. Then, peering over the rims of his spectacles at the prettiest girl in the front row, he asked:

"Young lady, can you tell me what that means?"

"Love and kisses," the girl instantly replied.

* *

NO CALCULUS HERE

A school principal was lecturing his teachers upon efficiency. "What," he demanded, "would be the thought of a glove-maker who at the end of the season found ten per cent of his stock returned because it fell below standard requirements? Why should we require one hundred per cent efficiency of the glove-maker and only ninety per cent of a teacher?"

"Because," responded a teacher, "he can select his kids."

* *

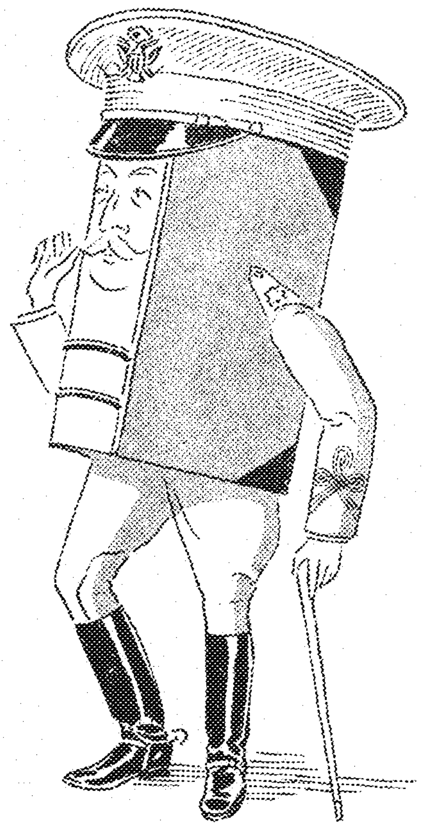
TYPICAL BRITISHER

Once an elderly lady was being shown over Nelson's ship, the Victory. As the party approached the spot where Nelson met his death, the attendant pointed to the brass plate fixed on the deck, and said, "There is where Nelson fell!" The old lady was impressed, but not in the right way. "No wonder," she said. "I nearly tripped over that thing myself!"

* *

ETIQUETTE OF THE HAT

Without consulting any of the authorities on etiquette, we will answer this question, "When is the proper time for a man to lift or remove his hat?" For the benefit of the engineers,—at the following times and on the following occasions, respectfully, the hat should be removed or lifted as the circumstances indicate: When mopping the brow, when taking a bath, when eating, when going to bed, when taking up a collection, when having the hair trimmed, when being shampooed and when standing on the head.—*Dodo.*



Is he a hard taskmaster or a loved leader?

IF you are a good soldier, you take orders from the major. But there is a great deal of difference whether you find the training an irksome routine or an enjoyable development.

When you follow the right major in your course, the work can become vitally interesting, and your college career will be more worthwhile.

"But what is my right line of work?," may be a puzzling question. All the thought you can give to finding the answer will be fully repaid. Analyze yourself and you will surely discover your natural aptitude.

And when you've found what line you feel you ought to follow, stick to it. Stand by your major and your major will stand by you.

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

Western Electric Company

Since 1869 makers and distributors of electrical equipment

Number 44 of a series

NEWS

TELEPHONE SET SECURED

A complete set of telephone apparatus as used in completing a call from one subscriber to another at a different exchange has recently been added to the student equipment in the communication laboratory. The set is equipped with the latest type of relays. A flashing recall, an arrangement by which a small light is flashed in front of the station operator if the called party does not answer, is included in the sample set.

From the Northwestern Bell Telephone Company at Omaha, a complete ringing machine for the telephone laboratories has been obtained. This machine gives voltages of the kind employed in a telephone exchange for ringing, the busy signal, and the test tone.

A. S. C. E. MEETS NOV. 12TH

At the last meeting of the spring quarter, the following men were elected to office in the local chapter of the American Society of Civil Engineers:

George Cornell, president; Arndt Duvall, vice-president; Thorston Berg, secretary; Norman Moore, treasurer.

On Nov. 12, an unusually large crowd attended the first banquet. Speakers for the evening were professors Bass and Cutler of the faculty; Mr. Briggs, secretary-treasurer of the Northwest Section of the American Society of Civil Engineers, and Leanord Hoisveen, Raymond Keller, and Walter Kendall, representatives of professional engineering and architectural societies of the college. The program was concluded with slides showing views of last summer's civil camp, with rapid-fire explanations and remarks by Garvin Peterson.

STOREROOM REMODELLED

This year starts the second decade of the establishment of the Department of Architecture. Few changes will be made.

The old storeroom at the south end of the fourth floor of the main Engineering building has been finished and equipped for a studio. This will supplement the old one, which was badly overcrowded, and the change enables the department to offer new courses in sculpture and life.

News from Here and There

ILLINOIS' ELECTRICAL SHOW

The Electrical College at the University of Illinois will present their show April 24, 25, and 26 of this year. The show this year will be one of the largest ever attempted, and some of the exhibits have required months in order to complete. A feature of the show will be a radio controlled vehicle. Many other novel radio exhibits will be featured. A complete electric railway, running on 400 feet of track, complete with all signal appliances, will comprise one of the largest exhibits.

The show will occupy the E. E. Laboratory and the Gym Annex. In the center of the lab will be a huge fountain. The show has made possible a $1000 loan fund for the use of needy students. It is one of the largest similar projects ever attempted, and will attract much attention.

* * *

IOWA ENGINEERS TO CELEBRATE

Committees have recently been appointed to take charge of "Mecca Week," the annual celebration of the Engineering College of Iowa. Mecca is a tradition at Iowa and ranks as one of the leading occurrences of the collegiate year. A play, the feature of the week, is written and produced solely by engineers. A dance, banquet, exhibition and parade are other important novelties.

* * *

NEW BUILDINGS FOR ILLINOIS

Appropriations made by the legislature have made possible the erection of eight new buildings at the University of Illinois. A new Agricultural building has been completed this winter, and by next fall, the new Clinical Building, a Research Laboratory, and Library will be ready for use.

Six other buildings will be completed within the next fifteen months, in the five million dollar program. A new men's gymnasium will be built a short distance from the stadium. The McKinley Hospital, a donation from Senator McKinley, will cost $205,000. Other structures included are the Women's Residence Hall, several Agricultural Service Buildings, and a Dairy Manufacturing Building. The stadium, made possible by gifts of Alumni and students, will also be completed this coming fall.

* * *

RECENT RADIO DEVELOPMENTS

It is not a commonly known fact that the wireless receiving station of the Radio Corporation of America at Riverhead, New York, has an antenna nine miles long and that messages received from Europe are amplified, sent direct to New York City, and recorded on tape, at the same instant that they leave the old country.

The Radio Corporation of America is the largest radio company now in existence and controls communication service between the United States and every large country in the world.

* * *

NEW TANTALUM VALVE

The Fansteel Products Company have recently placed on the market a new electrolytic rectifier, using the element Tantalum as the rectifying agent. This instrument has practical application in the functioning of storage battery chargers and many other electrical devices. The rectifier is a particularly efficient one and represents years of research in this line .

The cost of Tantalum is considerably greater than other metals used in connection with this work, but the compactness and efficiency obtained make up for these factors. The apparatus is sold under the trade name of "Balkite Battery Chargers."

* * *

AUTO WHEELS OF ALUMINUM ALLOY

Experiments have recently been made by several British Motor Companies using certain alloys of aluminum in the construction of wheel frames. These wheels have one-half the weight of an ordinary one and are remarkably strong. The advantages of these wheels are that the wear on roads is lessened, and that the scrap value is very high.

BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS.

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

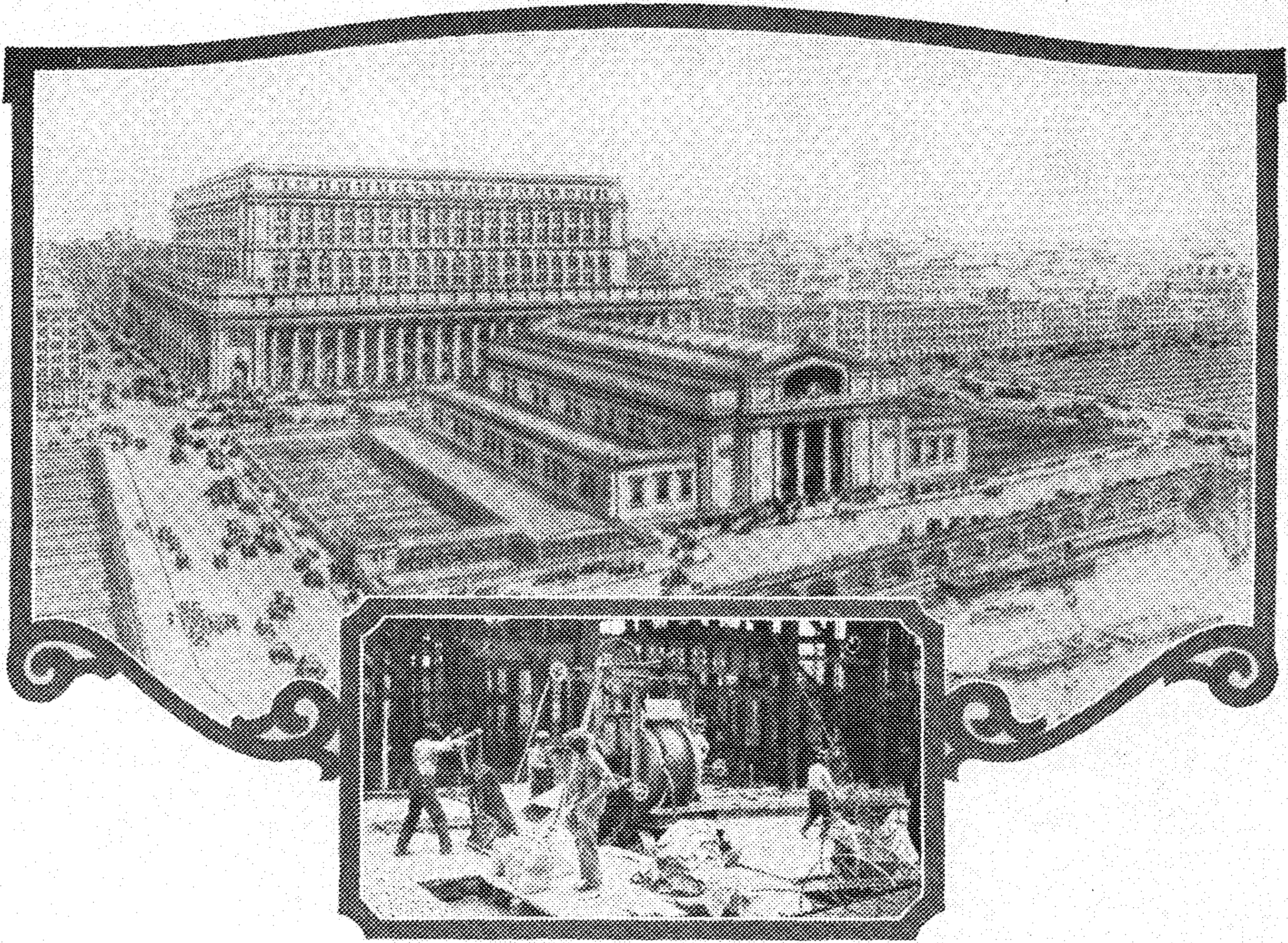
Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

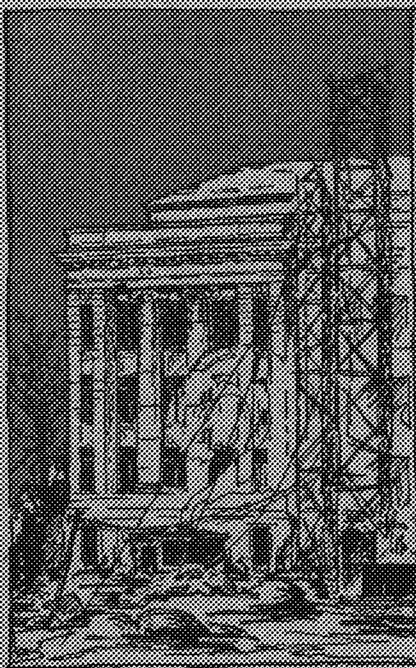
If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.
No. 3.



THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

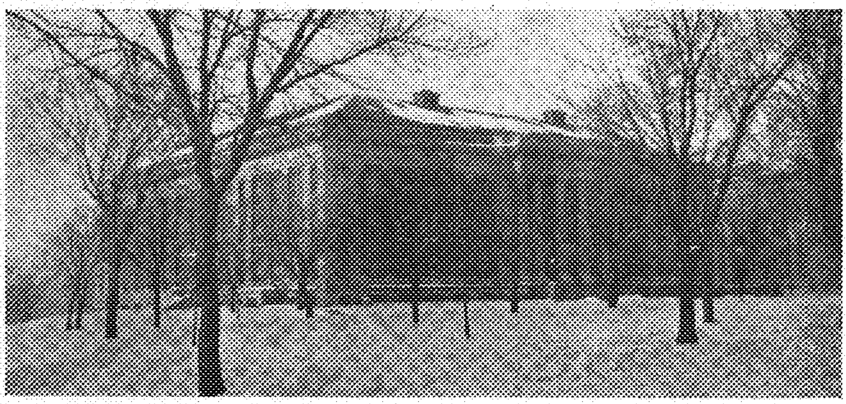


FEBRUARY
1 9 2 5

Volume V 25 CENTS A COPY Number 5

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES



WHERE ENGINEER AND ACADEMIC MEET: THE SCHOOL OF CHEMISTRY

The MINNESOTA TECHNO-LOG

37 Electrical Building

UNIVERSITY OF MINNESOTA

HERMAN F. BESELER AND KENEFICK ROBERTSON, *Managing Editors*
RICHARD W. JONES, *Business Manager*

VOLUME 5 NUMBER 5

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V FEBRUARY, 1925 Number 5

STREET ILLUMINATION — 1888-1925

By Clarence W. Teal

Former Managing Editor of the Techno-Log

THE first street lights in Minneapolis consisted of eight lights on a steel tower 250 feet high on Bridge Square.

This was back in 1888 when electricians wore plug hats and kid gloves, according to Stuart Laird, Superintendent of the Coon Rapids hydro-electric generating plant of the Northern States Power Company and one of the oldest electrical men in Minnesota.

"These first lights on Bridge Square were furnished with current from two machines down on the old wall at the Saint Anthony dam. The old flume is there yet," Mr. Laird said.

"The first Exposition which replaced the annual Wheat Carnivals was the beginning of our electric lighting. We got the Brush Company here from Cleveland for advertising purposes. They put in old engines and old Brush machines for the exposition and ran arc lights as far down as Nicollet Avenue. Then started the boom for street lighting. We put a heavy line up Nicollet as far as eighth street. It was an overhead line. The telephone company had one side of the street and we had the other.

"The early lights were all single carbon Brush arcs. They had to be trimmed every day and sometimes twice in a night. The chief trouble was caused by the variation of current due to the poor current control mechanism and to the liquids used in the dash pots. We couldn't get a liquid that would work all year. We used glycerine—mixed it with alcohol in the fall and spring, but in the winter it wasn't any good because the alcohol would corrode. When there was intense cold we would mix laudanum with it as laudanum will not freeze. Then when the lamps were changed they had to be cleaned and a new solution put in. You can see the trouble we had.

"Later we got double carbon lights. We thought when we got these lights that we would only have to trim them every other day, because when one tripped out the other would cut in. We had to trim them every day, however, because the two carbons were always working, first one and then the other. We also had trouble in getting a uniform carbon, but finally we secured Cleveland carbon, a uniform carbon which came in the same year that we changed over to the A. C. arc. With the new light the carbon slipped through a holder and had to be uniform.

"We used these lights until the development of the present 'Magnetite Arc.' This new type consisted of an arc between the electrodes one or both of which contained magnetic oxide of iron which improved the economy and steadiness of the light and prolonged the life of the carbons. I understand that this system is now being replaced by the Mazda system.

"The first district to get street lights was the territory around Bridge Square and the milling district. Later we branched out and began to take in the outlying districts and we have kept on to the present day. The lights were all ordered in by the aldermen. They would order in a bunch of lights in their ward and order the gas out. They kept that up until practically all of the city was lighted with electricity. Hennepin Avenue between Tenth and Twenty-seventh Streets, a part of the county road, was the last on which the gas lights were removed.

"We never used to burn the lights all night. Everything was on 'moonlight schedule' in the outlying districts. We only had 'all night and every night' in the milling district. Every moonlight night we would

Eight Arcs on a Single Steel Tower
Minneapolis' Street Lighting in 1888.

A brief resume of street lighting in Minneapolis opens this story by Mr. Clarence W. Teal, managing editor of THE MINNESOTA TECHNO-LOG last year.

The author gets away from the customary dryness that is common to "History of Development" articles by introducing us to Stuart Laird, one who has grown up with the development of street lighting systems. The colorful story told by Laird is edited by Teal in such a manner that the history should have a strong appeal to all regardless of their acquaintance with the technical paraphernalia described.

Following this unique introduction the former editor enters his main topic with a vigor that should please both the layman and the engineer. The results and recommendations of the city's engineers for improved street lighting in Minneapolis are excellently summarized by Mr. Teal. THE MINNESOTA TECHNO-LOG is pleased to give their readers the story.

—THE EDITORS.

turn out the lights. Then a new city inspector came and he worked up a moonlight schedule which we had to follow. The first year we didn't have light on many moonless nights and vice versa, but the next year he evidently changed almanacs.

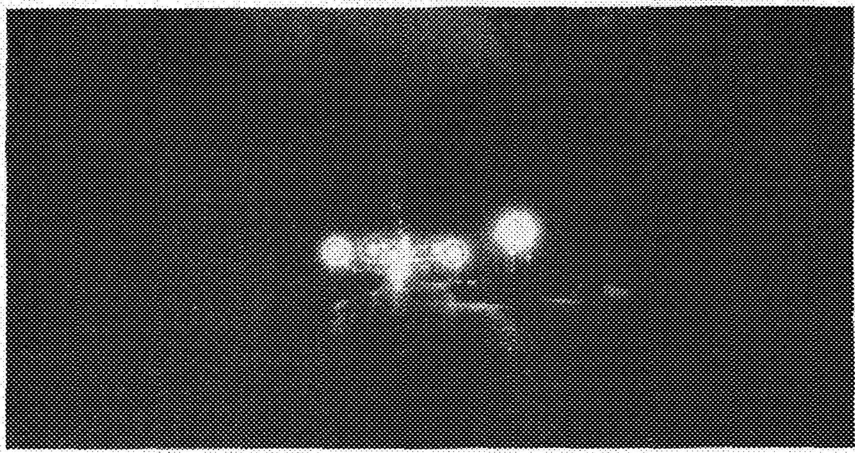
"We tried our first underground here in 1892. That was the Cobb system. We ran underground from the river up Hennepin to Washington, and then down Washington to Nicollet. The Cobb system was just bare wire, two or three strand, in a rubber cord. The line carried 1,000 volts.

"With respect to insulation and insulators, there has been some wonderful improvements made in them. At first we used glass, not even double petticoats, just single, and porcelain knobs for everything. You can see for yourself what progress has been made."

The above is the outline of the progress in street lighting with electricity as given by a man of the industry who has grown up with Minneapolis.

A long, long time ago lights used to be considered a luxury, only the rich could afford to light their homes. The streets of a city were free thoroughfares during the day only. At night they were the property of the highwayman and the robber. When a rich man went out at night he took his own torch-bearers to light the way for him.

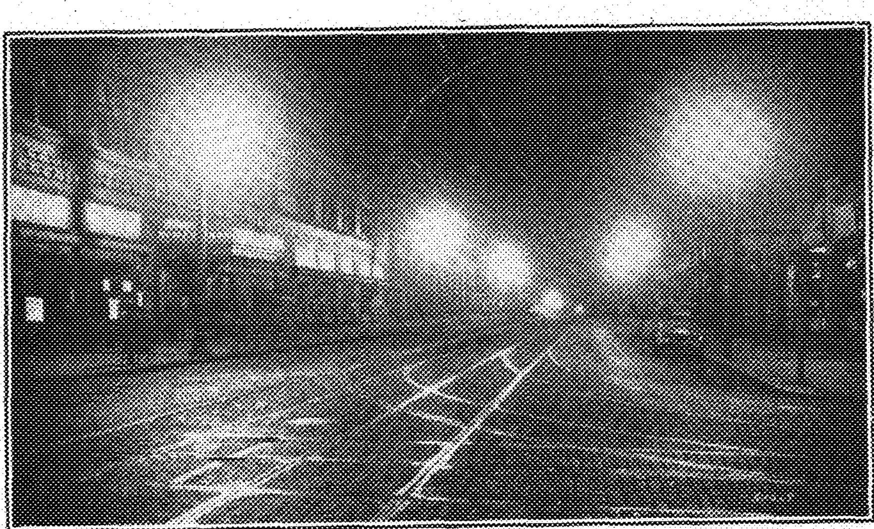
Now we light our streets continuously so that they are as safe for citizens at night as in the day. Our present systems are new, they are the development of the study of illumination which is a comparatively new subject. We might say that Sir Humphrey Davy started us on the way when he drew that first carbon arc from two charcoal electrodes with his many hundred cell battery, about a century ago.



A Well Lighted Residential Street in Minneapolis Before the Advent of Scientific Electric Illumination

Arc street lighting on a commercial scale did not begin in this country until 1879, when the Brush Company of Cleveland began to make series machines. From the innovation of these machines, when people were so ambitious as to try to light the entire city from one high tower, down to the present low voltage development, you have heard the story of Minneapolis' street illumination.

Engineers have always tried to devise a means of lighting city streets without running a separate circuit from the substations. These extra circuits use miles of copper wire and necessitate the use and upkeep of expensive regulating and operating equipment. The high voltage necessary for the series circuits has made the cost of insulators and insulation another large item. The struggle has been to get a light circuit that could be easily controlled from the substations without the installation of costly equipment, that would be an efficient remote control circuit, that would give bright light without glare, that would use the distribution network common neutral, and that would be operated from a low voltage source.

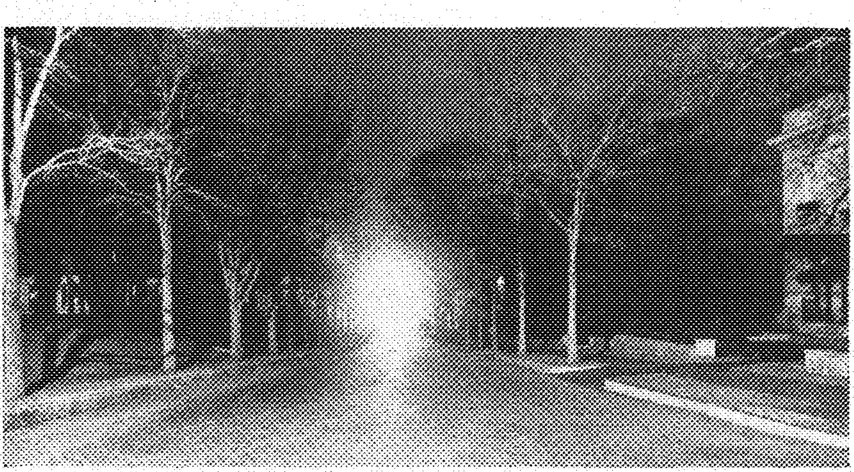


Night Turned Into Day: A Bit of First Avenue North Lighted by 1000 cp. Novalux Units Mounted at a Height of 22 feet.

These problems have been partially solved. The system that is gradually replacing the arc in Minneapolis is the nearest to the goal that engineers have yet devised. It embodies all the desirable features of the high voltage series and of the low voltage multiple systems while it eliminates many of the objectional features. Besides these advantages the cost of installation and maintenance is materially lower than with any of the common systems used today.

A number 6 B. & S. gauge single wire pilot, energized in the day-time from the 110 volt supply to the substation lighting, is carried out from the various substations to the switching relays controlling the street light groups in that section. The relays are connected between this pilot wire and the system neutral. When the pilot is de-energized the relay switches operate throwing on the street lighting groups. Any trouble in the pilot circuit, therefore, will merely turn on the lights. Because of the small current consumption of the selector relays, a number of relays can be operated from the same pilot.

With each selector relay and controlling each group of lights is either a small motor driven snap switch or a mercury switch. The latter has been worked out and developed by S. B. Hood of Minneapolis. The lights, usually six to a group, are fed from this switch by a single number six control wire, 110 volts, with the return through the system neutral. The 110 volt supply is taken directly



The Street on the Left After Installation of Modern Luminaires. Both Pictures were Taken During the Same Night Under Identical Conditions.

from the 110-220 volt residential secondaries, thereby using the surplus overload capacity of the existing transformers. This feature is an important improvement in as much as all constant current transformers operate at low efficiency, are high in unit cost, and operate at a very poor power factor.

The lamps are 1,000 cp. 20 ampere units with a small auto transformer mounted in the lamp housing. This converts the 110 volt supply down to about 25 volts for the terminals of the lamp. The high current series lamp is very efficient, its over all efficiency being more than that of the multiple lamp.

"The simplicity of this system can be best realized by comparing the usual cumbersome series station tub and control panel, using valuable substation space and operating at several thousand volts, with the little gang of 15 ampere push button snap switches that form the only substation equipment with the new system," Mr. S. B. Hood, Superintendent of the Engineering and Distribution Department of the Northern States Power Company, said.

One thousand candle power can, however, be delivered by various means and yet the quality of the light will be very poor and will not answer the purpose for which it is produced. Minneapolis, like many other cities in the West and middle West, has been slow to act for itself in the matter of obtaining correct glassware, proper heights, and the resulting good diffusion of light. They have been satisfied with the results of tests and experiments in Eastern cities and the recommendations of the factories.

Experimental tests were made on First Avenue North between Fourth and Eighth Streets, as authorized and directed by the City Council, "to install electric street lamps at different mounting heights." Test heights of 30, 23, and 15 feet were used, several types of glassware being tested at each height. The data gathered and the consequent recommendations are contained in a report made to the standing Committee on Public Lighting by engineer J. C. Vincent of the City Engineering Department.

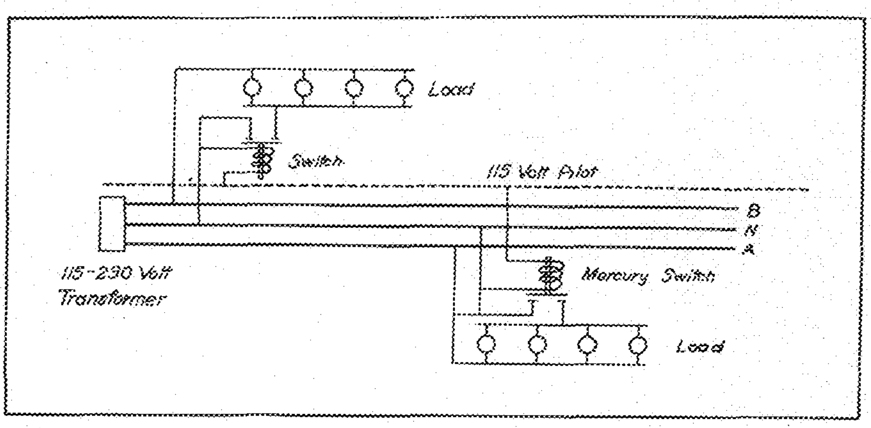
This report recommended a special fixture equipped with a rippled, clear, glass globe and a dome refractor. At the time of present writing, the city has over 1,550 of these units in service. Rippled or stippled glass diffuses the light by breaking it up and passing it through a external flashing of opal. The surface is covered with little ridges so the appearance of the units is quite different from that of those having the ordinary diffusing globe. The sparkling light from the rippled surface also suggests life and motion. Rippled or stippled glass is very effective in preventing glare and absorbs so little light that it is the most efficient type of glassware. These units produced an average intensity of 0.48 foot candles with only 75 per cent of the energy consumption of the next best unit.

In conclusion the report says:

"The evident superiority of the Novalux Form 6 installation at 22½ feet as shown by our tests, the lack of objectional glare which we noted by observation, and the excellent distribution of light on the buildings and roadways as shown in the photo, leads us to recommend this installation at the medium mounting height as most satisfactory for the business streets. The spacing of these units should be about five to six times the mounting height. The recent adoption by the City of Washington, D. C., of a mounting height of 22 feet and enclosing glassware of the rippled clear type after extensive investigation by many authorities on the subject is, to say the least, reassuring."

Big steps in Minnesota's "March of Progress" have been made in the art of artificial electrical street lighting since its innovation some 35 years ago. Distribution and maintenance have been radically changed, light distribution and quality have been increased many-fold and today we find ornamentation is also receiving its share of attention. Nicollet Avenue, Minneapolis' white way, has a cluster type of standard which is hard to equal in its ornamental value. The boulevards and parkways of the city also have ornamental standards, but only one ornamental post and mast arm has been tried in the residential districts.

Charles P. Steinmetz said, "When Prometheus stole the luminous spark from the gods and gave it to man, thus making him the master of light and power, his upward climb began, from the animal to the god-like master of nature. Indeed, the conquest of the fire and the mastery of the light and heat, which it gave, was the greatest step in the development of the human race, was the dividing line between animal and man."



The Simplified Circuit Used in Minneapolis to Furnish Street Lights with Energy from the Underloaded Distributing Transformers

DERIVATION OF OUR ELECTRICAL UNITS

By Carl B. Feldman and Frank O. Knoll

Students in the Department of Electrical Engineering

ALL branches of engineering are concerned primarily with physical quantities. The mechanical engineer, for example, deals with forces, velocities, and the other various quantities involved in the solution of his problems. The electrical engineer has to deal, however, with quantities *apparently* much more obscure in nature and relation. The ultimate nature of the physical quantities encountered in the study of electricity is, like all things carried to the ultimate, beyond understanding, but the study of the structure of our system of units brings out some interesting and significant points vital to our best understanding. The object of this paper is to make such a study.

Analysis of the matter discloses the fact that all physical quantities are related to all others in various ways, direct or indirect. A sufficient number of these may, then, be used as basic quantities in terms of which all others may be expressed. To so constitute the basis of a comprehensive system of units, these basic quantities must be chosen so that simple and fundamental quantitative relations subsist between quantities, and so that each will have one and only one unit in the system. Furthermore, they must be of such nature as to be easily standardized and copied. Three quantities, properly chosen, constitute the basis of a so-called "dynamical" system (a system comprising the quantities of mechanics). A unit of length, a unit of mass, and a unit of time satisfy the above requirements and, although other combinations have been proposed, the length-mass-time set is the only one in present recognition. Again, any arbitrary units of length, mass, and time might be used, but the familiar centimeter, gram, and second (constituting the C. G. S. system) are internationally accepted for all scientific purposes, although several others are in slight use. These three units will be referred to as fundamental units, those derived therefrom, as absolute units, and the entire system as the absolute system. It is to be noted that these three quantities constitute the basis of a dymamical system only; a system including electrical and magnetic units requires five fundamental quantities two of which may be (as will be shown later) properties of the ether.

In general, electricity manifests itself by four distinct effects, the thermal effect, the chemical effect, the physiological effect, and the mechanical effect. It is most readily studied quantitatively in terms of its mechanical effect, so a few units of the dynamical system must necessarily be considered.

In order to define intelligently a unit of any quantity in terms of the chosen fundamentals, it is of course necessary to know the mode of variation existing between the quantity and the fundamentals involved. For example, velocity is proportional to distance and inversely proportional to time. That is

$$v \propto \frac{L}{T}$$

or

$$v = c\frac{L}{T}$$

By making the length L our unit length, the time T our unit time, and the proportionality factor c, unity, the unit velocity v becomes defined as unit length per unit time. Thus the C. G. S. unit of velocity is one centimeter per second.

The appearance of the fundamental quantities in the "mode of variation" of a particular quantity furnishes an important index to its nature; the powers in which these fundamentals occur are called its dimensions. Thus the dimensions of velocity

$$\left(= \frac{L}{T} = L^{+1}T^{-1}M^0\right)$$

are plus 1 with respect to length, minus 1 with respect to time, and zero with respect to mass. In the common dimensional notation

$$[v] = [L^1M^0T^{-1}]$$

The importance of dimensions will appear later.

Several other dynamical units essential to our further considerations will now be defined.

Acceleration.

$$a \propto \frac{v}{T}$$

or

$$a = c\frac{v}{T}$$

As before, the C. G. S. unit of acceleration becomes one centimeter per second per second, and its dimensions:

$$[a] = \frac{v}{T} = [L^1M^0T^{-2}]$$

Force.

$$F \propto Ma$$

or

$$F = cMa$$

The C. G. S. unit of force, the dyne, then becomes the force necessary to impart an acceleration of one centimeter per second per second to a one gram mass. Its dimensions:

$$[F] = Ma = [L^1M^1T^{-2}]$$

Work or energy.

$$W \propto FL$$

or

$$W = cFL$$

The C. G. S. unit of work, the erg, is therefore the work done by one dyne acting through a distance of one centimeter. Its dimensions:

$$[W] = FL = [L^2M^1T^{-2}]$$

That work and energy are identical in nature can be seen from the dimensions of energy as defined from the kinetic equation

$$K.E. = \tfrac{1}{2}Mv^2$$

In dimensions

$$[K.E.] = [L^2M^1T^{-2}]$$

which is the same as that shown above for work.

These derived units of velocity, acceleration, force, and work are sufficient to build up a system of electrical units based upon certain mechanical effects displayed by electricity.

Electricity is always accompanied by an electric field, and the mechanical reaction between such fields furnishes a foundation for a system of units. Electricity *in motion,* however, has associated with it another more important phenomenon, the magnetic field. The mechanical reaction between magnetic fields furnishes the foundation for a second system of units, the two systems being known as the electrostatic and the electromagnetic systems, respectively. We will first consider the simpler one, the electrostatic system.

By virtue of the reaction between electric fields, two bodies charged with electricity exert a force upon each other, the force being attraction if the charges are unlike in sense, and repulsion if they are like in sense. From theoretical considerations the force between two isolated *point* charges should be an inverse square function of the distance between them, and experimental tests with very small charged bodies have shown this to be true within the highest limits of accuracy obtainable (approximately one part in 40,000). Experiment, as well as theoretical reasoning, has shown also that the force varies as the product of the two charges and inversely as another quantity k, a property of the medium in which they are placed. That is

$$F \propto \frac{Q_1Q_2}{kL^2}$$

or

$$F = c\,\frac{Q_1Q_2}{kL^2}$$

By making the two charges Q_1 and Q_2 equal and the proportionality factor c, unity, we have

$$F = \frac{Q^2}{kL^2}$$

or

$$Q = \sqrt{FkL^2}$$

If the value of k for air be taken as unity (modern authorities place k equal to unity for a vacuum; then k equals 1.000590 for air under standard conditions) we can define the C. G. S. electrostatic unit of Quantity, the statcoulomb, as that charge which will repel its prototype situated one centimeter away in air (rather, a vacuum) with the force of one dyne. The dimensions of Quantity are, from its defining equation

$$[Q] = \sqrt{FL^2k} = [L^{3/2}M^{\frac{1}{2}}T^{-1}K^{\frac{1}{2}}]$$

As has been noted, the above definition implies that the charges be point charges. This idea of a point charge, although a purely hypothetical thing, is of value in mathematical treatment and offers no real difficulties as it can be evaded in actual measurements.

The force acting on a charge placed in an electric field is taken as a measure of the intensity f of the field. Thus

$$F = fQ$$

or

$$f = \frac{F}{Q}$$

from which the C. G. S. electrostatic unit of electric field intensity becomes the field intensity which exerts a force of one dyne upon a charge of one statcoulomb. Dimensionally,

$$[f] = \frac{F}{Q} = [L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}]$$

By virtue of its situation in such a field of force any point in an electric field possesses a potential. The work required to bring a unit charge from outside the boundaries of the field, i. e., from infinity, to the point in question is defined as the potential of the point. Between two points of different potential, work must be done in transferring electricity, and this work is likewise taken as the measure of the difference of potential E. Since

$$W \propto QE$$

we can define E as work per unit charge:

$$E = \frac{W}{Q}$$

The C. G. S. electrostatic unit of potential difference, the statvolt, then becomes the difference of potential through which one erg of work is required to transfer one statcoulomb of electricity. It is to be noted that this definition implies that the transfer of electricity does not alter the potential difference. Dimensionally,

$$[E] = \frac{W}{Q} = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}k^{-\frac{1}{2}}]$$

The potential of a charged body is proportional to the charge, and the ratio of this charge to the resulting potential is defined as the capacity C of the body. Thus

$$C = \frac{Q}{E}$$

The C. G. S. electrostatic unit of capacity, the statfarad, is thus defined as that capacity which requires one statcoulomb to establish a potential of one statvolt. Dimensionally,

$$[C] = \frac{Q}{E} = [L^1M^0T^0k^1]$$

So far we have considered all the essential properties of electrostatics. We will now expand our scope and consider electricity in motion, retaining our derived units of Quantity, potential, and capacity.

The electric current I is defined as the time rate change of Quantity. That is

$$I = \frac{Q}{T}$$

Thus the C. G. S. electrostatic unit of current exists when one statcoulomb flows in one second. Dimensionally,

$$[I] = \frac{Q}{T} = [L^{3/2}M^{\frac{1}{2}}T^{-2}k^{\frac{1}{2}}]$$

Resistance is defined as the ratio of potential difference to current:

$$R = \frac{E}{I}$$

Thus the C. G. S. electrostatic unit of resistance R is defined as that resistance through which a potential difference of one statvolt will cause a flow of one statampere. Dimensionally,

$$[R] = \frac{E}{I} = [L^{-1}M^0T^1k^{-1}]$$

Inductance L is defined as the ratio of induced potential difference to time rate change of current, i. e.,

$$L = \frac{E}{\frac{dI}{dT}}$$

The C. G. S. electrostatic unit of inductance, the stathenry, then becomes the inductance in which a current changing at the rate of one statampere per second induces a potential difference of one statvolt.

We will now consider the system of units based upon the reaction between magnetic fields. For this purpose it will be convenient to utilize for mathematical treatment, the hypothetical point pole which may be defined as the limiting condition of one pole of a bar magnet as the opposite pole is removed to infinity. Between two such point poles m_1 and m_2 the force of attraction or repulsion is an inverse square function of the distance between them, and as in the case of point charges

$$F \propto \frac{m_1m_2}{uL^2}$$

u being a property of the medium. As before

$$F = c\frac{m_1m_2}{uL^2}$$

and by making the two poles equal and the proportionality factor c, unity, we have

$$F = \frac{m^2}{uL^2}$$

or

$$m = \sqrt{FL^2u}$$

If the value of u be taken as unity for air (strictly, it is taken as unity for a vacuum) we can define the C. G. S. electromagnetic unit pole as that pole which will repel its prototype situated one centimeter away in air (rather, a vacuum) with a force of one dyne. The dimensions of pole strength are from its defining equation

$$[m] = \sqrt{FL^2u} = [L^{3/2}M^{\frac{1}{2}}T^{-1}u^{\frac{1}{2}}]$$

As in the analogous electrostatic case magnetic field intensity H is defined in terms of the force acting on a pole situated in the field, i. e.,

$$H = \frac{F}{m}$$

from which the C. G. S. electromagnetic unit of field intensity, the gilbert per centimeter (so-called from its relation to magnetizing force), is the intensity which will exert a force of one dyne upon a unit pole. Dimensionally,

$$[H] = \frac{F}{m} = [L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{-\frac{1}{2}}]$$

Similarly, magnetic potential difference m is defined as work per unit pole. That is

$$m = \frac{W}{m}$$

The C. G. S. electromagnetic unit of magnetic potential difference, the gilbert, is thus defined as the difference of potential through which one erg of work is required to transfer a unit pole. Dimensionally,

$$[m] = \frac{W}{m} = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{-\frac{1}{2}}]$$

Here the parallelism between magnetic and electric field ceases.

Magnetic induction B, or flux density, is defined as the product of field intensity and the permeability u of the medium. Thus

$$B = uH$$

The C. G. S. electromagnetic unit of flux density, the gauss, is thus defined as being numerically equal to field intensity in air (vacuum). Dimensionally,

$$[B] = uH = [L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{\frac{1}{2}}]$$

Since induction is a quantity indicative of the strength of field, it is also indicative of the flux concentration. The product of induction and the area through which it exists gives total flux Ø. That is

$$\phi = BA$$

from which the C. G. S. electromagnetic unit of flux, the maxwell, is defined as that flux existing in a square centimeter when the density is one gauss. Dimensionally,

$$[\ \phi\ ] = BA = [L^{3/2}M^{\frac{1}{2}}T^{-1}u^{\frac{1}{2}}]$$

which shows that flux and pole strength are really the same quantity.

We may now define magnetic reluctance R in terms of magnetic potential difference and flux by the ratio

$$R = \frac{m}{\phi}$$

The C. G. S. electromagnetic unit of reluctance, the oersted, then becomes that reluctance through which one gilbert establishes one maxwell. Dimensionally,

$$[R] = \frac{m}{\phi} = [L^{-1}M^0T^0u^{-1}]$$

Having defined magnetic field strength we are now in a position to consider the relation between the electric current and its associated magnetic field which is therefore the relation between the two independent systems of units. The connecting link is the empirical equation of Laplace giving the field strength due to a current:

$$dH = \frac{I\ dl\ sin\ \ \phi}{r^2}$$

To define current in terms of its magnetic field by means of the above relation it is necessary to integrate. This is most conveniently done for a circle for which the equation then reduces to

$$H = \int_o^r dH = \frac{I}{r}$$

The C. G. S. electromagnetic unit of current, the abampere, is thus defined as a current such that will produce a field strength of one electromagnetic unit (gilbert per centimeter) per radius arc at the center of a circle of one centimeter radius. Dimensionally,

$$[I] = Hr = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{-\frac{1}{2}}]$$

In this connection it may be worthy to mention a distinction between field strength due to a current and field strength due to a magnetic pole. Laplace's equation gives the field strength due to a current as independent of the medium. The field strength due to a magnetic pole m, is, however, inversely dependent upon the permeability of the medium, as can be seen from the equation

$$F = \frac{m_1 m_2}{uL^2} \quad \text{where} \quad \frac{m_1}{uL^2}$$

is by definition the field strength which exerts a force upon m_2.

To express all electrical quantities in the electromagnetic system it is necessary to have one defined by some such bridging relation as Laplace's equation; then all others become determined by their inter-relations. We shall use the electromagnetic definition of current as derived above to define Quantity:

$$Q = IT$$

Therefore the C. G. S. electromagnetic unit of Quantity, the abcoulomb, becomes the quantity determined by one abampere in one second. Dimensionally,

$$[Q] = IT = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{0}u^{-\frac{1}{2}}]$$

As before

$$f = \frac{F}{Q}$$

The C. G. S. electromagnetic unit of electric field intensity becomes defined as that intensity which will exert a force of one dyne upon one abcoulomb. Dimensionally,

$$[f] = \frac{F}{Q} = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-2}u^{\frac{1}{2}}]$$

As before

$$E = \frac{W}{Q}$$

The C. G. S. electromagnetic unit of difference of potential, the abvolt, then becomes the potential difference through which one erg of work is required to transfer one abcoulomb. Dimensionally,

$$[E] = \frac{W}{Q} = [L^{3/2}M^{\frac{1}{2}}T^{-2}u^{\frac{1}{2}}]$$

Similarly

$$R = \frac{E}{I}$$

The C. G. S. electromagnetic unit of resistance, the abohm, becomes that resistance through which one abvolt will cause one abampere to flow. Dimensionally,

$$[R] = \frac{E}{I} = [L^{1}M^{0}T^{-1}u^{1}]$$

As before

$$C = \frac{Q}{E}$$

The C. G. S. electromagnetic unit of capacity then becomes that capacity which requires one abcoulomb to establish a potential of one abvolt. Dimensionally,

$$[C] = \frac{Q}{E} = [L^{-1}M^{0}T^{2}u^{-1}]$$

As before

$$L = \frac{E}{\frac{dI}{dT}}$$

The C. G. S. electromagnetic unit of inductance, the abhenry, is thus defined as that inductance in which a current changing at the rate of one abampere per second induces a potential difference of one abvolt. Dimensionally,

$$[L] = \frac{EdT}{dI} = [L^{1}M^{0}T^{0}u^{1}]$$

We shall now express the various magnetic quantities in the electrostatic system, using for the bridging relation the same equation used previously,—the integrated equation of Laplace

$$H = \frac{I}{r}$$

With I expressed in the electrostatic system, the C. G. S. electrostatic unit of magnetic field intensity becomes defined as that field intensity per radius arc produced at the center of a circle of one centimeter radius through which one statampere is flowing. Dimensionally,

$$[H] = \frac{I}{r} = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-2}k^{\frac{1}{2}}]$$

The C. G. S. electrostatic unit of pole strength then becomes defined from

$$m = \frac{F}{H}$$

as such pole strength that an electrostatic unit of magnetic field exerts a force of one dyne upon it. Dimensionally,

$$[m] = \frac{F}{H} = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{0}k^{-\frac{1}{2}}]$$

The C. G. S. electrostatic unit of magnetic potential difference becomes defined from

$$\mathfrak{M} = \frac{W}{m}$$

as that potential difference through which the transfer of one electrostatic unit pole requires the expenditure of one erg of work. Dimensionally,

$$[m] = \frac{W}{m} = [L^{3/2}M^{\frac{1}{2}}T^{-2}k^{\frac{1}{2}}]$$

To express flux in the electrostatic system it is necessary to use a different relation than

$$\phi = BA, \text{ for } B = uH \text{ and } u$$

is an electromagnetic dimension. We may, however, use the derived relation involving inductance

$$\phi = LI \text{ (per turn)}$$

Then the C. G. S. electrostatic unit of flux becomes defined as that flux produced per turn by one statampere flowing in a coil of one statheury inductance. Dimensionally,

$$[\ \phi\ ] = LI = L^{\frac{1}{2}}M^{\frac{1}{2}}T^{0}k^{-\frac{1}{2}}]$$

We may now define the C. G. S. electrostatic unit of magnetic induction from

$$B = \frac{\phi}{A}$$

as one electrostatic unit of flux per square centimeter. Dimensionally,

$$[B] = \frac{\phi}{A} = [L^{-3/2}M^{\frac{1}{2}}T^{0}k^{-\frac{1}{2}}]$$

The C. G. S. electrostatic unit of reluctance becomes defined from

$$R = \frac{m}{\phi}$$

as that reluctance through which one electrostatic unit of magnetic potential difference establishes one electrostatic unit of flux. Dimensionally,

$$[R] = \frac{m}{\phi} = [L^{1}M^{0}T^{-2}k^{1}]$$

Having now defined the major electrical and magnetic units in both systems it will be interesting and enlightening to make a few comparisons.

The most casual will observe that any particular quantity appears to have different dimensions in the two systems. Current, for example, has the dimensions

$$[L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{-\frac{1}{2}}]$$

in the electromagnetic system and has the dimensions

$$[L^{3/2}M^{\frac{1}{2}}T^{-2}k^{\frac{1}{2}}]$$

in the electrostatic system. It is unreasonable to suppose that any quantity can have two different natures so its dimensions in all systems must be really equivalent. Equating the dimensions of current gives

$$[L^{3/2}M^{\frac{1}{2}}T^{-2}k^{\frac{1}{2}}] = [L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{-\frac{1}{2}}]$$

whence

$$LT^{-1} = \sqrt{\frac{1}{ku}} = v$$

which shows that

$$\sqrt{\frac{1}{ku}}$$

has the dimensions of a velocity. Equating the dimensions of any other quantity gives the same result. The magnitude of the unit of this velocity may be determined by applying the principle that in equal quantities the product of number of units by the size of unit is equal to the corresponding product in any system. Thus

2x (1 yard per second) = 360x (1 foot per minute).

If we let I_s be the number of electrostatic units in a given current and I_m be the number of electromagnetic units in the same current we may write

$$I_s\,[L^{3/2}M^{\frac{1}{2}}T^{-2}k^{\frac{1}{2}}] = I_m\,[L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}u^{-\frac{1}{2}}]$$

whence

$$\frac{I_s}{I_m}\ LT^{-1} = \sqrt{\frac{1}{ku}} = v$$

If I_s and I_m be measured absolutely from the defining equations in each system for the same current*
it is found that the ratio

$$\frac{I_s}{I_m} \text{ equals } 3\times10^{10}$$

This ratio is independent of the medium in which the quantities are measured, for the measurements as made from the defining equations take account of the properties u and k. Accordingly, the *unit* velocity in centimeters per second represented by

$$\sqrt{\frac{1}{ku}}$$

is measured by this ratio, i. e.,

$$V \text{ equals } 3\times10^{10}\ cm \text{ per second.}$$

This result is significant in that it agrees, within the limits of experimental accuracy, with the velocity of light (in centimeters per second) through space. It is this suggestive agreement which led Maxwell to propound his celebrated electromagnetic theory of light which was later confirmed by Hertz.

It may be in place here to call attention to the reciprocal relation between relative size of units and relative numbers in equal quantities. It is also to be noted that the units in the two systems differ by immense factors; in several cases the ratios are approximately as 1 centimeter is to 34, 600,000,000 miles.

Contrasting the two systems of electrical units with the dynamical system, there is another observation worthy of note. The dimensions of electrical units all contain some fractional indices, together with either u or k. No meaning can be attached to a *fractional* power of length, mass, or time, nor can it be explained why the dimensional expressions of any quantity are not identical in all systems. It would be possible for u and k to have dimensions in length, mass, and time such that would rationalize all terms and make the expressions for the same quantity identical. It has been shown that

$$\sqrt{\frac{1}{ku}}$$

has dimensions in length and time but by no present means can the dimensions of either be determined independently. Many physicists hold the view that u and k have such rationalizing dimensions in length, mass, and time, but

(*Continued on page 29*)

*Such absolute measurements of current are difficult to make. Current was chosen for this illustration because it is essentially electromagnetic as well as electrostatic.

A FEW HIGH LIGHTS OF THE AUTO SHOW

By Ronald M. Hazen
Instructor in Automotives

THE outstanding features of this year's show are plainly visible to the casual observer, improved body design and finish and the predominance of the closed body type, especially the coach, forcing one to the conclusion that this is the body designers year. With the marked improvement in the beauty of line and form of the bodies has appeared a distinct trend toward bright colors and two-tone paint schemes of improved glossy finish. The newer pyroxilin base lacquers, such as Duco, are rapidly replacing the older paint and varnish finishes due to their greater ease and shorter time of application, superior durability, and better adaptability to various color schemes. Black leather upholstering is apparently disappearing with black bodies while smooth finished cloths seem to be displacing the mohair, mohair plushes and velours in the closed bodies.

Nickel plating of lamps and radiator shells has become almost universal practice again, probably due in part to improvements in the art of plating, partly because of better harmony with the gayly colored bodies. Attention has been given to the accessibility and convenience of the closed cars as is evidenced by the use of wider doors, narrower panels to improve visibility, wider use of the one-piece ventilating windshield and the like.

Worth-while progress has been made in the design of both the engine and the chassis without any spectacular advancements. Perhaps the greatest interest has been evoked by the numerous new eight-in-line engines appearing this year, there being some twelve listed at present. The increased production of closed cars and the continued tendency to increase engine speeds have forced designers to persist in their attempts to reduce vibration. Evidence of this is found in the increased stiffness of the parts upon which the vibratory forces act, the crankshaft and the crankcase, and the reduction of weight of the parts tending to cause vibration, the pistons and connecting rods. The diameter and weight of the crankshaft has been increased in several cases, the number of main bearings in some, and the practice of machining the crankshaft all over, especially where there is a main bearing on each side of the crankpin, is gaining favor both to obtain better balance of the shaft and to keep the overall length of the engine down to a minimum. An increased number of engines have the cylinders cast integral with the crankcase, thus giving more rigid support to the crankshaft bearings and at the same time eliminating some machine work. Light duralumin connecting rods are gaining in favor but the same cannot be said of the alloy pistons, which have lost two or three important adherents in the past year in favor of the skeleton construction, light cast iron piston. The use of permanent molds and die casting of cast iron, permitting thinner sections due to the accuracy of the method, the use of alloy cast iron and semi-steel and of the skeleton design are developments making possible the light construction. The reason for the reversion to the cast iron piston is apparently to retain the better wearing qualities of cast iron and still have a light piston. However, it seems doubtful whether any longer wear will be obtained with the skeleton type of cast iron piston than with the aluminum alloy piston, due to the fact that the surface area has been reduced to a minimum and the piston wall pressures considerably increased with consequent increased wear.

Attention has been given to the cooling systems, special provisions are made in several designs to insure equalization of the flow of water to and from the several cylinders. With but few exceptions pressure lubrication is now used to both the main and crankpin bearings and, in most cases, also the camshaft bearings. Better oil strainers and increased use of oil filters are noticeable as well as the greater accessibility of the strainers for cleaning and of the draincocks for draining the oil from the crankcase. Several manifolds have been redesigned to improve distribution and with an eye to better hot-spotting or heating to give shorter warming up periods.

Stiffer frames are used on many cars, the channels being deeper and thicker and the cross members made more rigid. With the change of the Chevrolet from the cone to the single plate dry disc clutch the cone clutch has practically disappeared from the modern car. The single plate clutch seems to have more followers than does the multiple disc type. Anticipated departures from the standard transmission design have not materialized this year but will probably prove a major development of the near future.

The vindication of four wheel braking systems and balloon tires is evident, although both are far from their final form. Wheel shimmy, as aggravated by balloon tires and to some extent by the increased weight of the front axle resulting from four wheel brakes, is still to be completely understood and overcome. The new users of four wheel brakes employ chiefly the hydraulic type which is well standardized while the mechanically operated brakes retain their former adherents but show a marked disparity of design. Some of the latter, however, appear this year again without major changes, as on the Buick, indicating satisfaction with the original design. Steering is probably easier this year with balloon tires than a year or two back with high pressure tires due to reproportioning of the steering gear and increased use of anti-friction bearings. Semi-elliptic springs have become almost universal. Shackle improvement has been accompanied by a variety of design, the new Hupmobile for example using multiple laminations of spring steel at the free end of the spring to maintain tight fits and ready adjustment. Rubber spring mountings are used on the Durant Junior, but on no other cars, although this promising development will undoubtedly receive attention in the future.

Bus design has received a great deal of attention in the past year, body design in particular having made great strides. Low hung bodies giving stability and excellent appearance are the rule rather than the exception. Comfort, convenience and riding qualities are markedly better. Bus engine design shows a trend toward the six cylinder engine and higher speeds are being used.

The auto show, as in past years, was a success from both the manufacturer's and general public's viewpoint. Each year the layman wonders how any further improvement in design can be made, but each year the auto show depicts further improvements which make one want to dispose of the "old bus" and secure a new model.

GRADUATE QUESTIONS CULVERT CLAIMS

The following self-explanatory letter was recently received by the Minnesota Techno-Log.

The magazine does not enter into any arguments there may be between the two interests involved, but publishes this letter in order to give justice to all interests concerned.

Editor
Minnesota Techno-Log,
University of Minnesota,
Minneapolis, Minn.

Dear Sir:

My attention has been called to the article in the December issue entitled "State Highway Culverts Inspected."

This article contains so many misleading statements and has such a strong resemblance to a piece of sales propaganda for a particular material, that in the interest of maintaining the standard of your magazine and in fairness to the other interest involved, it should not be allowed to go unchallenged.

The first criticism is that the author has not been quite frank in introducing himself nor in outlining the purpose of his inspection. The author identifies himself as Former Highway Engineer, State of Florida, but fails to state that at the time of this investigation, he was Chief Engineer for a company which manufactures the type of culverts that he rates so highly.

Mr. Kenny likewise failed to point out that The American Rolling Mill Company, which was represented on this investigation, are the manufacturers of the metal culvert pipe which he is promoting. His bare reference to the presence of an engineer from the Minnesota Highway Commission might give the impression that the inspection was of an official nature and that the Highway Department concurred in the conclusions announced. In this connection, one wonders just what prompted the author, after declining to present some figures to sustain the conclusions from this investigation on the plea of lack of space, to devote three-quarters of a page to praise the road system and administration of the Minnesota Highway Department. It is not that Mr. Babcock and his department are not deserving of this generous tribute, but to one who was inclined to be critical, it might appear that appending this to an article reporting the results of an engineering inspection was an attempt to prejudice the Highway officials in favor of the culverts advocated by the author.

The paper is full of statements which are both inaccurate and misleading. For example, in reference to the "faulting" which he illustrates in his Fig. 1, he says, "I believe it was due to hydraulic action that it is impossible to overcome this faulting in pre-cast concrete structures where we have to contend with the expansion and contraction brought about by frost action in the extreme climatic conditions of the Northwest." This is a mere statement of belief, however vague, followed by the gratuitous assumption that it is impossible to overcome this difficulty. It is interesting to note that the entire party did not concur in this belief, even though "several prominent engineers have concurred with the author's opinion."

In speaking of monolithic concrete structures, Mr. Kenny says, "I was indeed surprised to note in how many instances we found cracks in this supposedly permanent type. Most of these cracks were found, of course, in the older style design, for it would not be possible for them to develop in the short space of time in which the new method of installation has been in use. While the results of the new type of construction are problematical, it is hoped that the difficulty in cracking will be overcome. However, it is reasonable to suppose that such defects may develop at a later period, basing one's opinion upon the conditions which have tended to cause these cracks in the older type of structure." This hardly can be called a well considered conclusion from an unprejudiced investigation. Here again, "opinion of the party differed, but indications were that hydraulic action, or in other words, expansion and contraction of the concrete and the pressure of the soil had tended to cause defects." This difference of opinion is reassuring, for the writer confesses his inability to follow this explanation of hydraulic action.

Engineers who have been interested in the building of permanent concrete structures know that good results can be obtained and are being obtained under conditions of exposure just as severe as anywhere in Minnesota.

The writer has just completed a survey for a committee of the American Concrete Institute, covering nearly 50 million dollars worth of concrete in service from 10 to 25 years under conditions of exposure averaging fully as severe as those in Minnesota. This survey consisted in the collection of all available data pertaining to the construction and a thorough study of the causes of disintegration or failure where these were encountered. This committee has drawn the following conclusions from a study of these data:*

"The production of durable concrete involves no mystery. The requirements are: Clean aggregates of durable minerals; a mixture of a fair degree of richness; the use of a puddling consistency; and care in placing and curing."

Structures made from concrete conforming to these requirements in which proper attention has been given to the structural design and with sufficient protection for the metal reinforcement, should be permanent in any exposure except in certain very limited localities where the sulphate concentration in the ground waters is unusually high.

Every defect pointed out by Mr. Kenny can be traced to one or more of the three fundamentals; quality of the concrete, insufficient provision for the loads to be sustained or improper protection to the reinforcement. Mr. Kenny is wholly unwarranted in inferring or insinuating that failures of individual structures, no matter how numerous, are of necessity type failures and cannot be overcome by proper design and construction. Culverts are minor features of road construction and as such are frequently given little or no attention with a consequent higher mortality than for more important structures. Also, the loads to which a culvert is subjected have in the past been largely matters of estimate. Fortunately, highway engineers have been giving more attention to these features in recent years with the result that reliable data on the loads to be sustained are being collected and full considerations are being given to design.

It is to be regretted that the Techno-Log has been unwittingly "taken in" and allowed its columns to be the agency for such prejudiced criticism masking as the report of an engineering investigation.

(Continued on page 28)

*See Proceedings of the Concrete Institute, 1925, Report of Committee E-6, "Destructive Agents and Protective Treatments."

ENGLISH—AN ASSET TO ANY ENGINEER

By Raymond W. Keller

Member of the Senior Electrical Class

THE English language is the engineer's most powerful tool when it is properly used. In order to build bridges and power plants, he must persuade others to assist him financially. He can use his ability to speak no matter where he goes, because English comes nearer to being a universal language than any other tongue. English publications are read in the far corners of the world, wherever English civilization and culture is found. A ready command of the English language is just as essential in the workaday world as it is in the realm of literature and letters.

Walt Whitman, one of the best of American poets, characterizes the English language superbly in his preface to *Leaves of Grass*.

"The English language befriends the grand American expression . . . it is brawny enough and limber and full enough . . . on the tough stock of a race who through all change of circumstance was never without the idea of political liberty, which is the animus of all liberty, it has attracted the terms of daintier and gayer and subtler and more elegant tongues. It is the powerful language of resistance . . . it is the dialect of common sense. It is the speech of the proud and melancholy races and of all who aspire. It is the chosen tongue to express growth faith self-esteem freedom justice equality friendliness amplitude prudence decision and courage. It is the medium that shall well nigh express the inexpressible."

The art of conversation is one of the most important and one of the most neglected of the arts. A good conversationalist is a rare person and whenever he is found there will usually be a number of others less talented drinking in his every word. Men and women have opened the gates of society by means of a charming and interesting way of speaking. Many an ambitious young man has won his way to advancement through his ability to speak good English. The highest success is won only after a man has mastered public speaking.

Nothing betrays one's ignorance and lack of culture more than his tongue. B. C. Forbes calls it the "rudder of life." Many a business and social wreck might have been prevented had the pilot known how to manipulate this rudder. "Even a fool is counted wise if he holds his tongue," says the old adage. But in the present age, very few of us can maintain a perpetual silence. Sooner or later we must speak; and when we do, we either proclaim ourselves cultured masters of knowledge or mere uncouth and vulgar persons of little learning. It cannot be otherwise.

The study of English is just as important to the engineer as it is to the lawyer. An engineer who does not have an almost *perfect* command of his native tongue is without the use of one of his most powerful tools. Unless he can put his thoughts and ideas into clear, concise sentences, he is doomed to remain in a subordinate position. The ability to speak well is one of the prime requisites for real success.

Engineers are notorious for their general lack of culture, in particular their inability to express themselves. It is the engineer's own fault, because all of the best technical schools in the country require their students to take work in rhetoric. Ask a group of undergraduates what subject they dislike most, and seventy-five out of a hundred will declaim rhetoric to be their most disagreeable course. The engineers are usually too matter-of-fact. Anything imaginative is out of their small sphere of slide rules, logarithms, and integral tables; and how they hate to be dragged out into the world of poetry and fiction. Perhaps some students at eastern colleges are justified in calling the engineers "tin dinner-pail artists slightly graduated."

Slang and swearing are two of the worst enemies of good speech. The habit of inserting a slang phrase or a cuss word in a sentence in place of the proper adjective is indicative of a lazy mind. The practice is deplorable. Bad grammar is inexcusable, yet how prevalent it is. Bad spelling and punctuation usually go hand in hand with the inability *to speak* good English. This much can be said for most users of poor English, that they are much more careful of their written expression than they are of their spoken words. A person will chew at a pencil five minutes trying to discover the best way to write a simple sentence; yet this same person will rattle off a half dozen verbal sentences in one breath. The importance of writing well seems to be fairly well understood, but the study of speech is disregarded altogether.

Anyone who stops to consider the matter must agree that the study of English is important. The engineers should be just as familiar with the rules of grammar as they are with mathematics. The principles of rhetoric should be as thoroughly implanted in their minds as those of the basic engineering sciences.

Every engineer should master his English before he leaves college. Unfortunately this is not very often the case. The men leave school as barren and ignorant of good usage in English as they were when they entered the portals of their alma mater. The importance of a formal course in rhetoric cannot be overstressed, although it is not absolutely essential. If the engineering students could only be shown the dollars and cents value of good speech, they would get much more good out of the courses given by the English department. The general attitude is expressed in the common phrase, "What's the stuff good for." "Cui bono."

To those who have missed their opportunity in college it might be well to recommend some of the excellent correspondence courses offered in elementary English. The conscientious student will find them almost as valuable as class room work. Unfortunately most of us do not like to work unless we are prodded by our task masters. For this reason this method is not entirely satisfactory.

There are some possibilities for a man to teach himself to speak and write good English without any help. Benjamin Franklin, that versatile American statesman, scientist and publisher, taught himself how to write. His early education was very scanty, but this did not daunt him. His first method was to paraphrase some good article in the Spectator, then published by Addison and Steele in England. Franklin would read an essay, and then allow the idea to become firmly fixed in his mind. Later he would rewrite the essay in his own words with only his memory to aid him in getting the proper sequence of ideas. He carefully compared his work with the original essay; he noticed where the original expressions were better than his, and then mastered the better form. He found that writing poetry was a won-

(Continued on page 26)

SWISS RAILWAY ELECTRIFICATION

By Charles J. Cosandey

Member of the Senior Electrical Class

IT is a well known fact that Switzerland has played her part in the development of electric railways and that at the present time she has a greater percentage of her railways either actually operated by electricity or undergoing the process of electrification than any other country. To give a complete account of the various steps which led to the present conditions in that respect would require volumes and is beyond the possibilities of this article. It will be attempted in this article to point out some of the important steps taken toward the electrification of the railroad network of Switzerland; to give some of the reasons why electrification has taken such an advance in that country, and to point out some of the advantages of electrification.

Switzerland has long recognized the superiority of electricity as a motive power for her "mountain railways." Many of these lines which traverse the short steep mountain sides are driven through a geared third rail, a few others are of the finiculary type. In her cities, Switzerland uses electricity almost entirely to propel her street railways and to drive her suburban transportation units. This article will not refer to the advances made in these limited fields, but will treat of the main line networks of a general interest. Most of these lines are of standard gauge construction, that is, having a railspread of 1,435 mm.

The first lines to be electrified were of minor importance and for some ten or fifteen years these lines were to some extent mere experimental fields where various systems and improvements were tried and developed. As early as 1898 the Engelberg Railway and in 1899 the Berthoud-Thoune line were constructed to be operated with three phase 750 volt A. C. having a frequency from 30 to 40 cycles. In 1901 the Gruyere-Montreux-Zweisimmen line was put into operation, using D. C. with a voltage varying from 500 to 750.

In 1906 the Simplon tunnel was completed and communication established between Italy and Switzerland by means of the Simplon Railway which was built to operate on three phase 3,000 volt A. C. having a frequency of 16 cycles. In 1907 the Aigle-Ollon-Monthey line was put into operation using D. C. from 750 to 1,000 volts, and in 1908 the Bernina Railway, which is of narrow guage type (1,000 mm. rail spread) with a maximum grade of 7 per cent, began operation using D. C. at 750 volts.

Beginning with the year 1901 a careful study of the various systems of electric railways was undertaken under private initiative at the Oerlikon Works which resulted in numerous trials made on the Swebach-Wettingen line, during the years 1904 to 1909. These trials resulted in the adoption of the single phase high voltage A. C. system which has since prevailed in the building of new lines or electrification of railways already in operation.

In 1910 the Seethalbahn (Wildegg-Emmenbrücke and Beinwill-Munster) was completed and put into operation using single phase 5,500 volt A. C. at 25 cycles. The same year the line established communication between Martigny and Osiere using single phase 8,000 volt A. C. at 15 cycles. The later line is only 20 km. long with a maximum grade of 3.5 per cent but is of some importance, since it is the part of the Grand St. Bernard line which connects Turin, Italy, and Lausanne.

In 1911 the first division (Spiez-Frutigen) of the Lötschberg line was finished and put in service, using single phase 15,000 volt A. C. at 15 cycles. Also, during that year the Biasca-Aquarossa line and a year later the electric railway joining Lugano and Bonte-Tresa, both of narrow guage construction and energized with 1,200 and 1,000 volts D. C. respectively, were open for service. In 1913 the Tavanne-Tranelan-Noirmont line was open for service, using 1,200 volt D. C. The same year the electrification of the network known as the Rhetique railways was begun. The later step was the outcome of successful experimentation carried on since 1910 by the Rhetique company on the trial line joining Bevers and Schuls. Current is supplied at 16⅔ cycles, 10,000 volts, A. C. The latter frequency makes it possible to interlink the central stations generating power for traction purposes with stations generating power for local service at 50 cycles. Such interconnection is made possible by using frequency converters having a conversion ratio of three.

The Lötschberg tunnel and line was completed and used in 1914. The completed line was energized with single phase, 16⅔ cycles, 15,000 volts A. C., the standard voltage and frequency adopted by the Swiss government in their electrification of the Federal Railways. It will be recalled that the first division of the line was energized at 15 cycles.

Thus we see that just before the outbreak of the World War there were several electric railways in Switzerland and that the electrification of the Rhetique Railways was under way.

The electrification of the Swiss Federal Railways, which include the most important railroad systems of Switzerland, was not undertaken until the World War made it a national necessity. During the war the electrification of the St. Gothard line was undertaken by the government and at the close of the war the major portion of the line was operated by electricity. The Swiss government had built the Simplon Electric Railway, but it had not ventured to electrify other federal railways until the shortage of coal brought on by the war made it a necessity. The electrification of the federal railways was pushed as much as possible during the war and still more since the war. By 1920 the St. Gothard line had been electrified over its entire length and the electrification of the Lucerne-Erstfeld, the Zürich-Arth-Goldau, the Zong, Rothkrouz and the Bellinzone-Lugano lines was well under way in 1921. At the present time, these lines are all operated by electricity as several others. The most important of these is the line establishing communication between Lausanne and the Simplon tunnel (Lausanne-Sion-Brigue) via the Rhone valley. Beginning January 1, 1925, freight trains were operated electrically between Lausanne and Yverdon and on the first of February, 1925, all traffic over the latter line has been handled by electric traction. After April 1, 1925, all traffic over the line joining Daillens and Vallorbe will be handled by electric locomotives. This will complete the electrification of the portion of the international line, Paris-Simplon-Milan running on Swiss soil.

Several other lines of importance are to be completely electrified by the end of the present year, and plans are made to continue the process until all the federal railways will be electrified. At this time, 675 km. of the federal railways are electrified and it is expected that by 1928, all of the main lines of the federal railways, which include about 1,530 km. of track, will be electrified.

It is needless to say that the primary reason for the electrification of railways in Switzerland is extremely important. This reason holds equally well for the less important privately owned lines and for the Swiss federal railways. By electrifying its railways, Switzerland is taking a tremendous step toward freeing herself from the necessity of depending upon foreign countries to supply her with coal with which to operate her railroads, and thereby gaining greater independence as well as better and cheaper railway service.

Switzerland suffered severe handicaps during the late war owing to the fact that she had to depend upon the countries involved in the war for her supply of coal. Train service had to be reduced considerably and industries as well as the city population suffered from shortage of coal. Not only was she forced to undergo severe handicaps, due to the shortage of coal, but the belligerent countries attempted on several occasions to extort from her unreasonable favors in return for a guaranteed coal supply. This, of course, put her in a situation which required great diplomatic skill in handling.

By electrifying her railways, Switzerland is exploiting the only coal she has: white coal in the form of glaciers, perched on the craggy Alps, to give her economic as well as political independence.

By her post-war extensive program of electrification of railways, Switzerland was able to alleviate the crisis which followed the war by providing employment for thousands of idle working men and thus making it possible for some of her industries to survive. The project of the electrification of the Swiss federal railways involves considerable alteration of the existing steam railway lines, such as the remodeling of railroad yards and equipping them with the necessary protective devices. In addition to this, all telephone and telegraph lines as well as power transmission lines which run parallel to the tracks or cross them must be either removed or elevated. Nearly all railroad bridges are being remodeled or strengthened, due to the fact that with electric traction, a higher average train speed will be maintained and heavier trains will be handled.

The Swiss government has been very successful in the handling of its railways from a financial point of view. During the last two years, the income from the federal railways has exceeded all expectations which in turn has facilitated the carrying out of the electrification program. In some cases, the cost of electrification has been less than estimated at first. For example, the electrification of the sector Sion, Lausanne, had been estimated to cost 24,869,500 fr. as shown by the 1920 budget, while the actual cost of the complete undertaking was only 20,100,000 fr. or about 81 per cent of the estimated cost. This was partly due to changes of economic conditions as well as to some alterations made on the original plans. The electrified lines have already realized considerable savings in their operations besides giving excellent service.

The progress made in the past three years indicate that it will be only a matter of a short time before all of Switzerland's railroads will be of the most modern and efficient type. This change will greatly affect the physical aspect of Switzerland and will bring a new economic era to this historic little country.

The Electrical Engineering Wireless Towers

Above the dust and clamor here below
These sentinels of mind and spirit rise;
Deftly their fingers touch the vibrant skies
Where winged words are passing to and fro.
They dwell on high, where rarer currents flow—
Perhaps behold, in pity and surprise,
The low estate of recompense we prize,
The narrow round of things we seek to know.

O stalwart towers, unshakable, serene,
Make us more worthy of your office here!
Refine our message, whatsoe'er it be,
Attune our thoughts to listeners unseen.
On far horizons may our words ring clear,
Proclaiming there the truth which makes men free!

—George P. Conger.

The
MINNESOTA TECHNO-LOG
University of Minnesota

HERMAN F. BESELER, KENEFICK ROBERTSON
Managing Editors

WILLARD H. NORDENSON - - - - Alumni Editor
CLYDE W. LIGHTER - - - - Architectural Editor
JAMES M. SUTHERLAND - - - - Chemical Editor
HAROLD C. E. PETERSON - - - - Civil Editor
PAUL B. NELSON - - - - - Electrical Editor
LEONARD KLEINFELD - - - - Mechanical Editor
THOMAS F. ANDREWS - - - - - Mines Editor
RUSSELL S. GRANT - - - - - Humor Editor

Special Writers
Marshall H. Coolidge, Jr., Alva J. Haley, Philip F. Hartman, Joseph F. Meagher.

Assistants
Erling A. Amundsen, Thor A. Gustafson, L. W. Cameron, Kenneth Foster.

RICHARD W. JONES - - - - - Business Manager
NORMAN R. MOORE - - - - Advertising Manager
GEORGE M. LANGE - - Assistant Advertising Manager
A. S. BULL - - - - - - Circulation Manager
E. L. SLAGGIE - - - - - - - Sales Manager

Faculty Advisers
Prof. A. S. Cutler, Prof. C. A. Mann.

For the Greater Minnesota Technology, the institution which today is being constructed in mortar and brick, and which tomorrow will send into the world men recognized as the leaders of industry; for this THE MINNESOTA TECHNO-LOG stands, and to this end the staff devotes its thought and energy, always keeping foremost the welfare of the University.

A NEW TRADITION

ONE of the finest traditions that has ever been started in the Engineering School is the Senior Advisory System. We have an Engineer's Day that puts the engineers on exhibition before the rest of the world. We have a Class Scrap Day that, despite its name, brings forth a spirit of friendly rivalry between the Freshmen and Sophomores. But, until the establishment of the Big Brother Movement, there was not a force reaching across four years of college experience to bind the men who were entering with the men who were leaving school and to instill into the newcomers some realization of the ideals of the institution.

At its inception, the Senior Advisory Committee was organized as an aid in raising the scholarship of the Freshman class. The principle on which the duties of the Committee were worked out was the idea that if the Freshmen could be quickly acclimated to their new surroundings, new methods of study, new freedom, by forming some friendships among the upper classmen, the first year men would obtain a clearer conception of the responsibilities and means of meeting the responsibilities imposed by college study. As the Big Brother Movement developed, however, this first duty of the Senior Advisory Committee was overshadowed by a broader, finer responsibility—the establishment of a means for directly transmitting to each entering student the ideals of the school—ideals of honest co-operation in engineering service and of loyalty to alma mater.

We at Minnesota have been criticized for lack of college spirit. To a certain extent this criticism is just. However, if one will take the trouble to investigate, he will find, especially among the members of the Senior class, at least a few men who feel that their four years at college mean more than a $7,500 job and that there is something besides a $100 Stadium pledge that is due to Minnesota after graduation. It is the duty of the Senior Advisory Committee to bring these men who, no one can doubt, have at least a spark of college spirit, into contact with the Freshmen. And then it is the duty of these Big Brothers to instill in their advices the thought that Minnesota is more than the name of a group of college buildings.

There has been some talk of the ineffectiveness of the Senior Advisory System. Perhaps those who were talking in this vein were drawing conclusions from the work of this year's or last year's committees. It may be that the men who were chosen to carry out the work this year were not the men best fitted for the task. Possibly the committee has failed entirely in its task. Regardless of how these ideas may "line up," there can be no doubt of the fundamental soundness of the Big Brother Movement. If the Seniors of 1925 will do their part, the growth of the Senior Advisory System will go on whether we have an effective committee or not. Then, in a few years, when the Freshmen of today, who have never helped by the friendships formed among the upper classmen, are Seniors, the Big Brother Movement will be playing an important part in the development of men—Minnesota Engineers—who will be of ever increasing service to their school and to humanity.

—GEORGE M. CORNELL.

THE general policy of THE MINNESOTA TECHNO-LOG has, in the past, ruled against the publication of technical articles involving any considerable amount of mathematics. There are many good reasons why a student publication, such as ours, should not publish articles of an essentially technical type. Fundamentally, the College should furnish our technical education, while the Magazine should unite student spirit and promote the best of extra-curricula activities. In a larger way, however, the Magazine can sponsor a deeper student thought in matters of general engineering interest. It is with this idea that THE MINNESOTA TECHNO-LOG publishes "Derivation of Our Electrical Units."

The article should be of considerable value to every electrical engineering student because it thoroughly treats of the relations of the fundamental electrical units. To all other technical students it forcefully shows, in a simple and concise manner, the ever present analogy between electrical and mechanical quantities. The simplicity with which the authors arrive at equations showing the velocity of light and electricity to be equal, is a noteworthy feature. Messers Feldman and Knoll deserve great credit for the work they have expended on their paper.

—K. R.

Once more the months have rolled by and again the event of events looms before us—ENGINEER'S DAY!

The Juniors have done nobly in their selection of a chairman. Under the leadership of George Mork, the celebration is assured of success.

It's not the labor of a few individuals that will make our party a success, but the co-operation of the entire student body.

Engineers, get busy!

NEWS FROM THE ENGINEERING CAMPUS

ENGINEER'S DAY

April 24 has been set for Engineer's Day this year. George Mork, recently appointed chairman, has announced his committees, and definite plans are already under way. A cash prize award is being made this year for the design of the Button. The first prize is $5.00, second, $3.00, and the third is $2.00. Any student on the campus is eligible for competition. The designs should be handed in at the dean's office not later than March 13th.

This is the time for all good Engineer's to come to the aid of the party, and every one concerned is urged to start thinking up stunts, so that the Engineer's Day of 1925 will be the best in the history of the school.

GRADUATE DOES RESEARCH

Donald Earl, of the Mechanical Engineering class of 1924, has for his thesis problem, "Air Ejection Apparatus." The object of the experiment is the testing of various types of condenser air removal apparatus.

The particular device now under test is a two stage Westinghouse-Le Blanc B. C. type ejector, using steam at 125 pounds pressure. The principle of operation is as follows: The first stage steam jet entrains the air from the condenser, compresses it up to 20 or 22 inches of vacuum and passes it into the intra-condenser, where the steam is condensed. The air continues on to the second stage which compresses it to atmospheric pressure.

The ejector will be tested for air capacity and steam consumption. The makers claim that the device will handle 21½ pounds of free dry air at 70 degrees and a 28 inch vacuum; or 30 pounds at a 27 inch vacuum. The air leakage into a system is variable and depends largely on the skill of the operator in finding and remedying small leaks. In good modern practice the ejector under test should be large enough to readily handle the leakage of a 1,000 to 1,500 kilowatt unit.

The advantages claimed of this type of air removal apparatus are: economy of space, absence of moving parts, and low steam consumption. These ejectors use less than 1 per cent of the total prime mover steam consumption as against 3 to 5 per cent for the hydraulic entrainment air pumps, and also save space. There being no moving parts to replace or oil, the maintenance cost is very low. Usually several ejectors are connected for parallel operation in large installations, any units not needed being disconnected, leaving the others operating at best efficiency. The steam jet ejector is replacing other types of air removal apparatus, among which are the various rotary pumps and hydraulic entrainment air pumps. At present, practically every large maker of condenser equipment also manufactures an ejector.

In connection with this work, Mr. Earl will make tests on water jet ejection apparatus. The principle of operation is practically the same as that of the steam jet, water being substituted for steam. The water consumption in this type of apparatus is high, consequently considerable power is consumed. However, attempts will be made to reduce the amount of water necessary, and to develop a practical water jet ejector.

TWO ENGINEERS ON QUINT

Our own "Black Rasey" recently showed Purdue a thing or two about basket-ball. The eagle-eyed engineer threw in twenty points against the Boilermakers and is now near the top of the scorers in the Big Ten.

"Rodg" Wheeler, another engineer, is also on the basket-ball team and is giving a good account of himself. "Rodg," it will be remembered, is the man who took the "Range" out of Grange last fall as far as runs around Minnesota's right end were concerned.

ARABS START WORK

The Arab's, engineering dramatic club, held their annual banquet at the Chateau Tea-Rooms February 4th. Plans for the coming production were discussed. Theodore Jan Pritchard, senior architect, is author of the play which is a musical comedy. Much of the music has been written and work is progressing rapidly.

The Arab's will put on a dance at the Glenwood Chalet Friday evening the 27th of February. All engineers and their friends are invited. This event will be the Arab's big party before the work starts in earnest on the play.

ELECTRICAL PARTY PLANS

The Electrical Party, sponsored by the Minnesota branch of the A. I. E. E., and held every two years, will occur April 24 and 25 this year. Berkley Lewis, manager of the show, announced the following men on his committees: Clem Tunnell, finance; Bob Burlingame and Gaylord Gilman, student exhibits; Railways and trains, H. D. Smith; Radio, Win Hilgedick; Illumination, A. A. Lee; Communication, Henry Tholstrup; Decorations, Harold Heins; Programs, Albert Morse; Press, Kenefick Robertson; Music, C. W. Thyberg; Refreshments, M. A. Countryman; and special lighting, Win Brown.

Early indications show that the event this year will be the largest ever held.

A. S. C. E. HOLDS BANQUET

One of the most interesting banquets that has ever been held by the local student chapter of the American Society of Civil Engineers took place at the Union Ballroom on the evening of February 5th. Unfortunately the attendance was small due to the proximity of mid-quarter examinations, but those who were able to come felt well repaid.

Speakers for the evening were W. R. Smith of the Athletic Department who spoke on Intra-mural Athletics and Its Advantages; Professor Burton, whose topic was "Designing that is Economically Correct will be Beautiful," together with slides showing Spanish architecture; Mr. W. E. King, speaking on the Robert Street Bridge, pointing out the novel features which govern its design; and Mr. P. E. Thian of the Northwest Section of the A. S. C. E., with greetings from the senior chapter.

AWARDED GOLD BAND KEYS

The University of Minnesota Band awarded gold honorary keys to the following seniors in the technical Colleges: James McCully, Enan Johnson, Clarence Thyberg, John Banovetz and Joe Lushene. These keys are awarded each year to graduating members who have been with the band for at least four years and possess musical and other abilities that make them an honorary band man.

MINERS HOLD "SHINDIG"

The sixth annual Miner's "Shindig" was held at the Minnesota Union Ballroom February 11. The dance was sponsored by the sophomore class. Paul Derringer, president of the class, headed the committees. Edward H. Erck had charge of finances and programs, Erling Amundson of decorations and general arrangements, and M. H. Coolidge, Jr., of publicity and ticket sales. Assisting them were M. L. Broman, Lowell Arnold, and Robert Tousley. Lynn "Red" Hendry was superintendent and chief operator of the spotlight, a part of the evening's entertainment. Music was furnished by Chadbourne's orchestra.

The programs, printed on Van Dyke paper, were unique. The cover was designed by Miss Rhoda Cote, a prominent campus pen and brush artist, and depicts miners on their way to the Stagger Inn Dance Hall. Dances were named Preliminary Traverse, Basaltic Bawl, Shisty Shift, Silver Shimmee, Rodman's Ramble, and continued to Final Dividends.

The event was held at the Stagger Inn Dance Hall, owned and operated by the Bonanza Mines, incorporated under the laws of Temptation. The Board of Directors consisted of Messrs. E. H. Comstock and Peter Christianson. The Corporation lawyer was Mr. L. B. Pease. Shares of stock, sold previously, admitted the holders to the dance.

Decorations consisted of miner's lamps and dynamite cans placed about the room. At the bar noxious beverages were served by a hard boiled individual.

Many feet sought the brass rail.

TRIANGLE COPS RELAYS

Triangle engineering fraternity won first place in the trials for the annual professional inter fraternity relays held January 24, and finished third in the finals held the following week. The team included Olson, senior mechanical; Foster, junior civil; Larson, senior civil; and Billings, freshman architect.

NEW COIL WINDINGS

John Hilliard, senior electrical, is doing some very original work in the measuring of effective resistance of coils and the characteristics of various sizes and forms of windings. The measurements are made at frequencies varying from 1,500,000 to 7,500,000 cycles. The work which he is doing is entirely original.

Hilliard is making tests of a new coil winding known as the spaced wound coil. This coil was originated by Prof. Sanderson of the School of Mines. Results indicate that the merits of this winding are very high. An interesting feature has been brought out, namely that the dye in colored cotton insulation reacts on the material of the conductor and causes an additional resistance. This resistance is of sufficient magnitude as to alter the proper workings of a coil.

No. 18 B&S guage was found to be the proper size for use in low loss wound coils in radio receiving sets.

9XI SPANS 9,000 MILES

9XI, the university radio station, recently established a record for long distance communication when Australian 2BK was worked. The distance is over 9,000 miles. Previous to this time, the record was held by station 9ZT of Minneapolis who had talked with a New Zealand station 1,400 miles nearer.

Other records are also being made. On 40 meters, 1XW in Hartford, Connecticut, was worked at 2 o'clock in broad DAYLIGHT! Amateur stations in England, Belgium, and Australia are heard frequently.

SMOCKS AT PARTY

Bright color was much in evidence at the architects' party, given February 7, as the new yellow smocks of the freshmen mingled for the first time with the reds, blues, and greens of the upper-classmen. The senior drafting room, the scene of the party, was gayly decorated with murals, quite as colorful as the dress of the dancers, and very cleverly caricaturing habits and favorite remarks of faculty and students alike. One exceptionally attractive and complete piece of art was the faithful representation of the pre-Volstedean bar, of which no detail was lacking, not even the shiny brass rail. The popularity of this work was equalled only by the "Knickers Knick," another example of the skill and forethought of the decorators, whose innovations, together with a good orchestra and a happy crowd, made the party one of the most successful ever given in the department.

RECENT DESIGNS GRADED

The judgment of the work produced in design this quarter has resulted in the following awards:

Grade II. First short problem: "An Interior Doorway." Credits: Paul Havens, William Edwards. Con-credits: Gerald Kronick, Oswald Stageberg, Robert Potter, Gus Naslund.

Interior Decorating. First problem: "A Library for a Home." Mention: Rhoda Cote. Credits: Dorothy Mann, Helen Parker, Verna Smith.

Grade I. First short problem: "A Wall Fountain." Mentions: Lawrence Anderson, Jack Crimmons, Paul Eaton, Sidney Stolte, Donald Gilfillan, Neal Nelson.

Problems awaiting judgment and being worked on are: Grade III. "A Commemorative Monument," and "A Garden Dining Room." Grade II. "A County Court House;" Interior Decorating, "A Sea-captain's Room." Grade I. "A Library Pavilion."

The problem in Freshmen Elements of Architecture has been judged and A's were awarded to the following students: George Crosby, Maurice Locker, Bruce Church, Theodore McElroy.

ENGINEERS CONVENE

The third joint convention combining the 4th annual convention of the Minnesota Federation of Architectural and Engineering Societies with the 30th annual convention of the Minnesota Surveyors' and Engineers' Society was held at the Curtis Hotel on January 22, 23 and 24.

PROGRAM OF THE FEDERATION

Friday, January 23.

8:00 A. M.—Registration.

9:00 A. M.—Report of the Public Affairs Committee. This committee is doing work of great importance to the engineers and architects of Minnesota.

10:15 A. M.—Address of Welcome, Speaker General, George E. Leach, Mayor of Minneapolis.

10:30 A. M.—C. M. Babcock, Commissioner of Highways, discussed the work and policy of his department.

11:30 A. M.—Hon. Ray P. Chase, State Auditor, discussed the tax situation in Minnesota.

12:30 A. M.—Luncheon.
The ladies were entertained at a luncheon and bridge party.

2:00 P. M.—Dwight E. Woodbridge, Duluth, presented the iron and steel industry in Minnesota and the possibilities of its future development, illustrated by moving pictures and lantern slides.

3:00 P. M.—Max Toltz and W. A. Thomas, of Toltz, King & Day, and E. H. Cotton, assistant engineer, St. Paul Gas Light Co., presented the "Use of Powdered Fuel in Power and Heating Plants." Illustrated with lantern slides.

4:00 P. M.—Prof. Fredrick M. Mann, "The New Stadium at the University, illustrated with lantern slides and including views and descriptions of other stadiums.

6:00 P. M.—Dinner.

8:00 P. M.—Major C. F. Williams, U. S. Army Engineer Corps, presented with moving pictures of the Great War never shown in Minnesota before, "The Engineering Profession as an Arm of our National Defence System."

SATURDAY, JANUARY 24.

9:00 A. M.—Electric Power Survey by National Electric Light Association. Power survey committee, North Central Division (Minnesota) as a part of the Great Lakes System presented by Mr. G. C. Neff, vice-president, Wisconsin Power & Light Co. A discussion by Mr. S. B. Hood, superintendent of distribution, Northern States Power Co. Illustrated.

10:00 A. M.—Charles F. Keyes, president of the Board of Estimate and Taxation, Minneapolis, discussed municipal taxes and the opportunities and duties of engineers and architects to serve city, state and nation.

10:30 A. M.—General discussion of the tax problem.

11:00 A. M.—"Why Contracts Lead to Litigation in Engineering and Architectural Work," by Frederick H. Stinchfield, past president, Hennepin County Bar Association.

12:30 P. M.—Luncheon.

2:00 P. M.—Business Meeting and report of resolutions committee.

6:00 P. M.—Annual Banquet. The Rhys-Herbert Male Chorus of 28 voices, led by Mr. E. G. Killeen, director, gave a musical program during the banquet. Dr. C. A. Prosser, president of Dunwoody Institute, spoke on "The Broader View of Engineering and Architecture."

9:00 P. M.—Dancing and bridge or mah jongg.

The Committee on Program and Arrangements was composed of the following:

Walter H. Wheeler, Chairman
E. S. MacGowan, Publicity
A. M. Frazee
E. F. Kibbey
W. T. Ryan.

PROGRAM OF THIRTIETH ANNUAL CONVENTION, MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY.

January 22.

9:00 A. M.—Registration. Motion pictures and entertainment.

10:00 A. M.—Remarks by the president. Secretary-Treasurer's report.
Reports of standing committees.
New business.

10:30 A. M. to 5:00 P. M.—Sectional meetings.

6:30 P. M.—Stag banquet and entertainment.

January 23.

8:00 A. M. to 12:30 P. M.—The Minnesota Surveyors' and Engineers' Society attended The Federation general program.

1:30 P. M.—Short business session and election of officers. The rest of the day was devoted to the general program of the Federation.

ZELENY DOWNS TOBACCO

A census among the junior class in Electrical Measurements was taken during the Fall quarter at the suggestion of Professor Zeleny of the Physics department. The following results were tabulated by the committee of juniors appointed:

STUDENTS

Grade	A	B	C	D	E&F
Smokers	2	7	16	3	2
Occ. Smokers	1	5	2	1	..
Non S.	4	15	15	6	2

FATHERS

Smokers	4	12	17	6	4
Occ. Smokers	1	3	3	..	..
Non S.	2	11	13	4	..

A difference was made between smokers and occasional smokers: An occasional smoker is defined as a person who smokes only on rare occasions, not oftener than once in two weeks at least. These results speak for themselves and are very similar to ones taken several years ago among a class of pre-medic students.

ECLIPSE INVESTIGATIONS

Professor Wilcox of the mathematics department recently made a trip to Ironwood, Michigan, in the company of several astronomers from the university to get data on the eclipse. A total eclipse was to have been visible from there, but dense clouds made complete views impossible. Professor Wilcox has specialized in the study of celestial mechanics.

Professors Zeleny and Erickson also did some research at the time of the eclipse, going to Biwabik, Minnesota, where they took various observations. The adverse weather conditions made some results inaccurate, but much valuable data was recorded. The results of the absence of the sun's rays on the electric field potential gradient, and the measurement of the loss of the sun's emanations at the time of totality were recorded.

FROSH START BASKET-BALL

The Freshman engineers have shown real spirit by organizing eight basket-ball teams. Under the direction of W. R. Smith, director of intra-mural athletics, a Freshman Engineer's league has been formed and is well under way.

The eight Freshman teams also play in the regular intra-mural freshman league and are doing well. Good work frosh, we're proud of you.

SENIOR TEST RELAYS

Robert Burlingame, senior electrical, is doing some research work on the operation on overload time relays as used in central stations. The one being tested is a type OA relay made by the Westinghouse people. Curves showing the effect of both time and current are being checked. A large wiring diagram of the complete switchboard and auxiliary apparatus is also being drawn by Burlingame for future reference.

GRADUATE IN NEW FIELD

Walter F. Kannenberg, EE '23, is engaged in some very interesting and original research in the problem of sending photographs by wire. This has been accomplished to a certain extent by engineers of the Western Electric Company, but vaster improvements are yet possible. Mr. Kannenberg has been working on this problem for some time and has made considerable headway. The department has been fortunate in securing a photo selenium cell similar to the ones used by the Western people, for use in this connection.

JUNIOR CIVIL DIES

Axel C. Johnson, a member of the junior civil class, died at the home of his parents on January 26. He was a disabled war veteran.

Nine different men are engaged in research problems in radio and telephone work. Many of these have separate rooms and thus can pursue their work without interruption. A multiplicity of problems are being worked out and very good work is being done.

DRIPPINGS FROM THE OIL CAN

SALUTES

Hints for the Guidance of Our R. O. T. C. Officers.

The following is the correct procedure for a young officer in charge of an armed party upon meeting—

(a) A Staff Officer riding a bicycle.

Correct Procedure. If marching at attention, order your men to march at ease and to light cigarettes and eat bananas. Then, having fixed bayonets, give the order: "Across the road—straggle!"

(b) A funeral.

Correct Procedure. Strike up Tipperary, and look the other way.

(c) A General Officer who strolls across your Barrack Square precisely at the moment when you and your Platoon have got into mutual difficulties.

Correct Procedure. Lie down flat upon your face (directing your platoon to do the same), cover your head with gravel, and pretend you are not there.

Special Cases

(a) A soldier, wheeling a wheelbarrow and balancing a swill-tub on his head, meets an officer walking out in review dress.

Correct Procedure. The soldier will immediately cant the swill-tub to an angle of forty-five degrees, at a distance of one and a half inches above his right eyebrow. (In the case of Rifle Regiments the soldier will balance the swill-tub on his nose.) He will then invite the officer, by a smart movement of the left ear, to seat himself on the wheelbarrow.

Correct Acknowledgment. The officer will comply, placing his feet upon the right and left hubs of the wheel, respectively, with the ball of the toe in each case at a distance of one inch (when serving abroad, 2½ centimetres) from the centre of gravity of the wheelbarrow. (In the case of Rifle Regiments the officer will tie his feet in a knot at the back of his neck.) The soldier will then advance six paces, after which the officer will dismount and go home and have a bath.

(b) A soldier, with his arm 'round a lady's waist in the gloaming, encounters an officer.

Correct Procedure. The soldier will salute with his disengaged arm. The lady will administer a sharp tap with the end of her umbrella to the officer's tunic, at point one inch above the lowest button.

Correct Acknowledgment. The officer will take the end of the umbrella firmly in his right hand, and will require the soldier to introduce him to the lady. He will then direct the soldier to double back to barracks.

(c) A party of soldiers, seated upon the top of a transport wagon, see an officer passing at the side of the road.

Correct Procedure. The senior N. C. O. (or if no N. C. O. be present, the oldest soldier) will call the men to attention, and the party, taking their time from the right, will spit upon the officer's head in a soldier-like manner.

Correct Acknowledgment. The officer will break into a smart trot.

(d) A soldier, driving an officer's motor-car without the knowledge of the officer, encounters the officer in a narrow country lane.

Correct Procedure. The soldier will open the throttle to its full extent and run over the officer.

Correct Acknowledgment. No acknowledgment is required.

NOTE.—None of the above compliments will be paid upon active service.

—from "KI" by I. H.

* *

Roughly Speaking

The Track Supervisor received the following note from one of his track foremen:

"I'm sending in the accident report on Casey's foot when he struck it with the spike maul. Now under 'Remarks,' do you want mine or do you want Casey's?"—*Ex.*

* *

"A Little Learning—"

Harold—"My girl has too much education."

Ted—"How's that?"

Harold—"Why, she calls Child's Restaurant 'La Cafe des Infants.'"

* *

Untold

Servant—"There's a man come to see you, ma'am."

Mistress—"Tell him to take a chair."

Servant—"He has, ma'am, he's taken them all and they're moving the piano now. He's from the furniture store."

"IN THIS CAGE—"

Who is yon chap with flapping ears,
Vacuum look and frowsled hair?
He takes big engines apart and swears
Then to get them together invokes
prayers.
Don't you know him? Oh, dear!
Oh, dear!!
Why he's the Mechanical Engineer.

Who is yon chap with eyes of blue,
Long frock-coat of brilliant hue?
"I'm worked to death!" you hear him
howl.
Sits up all night like a reg'lar owl.
He is what you'd surely suspect,
A queer old duck of an Architect!!

Who is yon chap with air aloof,
Forever gazing up at roofs?
They say he's sane, but I've no proof.
He seems to me like the queerest goof.
But you'd be, too, I sadly fear
If you were a Civil Engineer.

Who is yon chap with absent look,
Never is known to look at a book.
Plays bridge all day in the smoking
room;
In a few years he'll be pushing a
broom.
Oh, gentle stranger, shed bitter tears,
For he's an Electrical Engineer.

Who is yon chap—Oh, pray me tell.
He looks as though he's been through
—a hard winter.
O, sir, he needs no pity at all—
Why he distills his own alcohol.
And General Butler can't interfere—
He's a spirited Chemical Engineer.

* *

His Discovery

A certain man says he has discovered how to make both ends meet. His wife served cold tongue and ox-tail soup the other night.

* *

Of Course!

I read that "the eferveal effusionism of contapherbial races dispose, sertistically and butonically, of the erroneous supposition advanced by Hertzmonhausen in 'Zeilungerwiesternaxman Weitertruzke.'"

That's what I always did say.

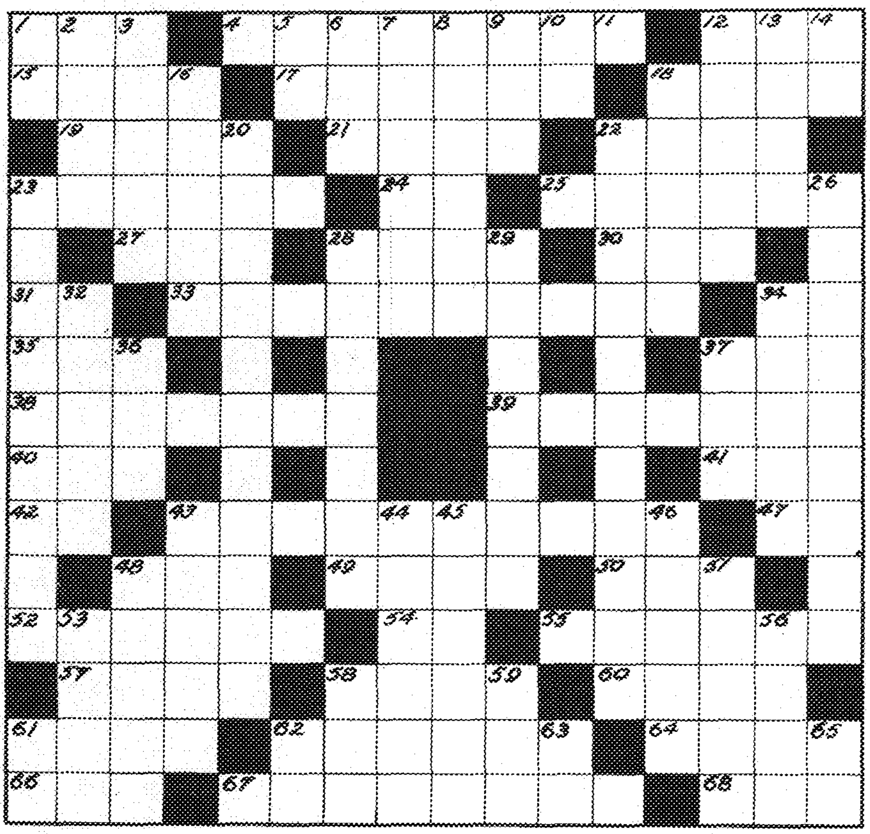
* *

Hospitality

A cannibal's motto for strangers: "First come, first served."—*Literary Digest.*

THE TECHNO-LOG'S CROSS WORD PUZZLE

By W. O. French, R. Wilson, A. Algren, W. Pendergast, R. Holmes,
Senior Mechanical Engineers



Horizontal

1—Unit of resistance.
4—The 19th amendment.
12—First part of the locomotive.
15—What the mule uses to make an impression.
17—Instrument used by electricians and graduate electricals.
18—Point of land extending into the sea.
19—One of Prof. Erickson's proteges.
21—Musical instrument.
22—Bird.
23—Sold on downtown streets.
24—A railway (abbrev.)
25—Most dreadful.
27—After three strikes.
28—Conveyance used in winter.
30—Conveyance used by bootleggers.
31—A measure "Stiffey" uses at the Gopher.
33—The hardest course in the University.
34—Exclamatory remark.
35—Prof. Zeleny's other topic.
37—Large cask.
38—Of little importance.
39—Transforms straight line to rotational motion on a locomotive.
40—Adept.
41—Including everything.
42—A degree.
43—The most popular engineering course.
47—A continent (abbrev.)
48—Brand of cigarettes (Roman numerals.
49—Description of a classy coed.
50—Familiar sized loan.
52—Passing of time.
54—A state (abbrev.)
55—Grave.
57—To encourage.
58—Tribe of Indians.
60—Scorch.
61—Breathing organ of a fish.
62—Good thing to have when broke.
64—Not odd.
66—Type of poem.
67—To marvel (past tense).
68—Lengthen.

Vertical

1—Coed's exclamation on seeing a handsome engineer.
2—To deceive.
3—A guiding principle.
5—Not down.
7—A bone in the forearm.
8—What a Washington Ave. store does after a bankruptcy sale.
9—Present indicative plural of verb be.
10—General secretary (abbrev.)
12—Large, black bird.
13—Our ancestors, according to Darwin.
14—Pronoun.
16—A public discussion.
18—Substance composed of numerous skeletons of marine animals.
20—An unemotional person.
22—Parts.
26—To change to other co-ordinates.
28—A hard-hearted Shakespearian character.
29—Contempt.
32—Division of the army.
34—To throw with violence.
37—An academic's favorite beverage.
36—Colloquialism for not.
43—A "road" scholarship.
44—Tired.
45—Backward movement.
46—Bank to hold back floodwater.
48—Wire rope.
51—Required to face student work committee.
53—To put down.
56—To fume.
58—Vase.
59—Title.
61—To depart.
62—A concern (abbrev.)
65—A direction (abbrev.)

ALUMNI AND FACULTY PERSONAL NEWS

CIVILS

L. E. Ashbaugh, '01, is associated with the Sessions Engineering Company of Chicago, and is at present making an investigation and report on hydroelectric development around Portland, Oregon.

A. O. Cunningham, '94, is a consulting engineer, with offices in the Railway Exchange Bldg., St. Louis, Mo.

N. W. Elsberg, '09, is city engineer for the City of Minneapolis. He was recently elected as president of the Minneapolis Engineers Club and also president of the Odin Club.

A. C. Goodward, '10, has resigned his position as engineer for the Minneapolis Park Board and has been appointed engineer to the Board of Estimates and Taxation. His address is 4621 Vincent Ave. So., Minneapolis, Minn.

E. R. Grant, '24, is assistant engineer on the Lexington Bridge at Lexington, Missouri, being built by the Bridge Department of the Missouri State Highway Commission. His address is Missouri State Highway Department, Jefferson City, Missouri.

E. M. Grime, '00, is with the Northern Pacific Railway as supervisor of Bridges and Buildings with his headquarters at Fargo, No. Dak.

N. Johnson, '94, is valuation engineer for the Wabash R. R. at St. Louis. His address is 2069 Railway Exchange Bldg.

Earl H. Lund, '22, is an instructor of mathematics in the Engineering college of Washington university at St. Louis and is also completing his work for a degree in Law. His address is 5737 Vernon Ave., St. Louis, Missouri.

Everett J. McCubrey, '21, is resident engineer for the Minnesota State Highway Department at New Ulm.

Archie McCrady, '24, has resigned his position with the Minnesota State Highway Department and is in the U. S. Patent Office at Washington, D. C. Address "Archies'" mail to division 25, The Patent Office, Washington, D. C. "Archie" states that a reunion of the old class occurred Homecoming Day after the game, and those present consisted of Broddock, Hovden, Thompson, Frantz, Normann, Nyvall, McCrady.

John N. Morrison, '22, was married to Miss Helen Clayton of Minneapolis last August. They are now living at 104 E. Franklin Ave., Minneapolis. Mr. Morrison is field engineer Special Construction Department, Northern States Power Co., Minneapolis.

L. L. Peterson, '24, since graduation has devoted all his time to work with the allied interests of the Northern States Power Co. His various employments have been on the St. Croix River Investigations, Riverside Station at Minneapolis; St. Cloud Division and then at Fargo, No. Dak. with the Union Heat Light and Power Co. His work for the past six months has been on power plant efficiency, with particular attention to fuel combustion. Mr. Peterson may be addressed care of the Union Heat Light and Power Co., Fargo, No. Dak.

Louis Powell, '24, is in Norway and Sweden on a sight-seeing tour. He secured free transportation to New York by auto and worked for his passage across the Atlantic. Powell claims a better idea of the country is gained by this mode of travel.

F. C. Shenehon, '95, former Dean of the College of Engineering read the principal paper before the A. S. C. E. at their October meeting in Detroit, Michigan, on the Great Lakes-St. Lawrence Waterway. He presented this topic to the Northwest section of the A. S. C. E. at the January meeting. At present Mr. Shenehon is an hydraulic engineer with offices at Minneapolis, Minn.

Thorwald S. Paulson, '22, is working for the government on the Wilson Dam project as junior engineer. The dam is practically completed and has ten feet of water running over the spillways. Mr. Paulson has filed his application for work with the U. S. Coast and Geodetic Survey upon completion of the Wilson Dam project.

Carl I. Aslaksen is with the U. S. Coast and Geodetic Survey engaged in hydrography and topography. He spent last winter in the Florida Everglades and at present is executive officer on board the S. S. Bache.

Mike Mitchell, '23, is with the C. F. Lytle Contracting Co. at Bradenton, Florida, working on a 3,600 foot bridge. The bridge is of reinforced concrete and crosses the Manatee River. It is 35 feet high with 116 spans. He has been at Tulsa working on sewage disposal plants, and in company with a friend, he drove to Brandenton in a Ford.

A. C. Zimmerman, '22, has been on triangulation, sounding, and topography in Alaska during the past year. He visited school last week and expects to remain at Minnesota for some time.

Martin Nelson is at Camp 63 with the California Edison company on their Big Creek development. Nelson has been making computations on a multiple arch dam. The outside of the arch is cylindrical with five centers. The inner surface takes the shape of an inverted cone of five axis. The work has been arranged so that all forms can be set with a transit. Mr. Nelson writes that he is getting one grand view of all his undergraduate mathematics.

CHEMISTS

E. T. Fegan, '15, is chief chemist for the Fleischmann Yeast Co., Columbus, Ohio.

I. O. Juvrud, '14, is chief chemist for Balfour, Guthrie and Co., 722 East 74th St. No., Portland, Oregon.

M. W. Seymour, '21 doing research work in the chemical laboratory of the Eastman Kodak Co., Rochester, N. Y. His address is 19 Knickerbocker Ave., Rochester, N. Y.

Victor Yngve, '13, is director of research for the Manhattan Electrical Supply Co., 116 Appleton St., Cambridge, Mass.

ELECTRICALS

Leonard Aarstad, '24, has been in the northern part of Minnesota for the last six months on telephone line construction. He is now in Minneapolis working out of the local office.

V. H. Carlson, '20, is down in the land where long names are prevalent. He is with the Chile Exploration Co. as a junior electrical engineer. Mail addressed care of Chile Exploration Co., Tocopilla, Chile, S. A. via Antofogasta, should reach him.

C. P. Carlson, '21, is with the Chili Exploration Co. in South America, and Basil Mayne is down there also.

Barry Dibble, '03, has had a brilliant career as an electrical engineer. He was on the U. S. Bureau of Reclamation and former project manager in charge of the Minidoka Project and American Falls development, Idaho, and has recently resigned to enter private practice in Southern California. His greatest work was on the American Falls project where he worked out a number of the most difficult problems, physical and human, upon which the success of the project depended. The above data appeared in the "Engineering News Record" for November 20, 1924.

L. M. Frazee, '24, is taking the Students' Training Course of the General Electric Co., at Schenectady, N. Y.

Vincent H. Irwin, '13, is in sunny Tennessee as superintendent of Steam Generation for the Electric Power Co., Guild, Tenn.

L. W. Johnson, '24, is with the G. E. Co., taking the Students' Training Course, at Schenectady, N. Y.

Gerhard L. Oscarson, '22, is service and sales engineer for the Electric Machinery Mfg. Co. of Minneapolis.

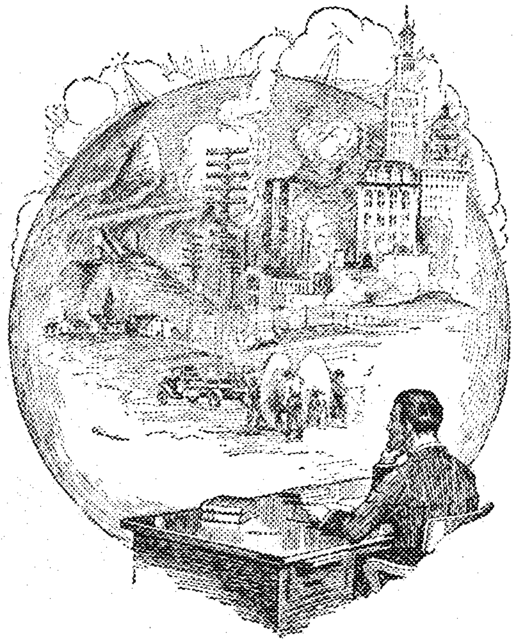
O. B. Poore, '09, is research engineer at Federal Dam, Cass County, Minn.

D. C. Swift, '24, is a cadet engineer with the St. Paul Gas Light Co. His address is 6th and Cedar Sts., St. Paul, Minn.

Waiting until disputes with Chinese bandits could be settled, so that he could go into the interior of China to take the place of another missionary murdered by the bandits, Rev. William D. Stinson turned sawmill operator in a little Chinese town and was killed Thanksgiving day, 1924, in a mill accident. Mr. Stinson was a graduate of the electrical engineering college of the University of Minnesota, and was at one time works manager for the North Star Woolen Mills. He had spent the last six years in China, using his engineering and his theological training.

R. H. Tunell, '24, is with the Western Electric at 463 W. St., New York City.

(*Continued on page 26*)



(Continued from page 24)

Theodore Vita, '09, is connected with the department of public service of Los Angeles, Cal. He is located at Independence, California.

Adolph W. Wagner, '98, is a member of the firm of the H. T. Electric Co., 612-614 W. Capitol Ave., Indianapolis, Ind.

L. W. Wilcox, '13, is superintendent of Elect. Dist. for the St. Paul Gas Light Co., St. Paul, Minn.

Benjamin S. Willis, '17, has resigned his position with the Bureau of Standards at Washington, D. C., to accept an instructorship in electrical engineering at Iowa State College, Ames, Ia.

Geo. Wolffe, '24, now with the Public Utility Co. of Denver, Colorado, came in during the holidays. He is taking the student course with the company and says that to date he has been working with gas production alone. He has hopes, however, of getting some work on the electrical end before all the ice melts off the transmission lines through the mountains.

MECHANICALS

H. N. Anderson, '20, is sales engineer for the Worthington Pump and Machinery corporation. His address is 1757 Capitol Ave., St. Paul, Minn.

G. C. Andrews, '87, is manager and president of the Andrews Heating Co., 2629 University Ave. S. E., Minneapolis, Minn.

R. P. Blake, '97, is Division Master Mechanic for the Montana division of the Northern Pacific R. R. His address is Park Hotel, Livingston, Mont.

H. C. Estep, '08, is European manager for the Penton Publishing Co., 2-3 Caxton House, Westminster, London, S. W., 1 England.

A. W. Kumm, '22, is an instructor in mechanical engineering at Rice Institute, Houston, Texas.

ENGLISH

(Continued from page 15)

derful help in improving his vocabulary. Anyone who has read his fascinating AUTOBIOGRAPHY cannot deny that he succeeded in mastering a clear, forceful style that is exceedingly interesting to read.

Abraham Lincoln taught himself to speak and write good English. The Bible, which he read in early childhood, left its impress on his clear, simple style. Lincoln realized the power of simple expressions. His wonderful address at Gettysburg will always remain as a living monument to his ability as an orator.

One of the best and simplest methods of mastering English is to read good books. Through a few hours a week spent in delightful moments with books, the reader soon will discover that his speech has improved. The best plan is to read at least fifteen minutes just before going to bed. Reading aloud is most beneficial. Poetry is best appreciated when read aloud. It is the only way to get the music and beauty of verse. The best English literature is poetry.

It is well to follow Francis Bacon's admonition, "Read not to contradict and confute; nor to believe and take for granted; nor to find talk and discourse; but to weigh and consider." The pleasure of reading is doubled when one stops to "weigh and consider." The reader then feels himself to be more a part of the book. The author then speaks directly to the peruser of his pages.

The art of reading is quickly mastered. To be able to learn English through the pleasant diversion of reading seems almost a paradox, yet it is an accomplished fact. Many of America's most successful men learned to speak their native tongue correctly by this method. Almost without exception, these men appreciate and love good literature.

Perhaps a few suggestions about the proper books to read would not be amiss. Shakespeare and the Bible should be the right hand companions of every reader. One should learn to love Shakespeare. He is not at all a "high-brow" as commonly supposed, but a playwright of the people. The Bible should be read as a masterpiece of literature, at least.

Henry Fielding's *History of Tom Jones* is as delightful a tale as any modern novel. Benvenuto Cellini's Autobiography is far more entertaining than fiction. Tolstoy's *Anna Karenina* and Dostoevsky's *Crime and Punishment* are tales of Russian life. Balzac and Victor Hugo are always interesting.

A volume of English poetry will furnish many hours of pleasant diversion. Dickens is splendid if you can live down your early childhood ideas about him. For more mature reading, Homer's *Iliad and Odessey* and Dante's *Divine Comedy* are insurpassable. The Greek dramas are excellent, and they are capital entertainment, too. But one could go on indefinitely naming worth while books.

Reading, then, is one of the best methods of mastering good English. A knowledge of English is essential to true success in the present day. The engineer must become more familiar with English if he is to take his place in the world of affairs that he otherwise deserves. "Reading maketh full man; conference a ready man; and writing an exact man."

Walter S. Olson, senior miner, was recently initiated into Tau Beta Pi. Mr. Olson was second high man in the senior class. He is specializing in geology, and is a member of Sigma Rho, professional mining fraternity.

Progress is being made in the undergraduate thesis contest as sponsored by the A. I. E. E. It is hoped that it will be sanctioned by the Great Lakes branch of the Institute and thus become national in character. Similar work is being done also at the University of Wisconsin.

SENIOR CIVILS BANQUET

By Harold C. E. Peterson

"I'VE been to banquets without number; to parties of every variety; but never in all my life have I been to a party where I enjoyed myself as much; to a banquet where I laughed so continuously; or to any sort of an affair where I had such a 'gol-durned' good time as at the Senior-Civil party last night. Why, when John Banovetz gave that imitation of A. S. C., I laughed—ha! ha! ha! until—ha! ha! I—ha! ha! ha! ——— etc., etc., etc." Such were Professor Zelner's opening words to Professor Parcel in discussing with him the laugh-fest the Summer Camp gang gave in the Engineering Auditorium Friday, February the 13th. And the concensus of opinion of all who attended—and it was practically 100% of the class—only two being absent, for they were sick in bed—is that Professor Zelner's words are not half adequate in expressing what they think of it. For it was *Some Party!!*

It started with a BANG!—by the cook—on a saw—just as at summer camp. And just as at summer camp, Moore edged out Thompson by a nose in the mad rush to line up—the rest of the bunch being from six to ten yards in the rear—that is, the rest with the exception of Beese, who came trailing in half dressed just as Professor Cutler finished calling the roll. As usual, he had over-slept.

Most everyone was in summer camp regalia—boots, breeches, and leather vests predominating, so they were all set for the stampede for seats when Mr. Cutler gave the word.

The food was served a-la-camp; that is, pass it around, help yourself, and eat as much as you can. And so that those who ate could tell what they were eating, Johnnie Ward had designed blue-print menus—exact replicas of a surveyor's note book, with a picture of a table, and a map of Cass Lake superimposed upon it—and with a typical daily summer camp program in place of the surveyor's notes. So the hungry mob was fed.

And then Eddie Fulton spread his stuff—and in so doing set a new mark for future toastmasters to shoot at. His witticisms, aimed at instructors and students alike, never missed their marks and were so phrased and spoken that no one enjoyed them more hugely than the person most concerned. And his introductions—so worded that no one was in doubt as to who was to be the next speaker or entertainer—left the listeners in just the exact mood most suited to the entertainment to follow.

The entertainment left nothing to be desired. Never dragging, never monotonous, always full of pep, ever surprising, it showed the effects of the large amount of thought and work expended by the entertainment committee upon it. There were short and snappy speeches—none of which were more full of surprises than that of Professor Cutler, wherein he showed that there were not so many things going on at summer camp that he didn't know about, as most of the fellows thought—and hoped there were. There were songs, and parodies on songs popular in camp life, interspersed among little pantomimes reminiscent of life in camp, take-offs on the instructors and on the examinations given by certain instructors, and as a grand finale a condition exam was given, in which practically every person present was asked a question, pertinent to some phase or happening in camp life, to be answered as best he could. Judges were appointed to judge who had passed, and while awaiting their verdict, slides showing pictures taken during camp were shown.

Coffee and doughnuts were served, and the best banquet of all passed into history—setting another record for the following Civil classes to aim at. "Some of them may surpass our 'totem pole,' for trees do grow higher, but it is doubtful if they can ever equal our banquet," was one of the remarks heard as the crowd was leaving. However, time alone will tell, and Professor Cutler and Zelner, and Mr. Boon will be the only judges.

Sounds Hopeful

Grad—"This university certainly takes an interest in a fellow, doesn't it?"

Tad—"How's that?"

Grad—"Well, I read in the graduate magazine that they will be very glad to hear of the death of any of their alumni."

Next!

A man named Barber married a girl by the name of Shears. They now have a little shaver by the name of Bob who is so dull that the teacher has to strop him, which puts the father on edge and he has to be restrained from giving the teacher a trimming.—*Gillette.*

Chemical Research at Minnesota

From the Chemical Bulletin

GOITER AS IODINE DEFICIENCY

J. F. McClendon and
J. C. Hathaway

The human body in health may contain 20 mgs. of iodine, half of it being in the thyroid gland. By determining the intake and outgo we found that a healthy young man took 0.02 mgs. per day in his food, and excreted less than 0.01, showing a retention of 0.012 mgs. per day. At this rate it would require him about five years to accumulate his store of iodine.

Various waters and food products were analyzed for iodine by McClendon's method [Journal of Biological Chemistry, LX, 289, (1924)]. White flour contains the least amount and the leafy vegetables and some whole fruits and especially butter-fat, the greatest amount.

Drinking waters fall into several classes which may be considered from a chemical standpoint as, (1) rain water with a very small amount of additional substances; (2) waters that have become highly mineralized due to the leaching of salt deposits, and (3) waters mineralized by products from organisms.

Notwithstanding the difficulty of comparing waters of these different classes, the country is in general divided into two regions: the North half of the United States with the exception of a narrow border on the sea coasts and the region of marine deposits centering in Kansas, is very low in iodine and high in goiter, whereas the rest of the United States is high in iodine and low in goiter. The dividing line is at about one part of iodin to a billion parts of water, but the extremes are quite different, some of the waters in the southern region having 20,000 times as much iodin as the water in Lake Superior.

CHEMISTRY IN GEOLOGY

F. F. Grout

The attempt is being made to discover the controlling factors at work during the formation of the various minerals. Indirect evidence is obtained by studying the relation of composition to size of grain in clay, and to the index of refraction in biotile and in natural glass. The composition of certain Minnesota granites and of feldspars is being determined. Other lines of investigation are the action of organism in precipitating manganese in nature, the natural solvents and precipitants for phosphate rock, the oxidation of magnetite to hematite at moderate temperatures, and the effect of weathering on the composition of spodumene.

SILICA GELS

L. H. Reyerson

Silica gel, in addition to being a catalyst in itself, is also an excellent vehicle for carrying metallic catalists. This field is being carefully explored, using various metals, under various conditions, and with various reaction mixtures.

RADIOACTIVITY

L. M. Henderson

Studies in the radioactive elements are being confined largely to the measurement of the average length of life of mesothorium.

TECHNOLOGICAL CHEMISTRY

E. P. Harding

The various factors involved in the distillation of oil shales, and the products which result from the various conditions of distillation, are the main subjects of investigation at the present time.

CULVERT CLAIMS

(*Continued from page 14*)

Before closing, the writer should introduce himself. Since May, 1924, he has been a member of the staff of the Structural Materials Research Laboratory, Lewis Institute, Chicago. This Laboratory is maintained by the Portland Cement Association for the investigation of Concrete and Concrete Materials. Previous to May, 1924, the writer has been actively engaged for 19 years in engineering work involving concrete construction in all its phases with The United States Shipping Board, The U. S. Reclamation Service, the University of Minnesota, The Turner Construction Co., The New York Central Railway and as a Consulting engineer.

Very truly yours,
—F. R. McMillan, C. E. '05.

The Anger-Maker

A doctor says that anger is caused by a tiny organ the size of a pin-point. Something of that size carefully placed on a chair will do it every time.

ELECTRICAL UNITS

(*Continued from page 12*)

little is known concerning the nature of these two medium properties. That they are not merely abstract ratios, however, is evident, for if they were they would disappear from the dimensional expressions and this would lead to various absurdities. Quantities in different systems would then be unexplainably different dimensionally, and magnetic pole strength and electric charge would be identical dimensionally.

These units derived from such arbitrary sizes of fundamental units do not prove to be convenient for practical use. Some are far too large and others are far too small. To suit the demands of everyday use, a system of practical units has been developed. These are merely multiples of the absolute units.

THE LARGEST GENERATOR

The largest steam electric generator in the world was recently put into commission in Brooklyn, N. Y. The generator was built at a cost of $1,000,000, and will generate 50,000 kilowatts, the equivalent of 67,000 horsepower. Within 24 hours of its complete installation, it was producing at full capacity.

—*Popular Science Monthly.*

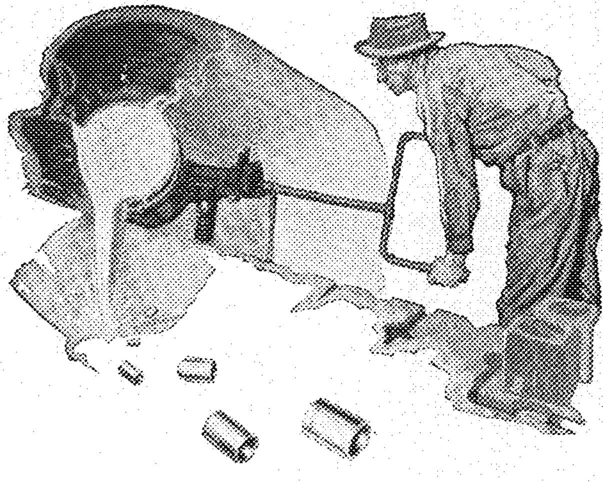
IOWA'S MECCA WEEK PARADE

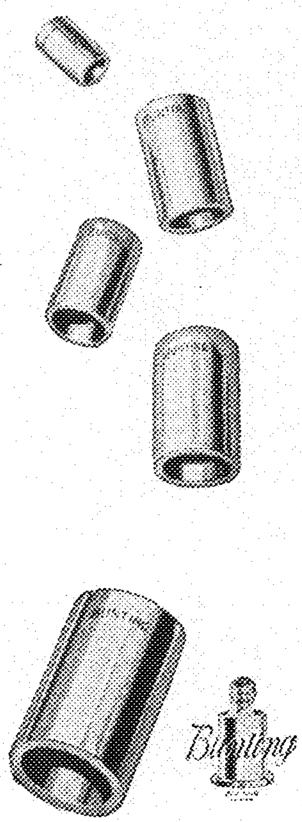
(Saturday, March 14, 1925)

(*Line of march follows the main city streets*)

Gus Miller .... Grand Marshall
Mrs. St. Patrick.......... Guest of Honor
The No-dor Sedan
Crowning King Molar
Wright's First Aeroplane.......... (Float)
The Death Ray.......... (Co-eds)
Whetstone's Cowherds .... (Barge)
The L. A. Dumbells
Christopher Columbus, M. D.
W. S. U. I. on the air
The Gold Brick Machine.......... (Float)
Side-Car Speed Wagon
The Rudderless Wheel-Barrow
Engineer's Abroad
Electrical Synchronizer
Adiabatic Brakeing
Dingbat's Cat
The Journalism Hellbox
Custer's Last Stand .... (Glee Clubs)

—*The Transit.*





THE foundry operation is of first importance in the making of bronze bushing bearings. The bushing gets its quality and character from the scientific accuracy with which the different metals are combined by the metallurgist, and the skill with which they are blended and cast in the foundry.

The engineer who devises a particular design or alloy for some unusual application has learned that he can depend upon this organization to achieve the exact results that his specifications contemplate.

We will gladly give students any special or technical information about our operation.

THE BUNTING BRASS
& BRONZE COMPANY
TOLEDO · OHIO

BUNTING
BUSHING BEARINGS

Resists Corrosion

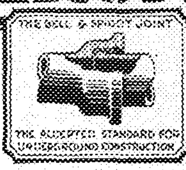
THIS picture, taken in the salt marshes near Kearny, N. J., shows two lines of 30-inch Cast Iron Pipe replacing pipe made of other material. The alternate exposure to the action of salt water and air is a severe test.

While the pipe shown in the picture is subjected to unusual corrosive influences, all underground pipe must be able to withstand corrosion to a greater or less degree. Cast Iron Pipe has this quality. It does not depend on its coating to resist rust; the material itself is rust-resisting. The first Cast Iron Pipe ever laid is in service today at Versailles, France, after two hundred and sixty years' service.

THE CAST IRON PIPE PUBLICITY BUREAU
Peoples Gas Bldg., Chicago

CAST IRON PIPE

Our new booklet, "Planning a Waterworks System," which covers the problem of water for the small town, will be sent on request



Send for booklet, "Cast Iron Pipe for Industrial Service," showing interesting installations to meet special problems

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%.

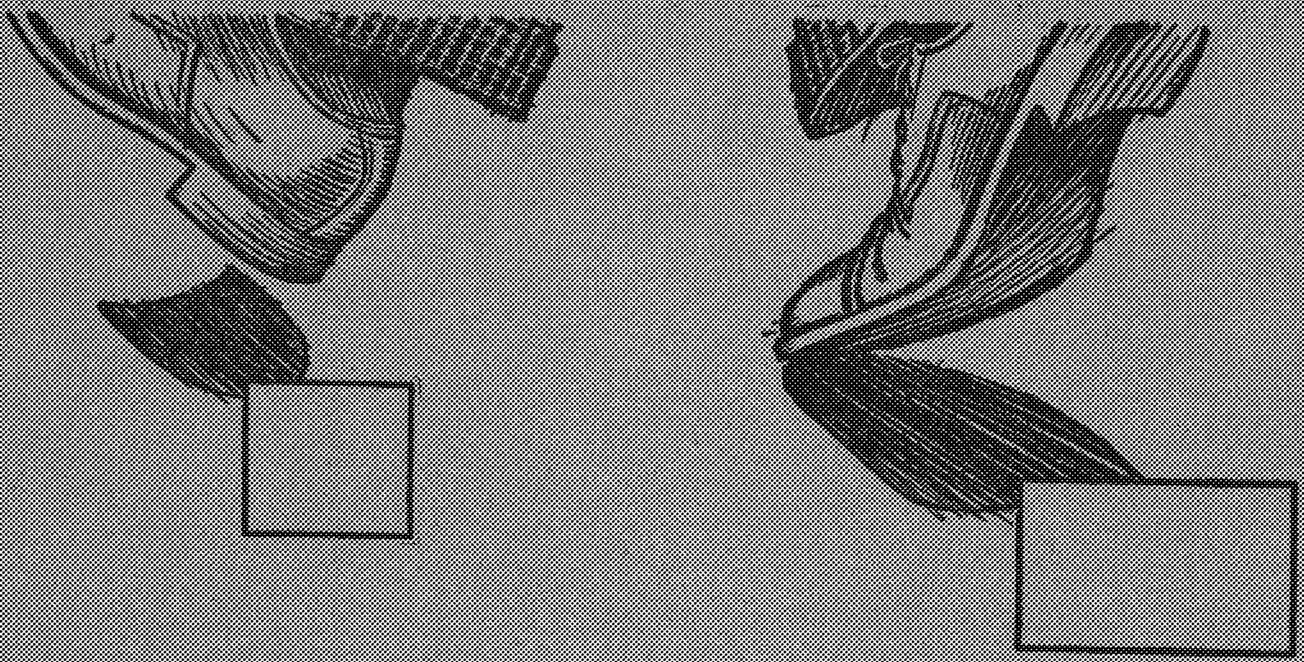
An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 67.5%.

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.
No. 4.



Footprints

Put a print of your sole alongside a print of your heel. Then you see part of the reason why soles wear longer than heels—why you must have your heels rebuilt twice or oftener, to every new pair of soles.

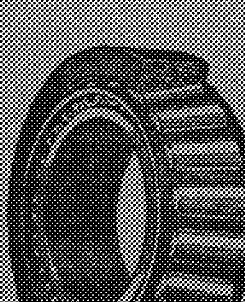
"Load area" is the technical explanation. Your heels have only about one-third the area of your soles. Your shuffles and weight are distributed over one-third less space. Hence the more rapid wear.

All this leads to Timken Bearings. The rectangle beside the sole print above shows the relative "load area" of a roller bearing as contrasted with bearings of other types (see square by heel print).

Put a bearing at the pinion gear of an automobile, or in the differential. Here the slightest effect of wear is to put the gears out of alignment—with deadly results.

But because of larger load area, wear in a Timken Bearing is so slow as to be unnoticeable during the life of the average car. And even if it should occur, a turn of a nut counteracts its effects. After thousands of miles, a Timken Bearing can be readily adjusted so that it's as good as new again. In which important characteristic, Timken Bearings are unlike *either* soles or heels!

THE TIMKEN ROLLER BEARING COMPANY
CANTON, OHIO
Columbus, Ohio—Walkerville, Ont.—Birmingham, England—Paris, France



TIMKEN
Tapered
ROLLER BEARINGS

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

MARCH
1 9 2 5

Volume V 25 CENTS A COPY Number 6

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES

Which Leg Gets the Weight?

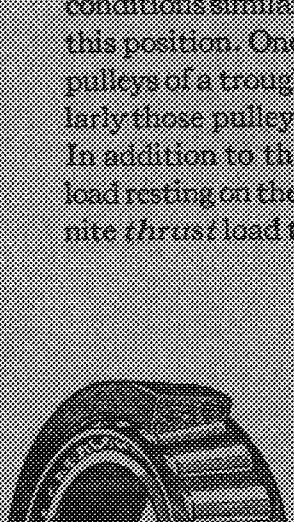
In time, Nature would answer this question. Make a habit of standing in this posture, and your right hip would become larger, due to the added muscular development.

There are conditions in industry when wheels and pulleys must operate under conditions similar to those of the body in this position. One example is found in the pulleys of a troughing conveyer—particularly those pulleys which run at an angle. In addition to the straight up and down load resting on the bearings, there is a definite *thrust* load that also must be carried.

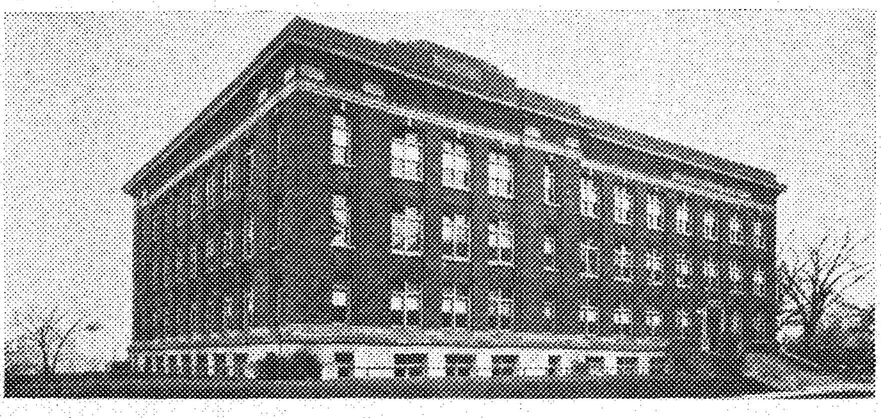
Timken Bearings differ from human legs in this situation by being *already developed* to carry continuously such loads. They are designed for intermittent thrust loads and for permanent thrust loads. The Timken tapered principle is the explanation.

From whatever angle the load comes—whether straight up and down, or from a side—it is evenly distributed over the entire length of the rollers. Hence the long wear. Hence, too, the wide use of Timken Bearings in every field of industry.

The Timken Roller Bearing Company
CANTON, OHIO



TIMKEN
Tapered
ROLLER BEARINGS



HOME OF MINNESOTA'S SCHOOL OF MINES

The MINNESOTA TECHNO-LOG

37 Electrical Building

UNIVERSITY OF MINNESOTA

HERMAN F. BESELER AND KENEFICK ROBERTSON, *Managing Editors*
RICHARD W. JONES, *Business Manager*

VOLUME 5 NUMBER 6

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.

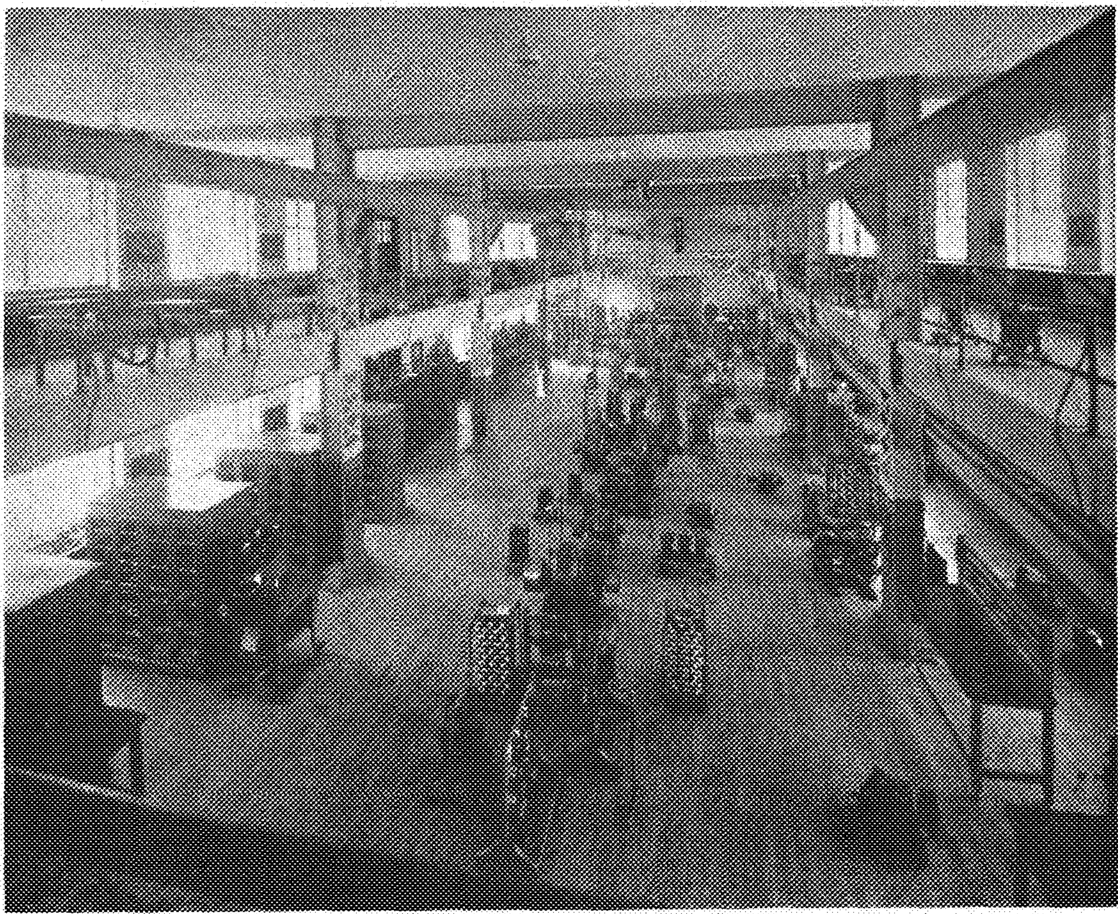


Fig. 3. View of Main Laboratory Looking East From Visitor's Balcony.

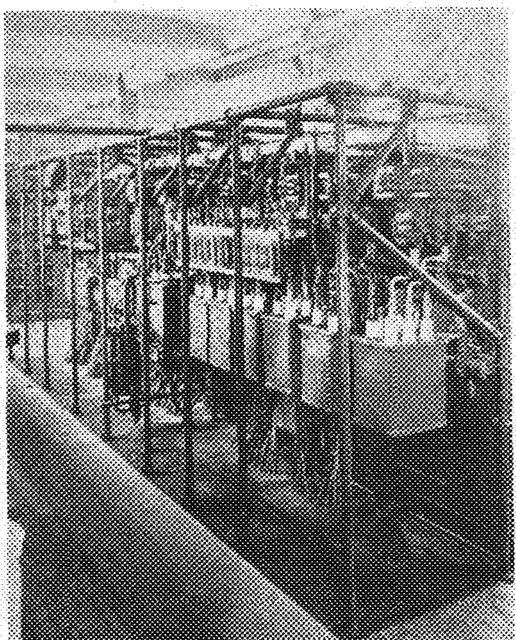


Fig. 7. Rear View of Main Switchboard.

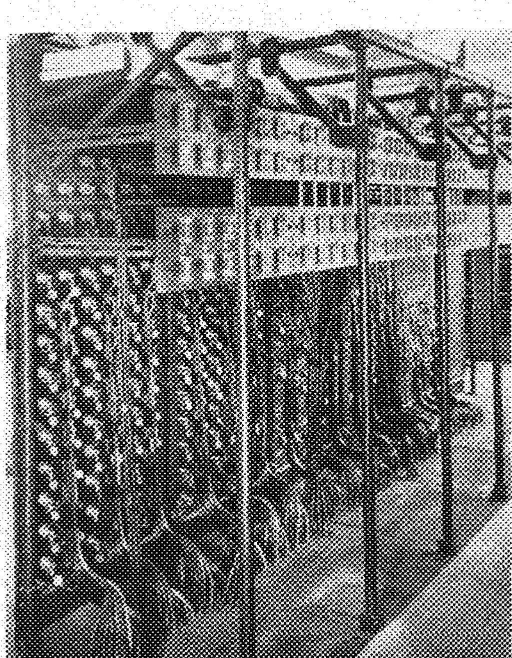


Fig. 9. Rear View of Plug Board.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V | MARCH, 1925 | Number 6

FUNCTION AND SERVICE OF NEW UNIT

By Franklin W. Springer

College of Engineering and Architecture

THE New Electrical Engineering Building is completed. It has been in regular use during the past two quarters and has been "run in" so that the building and service equipment are now ready for full speed and power. Much remains to be done in setting up and putting into service special equipment for special courses and research work, lecture room equipment, museums and exhibits, but this sort of thing is never finished so that such problems may be regarded as part of the regular educational program and to a certain extent, used as pedogogical material. A curious part of the whole problem of putting this building into action is that the members of the electrical faculty, having been trained for years to get along without adequate space, lighting, temperature regulation, lecture demonstration arrangements and many other laboratory, office and classroom conveniences, must now train themselves to make use of the new opportunities in order to increase the educational output.

A previous article, *"Functional Plans of the New Unit,"* appearing in the MINNESOTA TECHNO-LOG, March, 1924, gave the functional plans and some of the structural details. This article is intended to supplement the other by the use of recent photographs, which should be "worth ten thousand words" to the old grads who have not as yet seen the new building. As is usual in the case of new buildings many complimentary things have been said by alumni and others and, to some extent, at least, this approval appears to be justified by the past six months use of the building. The comment of one alumnus, Mr. James J. Garvey of the Western Electric Company, after he had thoroughly studied the building in action, should be especially pleasing to all interested. The following paragraphs are quoted from a letter which Mr. Garvey wrote to the MINNESOTA TECHNO-LOG.

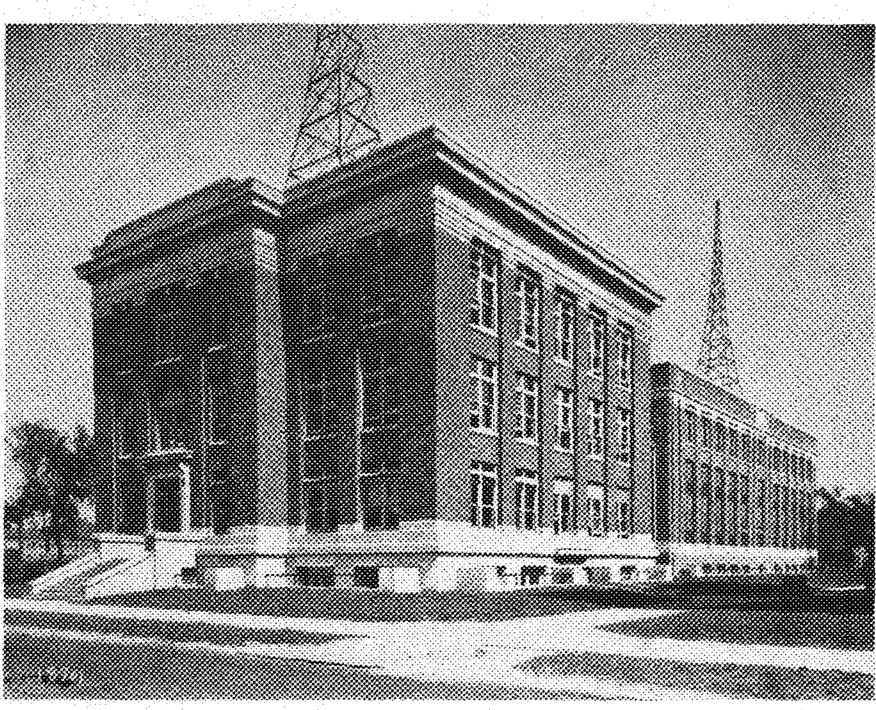


Fig. 1. The Completed Electrical Building.

"For several years my work in one of the largest manufacturing organizations of the country has kept me in intimate touch with all of the larger and more progressive universities and colleges of the Middle Western and Southwestern districts of the country. Imagine my feelings, therefore, when I recently came back to the University and as an old football fan I became elated when I saw the new stadium! As a thorough believer in the undergraduate life of the University I got a feeling of snug satisfaction in noting the many recent improvements around the Campus. The railroad cut has disappeared and the Administration building is rapidly nearing completion. The new Library is in full operation and the quadrangle dreamed of for so many years is gradually taking form."

"What caused me to literally swell with pride was the new Electrical Engineering Building, which has recently been completed, and which seems to me to be as nearly perfect for the purpose for which it was designed as anything that exists at any university. The building, I believe, and remember I am basing my opinion on the observation I have made in years of contact with all of the better known universities of the Middle West, is not surpassed by any of the Middle Western technical colleges of today."

"Too often I have found that an engineering laboratory was more or less an animated junk heap; collections of disorganized departments, poor equipment and arrangements that the management of any modern and efficient manufacturing organization would not tolerate for a moment. The oldtimers who are coming back these days are delighted that Minnesota has passed through this stage and has reasons to be proud of its present setup. I believe the "old bunch" that used to make the anvil ring in the forge shop of the old engineering building that is used as the

University Post Office today, and at that time contained all of the shops, drafting rooms, engineering laboratories, and some of the lecture rooms of the department, will feel as proud as I did at my recent visit."

"The general appearance and arrangement of equipment at any engineering college is one that always impresses the casual visitor from the industries with either its efficiency, or lack of efficiency, as the case may be. It is a fairly accurate guage of the quality of work done by the student body and one that is given very careful consideration by industries when they are in the field for technical graduates."

"After a thorough inspection of the arrangements of its lecture room and laboratories, its possibilities for expansion to meet the needs of the department in its future growth, I feel that I must express my personal appreciation to the faculty and to all others who have been instrumental in bringing about such a decided improvement—and I am certain that the undergraduate students who now have this enlarged opportunity have a feeling of pride and gratitude even greater than mine."

For the benefit of those who may wish to critically study the accompanying illustrations, it is suggested that they keep in mind some of the dominating objects embodied in the design.

No. 1. *No interferences* as between laboratory and classroom or laboratory and laboratory. Each part of the building to be used at any time without interference from any other as by noise, vibration, movement of students or equipment, voltage fluctuations, power service interruption due to shorts and overloads in any division, by stray currents, or by static or magnetic effects.

2. *Flexibility.* As far as possible, any test to be made anywhere in the building to care for expansion or contraction of the various lines of work. This involves a very complete system of laboratory power service and interconnections, proper means of transporting equipment and a sane and easily understood system of "homing" equipment and provision such that wires and pipes may be run concealed anywhere any time and at nominal expense. Equipment records to be always available to faculty and researchers.

3. *Laboratory service* available with minimum red tape and effort. Just as far as possible nothing should stand between an instructor, or a student, and his work or the equipment needed for his work.

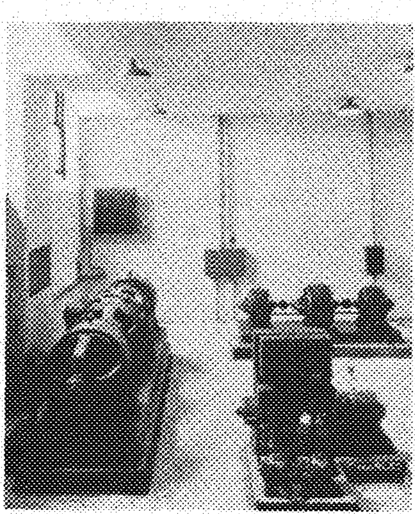


Fig. 5. Generating Room; Note Suspended Ceiling.

ILLUSTRATIONS

Referring to Fig. 1, showing the head-house, the south side of the laboratory wing and the connecting link, the departmental offices are at the immediate right of the front entrance on the main floor, classrooms and museum on the second floor and the main lecture room is on the third floor.

Fig. 2 illustrates the general layout of all floors. The dimensions are: overall length 275 ft., main laboratory wing 155x60 ft. wide, connecting ling 51 ft. long by 40 ft. wide and the head house 69x70 ft. The basement halls are 12 ft. wide to provide for space for student double-deck lockers. The distribution point for students is the cross hall and stairway in the head-house. The basement rooms are built for present or future complete laboratory service. The basement rooms in the north side of the laboratory wing are devoted to shops, stock, shipping and receiving and power service. It will be seen from this floor and from other illustrations that the elevator is located at approximately the center of gravity of laboratory service.

The communication laboratories occupy the entire third floor of the laboratory wing and have a similar arrangement as to cross hall and main hall and relation to the elevator so that no noises from the shop, machine room or main floor laboratories may become objectionable.

In general the controlling features of design are:

(1) Office and classrooms in the head house with the lecture room on the third floor and the laboratories in a separate wing. This is accomplished by the "T"-shape design.

(2) The main laboratory with the center of gravity of power service and general equipment placed on the first and second floors of the laboratory wing.

(3) The shops and power service machines placed in the basement and communication laboratories are on the third floor.

MAIN LABORATORY

Fig. 3 was taken from the visitors gallery on the second floor looking toward the rear of the main laboratory. The gallery at the left contains the dynamo museum. At the right is the computing space, laboratory library and working exhibits. Ample floor space remains on the galleries for testing near the wall benches and wall panels.

On the main floor the Main Switchboard and Plug Board are placed at the right and left of the passage way to the elevator on the north side, with instrument cases occupying the remaining space. The main aisle is served by a four-ton electric crane. A three-ton hand operated crane serves the testing floor under the south gallery. It will be noticed that there is a power source panel on each pilaster and column. All of the equipment on the main floor is subject to change in location by the various laboratory classes.

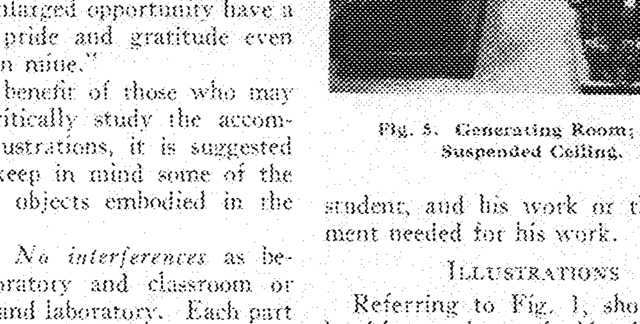


Fig. 2. Basement Floor Plan, Showing Shape of Building.

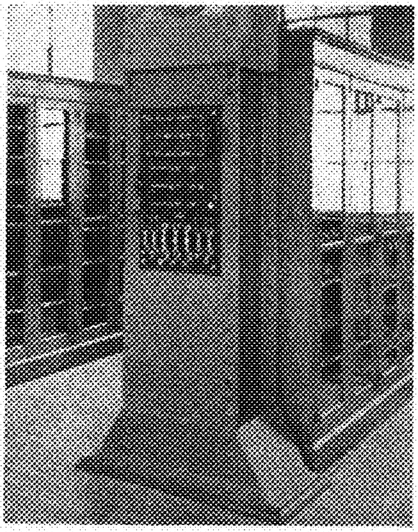


Fig. 12. Service Panel in Main Laboratory.

POWER SERVICE

The transformer vault of the Northern States Power Company is located approximately equidistant from the Main Engineering, Experimental and Electrical Engineering Buildings. The secondaries are connected as indicated in Fig 4. Lines marked 1 to 6 inclusive are fused at the vault and run in conduit in the steam tunnel to the Machine Room, shown in Fig. 5, and thence to the left hand panel (No. 1) of the Main Switchboard Fig. 6. Lines 1-3-5, 230 volts, three phase, are of two 300,-000 CM cables, and lines 2-4-6, 115 volts, 3 phase, are each 4/0 cable. Three-wire AC is obtained from lines 1-2-3. No. 2 line is permanently grounded at the vault and on the steam and water pipes and on one of the steel columns at the main switchboard.

The direct current power service is supplied by lines 7-2'-8 from the 150 horse motor generator set shown at the left of Fig 5. The two 115-volt, 50 KW generators of this set are flat compounded at the main switchboard so that throwing loads off and on by one direct curent user may not affect the voltage received by another. The synchronous motor driving this set is remote controlled from panel No. 4 of Figure 6. It is to be noted that the neutral 2' may be grounded at the switchboard as desired, otherwise lines 2 and 2' are entirely separate to avoid direct current returning through the a-c system or vice versa.

The storage battery, formerly used in the University Lighting Plant, is placed in the basement shown in Fig. 2. The storage battery lines 7' — 2" — 8' may be combined with the generators or be used separately.

The booster, used for charging the storage battery, is shown in the background of Fig. 5. The motor shown has been replaced by a three-phase induction motor and field switches arranged so that the boosters may be operated as self as well as separately excited. This gives another independent source of 110- or 220 volts d-c three-wire service when not in use for charging purposes.

All the above machines are remote controlled from the main switchboard and, being placed on an independent floor slab on the sub-basement floor level, do not in any way disturb tests in any laboratory.

The small unit at the right foreground is remote controlled from the communication laboratory. It supplies high tension direct current for radio work.

Space is provided in the machine room for additional special service machines.

MAIN SWITCHBOARD

Figures 6 and 7 show the front and back views of the Main Switchboard. Briefly, the panels, numbered 1 to 8 left to right are: No. 1, power lines with circuit breakers in lines (2)-4-6 and 1-3-5 and the power company meters; No. 2, circuit breakers in lines 1-3-5 and (2)-4-6 supplying the Plug Board; No. 3, circuit breakers in lines 1-3-5 and (2)-4-6 of the "Tree System" supplying the wall panels; No. 4, 150 horse power synchronous motor control; No. 5, circuit breakers in generator lines 7 and 8 and controls for generator No. 1 and No. 2; No. 6, circuit breakers

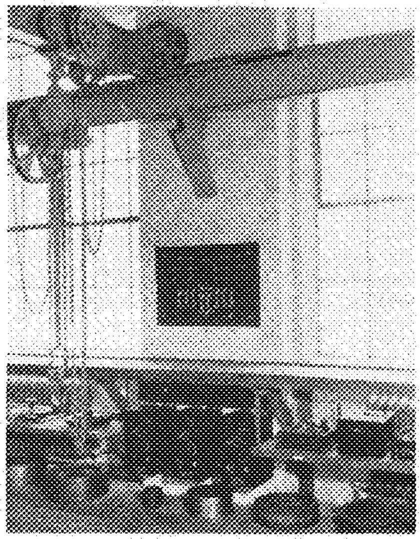


Fig. 10. Service Features for Juniors.

in lines 7 and 8 for the Plug Board service and for the "Tree System" panel service; No. 7 and No. 8 are battery panels for the negative and positive groups of 72 cells each.

PLUG BOARD, ETC.

Figures 8 and 9 illustrate the front and back views of the Plug Board. The automatic electric elevator, with noice reducing doors and safety gates, shown in Fig. 8, is provided with "up" and "down" starting buttons

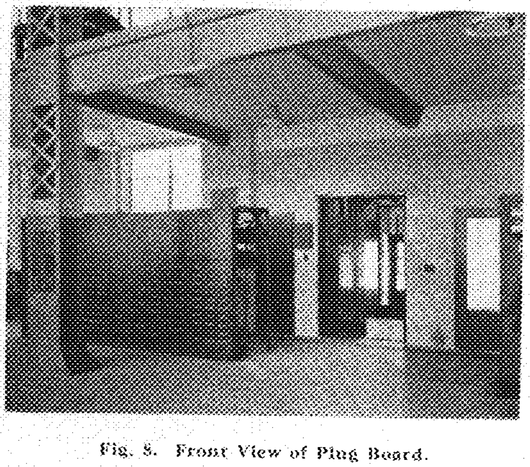


Fig. 8. Front View of Plug Board.

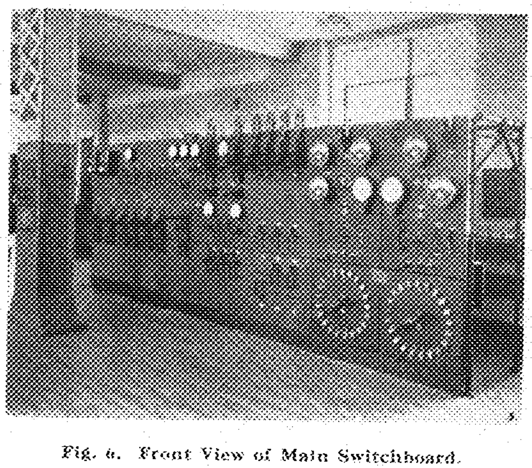


Fig. 6. Front View of Main Switchboard.

so that the elevator may be moved from a small fraction of an inch to the full trip distance. This service enables the elevator floor to be easily justified with the floor levels, a necessity in handling castor fitted equipment. The loading platform is seen at the rear of the elevator at a few feet lower level. The elevator stairway service door is seen at the right.

Immediately back of the right hand end of the Plug Board is seen the key box containing the case keys of all instrument cases shown in Fig. 3, also the door to one of the seven wire shafts.

The top panels of the Plug Board carry duplicated power service lines 1 to 6 inclusive a-c, 7-2'-8 d-c 7'-2"-8' battery, booster generator lines and individual end-cell lines from the storage battery. Special power sources may be added as needed. All of these multiple-power sources are fused to 60 amperes for the No. 4 plug lines on the lower panels. The fuses are shown in Fig. 9.

The plug lines are labeled the same on distant panels as on the plug board with black fibre discs, having white numbers and letters, each bearing the number of the room, panel and circuit on the panel.

When the demand increases sufficiently the left hand panel will likely be equipped with No. 8 wire plug lines and 2 and 3- point polarity type utility plugs for signals between stations, field control use, and similar needs.

Wall Panels

The wall panel construction shown in Fig. 10 is the standard form used in all laboratories, classrooms and lecture room. The only variations to this is the photometer room small plug panels and the size and arrangement of switches in the communication laboratories. These wall panels are 18' by 24", -28" or 30" long of ½" asbestos wood mounted in steel frames and each held by four thumb nuts. Two 60-ampere, 3-pole double-throw switches with special handles are used, the left hand switch being for 115 and 230-volt, 3-phase and the other for 3-wire, 115-230 a-c and d-c. The lower middle switch is a plug circuit line. Other plug lines may be added as needed.

Just back of the panel is a panel wire-shaft or chimney, several inches deep, which extends from top to bottom of the building and opens to all of the steel plate covered wall trenches. Above all wall trenches are built the type of linoleum covered wall bench shown. The use of the spaced and labeled wall shelf and the wall trench for "homing" apparatus has proven to be very satisfactory as to convenience and saving of space.

Below the wall panel shown are

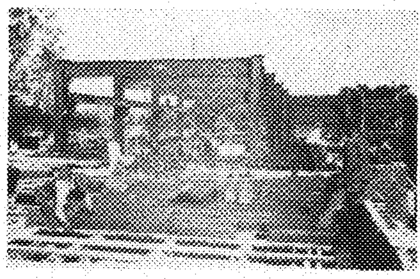


Fig. 11. Construction of Concrete Wire Conduits

three porcelain tubes for running wires to tests or water boxes placed outside the building.

In the particular case shown, the wall shelf is cut away to make place for 3 sectional circuit breakers placed in lines 1-3, 4-6, and 7-8 in order to prevent a general interruption of service from short circuits and overloads in this part of the laboratory.

Except in the main laboratory all laboratory walls are plastered. All partitions are of pryrobar throughout the building.

Wire and Pipe Conduits

The "conduit" system for laboratory wiring, including all testing circuits connected to the plug boards and main switchboard, is believed to be new in many respects, relatively inexpensive and to provide great flexibility for the changes and additions of the future. Fig. 11 illustrates a part of the method used in constructing these concrete conduits. The photograph was taken from the rear of the head-house on the second floor looking toward the crane way of the main laboratory. The workman in the right foreground is standing in the space to be occupied by a wall trench, bench and pilaster and panel such as that shown in Fig. 10. The box, placed immediately in front of the workman at the end of a line of tin pan tile, is set to core out the floor slab, but not the floor beams. This provides entrance through the bottom of the wall trench to the spaces or runs formed under the tin pan tile and to the panel shafts. There are three of these spaces used at each pilaster. Connection is made by this means between the wall trenches and the two 24"x30" raceways placed on either side of basement hallway on the ceiling. The tin pan tile spaces are also used to connect the two raceways over the basement hallway ceiling and under the main floor slab.

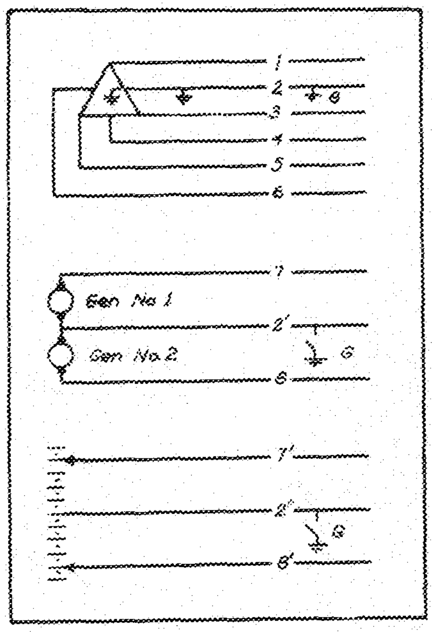


Fig. 4. Numbering System of Power Lines.

A tangle space is built under the two main switchboards by the use of a suspended ceiling in the basement. A part of this is shown in Fig 5. The north raceway connects with the switchboard tangle space. Slieves are used in beams and T-shaped boots at the bases of columns to enable runs to be made between raceways and wall trenches and up into and through column bases.

The above system of tangle spaces, raceways, slieves and boots, tin pan tile spaces, wall trenches and panel shafts or chimneys are tied at all possible points by openings to the seven wire shafts.

"Laterals"

Fig. 12 illustrates the type of panel used on the columns of the main floor. The 100-ampere switches are arranged to give 115-230 volts, three-phase and 115-230 volts d-c with two plug lines for any other service desired.

The shelf labels and shelf partitions, providing individual "homes" for instruments, of the standard type of instrument case are also shown in this figure.

Set-ups of motors and generators are made by means of the belt tightener shown in General Electric Bulletin No. 40406 of March, 1918, and as developed while in the old building. Floor plates with suitable

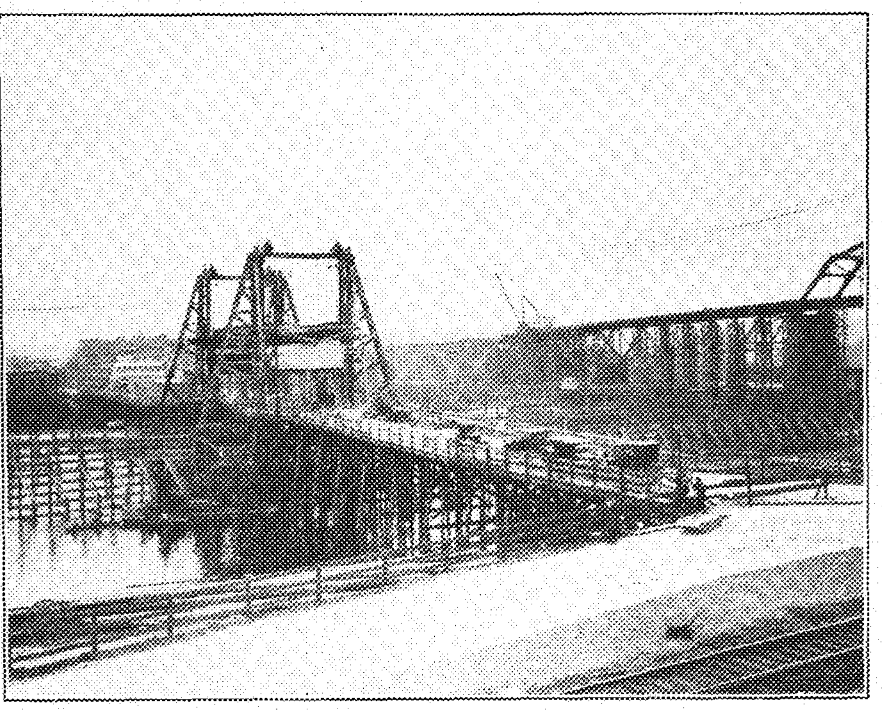
(*Continued on page 23*)

LONG TRESTLE BUILT IN RECORD TIME

By George A. Nelson

Member of the Senior Civil Class

THE closing of the old Robert Street bridge across the Mississippi at Saint Paul, necessitated the erection of a temporary structure to take its place while the old Robert Street bridge was torn down and the new one built. The Wabasha Street bridge farther up the river, to which the traffic to South and West Saint Paul would naturally be diverted, was deemed inadequate to take care of this increased burden, and in addition was too far away for convenience. The only solution was a temporary bridge or trestle. A wooden structure was decided upon, to be built from Jackson Street on the north side of the river, to Eaton Avenue on the south. This was less than 100 yards from the Robert Street bridge on the north side, and diverged from it at about a 15° angle. The heavy commercial traffic to South Saint Paul was thus taken care of with the least inconvenience possible.



Temporary Structure Erected While Old Robert Street Bridge Is Being Replaced.

The bridge is 892 feet long from center to center of end bents, and enjoys the distinction of being the longest wooden bridge across the Mississippi. There is a 90 foot through plate girder lift span placed about 200 feet from the north end. This lift span was required by the Federal government to take care of possible shipping. The dead weight of the steel span itself is about 80 tons. This, together with the flooring, required two counter weights weighing 50 tons each. These counterweights were made of 1-2-5 concrete, reinforced with a riveted steel truss. They were poured in the air. The alternative of pouring the weights on the deck of the bridge and assembling the lift span at the elevation of its maximum lift, which is 47 feet above ordinary high water, would have been the more expensive of the two. Since the construction of the bridge was carried on during the shipping and dredging season, it was necessary that the channel be kept open. The construction of the lift span in spite of this difficulty was accomplished by pouring the counterweights in the air at their maximum elevation. When these had set sufficiently to stand operation, the steel girders were swung across the span at night, attached to the counterweights and lifted to the top where the remainder of the assembling and all of the riveting was done. An interesting feature of the counterweights is a two inch pipe 12 feet long imbedded in the concrete. This is to facilitate the blowing up of the weights when the usefulness of the bridge has come to an end. This will be at the completion of the Robert Street bridge, a year or more from now. Each weight is attached to the lift by six strands of 1¼ inch cable. The span is operated by means of a steam engine, the time of lifting being 2½ minutes.

When the bridge is in the normal position, that is with the lift span down, the weights are automatically locked in place. To unlock them, the weights must be lifted until they strike a small suspended weight above them which releases the catch and allows the counterweights to go all the way down. The lift span is similarly locked in place when it reaches its maximum height by lifting another small suspended weight which operates a catch. The impact of the lift span as it is raised and lowered is taken care of by means of ordinary box car springs attached to the bumpers or supports.

With the exception of this lift span and the oak timbers which carry the steel frame, the entire span is of Washington fir. Twenty-five car loads of timber were used in the span, all of it being shipped from the Pacific coast.

During the course of construction, a sudden rise in the river of four feet, practically overnight, came very nearly causing a serious loss. The timber had been piled on the flats on the south side of the river and when morning came most of it was afloat. Booms were hurriedly swung around the floating timber and all of it saved.

The bridge is in reality a trestle: each bent is formed by five piles. The piles varied in length from 20 to 35 feet, most of them being the longer length. The bridge is 30 feet wide, comprising a 24 foot roadway and a 6 foot sidewalk. The planks forming the roadway are laid at an angle of 45° to prevent their working loose too easily. The railing is four feet high and has three horizontal planks equally spaced.

The bridge was built by Wm. Murphy and Son, general contractors of Saint Paul. Carlos W. del Plaine, engineer for this firm, is a Minnesota graduate, receiving his B. Sc. degree in '21 and C. E. '22. He is a member of Sigma Xi, and was decorated by the British with the Military Medal for engineering services in Belgium while serving the the Canadian Overseas Forces.

MANAGER OUTLINES ELECTRICAL SHOW

By Berkeley R. Lewis

Member of the Senior Electrical Class

IT has been the custom at Minnesota for the upper-classmen in Electrical Engineering to stage an Electrical Party every two years. This affair has been called a party in the past for two important reasons. It has been customary for the Juniors and Seniors to invite their personal friends, and in this way to pay social obligations incurred while at the University. This is possible in connection with a party in a manner incompatible with the idea of a show. The second and controlling factor was the fact that the old electrical building would not permit the housing of a group of activities extensive enough to be called a show.

Because of the possession of our new building, it has been decided that the party and show themes be combined this year. The dates selected are the 24th and 25th of April. The first date and the show coincide with celebration of St. Pat's, or Engineer's Day. On this day, the show will be thrown open to the University public in conjunction with the customary "open house" on the Engineering Campus. It is expected that the traditional Dansante and other afternoon activities will be held on the main laboratory floor of the Electrical building instead of in the Auditorium of the Main Engineering building. The Auditorium has not proved to be large enough in the past. On the evening of the 25th, the show will fade out of the picture and the Party will take its place. This will be for the students in Electrical Engineering and their guests, and will satisfy the traditions of the department.

There are many and various incentives for putting on such a production. The small boy's ambition to have a "show" is with us throughout life. One purpose, outside of publicity for the Electrical Engineering college, is the development of those who take part in the show's production. The educational value of actual execution and management cannot be over-emphasized. The experience gained in such occupation cannot fail to be of great help in later life. An opportunity is presented to the students for the use and exercise of any initiative, ingenuity, and inventive genius, with which they may be individually endowed, in the working out of ideas at a negligible expense in cash. It is hard to realize the magnitude of an undertaking of this sort. Many really big problems are encountered. Weeks and even months of planning and work are necessary if success is to be assured. Since the show was first founded, it has involved an enormous amount of work on the part of the students. A little objection has been raised by the faculty from time to time on account of the unavoidable detraction from class work. To avoid this as much as possible, the show has been put on as near the beginning of the spring quarter as could be arranged, and the combination with Engineer's Day has been affected to lessen the disturbance with the routine of classes. It is acknowledged poor business policy to incur expenses without visible source of income. This dilemma has been avoided on the previous occasions by the expedient of subscribing the necessary sum among the students. In many ways this method is not entirely satisfactory, especially when applied to a show of the nature considered. There are, and no doubt correctly so, no profits whatever in connection with the show, as run. It seems no more than right, however, that the shows of the future should be self-supporting. The handicap of organizing an affair of this sort without any working fund is very great. In the future, a fund should be established and contributed to from the proceeds which each show should produce. This would give the succeeding organizations something to work on and would insure against a deficit. The only other alternative is to distribute the expense among the students, as they should not indulge in such activities without adequate means of meeting expenditures. Of course the show is backed by the Electrical Engineering Department, but the ultimate responsibility must fall upon the students. It has been found that the show achieved a maximum of success when held on alternate years. This enables a man to take a minor part in his first or second year, and a major part during his Junior or Senior term.

The show this year will have many independent features. Perhaps the largest group of exhibits will be those worked up by the students. These will attempt to demonstrate unusual phenomena, mechanical and electrical tricks, modern accomplishments in the electrical field as applied to the general public, and the usual "stunt" demonstrations. There will be a section on railway signals and transportation. This will include streetcar equipment with starting devices, and other apparatus used in modern installations. Some of the larger units as made by G. E. and Westinghouse will at least be pictured. Automatic switching and signal material will be demonstrated. Another popular section will be that on radio. This will be educational and interesting to the general public as well as to the radio bug. The section on illumination should be of great instructive value. The effect of light on speed of manual operations, observation, and reading is to be demonstrated. The effect of various types of lamps on color and eye strain will be shown, as well as some of the past history of illumination. All stages of lighting from the most primitive to the most modern will be represented in the unusually complete collection available. Communications are to be well represented by manual and machine operated telephone systems. Other phases of electrical engineering will be covered by student and manufacturers exhibits. All sorts of machines are to be run and students will be on hand to explain their operation and answer questions. Several reels of motion pictures will be shown in connection with the show. These will be of an educational as well as a most interesting nature. The building is to be wide open (not a door will be locked) and there will be students at various points to explain its many interesting and unusual features.

A word or two in regard to shows of the future might be in order at this time. The writer believes that the show should be a source of income instead of expense. A worthy purpose, aside from the guarantee of success of later shows, would be the establishment of a Student Loan Fund for electrical students. Statistics show that students are self-supporting to the extent of about 50% of their college expenses. Many find it necessary to borrow money during their college course. The Fund could be limited in use to Juniors and

(Continued on page 28)

NEED FOR REGIONAL PLATTING STRESSED

By George H. Herrold
Managing Director, St Paul Planning Board,
Stanford University, '96

THE growth of cities has exceeded the imagination and prediction of all authorities. In books of 100 years ago we read that Paris and other cities could never exceed 500,000 in population. In 1880 29% of the population of the United States lived in cities and towns. Today approximately 52% live in these urban centers. With the advance in sanitary science, the discovery that household wastes could be carried away by flowing water, that garbage and other refuse might be destroyed by incineration, the development of the public utility, new methods of transportation, municipal water plants and new types of architecture, it may be said that the only possible limitation to the size of a city is an economic one. We are living in a cycle when people like to go where the crowds are, where there are greater opportunities, greater financial returns and more pleasures, whether real or fancied. Manufacturers go to urban centers because of the labor supply. Surplus labor from rural communities is attracted to the city because of the opportunities for employment. Laborers in factory centers become "factory minded" and this attracts other industries. Thus by a vicious circle we build up great pulsating centers of industry in which we are unable to cope with the social problems and many of the physical problems created.

A city is the result of a varied number of economic impulses. The townsite plat laid out by the owner of the property becomes the plan, pattern or framework of the future metropolis. Railroad engineers influence the development of the plat by their railroad lines, manufacturers by the location of their industries, city engineers by their development of public improvement work, realtors in their development of the land, street railway companies by their transit plans and finally each individual—he who cannot be deprived of life, liberty or property without due process of law—insists on using his property as he wishes and thus in many cases deprives his neighbor of life and liberty.

City planning attempts to coordinate these interests and create something more worthy and more useful. It is the exponent of a new theory—that an economic program is better than political expediency. The old conception of land within a city was that its sole and only use was to furnish area on which to build. A new idea is that there is value in open spaces, that there is an economic ratio between the width of a street, the area of a block and the height of buildings, that this ratio varies for the different uses to which property is put; in other words, some attention is being given to "scale" and to means which will permit the full economic use of a building.

The value of land is based on rent. Rent is based on superiority of location, and superiority of location is determined by environment. The difference in value between a lot in the Sahara Desert and a lot on Nicollet Avenue is due to the spirit of business surrounding the latter location. There is a superior location for each use of property, a center at which the values are greatest for a particular use, either in city, town or country. The different uses of property have a certain economic dependence one upon the other, therefore there is a logical arrangement or location for each.

At the present time we are making improvident use of our streets and penalizing business. We have built tall buildings in a small area in our business district and created more traffic than our streets can accommodate and the great advantage of the motor vehicle as a time saver has been lost. We have laid complete plans for the strangulation of business.

Formerly there may have been some economic advantage in a concentrated business district for the general transaction of commerce, but now that space has been annihilated by the telephone and automobile and with all the possibilities of the aeroplane and the radio, this type of city building should stop and serious consideration be given to decentralization. The president of the American Electric Railway Association has stated in a public address that within five and at the most ten years all motor buses operating on a schedule will be operated by electric railway companies. This will give a far more flexible type of transportation than we have ever enjoyed. An eastern railroad company has petitioned its Railroad & Warehouse Commission to permit them to abandon certain branch lines and construct on their own right of way a pavement on which they will operate freight trucks and passenger automobiles. This again points to a revolutionized transportation system.

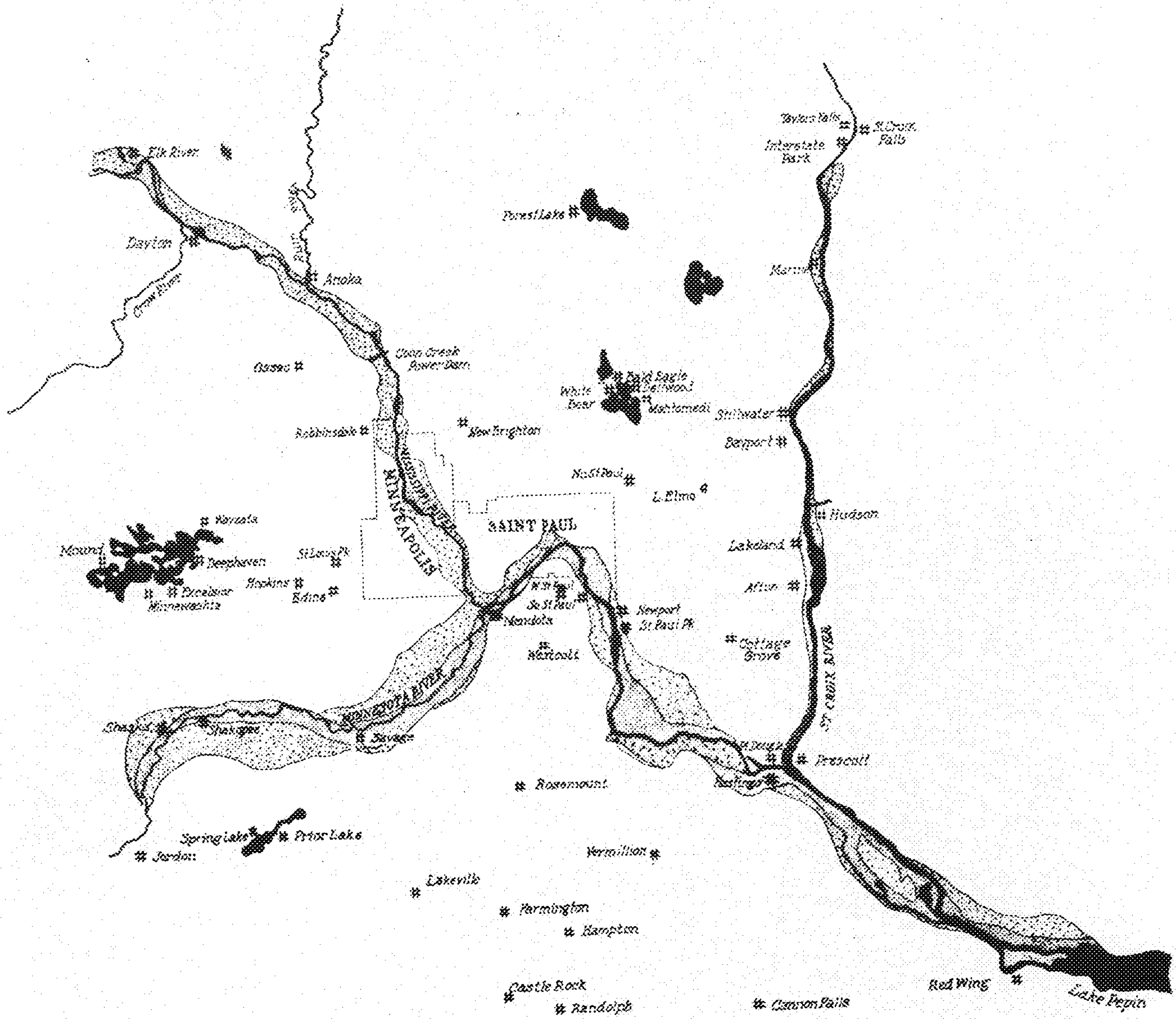
Again the development of the public utility during the last few years has greatly raised the standards of living in small towns and outlying communities. In a very short period of time they have been given the electric light, central heating plant, water supply, sewers and sewage disposal and the telephone. Many people now live where it is a privilege to live, and conduct their business miles away. The small town and the country community are now coming into their own.

St. Paul and Minneapolis within their political boundaries have a total population of 750,000 people. It is not unreasonable to anticipate a million population within a few years, or a million and a half population within the area surrounding the two cities which may be said to come within their economic influence. Both cities are doing planning work and have active planning commissions, but planning for cities within their own boundaries is insufficient. The surrounding region is destined to become, in effect at least, a part of these cities. There is a community interest which must be reckoned with between the population of these outside communities and the central city; in fact, the problems of these cities are in reality problems of the region which have been accentuated and made apparent by closer contact of individuals. A regional approach and treatment is now necessary. We are likely to be confronted at almost any moment with a situation in which the environs will grow in population more rapidly than the cities, aggravating all of the problems we have been trying to solve through city planning.

Suburban platting has been very haphazard and will not improve, for land holdings around the cities are becoming smaller in area and the number of owners increasing to such an extent that any correlation of the plats will be almost impossible. Each piece of property is likely to be subdivided into lots and streets as the owner sees fit without regard to his neighbor or to the necessities of the surrounding community, or of traffic. Later on these conditions will have to be corrected, and the correction will include payment of damages to owners, for a plat, as soon as accepted by the authorities and placed on record, becomes inviolable. A tract of land that is not properly platted not only causes depreciation in itself but also lowers surrounding property values and creates a loss in tax revenue to the community, and besides there is the economic loss due to inconvenience in getting about. A thorofare plan should be devised and adopted as early as possible. The residents of St. Paul, Minneapolis and their surrounding satellite towns are one large community. They are all striving, through their business or profession, to provide the largest measure of spiritual, intellectual and physical satisfaction possible for themselves and those dependent upon them. They are endeavoring to do this in the most economic way. Some will succeed, and many will fail, because it requires something more than individual effort to create an environment fine and beautiful that will extend beyond the confines of your own door yard.

There are a great many problems confronting these various communities and these problems cannot be solved to advantage without joint action. Each governmental body may enact resolutions relating to its own business and within the confines of its own boundary lines, but when this business overlaps and involves the adjoining city or country, an adequate solution is not possible under present conditions. The water supply, sewage disposal and garbage disposal of these two cities and the surrounding towns must be approached as a single problem of the entire region, otherwise governmental cost of administrating these activities separately will pass beyond all reason. Plans must be made now for a free circulation of traffic, for traffic increases nearly as the square of population. Interurban transit and bus lines are a regional problem as they provide the chief means of communication between the urban and rural communities. Forest reserves, game preserves, golf links, amusement parks, athletic fields, cemeteries, botanical gardens, should now be given thought in order to serve adequately the growing population. The preservation of historical sites must be given consideration. Lakes and their preservation is an outstanding problem. It is possible that the lake areas within a short distance of the two cities have a far greater value per acre than the land

(*Continued on page 28*)



MANY AWARDS AWAIT REAL SCHOLARS

By Joseph E. Meagher

Special Writer The Minnesota Techno-Log

TO the new student in the College of Engineering, the problem of how much time he should devote to outside work or extra-curriculum activities and how much he should spend on his class work presents itself. It soon becomes evident that too much concentration on the former may play havoc with his scholastic standing, but it is not at once so evident that benefits may be derived from intensive work in the latter. It is generally conceded, although often overlooked, that success in professional life requires a fair degree of technical skill, the foundation for which can be most successfully laid during one's college career. There are so many distracting influences at work that one often loses sight of this end and loses interest in obtaining the means to reach that end. To stimulate a greater interest in scholastic and scientific effort by putting before the student an end or prize which is both intrinsic and obtainable while in school, various prizes, scholarships, and fellowships are annually awarded by different organizations.

A brief resume of these awards may show the under-classman what there is that he can strive for, and at the same time may be of interest to some of the upper-classmen. The brief description given below is so planned that the reader can tell for what competition he is eligible by referring to the heading.

All Architects, Engineers, Chemists, and Miners

All students of the Colleges of Engineering, Architecture, Chemistry, and Mines are eligible to compete for membership in Tau Beta Pi, honorary engineering fraternity. Its members are selected from the upper eighth in scholarship in these colleges during their Junior or Senior year. While Tau Beta Pi carries with it no financial remuneration, it conveys a sense of satisfaction in personal achievement and the wearing of the Tau Beta key symbolizes the possession of worth-while characteristics by the owner.

Engineers and Chemists

Two research fellowships for a period of one school year and carrying a stipend of $750 are awarded each year by the College of Engineering and Chemistry. The Fellow does no teaching, but spends a certain part of his time in investigating some research problem assigned by the Dean of the College. He is allowed sufficient time to write a thesis and to carry enough scholastic work to obtain his Master of Science degree. The Fellows are selected upon application from amongst the Seniors having the highest grades and showing a particular aptitude for research work.

Sophomores in Engineering and Architecture

All sophomores in the Colleges of Engineering and Architecture are eligible to compete for the Briggs prize in Foundry Practice.

"Seventy-five dollars annually, in two prizes, accompanied by gold medals, will be awarded to sophomores in the College of Engineering and Architecture for the best essays relative to foundry practice. No Prize will be awarded if less than five essays are submitted in competition. Essays should contain about 3,000 words, and must be submitted to the instructor in rhetoric on or before May 1."

The sophomores wishing to compete should notice that no prize is awarded unless five essays are submitted. The writer recalls a friend who spent several weeks on an essay and received no consideration because only three essays were submitted. If you wish to compete, have your instructor give the matter a little publicity and see to it that there are five or more competitors.

Architectural Students

Since the work in Architecture is largely competitive in nature, we find more prizes here than in any other department. A notice on the Architectural Bulletin Board gives the following information:

List of Prizes to be Awarded, 1924-25

(a) Moorman Prize provided by Mr. Moorman, architect of St. Paul, consisting of a sum of money sufficient to cover traveling expenses for a two weeks trip for the purpose of studying American Architecture.

(b) American Institute of Architects Medal, awarded by the Institute to the Senior attaining the highest general average during his four year course in Architecture.

(c) Minnesota Chapter of American Institute of Architects. Prize of fifty dollars ($50.00) and twenty-five ($25.00) respectively, in books, to the students attaining the highest general average in work in the Junior year in Architecture.

(d) Faculty Prize of thirty-five ($35.00) and fifteen ($15.00) in books to the students attaining the highest general average in work in the Sophomore year of the course in Architecture.

(e) Alpha Alpha Gamma Prize of fifteen dollars ($15.00) in books to be awarded to the author of the design placed first in a Long Problem Competition of the Sophomore year.

(f) Magney and Tusler Prize of twenty dollars ($20.00) and ten dollars ($10.00) to be awarded to the authors of the design placed first and second in a Sketch Competition, the subject of which pertains to civic beautification.

(g) William A. French Prize of twenty dollars ($20.00) and ten dollars ($10.00) to be awarded to the authors of the design placed first and second in a Special Problem in Interior Decoration.

Membership in Tau Sigma Delta, honorary Architectural fraternity, is based upon scholarship, personality, ability, and leadership. The members are selected in their Junior or Senior year.

Chemical Engineers

Phi Lambda Upsilon is the honorary chemistry fraternity. Members are selected on the basis of scholarship and personal qualification from amongst the upper classmen.

Civil Engineers

"The Northwestern Section of the American Society of Civil Engineers offers two prizes of cash or books to the value of $15 and $10, respectively, for the best two papers submitted each year by civil engineering students who are members of the Minnesota Student Chapter of the American Society of Civil Engineers."

The members of the Chi Epsilon, honorary civil engineering fraternity, are selected upon the basis of scholarship and personal qualification from amongst the upper classmen.

Electrical Engineers

No special monetary prizes are awarded to electrical students, but excellent work is rewarded by membership in Eta Kappa Nu or availability of teaching fellowships. The American Institute of Electrical Engineers is at present contemplating and will undoubtedly soon offer a prize for work along electrical lines.

Eta Kappa Nu is the honorary electrical engineering fraternity. Its members are selected from the upper fourth scholastically during their Junior or Senior year. Personality, leadership, ability and interest in electrical endeavor are stressed in the selection.

Four teaching fellowships are awarded every two years by the department of electrical engineering. The term of appointment is for two years and carries an annual stipend of $750 plus exemption from graduate school fee payments amounting to $30 per year. The Fellow devotes half of his time to teaching and the other half to graduate school work, so that at the end of two years he may obtain his Master of Science degree. The fellowships are awarded to graduating Seniors of this or other schools, upon application of the students. Scholarship and experience are the most important qualifications considered in these awards.

Mechanical Engineers

The local branch of the American Society of Mechanical Engineers is offering for the first time this year $50 in prizes to be awarded for the best paper or papers submitted on some mechanical engineering subject.

Pi Tau Sigma is the honorary mechanical engineering fraternity. Membership and purpose are similar to Eta Kappa Nu in the electrical and Chi Epsilon in the civil engineering department.

The above list is given to promote interest rather than as an authoritative reference. Various other prizes are offered from time to time as the occasion arises and the ambitious student may take advantage of these offers if he so desires. Scholarships and fellowships are offered by other schools and notices thereof are posted on the various bulletin boards around the Engineering College.

It has become evident, then, that there are certain material rewards to be obtained while in school through excellence in scholastic work. While the different honorary fraternities do not offer a financial reward, the associations formed and the privileges obtained are well worth the effort expended to gain membership. It may be noted that every application blank for employment of college men that has come to the writer's attention contained a question similar to this one, "To what honorary fraternities do you belong?" This should be evidence sufficient to convince the student that membership in an honorary organization is worth striving for.

The rewards, honorary or financial, obtained in school are not meant to be an end to be sought after for their value alone, but they are of extreme value in stimulating the student to greater effort while in school and thus aiding him in securing greater returns from his college education when he gets into practical work.

FACTORS IN THE STRENGTH OF WELDS

By Thomas P. Hughes

Instructor in Forge Practice

THE opinion seems to be common among laymen and craftsmen alike that the physical properties of a welded bar are not as high as those of an unwelded one. Such opinions may have originated in a preconceived notion based upon no actual knowledge of what a weld actually consists of, or to an experience with a poorly executed weld. The average smith will commonly state that a welded bar is only about 80% efficient. In this paper we intend to record only those results which were obtained by a fair test of a number of specimens. The results should be taken only as indicative of what might be expected under normal conditions.

A brief definition of a weld, and a description of the conditions essential to successful welding will be given first:

The term "weld" is applied to a thoroughly cohesive union between two metals brought about by hammering or pressure at their fusion temperature. This implies that the metals are fused together to form a complete cohesion of the molecules. Since this is the end sought, it is obvious that no foreign substances such as slag, oxide, or binders should be allowed in the weld, for these will, very effectively, prevent the molecules of iron from coming in contact and thus make their cohesion impossible. The writer had an experience of this kind some years ago when a heavy tire, apparently successfully welded, broke in the weld the first time it was put in service. Examination showed that with the exception of the two thin ends of the scarfs no weld had taken place, because slag had been entrapped between the faces. It was merely an adhesion and not a cohesion. Granting, therefore, that actual cohesion happens, it seems reasonable to assume that a welded bar should be as strong as the unwelded one on the basis of what has been said. However, a certain amount of chance is involved in welding, which, together with the ability and experience of the welder accounts for the wide divergence of results obtained for the few tests made. Unquestionably the greatest care must be exercised with the fire and first consideration given to it. Ability and experience are important but are only of secondary importance when considered with that of the fire. The fire should be clean of clinkers, deep, and composed of coke banked with green coal. A slightly used fire is better than a fresh one in that the coal gases have been somewhat reduced by burning, leaving practically free almost pure carbon. The manner of heating is also an important factor. Slow heating is much more desirable than rapid heating. The metal should be given time to heat uniformly and thoroughly, for this is a prime requisite. Too rapid heating will cause the outer surface to come to fusion temperature sooner than the core, which is obviously very undesirable. The air-blast used should be governed by the depth and size of the fire and to some extent by the size of the specimen being heated. Theoretically it may be stated that the amount of air or blast used should be determined by the amount necessary for the proper combustion of the coke or fuel used.

Oxidation

Probably the condition presenting the most difficulties in welding is oxidation. Next to overheating, it plays the leading role in weld failures.

At low temperatures it prevents a clean surface owing to its infusibility. At high temperatures it causes burning, or, more correctly stated, *is* burning. In either case it is very detrimental and annoying. Further, the higher the temperature the more rapidly oxidation takes place, other things being equal. Practically, oxidation invariably occurs. It may be too much to expect that it can be entirely eliminated, but it may be controlled within rather wide limits even in an open forge fire and more easily in a furnace. A blast of air commensurate with the demands of combustion will reduce oxidation to a minimum. To heat a piece thoroughly, slow heating is necessary, consequently low blast will have this important result. Oxidation is the combination chemical of Fe with O_2 forming ferric oxide, Fe_2O_3, and it is evident that for the purposes of this reaction an excess of oxygen is required in the fire or furnace atmosphere. A serious aspect of this condition is that, as the Fe and O_2 combine, decarburization or a reduction of the carbon takes place. One authority found in one instance by using a very low blast that the per cent of carbon was actually increased owing to the presence of an excess of CO in the fire and the fact that the piece was surrounded by solid carbon in the form of coke. This, however, is seldom if ever experienced in practice. While this condition may be improbable in practice, it is a well known fact that an excess of oxygen will cause the opposite effect. The illustration is a photomicrograph of a weld made from 0.20% carbon steel. The white areas show the extent of the decarburization of the welded surfaces.

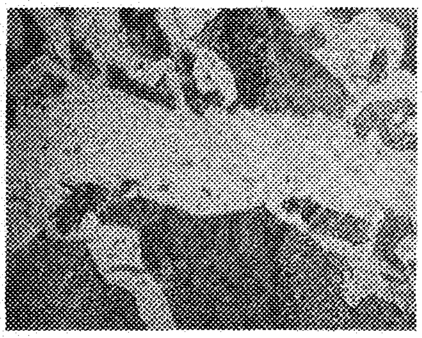
Fluxes

In order to lesson the difficulties resulting from oxidation, various fluxes are used which act in two ways:

(1) The fusion temperature of the oxide is lowered to a point below the welding temperature of the steel.

(2) A protective covering is given the steel against further oxidation.

The most common fluxes are sand (silica) and borax. The former is used only on low and medium carbon steels very satisfactorily while the latter is better adapted for high carbon or tool steels. While sand is very infusible alone it becomes very fusible in combination with ferric oxide and forms the silicate. This combination takes place with definite amounts, and when sand is used excessively it remains as sand. As sand is infusible at ordinary welding temperatures, if allowed on the surfaces, it will prevent a good weld. Also, the greater the amount of sand in excess, the more viscous the silicate, and the more sluggish its flow. Borax, which is fusible at low temperatures, functions mostly as a coating against oxidation rather than as a dissolver of the already formed oxide. A flux, if judiciously used, will aid materially, but its excessive use, or a feeling



Microscopic View of Weld in 0.20% Carbon Steel Showing Decarburization.

of dependence upon it for a good weld should be discouraged. Many smiths lacking the confidence in their own ability turn to flux for a psychological bracer.

Scarfing

Whatever type of weld is employed, the pieces should be prepared or scarfed so as to facilitate the removal of slag and oxide, and be so formed as to be easily accessible to the hammer or tools.

Upsetting

The ends to be welded should be stoved or upset a sufficient amount to afford an opportunity for hammering and refining the structure which has been weakened, and the ductility lessened, by the high welding temperature.

Results of Tests

Tests of several specimens in both the heat treated and untreated condition were made. The stock used was ⅝" in diameter. A section 3-¼" long was turned in the welded area to 0.505". Elongation was measured between 3" guage lengths and the tests were made on a Riehle' Tension Testing Machine. The lap type of scarf was used in each case.

Group 1

These specimens were upset, welded, and hammered to below their critical temperature and allowed to cool in the atmosphere. The average ultimate strength obtained was 69,000 lbs. per square inch, with an elongation of 23% and a reduction of area of 41%. Fracture occurred outside of weld.

Group 2

These specimens were upset, welded and hammered as before and subsequently reheated to 1500° F. and cooled slowly. This temperature being below the critical range of this steel a full anneal or refinement was not obtained and only forging strains and hardness were reduced. However, a very conspicuous result of this reheating is evident. The ultimate strength dropped to 65,000 lbs., a reduction on group No. 1 of approximately 6%, while the ductility measured by the elongation and reduction of area was materially increased. The elongation being 26% and the reduction of area 60.5%, an increase over group No. 1 of 13.0% and 47.5%, respectively. Fracture occurred outside of weld.

Group 3

These specimens were not welded but were given a heat treatment similar to those in group No. 2. The average ultimate strength obtained in this group was 68,000 lbs., an increase of 4.6% on group No. 2 and a decrease of 1.5% on group No. 1. Elongation was 30%, an increase of 15.3% on group No. 2, and 30.4% on group No. 1. The reduction in area, however, dropped slightly to 54.5%, a decrease of 9.9% on group No. 2, but an increase on group No. 1 of 32.9%.

Group 4

This group was composed of the original bar unwelded and untreated. The ultimate strength of these specimens was 65,050 lbs., with reduction of area 65.5% and an elongation of 31.6%.

Summary

On the basis of the foregoing figures it is evident that the strength of the original No. 4 untreated bar was very successfully maintained and exceeded in the untreated welded No. 1, and this reveals two things:

(1) That the weld itself was properly executed, and, (2) that the structure in the weld had been properly refined. For certain classes of work where strength alone is the essential requirement, this weld would give satisfactory results, for we found the strength was increased 4,000 lbs., an increase of 6%. The ductility, however, was somewhat impaired, be-

(Continued on page 28)

The
MINNESOTA TECHNO-LOG
University of Minnesota
Managing Editors
HERMAN F. BESELER, KENEFICK ROBERTSON
Department Editors
WILLARD H. NORDENSON - - - - - Alumni Editor
CLYDE W. LIGHTER - - - - Architectural Editor
JAMES M. SUTHERLAND - - - - Chemical Editor
HAROLD C. E. PETERSON - - - - - Civil Editor
PAUL B. NELSON - - - - - - Electrical Editor
LEONARD KLEINFELD - - - - Mechanical Editor
THOMAS F. ANDREWS - - - - - - Mines Editor
RUSSELL S. GRANT - - - - - - Humor Editor
Special Writers
Marshall H. Coolidge, Jr., Alva J. Haley, Philip F. Hartman, Joseph E. Meagher, George M. Cornell.
Assistants
Erling A. Amundsen, Thor A. Gustafson, L. W. Cameron, Kenneth Foster.
RICHARD W. JONES - - - - - Business Manager
A. S. BULL - - - - - - Circulation Manager
E. L. SLAGGIE - - - - - - - - Sales Manager
Advertising
Hilder W. Bergman, James A. Helbling, George M. Lange, Robert P. Walters.
Faculty Advisers
Prof. A. S. Cutler, Prof. C. A. Mann.

TEST OF ENGINEERING SPIRIT

THE Great Engineering Spirit, by which our College is distinguished so favorably from the rest of the University, is again at stake.

In rapid succession the student body must face winter quarter finals, and stage the majority of our extra-curricula affairs. The Junior class is expected to uphold our greatest tradition and stage the best Engineers Day in history. Heavy responsibility rests on the shoulders of the Sophomores, who must co-operate with their superiors and at the same time locate all errors in the Junior machine with the idea of removing them by 1926. The Freshmen who are unacquainted with the celebration can find the spirit of the affair by entering with vigor the work outlined for them by the Juniors.

Students enrolled in Electrical Engineering will also give an electrical party next quarter. The fact that the approaching party, or show, is the first of the biennial affairs to be held in the new building only increases the responsibility set before the Electricals by tradition. The recent announcement that the committees in charge of Engineers Day and the Electrical Party have decided to hold both affairs the last days of the same week means that students of the Electrical Department must co-operate to the last man.

Another student organization in the technical schools, the Arabs, faces the problem of giving a musical comedy a week before the affairs previously mentioned. In former years the Arabs have given worth while productions, and tradition demands that this year's cast exert every possible effort to surpass the high standard of former productions. Numerous minor affairs are also included in the list of spring activities.

Summing up the problems ahead of the Engineers one realizes that this year's activities will draw heavily from the study time of every student in the College. If the Engineering students fail to accept in full all the work demanded by these traditions, then the Engineering Spirit is dead. The only way for the student body of the College to pass the ordeal is to study now,—work early next quarter—then study until spring quarter finals are past.

Come on Engineers,—let's go.

—K. R.

STUDENT-FACULTY FRIENDSHIPS

MANY men on the faculty of the Engineering College, are nationally known, yet are really known by few of their own students. Most professors have personalities and abilities that should make their friendship a valuable asset to anyone. In most cases, they are men who have really accomplished "big" things and have a profound understanding of human nature and life's problems.

Unless one is a genius, it is quite certain that he will never hold a responsible position unless he is broadminded. Dean Leland, in a recent talk before a student organization, said that one of the purposes of the curriculum was to cause the student to unconsciously broaden his mind by studying the personalities of his numerous instructors.

Many of the professors and instructors have become acquainted with perhaps thousands of men, including many students. They have studied the problems and personalities of most of these acquaintances and have profited by it, perhaps not in a material way, but certainly in a finer way. They can, and do impart many of the benefits gained by their experience to their friends.

The classroom, because of the routine work associated with it, gives few opportunities for a student to become acquainted with his instructor. However, on the campus there are numerous little opportunities that are neglected by most students. The members of the faculty, busy as they are, enjoy little chats with their scholars, and the pupils likewise will find these talks interesting. An instructor may seemingly have a cold and uninteresting personality while in the classroom, but when outside of the room, it is invariably found that he is good natured, broad-minded, and an interesting gentlemen whose friendship is highly enjoyable.

Get acquainted!

—H. F. B.

FORWARD TREND OF SCIENCE

YESTERDAY—the First Inaugural by Radio. Today—the First Inaugural Photo by Wire. With such a headline The Minneapolis Journal on March 5 displayed a picture of Calvin Coolidge taking the oath of office as president of the United States. What does it mean? An application of a scientific toy to a newspaper fad—yes. But let us analyze the toy a little. From all descriptions, few as they are, the apparatus required to handle the actual transmission is not extremely bulky nor is the principle of its operation bewildering to one who has an analytical mind. The manner in which several well known physical phenomena are coordinated to produce the seemingly impossible is the outstanding greatness of the invention. This perfect coordination is the result of many months research by a large group of scientists. The Bell System, which has collected this group of men, is to be congratulated upon their new contribution to our already long list of marvelous electrical instruments.

(Continued on page 25)

NEWS FROM THE ENGINEERING CAMPUS

ARCHITECT GROUP MEETS

A banquet of the architectural engineers was held in the Viking Room of the Radisson Hotel, Thursday, February 26, with about forty engineers present. Aubrey Grisson was toastmaster, and Professor A. Mann, R. T. Jones, Parcel, and Maney of the faculty, and Clarence Lendeman, alumni were speakers. Mr. Lendeman was the first to graduate from the course in architectural engineering.

The architectural group intends to make the affair an annual tradition.

MORTAR AND BALL INITIATES

Nine members of the first year advanced Coast Artillery Corps were initiated into Mortar and Ball on the evening of February 10.

The initiates are: Albert W. Morse, Lester S. Faulkner, Theodore Haakensen, Leslie D. Croswell, Victor Etem, Philip W. Mouson, Russell S. Cheney, Barton Jewell, and Kenneth W. Foster.

After the initiation a banquet was held at the Nicollet Hotel at which Major Montgomery and Captain Adams were taken into the organization as honorary members.

A. S. M. E. HOLDS ANNUAL FEED

In accordance with an old custom, the student branch of the American Society of Mechanical Engineers held their annual banquet at the Minnesota Union, Wednesday, February 25. Members of the local sections of the Twin Cities were invited to attend and held a joint meeting with the student branch after the dinner.

The program for the evening opened with songs by the A. S. M. E. quartet. The quartet showed their old pep, and did much to sponsor a feeling of good fellowship.

The committee in charge had obtained Mr. Paul Doty, a man of wide experience and interests, as principal speaker for the evening. He spoke on the future of engineering and his remarks on the ethics of the profession should be an inspiration to any young engineer. Mr. Doty was Superintendent of the St. Paul Gas Light Company for 35 years. He resigned this position during the war period to accept a majorship in the quartermaster corps of the U. S. army and to take charge of construction at camp Grant. He was later promoted to Lieut. Colonel with charge of all camp construction and it is interesting to note that while acting in that capacity, 20 million dollars worth of business passed over his desk.

W. O. French, a member of the student branch, gave a highly instructive and interesting talk on heat cycles, pointing out the possibilities of each cycle. Some interesting remarks on modern tendencies in power plant practice and their relationship to heat cycles were given by Prof. Shoop in the discussion which followed the talk.

SENIORS CHOOSE ST. PAT

Joseph E. Meagher, senior electrical engineer, was recently chosen by his class to act as St. Patrick during the famous ceremonies to be held April 24. Meagher was elected from a field of four candidates. He received 60 votes to his nearest opponents 45. Cy Pesek, architect; Arthur J. Kroll, and Harry McAndrews, civils were the other candidates.

The Juniors who are in charge of Engineers Day announced before the election that St. Pat would choose his own queen this year. Last year the queen of the day was elected by the engineers.

Mr. Meagher is a son of the "ould sod" his grandfather having come from Cork, Ireland in the days of Irish immigration to this country. He has been very prominent in affairs on the engineering campus and is a true supporter of all engineering traditions.

NEW EQUIPMENT ADDED

Minnesota's foundry has recently acquired some new equipment, a Bacharach flowmeter to measure the air supply to the cupola, and an optical pyrometer. The additional equipment will enable Minnesota's foundry to operate on a more scientific basis.

SENIOR QUINT WINS

By defeating the School of Business in the final game of their schedule, the Seniors won first place in Division 2 of the All-Senior Basketball League. In the play-off with the Pharmacists, the winners of Division 1, the engineers won again and in the finals of the league they defeated the "Take-'em Ons," the leaders in Division 3, thereby winning the All-Senior championship and the right to compete for the All-University title.

For winning this championship the team is to be awarded a large cup on which the names of the members of the team are engraved.

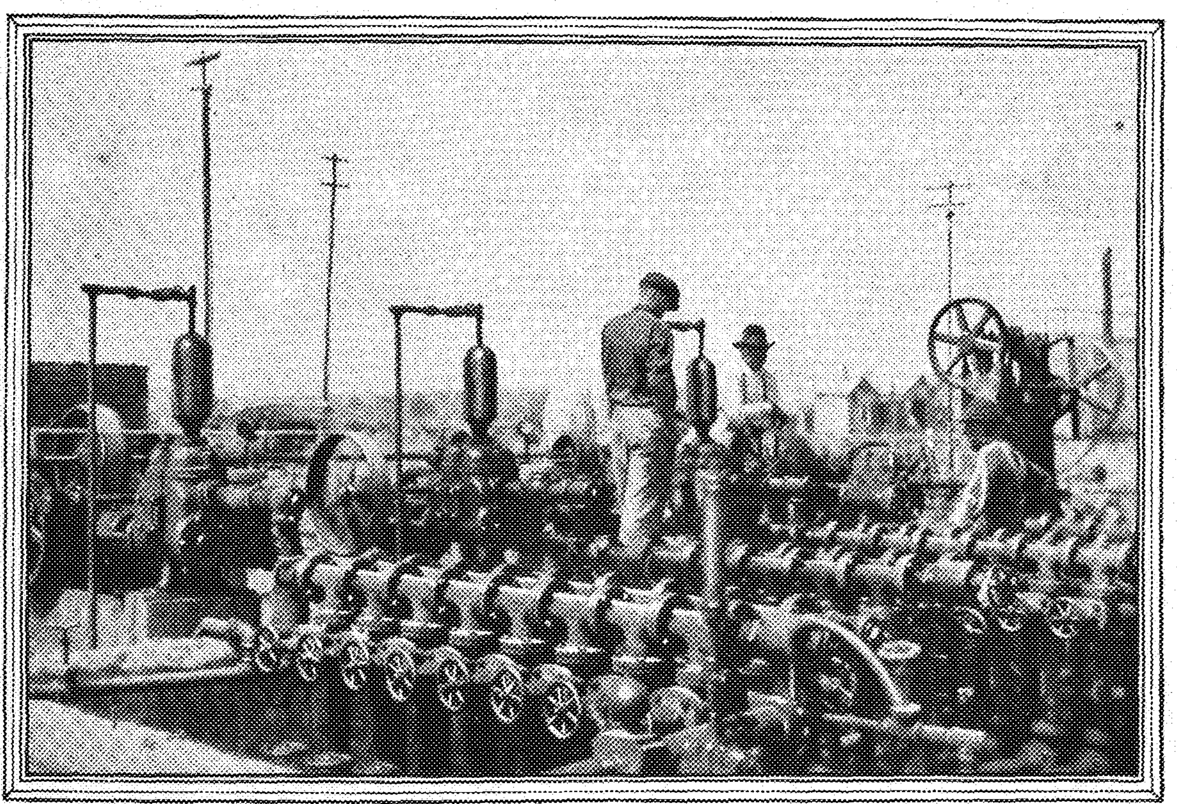
These men, who played last year as juniors, won the All-Junior League championship but were defeated in the play-off for the All-University title. For their work they were awarded intra mural letters, a cup, and sweaters from the Engineers Bookstore. The All-Senior champions are: Dwight Burns, captain, Steve Donahue, Harry MacAndrews, Eddie Hendrickson, Mark Hammia, Roy Schuck, Herb Dungay, and Ed Quinn, manager.

SENIOR CIVILS TO ORGANIZE

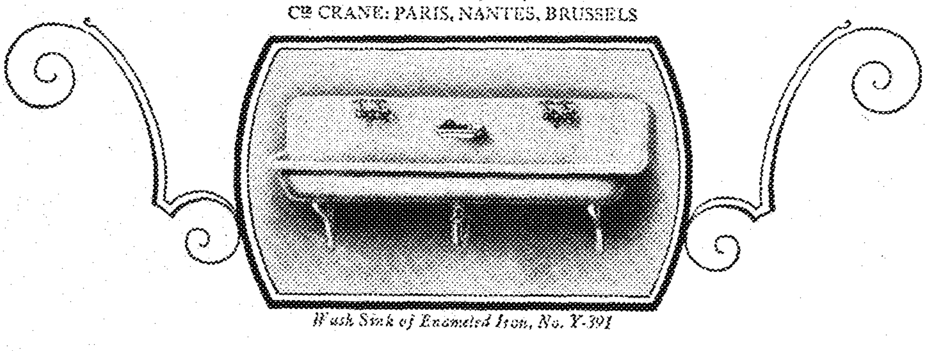
Perhaps the only serious topic discussed at the recent Senior Civil banquet was organization for the purpose of keeping the class in touch with each other, and with the school after graduation. Committees will soon be appointed by William Brose for the purpose of drawing up plans with such an object in view.

This is without doubt one of the most constructive steps that can be taken by a graduating class, if it is consistently followed up, and it the class as a whole will do their part towards keeping whatever plan is adopted from failure. Much help can be gained by the individual members of the class not only from a monetary standpoint, but in help with problems which might confront them in their life after graduation. The plan adopted will probably be outlined in a later issue.

A short intensive course for meter men will be offered next fall previous to the opening of school. This will be designed especially for the layman.



GATHERING-LINE HEADERS AT PLANT NO. 9 OF CHESTNUT AND SMITH CORPORATION, KIEFER, OKLAHOMA



Wash Sink of Enameled Iron, No. Y-391

DRIPPINGS FROM THE OIL CAN

Learning the Game

Smith, being introduced to golf for the first time, had hit the ball a terrific whack, and sent it half a mile.

"Now where do I run to?" he cried excitedly.

* *

Breathing Spell

"The population of China is immense," said the teacher. "Do you know that every time we take a breath a Chinaman dies?" Just then the teacher noticed a small boy, very red in the face and panting as though he were exercising strenuously.

"What are you doing, Willie?" asked the teacher.

"Killing Chinamen, sir. I hate 'em," answered Willie.

* *

Weighty

Hank—"I sent a dollar for an appliance to keep gas bills down."

Bank—"What did they send?"

Hank—"A paper weight."

* *

Oh Boy!

A runner in a silk stocking will attract more attention than any track meet.

* *

Bright!

During a recent quiz in Freshman chemistry, Professor Kirk asked for the source of mercury. One Freshman answered that "mercury comes from H. G. Wells."

* *

Space

Most of the jokes pulled these days are not "wise cracks;" they are aching voids.

* *

"Everyone's crazy 'bout me," said the keeper, as he locked up for the night.

* *

Etiquette

The proper way to eat an orange in society is to eat a banana.

* *

His Shortcoming

Dorcas—"Do you ever allow a man to kiss you when you are motoring with him?"

Phileppa—"Never. If a man can drive safely while kissing me, he's not giving the kiss the attention it deserves."

At R. O. T. C. Camp

"Bang!" went the rifles at the maneuvers.

"Ooo-oo!" screamed the pretty girl, —a nice, decorous, surprised little scream. She stepped backwards into the surprised arms of a young man.

"Oh," she said, blushing. "I was frightened by the rifles. I beg your pardon."

"Not at all," said the young man. "Let's go over and watch the artillery."—*Everybody's Magazine.*

* *

Point Off!

Someone should open a lost and found department for misplaced decimal points.

* *

Time Out

H—"Why do they call them clocks? I don't see any hands on them."

She—"No, and there aren't supposed to be any hands on them."—*Rose Technic.*

* *

No Proof

Just because the girls laugh at your remarks is no proof that you are witty. Perhaps they have pretty teeth.

* *

New Con

What is the difference between ammonia and pneumonia?

One comes in bottles and the other in chests.

* *

Poor Scottie

The Society for the Perpetration of Jokes against the Scots is broadcasting the definition of a Scotsman as one who, when invited to a friend's house for a drink, buys salt herrings to eat on the way.

* *

Seamy

"How do you feel?" asked the physician who had been called to attend the seamstress.

"Oh, sew, sew; but seam worse today, and have stitches in my side."

The doctor hemmed and said she would mend soon.

* *

Good Reasons

One reason why some girls are called radio flappers is because they are so easy to pick up.

Relativity

Twinkle, twinkle, little star,
How I wonder where you are;
High above I see you shine,
But, according to Einstein,
You are not where you pretend,
You are just around the bend;
And your sweet seductive ray
Has been leading men astray
All these years—O little star,
Don't you know how bad you are?
—*Ex.*

* *

Definitions From a Freshman's Notebook

Blizzard—The inside of a hen.

Mountain Range—A large cook stove.

Oxygen—An eight-sided figure.

Dispel—To spell incorrectly.

Butter—A billy goat. Buttress—A nanny goat.

Frontispiece—A headlight on a Ford.

Furlough—A fur-bearing animal.

Monomaniac—A man with only one wife.

Mistake—To steal something.

Observatory—A place where flowers are kept.

Tonsorial Parlor—Where you go to have your tonsils removed.

Joan of Arc—One of Noah's daughters.

* *

Things We Are Waiting For

A device for automatically clogging taximeters after a reasonable limit—say, after the first mile.

Lip sticks that won't smudge or otherwise leave evidence of a man's weakness.

A smoke screen for obscuring a chaperone who is particularly conscientious—or very curious.

* *

What Right Had He?

One day a clerk remarked to his employer, "I think we are going to have rain, sir."

"We?" growled the employer. "We are going to have rain? How long have you been a member of the firm?"

* *

Not Etiquette

He—"Would you consider it improper if I should kiss your hand?"

She—"Not improper, but decidedly out of place."

ALUMNI AND FACULTY PERSONAL NEWS

FACULTY

Dr. L. M. Henderson, who for seven years has been an assistant professor in physical chemistry at the University of Minnesota, has resigned to take charge of research work in petroleum at the Atlantic Refining Company of Philadelphia.

Since 1916 Mr. Henderson has published several papers on radio activity. He was secretary of the Minnesota section of the American Chemical Society for a number of years. During the war, Dr. Henderson worked with the Chemical Warfare Service in various camps through the country.

Dr. Henderson received his Ph. D. from the University of Chicago in 1916, and his M. A. and B. A. from St. Olaf College, Northfield, Minn. He is a member of Alpha Chi Sigma, Chemical Fraternity; Phi Lambda Upsilon, Honorary Chemical Fraternity, and Sigma X, National Honorary Scientific Society.

ARCHITECTS

Donald H. Buckhout, 17, is with Harry W. Wachter, Architect, at Toledo, Ohio.

Wallace Bonsall, '24, is now at Harvard, where he won a prize on his last problem, "Bonnie," and another man tied for first and thus the prize was divided. This gave Bonsall almost all the points required before starting his thesis.

William Kirchner, '22, is doing work quite removed from the field of Architecture. He is reporting on the night staff of the Minneapolis Tribune.

Harry Korslund, 20, is at Harvard doing thesis work.

Edwin Love, '20, wife and six months old daughter, have returned from London and are now located at 1789 Undercliff Avenue, New York City.

M. J. Markuson, '23, informs us that in June, 1924, he married Miss Laura Ashton. They are now living in Blacksburg, Virginia, where he is employed in the engineering department of the Virginia Polytechnic Institute.

CIVILS

Addison H. Douglass, '17, industrial secretary of the Minneapolis Civic and Commerce Association, has been named sales manager of the Northwestern Terminal Company. This company has launched a program for development of the industrial area at the terminal.

Mr. Douglass has been actively identified with surveys and industrial development work, notably the Milwaukee grade separation project, a street cleaning and snow removal survey for the City of Minneapolis, and with highway, river development, traffic and city planning work.

B. F. Johnson, '20, was a lieutenant on board the U. S. S. Utah, which was at Calao, Peru, in December, bearing General Pershing on a special diplomatic mission to Peru. The ship will visit practically all the countries of South America before returning to this country about March.

Don O. Nelson, '20, is on the coast with the Truscon Steel Company of Portland, Oregon. His address is Hope Garden, Troutdale, Oregon.

Martin J. Orbedk, '11, is principal assistant engineer with Holland, Ackerman and Holland, consulting engineers at Ann Arbor, Michigan.

Oscar E. Swenson, '15, '16, is with the Lackawanna Bridge Works Corporation, 51 Seminole Parkway, Buffalo, N. Y.

CHEMISTS

A fellowship in chemistry has recently been awarded to Ruth Elmquist, '23, by the Dupont Powder Company, allowing her a year of study in France. Miss Elmquist will be accompanied by Miss Esther Bauer who completed her masters degree in science last July. They will study under Paul Brinoin, professor of Analytical Chemistry, who is in France on sabbatical leave from the University.

ELECTRICALS

At a Gopher New Year Party, which was held at the home of Dr. Burt L. Newkirk of Schenectady, New York, the following Minnesota engineers were present: A. F. Beardmore, '21, E. M. Bill, '12, J. R. Heinemann, '19, Louis Rash, '03, C. M. Burrill, '23, L. M. Frazer, '24, J. J. Kater, '24, T. H. Marshman, '23, A. H. Mittag, '11, L. W. Morton, '23, E. M. Ostlund, '24, and L. C. Warren, '24.

The Minnesota Gang is on the air with WGY, the General Electric Company's radio station, on their college night programs, so tune in some time and listen to the old Minnesota spirit from this gang of engineering grads.

C. F. Benham, '12, '13, is assistant to the general superintendent of the Great Western Power Company of California. His particular responsibilities involve the operation and maintenance of several hundred miles of high voltage transmission lines and sub-stations, and at the present time, the installation of several automatic sub-stations on a 100,000 volt system. His address is 14 Lansome St., San Francisco, California.

W. C. Bosshardt, '22, is "engineering" collections and credits for the Fosston Manufacturing Company of St. Paul, Minn. His official title is "Credit Manager," and is a position somewhat removed from an electrical engineering education.

William G. Dow, '16, and Edna L. Sontag were married October 24, at Herron Lake, Minn. Mr. Dow is associated with the Westinghouse Electric Company in Minneapolis. His present address is 707 University Avenue Southeast.

F. R. Fleming, '09, is valuation engineer, mechanical branch for the Northern Pacific Railway. His address is 1705 Hague Avenue, St. Paul, Minn.

J. A. Fitts, '09, is with the Electric Storage Battery Co. at 613 Marquette Building, Chicago, Illinois.

Raymond R. Herrmann, '12, '13, who is an assistant professor of mathematics in the engineering college, recently wrote an article on "Power Factor Rate Clauses," which was published in the Electrical World for December 27.

F. M. Williams, '09, is with the Western Electric Company at Chicago, Illinois. His address is 444 7th Ave. So., La Grange, Ill.

MECHANICALS

C. R. Blodgett, '24, is with the Cincinnati Ball Crank Company, Cincinnati, Ohio.

Bill Clark, '12, '13, is with the Pure Oil Company at their Columbus, Ohio, headquarters.

Ernest F. Carlson, '22, is in the power plant department of the Northern States Power Company at their

High Bridge Plant in St. Paul, Minn.

The following men are with the Western Electric Company in the various departments: A. J. DOWD, '19, manufacturing; C. J. EDDY, '22, manufacturing; E. H. EIGE, manufacturing; L. A. ELMER, '21, engineering; R. D. HOLMSTEN, '24, manufacturing; R. C. McKINLEY, 18, manufacturing; E. LINDELIEN, '23, instructor, and W. J. PARCK, manufacturing.

ODEGAARD and GREENBURG were at A. S. M. E. banquet held the other night in the Minnesota Union.

MINES

JULIAN H. LEVY, '23, has changed his location to Kenneth Square, Pennsylvania, where he is construction inspector with the Pennsylvania Highway Department.

Making his way by river boat and on foot through the heart of African wilds, his only company a group of native black men, JACK MIDDLETON, '23, is searching for an undiscovered patch of blue mud to tell him where diamond niches are hidden. For months Middleton travelled by riverboat with about 150 natives, through Cairo, Ava, Miangara, before he reached Forminiere. He states that domestic relations there are very business-like, the black man buying a wife for 10-15 francs, according to her worth, and if later he finds her unmanageable, he has a perfect right to resell her.

NEW UNIT

(*Continued from page 8*)

"T" head bolts will be used when necessary for bolting machines to floors. All laboratory floors are of hard wood.

LECTURE DEMONSTRATION

Each classroom and lecture room has under the front edge of the lecture table a panel like that shown in Fig. 10. This together with portable lecture tables, equipped with rubber-tired wheels, caster fitted equipment and instrument carts, enables each instructor to make use of demonstrations as desired even when it is necessary to change lecture equipment during the ten minute interval between classes.

The design and construction of this building and the fixed equipment involved, of course, many deviations from standard building practice. Hence it is a pleasure to state that the absence of mistakes can be accounted for by the earnest effort and cooperation of architects, engineers and contractors as well as by members of the University.

Architects—Clarence H. Johnston, St. Paul.

Engineers—Chas. L. Pillsbury Co., Minneapolis.

Electrical Work—Commonwealth Electric Co., St. Paul.

FORWARD TREND OF SCIENCE

(*Continued from page 16*)

Perfection of this delicate new apparatus places a greater responsibility upon the faculty. They must present to the student body the fundamentals of engineering. To-day's developments will be fundamental principles to-morrow. More study and research is therefore demanded from the members of the teaching profession. Complete knowledge of certain branches of scientific endeavor is admittedly unavailable due to its control by large commercial organizations. A way to combat such a deplorable lack of quantitative data may be found in the laboratories of the state universities. It is reasonable to believe that Minnesota's faculty will do its share. —K. R.

ALUMNI ISSUE IS PRAISED

Professor Shepardson recently remarked to a representative of the Techno-Log:

"I appreciate your alumni issue very much. It is of constant service to me, hardly a day passing without my using it for reference. I sincerely hope that you will continue your past policy and publish another such issue this spring."

The Minnesota Techno-Log expects to publish such a number again this year as the June issue. Undoubtedly many mistakes were made in the previous edition, names omitted, addresses or occupations wrong. In order to make this coming list as accurate as possible, any additions or corrections from our readers will be gratefully received and made use of.

RUBBER PAVEMENT

The largest area of rubber street paving ever laid, was recently completed last fall on the Michigan Avenue bridge in Chicago. Rubber has been used as a paving material before, but never on such a large scale as here.

Several rigid requirements were met in the choice of a flooring for the bridge. Traffic is very heavy, between 58,000 and 60,000 cars passing over it every 24 hours. The bridge is a double decker one, and much trouble was experienced in rainy weather because of oil and dirt seeping through the ordinary wood flooring and dripping on vehicles below. Rainy weather also made skidding frequent on the bridge.

Rubber paving was laid across the entire span of the bridge, in two sections, a strip 12 feet wide and 150 feet long for sidewalks and a 30 foot strip of the same length for traffic, making a total of 6,300 square feet of rubber surface. This improvement is proving very efficient. Rubber has remarkable wearing qualities and also is not subject to such a degree of expansion and contraction as wooden blocks.

BETTER LIGHTING NEEDED IN INDUSTRIAL PLANTS.

In a paper read before the Illuminating Engineering Society, February, 1920, entitled, "A Survey of Industrial Lighting in Fifteen States," R. O. Eastman submitted some very interesting data regarding the lighting conditions in industrial institutions. The survey comprises some 446 institutions, in which lighting was considered by 55.4% as being vitally important, and by 31.6% as being moderately important, and by 13% as being of little importance. Practically 58% considered that lighting was as important as power in the operation of the plant, and a small proportion would give more attention to lighting than to anything else.

In considering the present condition of lighting as found in the various plants, only 9% ranked as excellent, about 1/3 ranked as good, 29% fair, 18.8% poor, 3.5% very poor, and 7.8% partly good and partly poor. It was found that the lighting in the offices was far superior to that in the shops; 19% being excellent, 36% good, 31% fair, and only 13% poor and none very poor.

On consulting the executives regarding what factors were most important in considering lighting, the following facts were revealed: Increase of production 73.4%, decrease of spoilage 71.1%, prevention of accidents 59.5%, improvement of good discipline 51.2%, and improvement of hygienic conditions 41.4%. Manufacturers who have good lighting appreciated its value largely from the standpoint of its stimulating effect upon output.

There is no question that any intelligent man who carefully considers the necessity for good lighting in an industrial plant, will agree that it is impossible for a person to do as good work, either in quality or quantity, in poor light as in good light, but yet the result of a careful analysis discloses the fact that only about 40% of industrial plants are furnishing good light to their workers and 80% are operating under poor lighting. It is hard to understand why such a proportion of concerns can be satisfied with a condition which is universally admitted to be a curtailer of efficiency and a prolific causer of accidents. The principal cause of this condition is that those in charge of such establishments have not given the attention to lighting that it demands. They do not know what constitutes good lighting, and in their absorbing interest of other factors of production have overlooked a vital one.

Every safety official should deeply interest himself in the lighting of his plant and insist upon good lighting as much as good goggles, good guards and other necessary accident prevention equipment. Every production manager should insist upon good lighting because the efficiency of the working force is increased by the condition of the lighting furnished. The plant physician should examine the lighting, for eye strain and eye fatigue are directly affected by poor lighting, as is the hygienic condition. Well lighted plants are invariably cleaner than poor lighted places. Plants equipped with Factrolite Glass in all windows are well lighted.

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. 5.

PLATTING

(*Continued from page 12*)

areas devoted to farming or gardening, judging from the income which may be attributed to each. There should be a fifty year program for schools, parks and recreation grounds. Every creek with its timbered banks or gently rolling slopes is a potential community playground or regional park. There are many waste spaces, dumping grounds, marshes and sinks which are now simply an eyesore, a breeding place for mosquitoes. A competent landscape architect will soon show how these may be converted into beautiful play and recreation grounds; furthermore the acquirement of these places would increase land values and the tax producing power of surrounding lands, for the value of land is determined by its potential use, and use is determined by environment. Land at White Bear Lake has value because of the competition for home sites. Land around a hog feeding farm has a low value, for its use limits or fixes the standards of use of the surrounding land.

A regional plan requires surveys and research work of a high order, for we cannot discuss a problem without having the facts relating to that problem. The surveys of the region would cover topography, population, highways, woodlands, factories, prevailing winds, land values, church and school centers, existing platting, lakes—their elevation and natural outlet, power supply, rural park systems, waste dumps, etc.

The first survey maps would be based primarily on existing section maps, for ownership of property and land values must be based on such maps. A very excellent control can be established over a part of this area by using U. S. Geological Survey Topographical Maps. It might be necessary to extend their triangulation system west to the St. Croix and south of the Minnesota River. The main topographic characteristics of the larger part of the region can therefore be obtained from existing maps, and when platted on the regional map would give a wonderful base for all future surveys. Upon this map would then be shown the culture—roads, bridges, railroads, electric railways, buildings, ferrys, ditches, ownership lines—and platting also the natural features such as drainage, streams, rivers, lakes, sinks, marshes and timber, and then would follow the social and economic surveys, charting on maps the facts that they may be easily analized.

The future environment of the University of Minnesota must be given a consideration which has not yet been given it. The minds and manners of young men and women should not be exposed to the distraction, levity and luxury of a commercial city continuously. When one considers such strictly university towns as Cornell, Cambridge, Ann Arbor, Harvard, Champaign, Berkeley and Stanford, it is evident that we may have to look to our laurels in competition with their fine setting. Can we not create environs of such fineness and beauty by a regional plan as to counterbalance the more mundane influence of the city?

The Metropolitan District should have a boundary line that would include the western valley of the St. Croix from Taylors Falls and the Interstate Park to Point Douglas. It should include the Mississippi Valley from Elk River to Red Wing and the valley of the Minnesota from Jordan to Fort Snelling, also Lake Minnetonka on the east and the great lake region north of St. Paul. A local government could be created covering this entire region, whose sole function would be planning, studying and planning only those problems which affect more than one community, leaving to the regular local authorities their jurisdiction over carrying out the plans. Such would be the Metropolitan Planning Commission of this dual city and its environs.

WELDS

(*Continued from page 15*)

cause of a drop of 27.2% in elongation and 36.5% reduction of area respectively. A comparison between a welded, hammer refined bar and a hot rolled, slowly cooled bar may not be an appropriate one to make: a more accurate and fairer comparison probably would be between a heat treated welded bar and an unwelded, hot rolled, slowly cooled bar. Between these two, represented by group No. 2 and No. 4, the properties very closely resemble each other. Both specimens possess an ultimate strength of 65,000 lbs. with an elongation and a reduction of area almost identical. This represents the ideal condition. For in structural work, bridges, etc., no purpose is served by strengthening, out of proportion, a comparatively small area in one section of a long tie rod for instance. The objective, rather, should be the maintenance of the properties which the original unwelded bar possesses, and this is all that should be expected and required.

Annealing of Welds

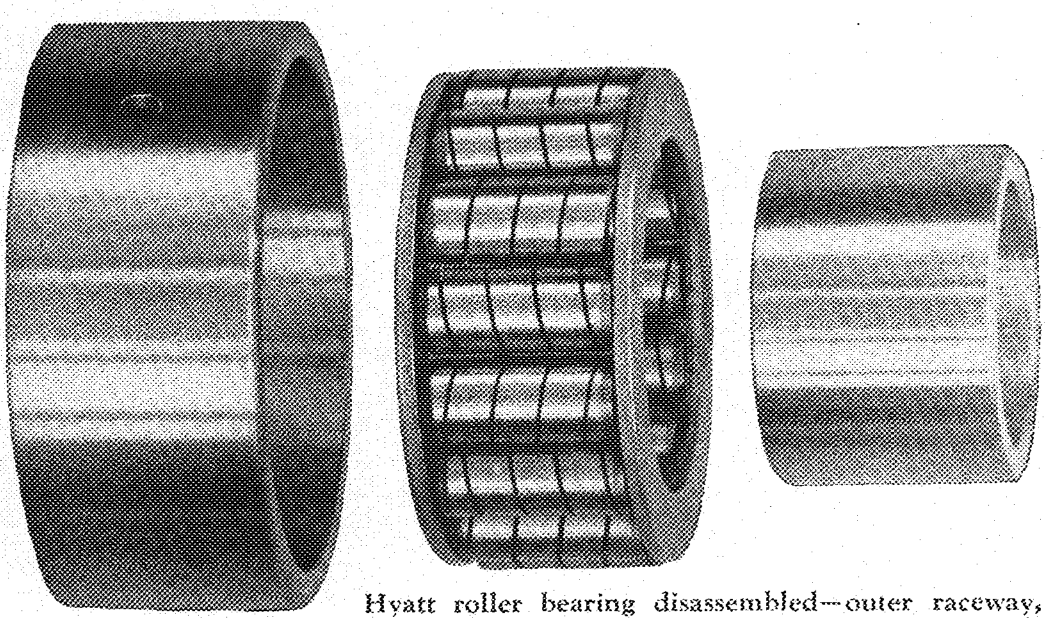
It was very clearly proven by these tests that, where fairly high tensile strength with high ductility are desirable that all welds should be annealed to release strains, due to forging, and hardness. It may be of significance that only one specimen fractured in the weld. The fracture showed a coarse, shiny crystalline structure and clearly indicated that it had been overheated. The other specimens showed a structure that varied from partly crystalline to silky.

ELECTRICAL SHOW

(*Continued from page 10*)

Seniors and could be turned over to the University authorities, with regulations and restrictions as to its use. It could be handled similar to other funds under University control. A loan committee would receive applications and grant loans upon recommendation of the head of the department. A definite number of loans would be made each quarter, so as to come back in a successive cycle. The electrical students work hard for their shows and should be allowed to benefit by the profit derivable.

Like any other show or public enterprise, the Electrical Show could not be undertaken without the utmost co-operation possible. If the Show's success were left to one or a few students, it would amount to nothing. Everyone has to take personal responsibility and enter into the spirit of the thing. The co-operation of the faculty cannot be over-valued. Although they are not actively engaged in the show, the value of their advice and encouragement is inestimable. The generosity of the department and of various manufacturers in loaning apparatus and material is most highly appreciated. The Electrical Party has become an institution at Minnesota, but the Show phase must be supported by the University as a whole, if its continuance is to be justified. We will try to make the exhibits educational as well as amusing, to minimize mere "stunts," and to impress upon visitors some of the basic principles of electrical engineering as well as some of the modern engineering achievements.



THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

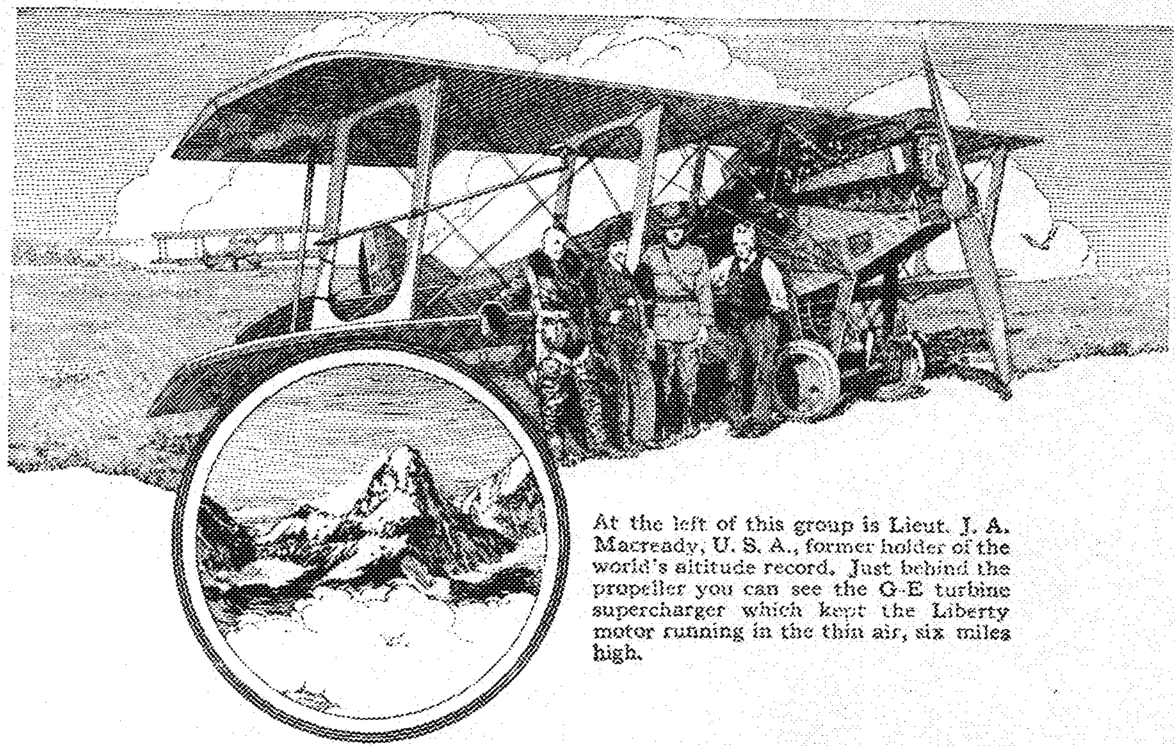
Engineers' Day Number

APRIL
1925

Volume V — 25 CENTS A COPY — Number 7

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE
TECHNICAL COLLEGES



At the left of this group is Lieut. J. A. Macready, U. S. A., former holder of the world's altitude record. Just behind the propeller you can see the G-E turbine supercharger which kept the Liberty motor running in the thin air, six miles high.

Over the mountain by a mile

Year after year, plucky explorers try to climb Mount Everest, the world's highest peak, 29,141 feet high.

With a G-E supercharger feeding air at sea-level pressure to the engine, an airplane pilot can go far higher. Lieut. Macready has reached 34,509 feet over Dayton, Ohio. He would have soared over Mount Everest with more than a mile to spare!

The tasks attempted for centuries in almost every form of human endeavor have been conquered with the aid of electricity, with more than a mile to spare.

The impossible today will be accomplished by men and women now in college. The scientist and engineer are doing their share. It remains for men and women entering upon their life's work to profit by the new opportunities that are constantly appearing in every profession and vocation in the land.

The supercharger is a turbine air compressor, which revolves as fast as 41,000 times a minute—the highest speed ever developed by a commercial machine. It is designed and made by the General Electric Company, which also builds the big turbines that supply electric light and power.

If you are interested in learning more about what electricity is doing, write for Reprint No. AR391 containing a complete set of these advertisements.

6-11DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The MINNESOTA TECHNO-LOG

37 Electrical Building

UNIVERSITY OF MINNESOTA

HERMAN F. BESELER AND KENEFICK ROBERTSON, *Managing Editors*
RICHARD W. JONES, *Business Manager*

VOLUME 5 — NUMBER 7

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

Application for second class rate pending.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.

St. Patrick

By William Magim

A fig for St. Denis of France,
He's a trumpery fellow to bragon;
A fig for St. George and his lance,
Which spitted a heathenish dragon;
And the Saints of the Welshman or Scot
Are a couple of pitiful pipers,
Both of whom may just travel to pot,
Compared with the patron of swipers,
St. Patrick of Ireland, my dear!

He came to the Emerald Isle
On a lump of a paving-stone mounted;
The steamboat he beat to a mile,
Which mighty good sailing was counted:
Says he, "The salt water, I think,
Has made me most bloodily thirsty,
So bring me a flagon of drink,
To keep down the mulligrubs, burst ye,
Of drink that is fit for a saint."

He preach'd then with wonderful force,
The ignorant natives a teaching;
With a pint he wash'd down his discourse,
"For," says he, "I detest your lay preaching."
The people, with wonderment struck
At a pastor so pious and civil,
Exclaim'd "We're for you, my old buck,
And we pitch our blind gads to the devil,
Who dwells in hot water below."

This ended, our worshipful spoon
Went to visit an elegant fellow,
Whose practice each cool afternoon
Was to get most delightfully mellow.
That day, with a black jack of beer,
It chanced he was treating a party;
Says the saint, "This good day, do you hear,
I drank nothing to speak of, my hearty,
So give me a pull at the pot."

The pewter he lifted in sport,
(Believe me, I tell you no fable)
A gallon he drank from the quart,
And then planted it full on the table.
"A miracle!" every one said,
And they all took a hand at the stinger;
They were capital hands at the trade,
And drank till they fell; yet, by jingo!
The pot still frothed over the brim.

Next day, quoth his host, "'Tis a fast,
But I've naught in my larder but mutton,
And on Fridays who'd make such repast,
Except an unchristian-like glutton?"
Says Pat, "Cease your nonsense, I beg,
What you tell me is nothing but gammon:
Take my compliments down to the leg,
And bid it come hither a salmon!"
And the leg most politely complied.

You've heard, I suppose, long ago,
How the snakes in a manner most antic,
He march'd to the County Mayor,
And trunded them into th' Atlantic.
Hence not to use water for drink
The people of Ireland determine;
With mighty good reason, I think,
Since St. Patrick has fill'd it with vermin,
And vipers, and other such stuff.

O! he was an elegant blade,
As you'd meet from Fair Head or Kilcrumper,
And tho under the sod he is laid,
Yet here goes his health in a bumper!
I wish he was here, that my glass
He might by art magic replenish;
But as he is not, why, alas!
My ditty must come to a finish—
Because all the liquor is out.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V | APRIL, 1925 | Number 7

EXPERIENCES OF A '23 GRAD IN AFRICA

MINNESOTA'S graduate engineers go in many fields of endeavor. Perhaps *none* have had such unique and thrilling experiences as Henri LaTendresse, Mines '23, who has been prospecting and mining in the heart of Belgian Congo. Henri, or "Hank," was champion heavyweight boxer while in school. This stood him in good stead as the reader will find shortly. The following are excerpts from letters written to LeRoy Grettum, a former classmate of LaTendresse:

From Letters by Henri La Tendresse
Arranged by Paul B. Nelson

"July 11, 1924. It is evening after an especially distressing day. I have just had my supper and can think of nothing better than to write to you. I am sitting alone in front of my grass tent and I cannot see further than eight feet away—the distance that my old kerosene lamp throws its rays.—The night is an especially dark one and it is just the ideal kind to write a short letter and go to bed early.

"As I sit here I can hear the distant beating of drums, which is the only thing that makes me realize that this part of the country is not mine alone. I feel unusually lonely tonight; it may be the drums or maybe it's because the night is so dark. But let me forget about drums and darkness.

"Already the climate is thinning my blood and I react quickly to the cool (evening) breezes. At first I didn't notice it, but now I find the mornings chilly; in fact, so chilly that I lie in bed for a few minutes and allow a few thoughts of self pity because I must change from pajamas to B. V. D.'s.—In the mornings, I have as much energy and pep as I ever had in the states, but about 3 P. M. I begin sinking—all people do—and then my physical effort lays havoc; worse still is that it makes one lose his temper.

"Two days ago, at 2:30 P. M., one of the creeks broke loose. I hollered my lungs off for the men to come and stop up the gap, and ran around a corner to see a few natives non-chalantly trying to catch minnows. I ran up, knocked two down, and almost died myself. My heart missed a few beats and then thumped all around my chest. Bad business; must take it easy. Nights I feel alright, so it's the blasted sun sure."

* * *

"A week ago I went down to the crossing on the Luembe River to see some material that was to be transported across the river. The company owns a small native boat (hollow log) which is used by native porters and others in crossing the stream. When I arrived at the river, there were two strange natives in the boat trying to land, and a strange Belgian shouting vociferously that they had no business in the boat. The river is a large one with dangerous eddies and currents. The boat was caught in one of these eddies so that it came close to shore, out and then back again. Each time the natives tried to grab the limb of a tree as they approached, but failed in both attempts. Finally the Belgian lost his temper and threw a rock at the boat.

"In trying to dodge the rock, one native lost his balance and went overboard. I was upstream a bit when this happened and I heard the Belgian yelling 'Cum Queek!', so I 'cum' and just saw the negro's arm disappearing. I rushed pellmell into the water towards the boat, followed by the excited Belgian, who wanted to help and forgot he himself could not swim. The remaining native in the boat saw us coming and, misjudging our intentions, he, too, jumped overboard and sank. In front of me were the two natives drowning, behind me the Belgian also trying his best to do the same thing. I thought a moment and decided to save the Belgian, which I did. I am not sure that it was a wise decision, but it cannot be undone. The Belgian felt very badly about it all and cried, whereupon some natives, who had collected, said: 'What's the matter with the white man? Those fellows didn't work for him. What's he feeling bad about?'

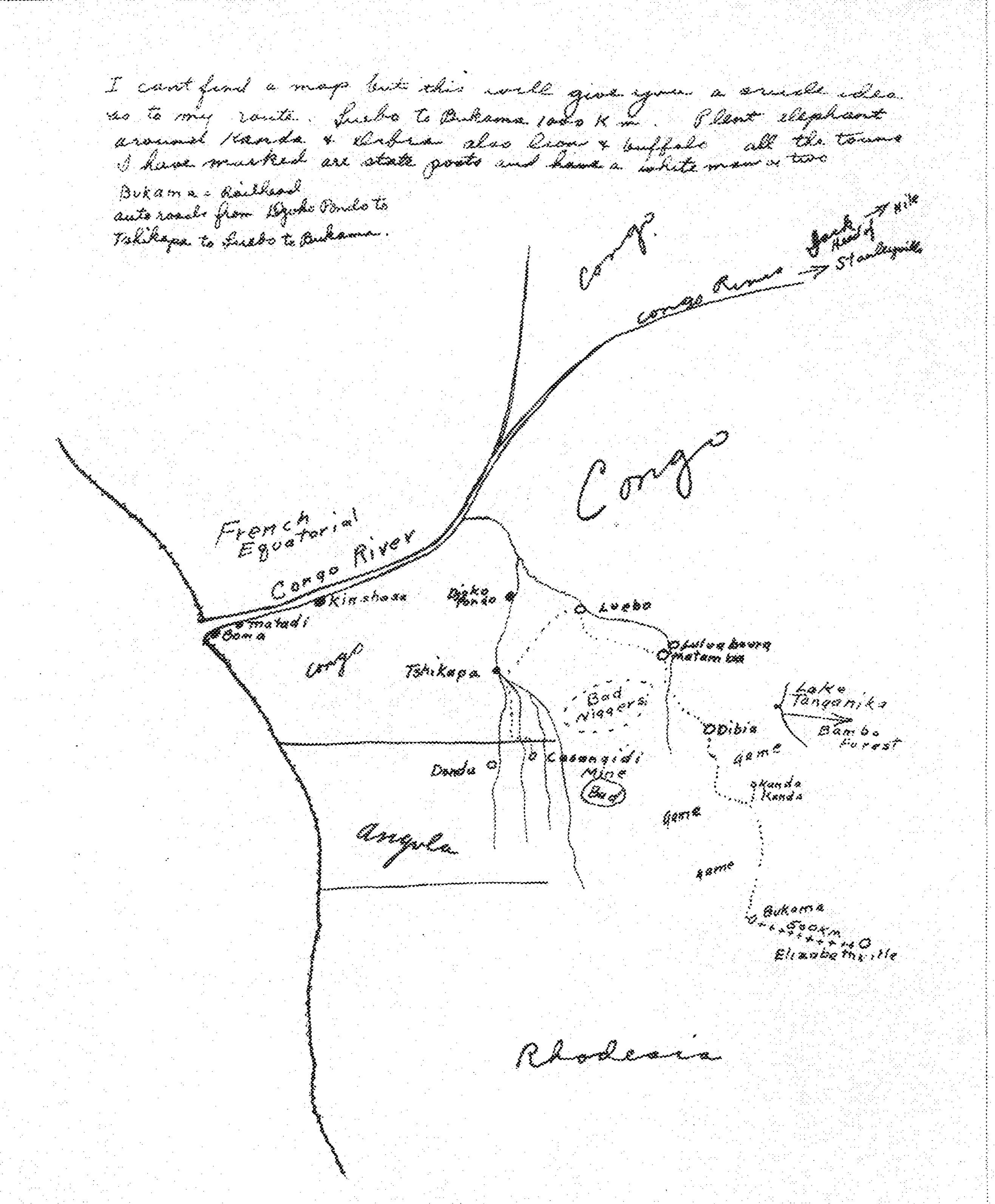
"Things are getting in a bad way here. The Portuguese government resents the fact that Americans are managing all the mines in their province and the government is stepping in and making trouble. First they demanded that one-half the agents be Portuguese, which was granted. Now they desire that the Portuguese run the whole shebang and gradually they will squeeze the Americans out. When the Consulting Engineer leaves in two months, it will be for good, and the Portuguese will step in. Then watch out! I am the last American to enter the country and in a year I will be the only one in it; that is, if I am here that long. Personally I look for trouble from that source and nothing will surprise me. To me it appears right now like the lull before a storm.

"The night is blacker than ever, and I must go to bed before I get the beebie-jeebies."

(Note: There was no date on this next letter, but it was evidently written about two days afterwards.)

"Last night, the moon was too damned bright and round—I felt it right along. Tonight it is still bright and round, but not nearly so interesting to me. It seems to say: 'I told you so.' This morning quite a number of men were missing from the mine—they've been getting the habit lately—so I sent a man up to the village to bring down every man, sick or not sick. Those who were really sick I planned to send back. About noon he brought six or seven men to me, two of whom were really sick.

"I am not in the habit of striking natives, as I have mentioned in other letters. I do not believe in booting them around to appear hard, but when it appears necessary, I have always had an open hand ready to flatten them out. On this day, men were



Unretouched etching of the map drawn in Africa by LaTendresse, showing his 1,000 mile journey through the jungles.

badly needed. I forgot myself and hit the five healthy looking ones with my closed fist and stretched them out around me, to the great amusement of the workers. Unfortunately, however, one of them took it into his head to die, which he did without any fuss other than a lot of saliva and a few quivers. The village sentiment is not for or against me, excepting, of course, the friends of the deceased. They all say the same thing—that I am good most of the time, but when I hit them it is mighty hard. You see, I have been feeling the lay of the ground.

"The last two I spoke to said that when I hit them it was like a blow from a hammer, and with a slap I put the biggest fellows out of order. All of which was flattering, but not quite true, and I hope they don't speak that way about me to the government men should they investigate. I do not know as yet what will come of it as it just happened, but in the case a howl should start up, I'll bet you an American dollar against a Portuguese escuda that they can't catch me on this side of the border.

"If the natives were not such a cowardly lot, I might expect an avenging bullet from the bushes as I sit here near my lamp. But instead of pulling a real stunt like that, they go and die when you least expect them to try to get you in trouble. It wouldn't surprise me if that fellow did it on purpose. Something which worries me more is that I hooked the palm of my hand on one fellow's filed teeth; the cut may become infected. If I had any say in the matter, I'd pass a law against the filing of front teeth; they're dangerous.

"In a couple of weeks, or maybe in this letter, I'll let you know how the affair turns out.

"Two days later and things are looking bad for me here. Mr. Kelsey and Mr. Doyle (the head of the Company here) talked it over with me and they felt that in a trial I didn't have one chance in a hundred of exoneration, but he asked me to wait and see if I received a summons. This morning I am packing, and if soldiers should come, I am off through the jungles with one native and one trunk, for the Congo border, because I would rather die than go to a Portuguese post. If you don't hear from me for some time, I may be in the bushes."

(*Note: The following letter was written four day later, about July 20, 1924.*)

"Dear Roy: The day after an unfortunate native fell down and died, Mr. Kelsey and Mr. Doyle (high chief of them all) came out to the mine. Kelsey thought it was extremely unfortunate that 30 natives had just left for Dunder to complain to the government and said that I would surely go to jail if the Portuguese took up the matter. Mr. Doyle, however, felt that he might be able to smooth matters over a little and they left immediately for Dunder with that idea in mind. Knowing the malice held for Americans by Portuguese, I decided to take no foolish chances, so the next morning I donned my best hiking clothes, packed my medicine kit, food and change of clothing into a box, and formed a general plan of action. It was well that I did.

"That afternoon at 1:30 o'clock, Mrs. Eulich's boy came running up crying, 'Mamma says to go quick—go quick—go.' It came so suddenly that a chill ran down my spine and my mouth became dry, but I gave my orders with precision, celerity, and dispatch. While at the mine, a young native always followed me around to run errands and such. He was named 'Nyama' (animal) on account of his nerve, a thing remarkable in itself, inasmuch as he was a slave. I now turned to this boy and told him to tell Louie (one of the best men at the mine) to run quickly to my house, and for him, Nyama, to take my canteen and follow me. We took a side trail to my hut and upon arriving there found everything in confusion. The boys said excitedly that the Portuguese were after me—an entirely uncalled for repetition—and then stood around and stared. All but Louie, who had reached the hut before me. He had already suspected what it was all about and had stripped for action. I told him I was going to the Congo over the native trail and that he should follow with two blankets and the wooden box. He said he understood, and I started out, Nama carrying my canteen and a saddle bag filled with salt.

"Now that I was being hunted, I felt very primitive ideed, still I would have welcomed the revolver which I had left at the border when I had entered the country. I had Nyama follow the trail, but I walked in the brush alongside of it so that my tracks would tell no tales. After three miles of this, I decided to take the trail and move, which I did. Mile after mile we covered over shrub-covered hills and through valleys of dense jungles. At times we had to cross creeks and muddy spots; at first I took off my shoes, but I tried to jump the third creek and landed in the mud and water. After that I just waded through. I was muddy and my shirt was torn and stained with blood (I had nosebleed several times on this first trip). The exertions set my heart to pounding until I thought it would break itself against my ribs, and the perspiration was streaming off my body, but we kept on.

"Eighteen miles from Casangidi, a short distance from the trail, a Portuguese fort was situated and I was slightly worried for fear we would encounter soldiers on the trail at that point. As we neared the place where I felt the fort had ought to be, I had Nyama keep some distance ahead of me and told him to examine the trail for footprints. Once we heard movements in the tall grass to one side; Nyama found lion tracks on the trail; I gave a sigh of relief and motioned him on. At 5:30, just as the sun was moving rapidly for the horizon, we came within sight of the fort and then I heard a cough behind me. I turned suddenly, half expecting to find myself in a trap, but it was Louie with the two blankets but no box. There was nothing to be done now but to continue on to the border. Louie said we would go on to the small native village of Monzombe and I said, 'Alright, just so we move north.'

"Believe me, Roy, I was mighty tired, especially now that we were walking along in the dark. I kept my eyes fixed on the dark outline ahead of me and did some mighty heavy thinking. It was hard to realize that it was all real, not a dream—traveling in the night through African jungles, a fugitive from justice (or injustice). My emotions varied: at times I wished myself back in my little old bed and again I'd think of what an adventure it would be if I wasn't caught. Adventures are uncomfortable usually.

"At 9:00 P. M., just as I was musing on what a nice thing it is to have the law always *back* of you, we entered a native village and approached a group of the natives sitting around a fire and smoking their community pipe. As we came up, the chief 'Monzembe' stood up and said 'Moya!' (meaning welcome or good-by) and I saluted, after which he departed to return with an old camp chair and eight eggs as a present. Briefly, the idea of gift giving is this: when a chief brings a present, he admits by the action that you are a bigger chief than he and quite naturally he expects a larger gift from you. In this country, however, the custom has degenerated into a means of getting a better price for food, so when a chief brings you eggs and chickens, just give him a generous portion of salt, say a cupful. I was damned near finished, so I sat down and sucked a raw egg. I had intended to suck them all, but the first one broke in my mouth and then I told Nyama to boil them—hard. That night I slept in the camp chair in preference to the hut offered to me by the chief. Louie and Nyama slept near the sickly fire in front of me.

"It was terribly chilly and I got up at 4:00 A. M. The night before I had eaten seven hard boiled eggs (and one awfully raw). Now I ate three more and some native potatoes. For an hour I argued with the chief to let me have men to go for my baggage.

"'Come, chief,' I said, 'Don't be a crab—what's a few men between friends. Let me have them, will you? Be a sport. Sure, I'll give you some salt and cloth.' So in the end he saw the logic of my argument and gave me ten men, who left for the mine with Louie. I spent the day in the camp chair, swatting flies and eating native potatoes.

"About 6:00 P. M., just after I had finished another batch of potatoes, the men came running in with my wooden box—both trunk, bed, and a box of food. I could have wept for joy when I saw my cook come in, but I simply said in my best native slang, 'Things has gone fur enough, we has got to have something to eat. Cook a meal without potatoes.' An hour later, Louie came in with his household furniture, his wife and two kids. With that responsibility on his hands, he ceased to be of any value or assistance to me. Upon his arrival, he handed me a note saying, 'Do you know Monzembe is not in the Congo?'

"The men knew I was in a palaver and the next morning they held me up shamelessly to transport my stuff to the next point, Cambushi. They even forced me to pay in advance. I regretted this later, for two of them ran away the first morning. However, I adjusted the load to eight men and moved on without further difficulty. The usual time for travel for parties is from five to twelve in the cool of the day and white men are usually carried in tepoi, but I walked and there was no stopping for the mid-day sun. Sunday was the first day of real travel and we covered thirty-five miles.

"On Monday, we arrived at Cambushi, where I met an old American prospector who advised me to beat it down to the cape, as the Portuguese undoubtedly would get me out of the Congo by extradition. This was a blow to me and I began to appreciate the real seriousness of my position, but as I was broke, there was nothing to do but await developments. I was in no shape for leaving the country as all of my belongings had been left behind at the mercy of the Portuguese and no telling when I would get them back if ever.

"I waited two days at Camakershi and finally an American, Mr. Moody, came out and said that Mr. Doyle had said I could go back to Ishikapa with him if I wanted to. This sounded very much as if I no longer was with the company. Having nothing better in mind, I went in to Ishikapa that afternoon.

"All this time as I pondered over the matter, I kept saying to myself, 'Things will turn out all right, things hardly are ever as bad as they appear at first.' But in this adventure, (if I may call it that), things kept gradually getting worse than I had anticipated.

The next morning I was surrounded by the big men of the company, stern and forbidding. They asked me to go back to Angola to stand trial, as the company's position there was very delicate. I also heard to my astonishment, that I had jumped on the native while he was down and that at post-mortem, they had found a brain hemorrhage and a caved-in chest. What hurt me most was that this was believed to some degree by the company men. Now, I cannot deny a hemorrhage, because I did hit the man, but I draw the line at caved-in chests. If that native's chest was smashed, who the Hell did it and when, is what I would like to know. I suspect Portuguese trickery some place.

"I shall never forget the scene that morning as we stood on the banks of the Kassi River. Some stormed and threatened, others pleaded, and all were nervous and jumpy. All but I. Roy, never in my life did I argue with greater ease and better logic. I had a ready answer to every question, a retort for every insinuation, a parry for every thrust. I ended with words to this effect:

"'Gentlemen, I am sorry for this sad occurrance, and I am perfectly willing that the company enjoy special privileges in Angola, but I am not willing to sacrifice my liberty in the cause. You say that the company will back me to the fullest but you can promise nothing. With that hard and fast evidence against me, I wouldn't stand a chance in any court in the world. That, you know. One of you carelessly remarked that I deserved a jail sentence. That is a reason why I am not returning to Angola. If you half feel that I was guilty, I cannot hope that your support will be as strong as it might be. Gentlemen, hand me over to the Belgian authorities. It will clear and it will please me better.'

"After this they treated me better and evidently saw some fallacy in the evidence found. But all they could do was to send me to the state post, 180 miles away.

"Roy, maybe I did kill that native, I don't care about that. The thing that hurts is to be accused of jumping on him, hurting all the more because it will find believers. There is no doubt in my mind but that I will be confronted with that accusation from time to time during my future life, and I hope for the sake of all concerned that it will be put in question form. As I write, I am at some unknown body's house midway between Isikapa and the state post. What will await me there I do not know."

* * *

Later. "Worse every step. Am on the verge of being arrested by the Belgian authorities and am beating it south on a 1000 mile hike with less than $25, a little clothing, and no food. Can you imagine a worse pickle? Going to pass through big game country and have only my 45 revolver. Oh, well, if I can get away, suppose I'll live through it all right, but I expect to be thin at the finish. Barring accidents, I ought to make the border in thirty days. Good-bye and pull for me. Your friend, HANK."

Letters that followed stated that LaTendresse never found out for sure whether or not the native he struck died from the blow or was merely unconscious when Hank ran back to direct the work of the natives, probably being killed later by some

(*Continued on page 28*)

ST. LAWRENCE-TO-THE-SEA WATERWAY

By Francis C. Shenehon
Former Dean of Engineering
Consulting Hydraulic Engineer

IN October last, at the summer meeting of the American Society of Civil Engineers, the writer presented a voluminous paper on "The St. Lawrence Waterway to the Sea." The question may arise why a Minneapolitan should be chosen to present the subject of this waterway, since the St. Lawrence River itself lies 1400 miles away by river and lake.

The answer to this question has two phases: One is that Minnesota is most vitally concerned of all the states of the Union in transforming the rapids section of the St. Lawrence River into a deep draft waterway, permitting the vessels of the world to come from the blue Atlantic to the westernmost port of the Great Lakes system at Duluth; and conversely, permitting the grain and other farm products of Minnesota and the red hematite ore of Minnesota mines to be carried without transshipment to the ports of Europe and through the Mediterranean and the Suez Canal to India and the Orient. And the second reason is that the writer, as a young engineer, helped to build the Soo Line, and when the Soo Line was completed he found himself at Sault Ste. Marie, Michigan, where he had a part in water power development in St. Mary's River, the outlet of Lake Superior, and in the building of the biggest ship lock in the world to permit lake vessels to pass between Lake Superior and the lower lakes. After this work in water power, hydraulic investigations, the building of ship locks and river channels, he was transferred to Buffalo for two years of hydraulic investigations on Niagara River; and after that, two years at surveys and hydraulic investigations on the St. Lawrence River. This last work, completed in 1902, gave him a first hand knowledge of the problems of navigation and water power on this magnificent river carrying towards the sea the surplus waters of the Great Lakes system. Since that time his work as a consulting engineer, in matters relating to the Great Lakes system, have almost continuously kept him in touch with the great problems of these inland seas.

The Great Lakes, with their connecting and outflow rivers, are shown on the map. This map, however, does not show how deep the penetration of the Great Lakes brings water-carried commerce into the heart of

FRANCIS C. SHENEHON

the continent. It is a little startling to find that Seattle lies only 1400 miles to the westward of Duluth.

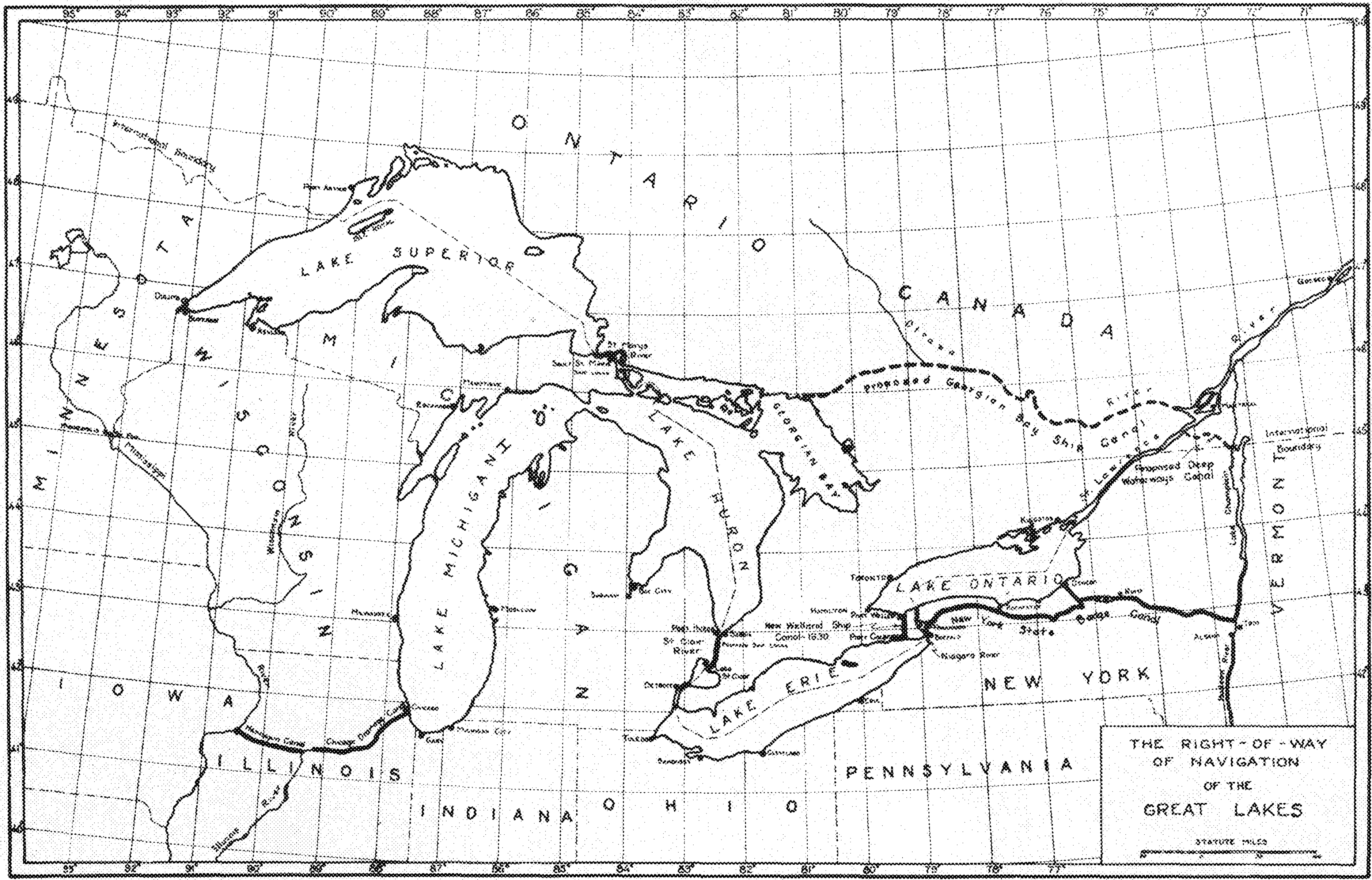
In presenting as briefly as practicable the St. Lawrence project it should be understood that this project has two main elements—navigation and water power. The water power means little to Minnesota and the other western states tributary to the Great Lakes, except that water power will very largely subsidize the building of the navigation parts of the rapids section of the St. Lawrence and therefore make the waterway commercially feasible. But the navigation element—the outlet to the salt seas will ultimately mean tremendous things for the states tributary to the Great Lakes.

Navigation itself may be thought of in three ways. First, the present land-locked navigation of the Great Lakes with its westernmost terminal at Duluth, its southernmost terminal at Chicago, and for deep-draft navigation, its easternmost terminal at Buffalo. This land-locked commerce makes of the Great Lakes system the most important waterway of the world. In 1923 the freight carried through the Detroit River exceeded 100,000,000 tons—which is several times the combined tonnage of the Suez and Panama Canals; and this freight is carried so cheaply that this right of way of the Great Lakes is a vital resource of the United States and Canada.

The greatest part of the downbound commerce is the iron ore from Minnesota mines and the largest portion of the upbound commerce is coal brought from the Pennsylvania mines by rail to the Lake Erie shore and then shipped by boat to Duluth and West Superior. As an illustration of the cheapness of the freight charges it may be said that a ton of coal is carried a thousand miles for 50 cents, while it actually costs as much to move the same ton of coal from the curb at your home, 100 feet to the coal bin in your cellar. It is obvious that the creation of deeper drafts in the Great Lakes system will greatly benefit this existing land-locked navigation.

The second kind of navigation which now exists consists in exits to the sea through various shallow draft and limited capacity canals to the ocean. The most important of these are the Erie Canal, reaching the Atlantic Ocean at the Port of New York, and the Welland Canal passing from Lake Erie and Lake Ontario and thence through the St. Lawrence Canals to Montreal and on to the sea. This type of navigation has the vital defects of small cargoes and transshipment of freight to ocean vessels for the continuation of its trans-Atlantic journey.

The third form of navigation is that contemplated in the St. Lawrence Waterway to the Sea, with all the economic advantages of large cargoes and through routing from Duluth to perhaps Liverpool. It is not probable that this commerce will compare in volume or importance with the land-locked commerce at


THE RIGHT-OF-WAY
OF NAVIGATION
OF THE
GREAT LAKES
STATUTE MILES
ONTARIO
CANADA
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
MINNESOTA
WISCONSIN
MICHIGAN
IOWA
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
NEW YORK
VERMONT
International Boundary
Proposed Georgian Bay Ship Canal
Proposed Deep Waterways Canal
St. Lawrence River
New Welland Ship Canal 1930
New York State Barge Canal
St. Clair River
Niagara River
Toronto
Kingston
Duluth

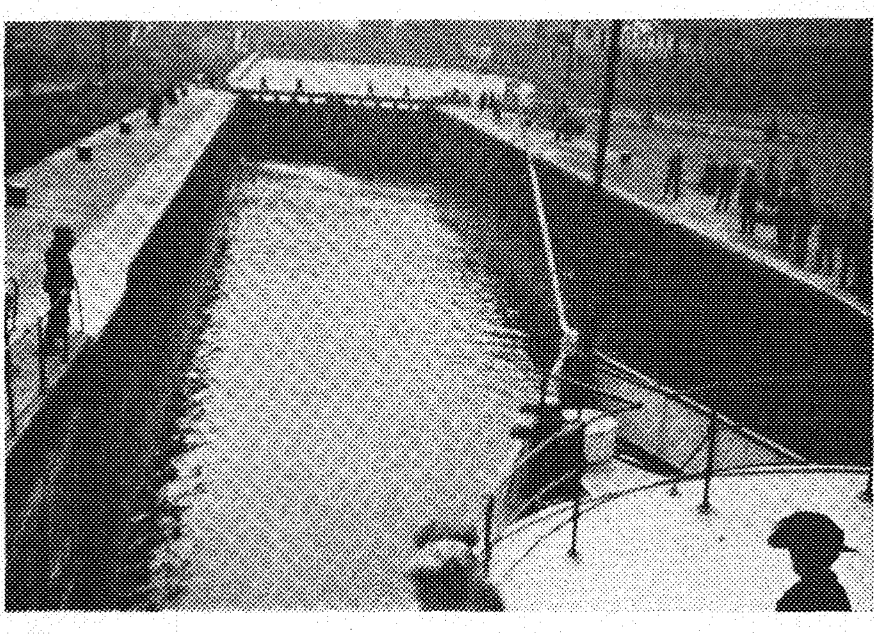
present existing in the Great Lakes system, but it will serve to make Duluth and Chicago ocean ports, where vessels flying the flags of all nations will enter and where vessels flying the American flag will depart for trans-Atlantic ports.

Several routes to the sea for deep draft vessels have been given consideration, but the St. Lawrence route has a transcendent superiority because it is the geological avenue to the sea through which the surplus waters of the Great Lakes pass. And these waters will yield in their descent from Lake Ontario to Montreal upwards of 4,000,000 electrical horsepower as a by-product of the construction of the navigable waterway. This by-product will largely subsidize, as has already been stated, the construction of the navigable way.

It is obvious that when a dam is built in a river, such as the High Dam between Minneapolis and St. Paul, for purposes of navigation, that incidently a water power is created, which in the end may be more valuable than the navigable waterway itself. In a similar manner, the dams creating slack water pools on the St. Lawrence, create deep draft waterways. When ship locks are built, bypassing the dams, and the river itself is, in part, deepened by dredging, the waterway becomes an accomplished fact.

The St. Lawrence Waterway has been visualized by many people as the improvement of the St. Lawrence River itself. This is very far from the truth, because after the St. Lawrence River is improved it is necessary to pass from Lake Ontario to Lake Erie with a rise of 326 feet; and then to pass from Lake Erie to its west end where the Detroit River enters, then from this river and Lake St. Clair to the St. Clair River and up through the St. Clair River to Lake Huron. Then through Lake Huron to St. Marys River and to Sault Ste. Marie, where vessels are lifted 20 feet in the ship locks to the level of Lake Superior. The plain truth is that the St. Lawrence waterway to the sea begins at Duluth or Chicago and ends in the Gulf of St. Lawrence.

Not only must the St. Lawrence River be improved for 25 ft. navigation or 30 ft. navigation, but each of the lakes and all the rivers connecting them must also be deepened so as to permit ocean-going vessels to pass up and down the present shallow channels. The present drafts on the Great Lakes are perhaps 19 ft.



A Typical Canal Lock, Montreal

Ocean-going vessels require 25 or 26 ft., so that a good many millions of dollars must be expended in the Great Lakes system in addition to the sums expended in developing the rapids section of the St. Lawrence.

In deepening these channels two methods are possible: one is to excavate with dredges to secure the required channel depths and the other is to secure some considerable portion of the needed larger draft by raising the surface levels of the lakes and rivers. The writer prefers the latter method so far as it is possible, but appreciates the fact that much dredging must also be done to deepen the channels to the required extent.

PERHAPS the simplest way to explain this waterway is to visualize a downbound voyage on a 600-ft. freighter leaving the commodious harbor of Duluth loaded with 10,000 tons of freight bound for Liverpool. In this journey it will be assumed that all the things have been done which are required in the creation and development of the St. Lawrence Waterway to the Sea. The 600-ft. vessel will have a draft of 25 ft. and it will steam at the rate of about 11 miles an hour. It passes down Lake Superior with a surface elevation of 602 ft. above the sea and with depths in places of 1,000 ft. At the end of 36 hours it reaches the ship locks at Sault Ste. Marie, 394 miles from Duluth. Here an hour is spent in locking down 20 ft. from the level of Lake Superior to the lower level of St. Marys River. The ship locks, which will accommodate sea-going vessels, are already built and in operation. About 25 miles of St. Marys River will have been deepened. The other 30 miles of the river has already available depths.

While our freighter is passing through the ship locks it will be well to visit the regulating works which control the outflow of Lake Superior. Here, in order to utilize the power in the outflowing water—about 70,000 cubic feet per second—lateral water power canals have been built on each side of the river, and where a quarter of a century ago a magnificent rapids with white horses and violent currents existed, now only a dwindling stream runs; while the outflowing waters of Lake Superior turn the turbine wheels in power plants. What has already been done for the outlet of Lake Superior in the way of regulating works remains to be done at the outlet of Lakes Huron, Erie and Ontario. These works will be touched upon as our 600-ft. freighter pases the site.

After passing down the 50 odd miles of the beautiful St. Marys River our freighter passes through Lake Huron—still 583 feet above sea level, with depths as great as 400 feet—and after 216 miles of travel reaches the foot of Lake Huron and the head of St. Clair River.

At the river head regulating works will have been constructed to raise Lakes Michigan-Huron three feet. Here our vessel will pass at full speed through a series of three basins, with a slight descent in each, into the head of the St. Clair River. After 40 miles of the St. Clair River—with a volume of outflow of perhaps 185,000 cubic feet per second—the freighter passes out into little Lake St. Clair, 15 miles across, then into the Detroit River, and 27 miles of travel to the western end of Lake Erie.

Lake Erie is 573 feet above sea level. It is the shallowest of the lakes with depths not much exceeding 100 feet. This lake has a length of 240 miles to the present easternmost port of Buffalo. This port is 985 miles and 90 hours of travel from Duluth. It is situated at the head of the Niagara River, where regulating works will be constructed to maintain the surface levels of this lake and deliver the outflowing water—with a volume of about 195,000 cubic feet of water per second—to the cataracts and to the water powers at Niagara Falls. The descent in the Niagara River from the level of Lake Erie to the level of Lake Ontario is 326 feet. This is one of the greatest water power resources of the world.

The deep draft vessel track which our 600-ft. freighter will traverse descends over the Niagara Escarpment through the Welland Canal, at the present time under construction by the Canadians. The freighter passes through seven ship locks, capable of passing ocean liners of 30 ft. draft—each lock having a descent of 46½ ft.

Leaving the Lake Ontario exit from the Welland Canal and steaming 156 miles through Lake Ontario—with depths exceeding 600 ft.—the head of the St. Lawrence River is reached. After passing down through the Thousand Island region and then through the stately, spacious river, past Ogdensburg and Prescott, our vessel reaches the head of the Galops Rapids 68½ miles below the head of the river and still 247 ft. above the sea level. This point is 1225 miles by vessel track and 121 hours in time from Duluth.

At the head of these rapids, or, in this vicinity, regulating works will be built to maintain the level of the upper St. Lawrence River and Lake Ontario and to release under a budget system the stored water for power uses.

It will be well to disembark from the 600-ft. vessel of our projected journey, because the navigation schemes and water power dams and developments are not yet definitely enough established to describe in any detail. The rapids section of the St. Lawrence will be described as it now exists.

At the Galops Rapids a limestone formation exists creating a natural dam which holds in check the waters of Lake Ontario and the upper 70 miles of the stately, still-flowing St. Lawrence River. Between the head of the Galops Rapids and Montreal—a distance of 112 miles—the river makes a descent of about 220 ft. In the Galops Rapids, the descent is about 8 ft. in 3 miles, then 8 miles of sloping river to the head of the Rapids Plat, in which a descent of 10 ft. is made in 3 miles; then a swift-flowing river for 17 miles to the head of the first big descent. This is the Long Sault Rapids and in the rapids a descent of 30 ft. is made in 3 miles; and the full descent in a distance of 13 miles to the head of Lake St. Francis is 50 ft. To the head of Lake Francis, with a fall of 91 feet, the St. Lawrence River forms the boundary line between Canada and the United States. Then the river departs into Canadian territory and the boundary line follows along the 45th parallel of latitude. Lake St. Francis itself is a capacious expansion of the river 30 miles long with widths varying from 1 to 5 miles, and with water, for the most part now abundantly deep for 25 ft. navigation. The total area of the lake is about 90 square miles. At the foot of Lake St. Francis, the river enters a tandem series of 4 rapids: the Coteau, the Cedars, the Split Rock and the Cascades—the full series making a descent in 14 miles of 83 feet to the head of Lake St. Louis. This lake is another capacious, deep lake, 15 miles long with deep water and an area of over 50 square miles. One branch of the Ottawa River enter Lake St. Louis. The last of the rapids is the Lachine, which makes a normal descent of about 45 ft. in 9 miles to the lower St. Lawrence and the port of Montreal—with the Atlantic Ocean still 1000 miles away, down a magnificent, still-flowing river—with 30 ft. drafts on trans-Atlantic liners an accomplished fact.

Montreal is one of the great ocean ports of the world, equipped for the fast handling of large volumes of freight. Strategically it is 370 miles nearer Liverpool than the Port of New York, and the distance to Gibraltar, the gateway to Mediteranean ports and the Suez Canal, is approximately the same distance as from the Port of New York.

The existing canals of the St. Lawrence River above Montreal, flanking the river along the various rapids, permit the passage of lake boats carrying about 2000 tons of freight on 14 ft. drafts.

At the present time an insignificant amount of water power has been developed, but the potentialities in water power of this magnificent stream are very great. The stabilized volume of flow in the St. Lawrence River, after regulating works are in operation—utilizing the full reservoir flow of Lakes Superior, Michigan-Huron, Erie and Ontario—will be about 220,000 cubic feet per second. This means something over 4,000,000 dependable horsepower. Of this amount about 1,600,000 electrical horsepower is in the International section of the river where half of the power developed will belong to the United States. The balance of something over 2,400,000 is in the Canadian section of the river and will belong to Canada. It will be observed from this that the Canadians' share of the water power is about 80 per cent of the whole, while the United States will have rights in only 20 per cent of the water power.

The great volume of electric current possible of production cannot at the present time find a market, so that it will be perhaps 25 years or longer before the full development may be expected. It is very probable that Canadian policy will compel manufacturers to use the power on Canadian soil, thus building up the industrial importance of that nation.

The great competitor of St. Lawrence power is the electric current produced and producible on the Niagara River, where cheap power may be obtained. It is probable that electric current on the power plant switch board will be produced at about $15 per electrical horsepower year, with 24 hour service, and much of the electric current will be used in electro-chemical and electro-metallurgical processes, where factories run continuously day and night.

The scope of this project is so great that the writer can only sketch in the simplest way its outlines. Just how soon the project as a whole will be completed is difficult to forecast. It is not probable that the canal will be in operation much before the year 1935. The cost of the constructions on the rapids section of the river, with only the Long Sault Rapids developed for water power, amounts to something over $250,000,000. The total cost, when all power is developed will doubtless exceed $400,000,000. To this sum must be added per-

(Continued on page 28)

CHEMICAL WARFARE AND ITS PROBLEMS

By V. N. Morris
2nd Lt., CW-ORC
School of Chemistry

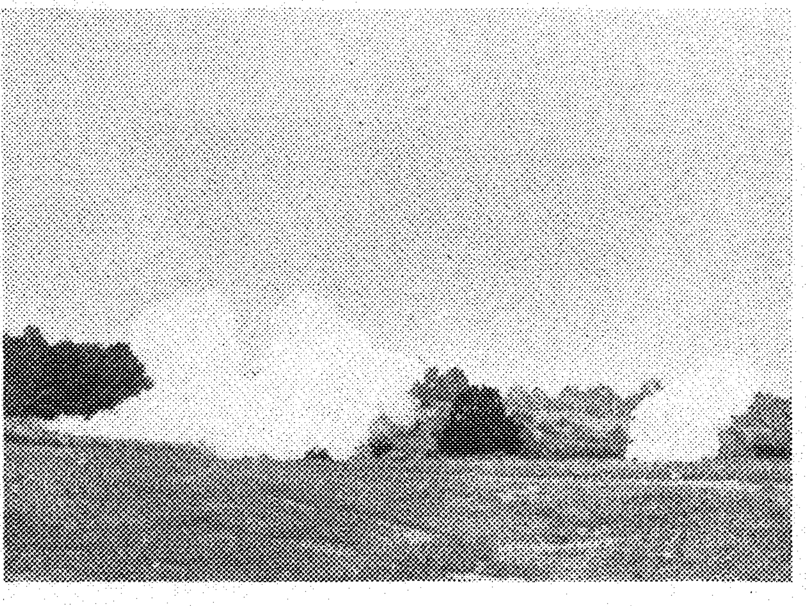
THE idea that chemical warfare was born during the recent World War would probably be accepted without question by the average citizen. A close perusal of history, however, will bring out that such is not the case. It certainly was not always lack of inclination on the part of the various adversaries that kept chemical warfare from playing an important part in earlier wars.

As early as 430 B. C. chemical warfare was attempted by the Spartans, who tried to rout the Athenians from certain besieged cities by burning wood saturated with pitch and sulphur under the walls in the hope of choking the defenders. We have accounts of the attempted use of poisonous gases at various times during the middle ages. Most of these attempts had much greater psychological than physiological effects.

Coming down to more recent history, is might be mentioned that Charles XII, the noted soldier-king of Sweden, made use of a smoke-screen against the Saxons two centuries ago. In crossing the Riga River he ignited masses of damp straw, the smoke from which hid his movements from the enemy.

In fact, the possible use of gases in warfare had so often occurred to military men, that it was brought up for discusion at the Hague Conference in 1899. At that time, most of the prominent nations signed a pledge to refrain from the use of suffocating or poisonous gases. Germany ratified this pledge in 1900. It would probably be a surprise to the average American citizen to learn that the United States refused to sign it.

The suggestion for the use of gas in the recent war has been attributed to Professor Nernst of the University of Berlin, while the first field operation were directed by Professor Haber of the Kaiser Wilhelm Institute. The British were warned of the attack by a German deserter but smiled off the information as being too preposterous to be true. On April 22, 1915, the conditions were just right for the Germans to start a rolling cloud of chlorine against the junction of the French and British lines. The result was a total demoralization of the forces attacked. Had the Germans appreciated the effectiveness of this new mode of attack; had they been well enough acquainted with it to push forward at once instead of waiting twenty-four hours, the whole course of the war would undoubtedly have been changed.



Smoke Shells Fired by the R. O. T. C. at Camp Knox

From that date, the progress of chemical warfare was rapid. High points in its advance were the introduction of phosgene, tear gas, gas shells, Livens projectors, Stokes mortars, sneezing gas, chlorpicrin, and mustard gas.

Not only does chemical warfare include among its agents a number of substances designed to attack some function of the human body, but it also makes liberal use of smokes, incendiaries and pyrotechnics, and explosives. Lack of space will prevent any discussion of these substances.

Among the gases used, chlorine should quite naturally be mentioned first, not only on account of its early use in the war, but also in view of the fact it is used in the manufacture of so many other poisonous substances, such as phosgene, mustard, lewisite, and chloracetaphenone. The next gas to appear was the very lethal substance, phosgene, $COCl_2$, which is manufactured by the direct action of carbon monoxide and chlorine in the presence of a catalyst.

The majority of the lachrymators or tear gases used were aromatic compounds with halogens in the side chains. In general, the value increases from chlorine to bromine to iodine. Brombenzylcyanide, C_6H_5-CH.CN.Br., was probably the most effective of the tear gases actually used. Chloracetophenone, $C_6H_5COCH_2Cl$, while not as effective as brombenzylcyanide, has been found quite advantageous for peace-time uses.

In the spring of 1917, the Italians reported the Germans to be using a new gas, which besides being a tear gas, was also one causing vomiting. This latter action necessitated the removal of the gas mask in an atmosphere of lethal gases. This gas was chlorpicrin, CCl_3NO_2.

The war's most famous, or perhaps most notorious gas, "mustard gas," was really not a gas at all, but a heavy, oily liquid, with a garlic odor. While unstable at high temperatures, it gives off toxic gases on decomposing. The lower the temperature, the longer it remains on the ground or vegetation. Its most valuable property is that of blistering the skin and thus causing wounds which require weeks and even months to heal. Its chemical name is dichlordiethylsulfide and its formula $(ClC_2H_4)_2S$.

Lewisite was the last of the famous war gases. It came so late, in fact, that it was never tried. Undoubtedly many of the fabulous tales of its potency have been greatly exaggerated. While it has a greater physiological action than mustard, it is more easily hydrolyzed, and so may not prove as effective.

(*Continued on page 28*)

SENIOR DESCRIBES DESIRABLE STUDENT

By Henry R. Reed

Member of the Senior Electrical Class

THE fundamental purpose of engineering education it to turn out or fashion men, engineers, who will be of service to humanity. The aims of the employers of student-engineers are to take young men, fresh from college, and mold them to fit into society through their course of training. The courses offered by many of the large manufacturing companies to college graduates may not be that which many students anticipated when they first came to college, but it provides the means by which experienced engineers may teach their successors. These men will teach them, not only along lines pertaining strictly to the scientific side of engineering, but also to the human phase of the profession.

What are the qualities that employers wish to find in students that they may develop into men capable of holding responsible positions? These qualities are the same that time-tried engineers possess, although, of course, they are developed only to a greater or less extent in the student.

A prominent engineer of our day once expressed his opinions as to the three major requirements necessary for a successful engineer. These, as he gave them, are judgment, courage, and willpower. With these three traits a man could move the world. Nothing could stop him—no obstacle could be big enough. He needs judgment in order to decide questions that arise. Engineers must use commonsense, together with their technical knowledge, when called upon to give their opinion, or render a decision. Courage is that quality of mind which enables men to meet opposition with intrepidity, calmness, and firmness. The vast field of engineering is one of opposition and rivalry between individuals and corporations and a man must be able to hold himself up under the fire of competition. Willpower is the power of determination and action. But he must know when determination is effective and when it degenerates into stubbornness.

W. W. Horner, Chief Engineer of Division of Sewers and Paving of St. Louis, Missouri, made the following statement as to the requisites indispensable to the engineer. These essentials can well be heeded by the undergraduate, as they are the elements by which employers class their men. "The engineer cannot afford to neglect the cultural side of life. He must take his place among big men—educated men. To do this worthily, the engineer must have a native ability for mixing, and he must know something of art and a great deal of literature. He should know the fundamentals of law and economics and, above all else, must be able to write and speak good English. He must interest himself in people and train his mind to analyze character. The engineer must also study the psychology of organization and management." All of this deals with the human side of engineering and is essential in order that the engineer may be a big man.

The engineer receives a highly technical training while in college but, never-the-less, he can no longer be criticized as being an individualist. The belief that the engineer lives in a world of his own is no longer true. He is not the man who was believed to glory in pondering over problems in a secluded corner by himself, but is the one who helps to run his state and nation.

The engineer has always been looked upon as a pioneer. The late Samuel Gompers once spoke concerning the engineer and his statement gives the general conception held by the layman a few years ago. He said, "Engineers are the scouts of civilization. We send them ahead into the lone places, the wilderness, the jungles, and the great waste expanses, to build the necessary highways for civilized man." This thought was predominent when civil engineering was the principal phase of the profession. But today, with the wide scope of electrical and mechanical engineering, the so-called pioneer has almost vanished. Even the civil engineer has been brought from the open places to the congested domestic centers. These men are now primarily concerned with industrial development and with the details of modern life and human affairs.

Manage men—that is one of the big jobs that an engineer has to perform. To do this, he must be able to work coherently with all classes of men, and he must be fair and square to everyone. He must have control, not only over others but also over himself.

When the Personnel Engineer of any large manufacturing company comes to a University or Engineering school to interview prospective men for his concern, he always has a number of qualities, besides those stated above, which he looks for in the men. If, in his short interview, he cannot find certain of these features, he attempts to learn about them through the students' professors, as he considers them vitally important. These requisites may be readily summed up. The first is physique, the firm body to aid a strong mind; then energy and aggressiveness, the desire and ambition to forge ahead; thoroughness, the quality in a man to perform a task neatly and completely. Also, accuracy of observation, the faculty of seeing what one looks at, an attribute that is lacking in many people; a reasonable amount of self-confidence, if this feature is wanting, a man will not rise in the business world. Dependability, courtesy, and punctuality are characteristics not to be neglected.

Last, but far from being the least in importance, is personality. The ability and tact to get along with and move among men without friction. It is that quality in a man which makes friends and this attribute is to be found in all the leaders of student affairs. What would it avail a man who possessed many of the above qualities if it were not for his friends? It is always the human relationships that count. Success is brought about through friendship. We all know that there never was a man who attained real success who did not have a host of friends.

The employer who has found and helped to develop any or all of the above characteristics in any student-engineer has performed his task. He has helped to shape that man into being a pilot and a leader in the world which he aims to serve.

PROFESSOR GRANTED LEAVE

Professor Shepardson, head of the department of electrical engineering, has been recently granted a year's sabbatical leave of absence. He will spend most of this time in study and travel, planning to be away all of the coming summer. His leave starts July 1st. He also hopes to care for his many duties that he has been forced to postpone from time to time on account of other business.

St. Patrick's Soliloquy on His First Observation of the Blarney Stone After His Coronation

By Joseph E. Meagher, Alias St. Pat.

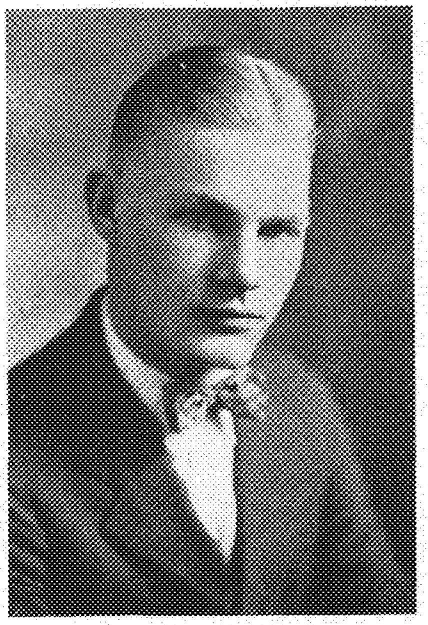
SHURE and divil a bit ye've changed since I saw ye last year. Faith and a sort of ordinary lookin' stone ye are to be causin' all this fuss and rumpus. Shure an' people might be thinkin' ye to be far greater and grander. There ye sit in all your smug complacency far grandoor lookin' for all the world like one of the stones in me praty patch. An' the shape of ye! Shure ye are neither round nor square nor anything else;—but ye do have an iron ring that makes ye look different. If I were ye I'd be afther considering it an insult to have a ring in me nose like one of those big, rough-looking cows. Ahh,—and I see ye have some scrawly lookin' figures on ye. Faith an' if the b'ys hadn't been tellin' me your history, I'd be thinkin' that one nine one four marked the beginnin' of the R. O. T. C.

Shure an' it is none other than Shamus O'Brien who has been tellin' me the tale. It was Shamus, hemself, and Axel Torgeson, Isidor Levinsky, and Nels Soderquist that brought ye to this noble instectootion for the culture of the ingeneers and the care of the feebleminded. Oft has Shamus tould me how they landed at the city of Cork and under the cover of darkness made their way to the famous Blarney Castle. How they nearly gave up hope entirely when they found the Castle watched by armed guards, but that Nels routed iviry one o' them by sneakin' up and throwin' some powerful smelly brown stuff in their eyes. What with the b'ys workin' in relays a hangin' by their toes and the guards liable to come back it must have been rough and dangerous work that they did. Didn't ye feel a wee bit sorrowful at leavin' home,—an' what a thud ye must have made when ye fell to the ground. 'Twas a marvelous bit o' work the b'ys did when they loaded yo onto an Irish baby buggy and all in one night loaded ye safe on board the cattle boat. And the cry that went up in Ireland when the people discovered your theft. They would have been thinkin' it was the work of Ould Nick himself, or, maybe some of the Good People if they hadn't found a curious little round tin box with an inscription on the top an' some smelly brown powder inside. Shure an' if Nels had been more careful, they'd never have suspected a mortal. But the b'ys hid ye under the hay and laid low and landed ye safely in Noo York. Shamus tells me that ye were a far different lookin' stone then. He says ye were much bigger, and rougher, and sort of square, until they put the ring in ye so they could lead ye around. An' what a wild ride that must have been with ye joggin' and cavortin' along at the end of your chain and the b'ys bangin' on to the tops and the rods of one train after another. 'Twas then that ye banged and bruised around till ye were worn down from the rugged lookin' brute ye were to the care-worn thing ye now are. But I'll wager ye forgot all your troubles when the b'ys drove ye into the University of Minnysoty on that mimorable St. Patrick's Day of 1914. How proud ye must a been to be ridin' along on your plush covered wagon pulled by eight horses—and the band a playin' and the people all lookin' on. I'll bet ye forgot that ye ever looked down on the river o' Blarney.

And all the neckin' ye've had. Shure and ye are the envy of iviry co-ed on the campus. Faith an' ye get kisses from more o' the lads in one hour than some of our best neckers do in a month. But, then, I s'pose it has its drawbacks and uncertainties. I s'pose that the dribblin's from some o' the snoos chewers don't be givin' ye an appetite, and when some o' the b'ys start cilibratin' a little early I bet that their breath do be makin' ye homesick. But don't it fill ye with aspirations and ambitions when iviry year or so some coy young lady ingineer comes along an' gives ye a warm moist token of her regard that had always been reserved for her ould mother alone. Faith, an' 'tis then that I envy ye.

There ye sit in all your glory not answerin' me at all. I s'pose ye think ye are better than me. Well, I s'pose ye are, because my honor lasts only for a year while yours is eternal,—I do homage to ye. But mark me words,—ye know in the days gone by how the Miners were afther stealin' ye and hidin' ye. Shure and I've a good notion to help them this year so I'll be rid o' ye and ye won't be robbin' me of any glory. Shure an' Dinty McCarthy, himself, told me that one time those black-guards of Miners rolled ye down into the river and ye purty near missed out on the cilibrarin. 'Twas only by a miracle that ye were recovered. Dinty says that they searched for a whole day before the repoort came out that a large green shamrock was reflected on the surface of the water behind the Mines building. An' 'twas then that Oscar Larson proved himself worthy of knighthood by divin' into the icy water an' confirmin' the belief that the shinin' shamrock was a reflection of your own glory. An' he went down a second time to fasten a cable about ye, and it took all the lads in the Ingineering College, except three, to pull ye out,—and those three were havin' all the fun batin' up on the Miners who were tryin' to interfere. How ye must have swelled with pride at the faithfulness o' your knights and guards. It would be kind of hard on ye if the Miners out-guessed your guards and you weren't on hand for the cilibration. Then I'd be afther getting all the glory and ye wouldn't be near so proud. But bad 'cess to ye, I s'pose we had better kape close watch because your absence would be afther spilin' the cirimony. An' if ye do detract from me glory, shure an' now I have a quane to console me.

(Continued on page 24)



GEORGE W. MORE
Engineers' Day

The Chairmen and Committees

BERKELEY R. LEWIS
Electrical Show

The Engineer's Day Committees

Parade
CLIFFORD ANDERSON
Chairman
CARL LIESE
PAUL BURT
JAY R. PIKE
MARVIN C. ROGERS

Open House
GEORGE LANGE
Chairman
KENNETH FERGUSON
RUSSELL GRANT
TED HAAKENSON
JOSEPH KUGLER
WALTER KENDALL

Finance
JACK CARMAN
BARTON JUELL

Knighting Ceremonies
ED GOULD
Chairman
LESLIE CROSWELL
VICTOR ETEM
GEORGE BOHANNON

Reception
PERCY FLAATEN
Chairman
R. R. KELLY
A. A. JAKKULA
CLARENCE LUND

Posters
LEONARD KLEINFELD
Chairman
A. J. BRENNER
BOB DUNNING

Dance
ED YOUNG
Chairman
CLIFFORD SANDBERG
WIN HILGEDICK
CARL LIESE
BOB KRANSFELDER

Decorations
DEWEY GERLACH
Chairman
A. FLEGAL
DOROTHY KURTZMAN
RHODA COTE
GUS NASLAND
CLYDE LIGHTER
JERRY KRONICK

Publicity
PAUL B. NELSON
WILLARD H. NORDENSON

Electrical Show Committees

ROBERT E. BURLINGAME
Student Exhibits
GAYLORD GILMAN
Assistant
ARTHUR C. JABOBSON
Manufacturers Exhibits
CLEMENT R. TUNELL
Finance
WIN C. HILGEDICK
Radio

HAROLD D. SMITH
Transportation
ALBERT A. LEE
Illumination
HENRY L. THOLSTRUP
Communication
ALBERT W. MORSE
Programs
HAROLD H. HEINS
Decorations

CARL C. NELSON
Invitations and Tickets
M. ALDEN COUNTRYMAN
Social
CLARENCE W. THYBERG
Music
HUGO H. HANFT
Floor
WINFIELD P. BROWN
Special Lighting

MARJORIE CHENEY
Queen

The Queen and Saint Patrick

JOSEPH E. MEAGHER
St. Patrick

The Program

Engineer's Day, Friday, April 24th

8:30-11:30 All departments hold open house and distribute souvenirs to parents and alumni. Registration in booth in main engineering building is necessary before souvenirs can be obtained.

11:30-12:30 Monster parade will put forth its appearance in gigantic procession through campus. Humorous and serio-comic depictions of various phases of campus engineering life and trials will be displayed.

12:30-1:30 Grand Knighting ceremonies on the campus knoll in which Marjorie Cheney, Queen of the Day, and Joe Meagher, alias St. Patrick, will dub each graduating senior a son of the ould sod.

1:30-5:30 Green tea and dansant in the laboratories of the new electrical engineering building.

8:30-12:30 Grand "Brawl" in the ballroom of the Minnesota Union. Grand March at 9:00 P. M. lead by St. Pat and his queen.

Electrical Show, Saturday, April 25th

7:30-9:00 Students' and manufacturers' exhibits of modern and historical electrical apparatus in the new electrical engineering building.

9:00-12:00 The students and faculty of the electrical department will entertain their friends at the first dance in their new home.

The
MINNESOTA TECHNO-LOG
University of Minnesota

Managing Editors
HERMAN F. BESELER. KENEFICK ROBERTSON

Associate Editor, PAUL B. NELSON

Department Editors
WILLARD H. NORDENSON - - - - Alumni Editor
CLYDE W. LIGHTER - - - - Architectural Editor
HAROLD C. E. PETERSON - - - - Civil Editor
CLARENCE A. JOHNSON - - - - Electrical Editor
THEODORE R. CORBETT - - - - Mechanical Editor
THOMAS F. ANDREWS - - - - - - Mines Editor
RUSSELL S. GRANT - - - - - - Humor Editor

Special Writers
Marshall H. Coolidge, Jr., Alva J. Haley, Philip F. Hartman, Joseph E. Meagher, George M. Cornell, George Nelson.

Assistants
Erling A. Amundsen, Thor A. Gustafson, L. W. Cameron, Kenneth Foster.

RICHARD W. JONES - - - - - Business Manager
A. S. BULL - - - - - - - Circulation Manager
E. L. SLAGOIE - - - - - - - - Sales Manager

Advertising
Hilder W. Bergman, James A. Helbling, George M. Lange.

Faculty Advisers
Prof. A. S. Cutler, Prof. C. A. Mann.

THE PROPOSED ST. LAWRENCE TO THE SEA WATERWAY

THE MINNESOTA TECHNO-LOG presents to its readers an article by Mr. Francis C. Shenehon, former Dean of the Engineering college, on one of the largest engineering projects now under consideration, the St. Lawrence to the Sea Waterway.

This proposed navigation project will rival the Panama Canal in construction and importance—perhaps not in strategic military importance—but certainly from an economic viewpoint. If the project becomes a realization, the flags of foreign nations will be seen on ships in the harbors of Duluth, Chicago, and other lake ports. The proposed system will decrease the volume of shipping at Montreal, New York, and the other big eastern harbors, and increase it at the inland lake ports. However, the water power created by the system will undoubtedly be of greater value to the northeastern part of the country than the decrease in the volume of shipping.

The subject is one of vital importance to the nation as a whole, and certainly should be of interest to graduate and student engineers.

Mr. Shenehon is one of the foremost authorities on the subject and has written his article in an interesting, non-technical style that should appeal to all.

—H. F. B.

JUNIOR WELCOME

ALUMNI and Visitors, Engineers' Day is here again with all its "vim, vigor, and vitality." Ever since last April we've been hiding; we haven't said nor done much except store away energy, potential energy, and now we're ready to set it loose.

Energy exists in three distinct forms, heat, mechanical, and electrical. You can always find a little of each wherever you go, but if you wish to find energy, all three kinds stored up in piles so big that they would make Paul Bunyan feel like an insignificant ant, follow the snakes on the sidewalks. We've got it piled up in huge stacks in the Main Engineering building; you'll have to crawl around it in the Electrical building, and if you can't get through it in the Experimental Laboratory, you'll have to climb through the windows.

I'll let you in on a secret if you'll promise to keep it quiet. A mammoth storage bin has been built down by the river. It's for the remainder of our energy, and if you think that I am exaggerating let me tell you something. It took our pioneer lumberjack three whole days to climb to the first landing. We're going to cart this remainder to the Union Ball room in the evening, and what's more, it will be there in all three forms, heat, mechanical, and electrical.

Alumni and Visitors, we welcome you to the biggest and best Engineers' Day ever held at Minnesota, so, as St. Patrick would say, "RAH for the Ingineers and all kicks of the mules to the contrarie nivirtheless."

—GEORGE MORK.

OUR MUCH NEGLECTED RHETORIC

A WELL known authority on child education is quoted as saying that a person in the early state of development should be required to do every day, some task that is disagreeable to him. To the minds of many technical students, this thought will bring back vivid memories of some detested course in rhetoric.

It is not very unusual that the most material engineer with his concrete views of life and the workings of nature should fail to go into ecstacy over the prospects of a 500 word theme or the ideas expressed in a volume of Browning. However, a technical training implies education. An education means among other things, the ability to appreciate the better things of life. Is this possible without a practical knowledge of our mother tongue in all its applications? Though optimists decree that everything will transpire in the not too dim future, we of today do realize the magnanimity of the works of our predecessors. How can one fully comprehend these wonderful thoughts if he has not had practice and concerted study in this branch of learning?

Again reverting to quotations,—we have often heard the statement ventured and think it quite true, that a graduate engineer who can ably explain himself either verbally or by writing, has a virtue devoutly to be wished. Scores of successful acquaintances bear us out in this belief.

The engineering branch of the department of English has a difficult task before them.

Full hearted co-operation will aid tremendously.

—P. B. N.

HEED THE ADVERTISEMENTS

From time to time our advertisers offer to any of their readers corresponding with them various free pamphlets and other material concerning their products. Our readers should take full advantage of this in view of the benefits received. Often these bulletins are in the form of complete treatises and represent valuable information not found elsewhere. In some cases they can be used supplementary to the regular text-books. The advertisers are sure to appreciate the interest that the readers of the TECHNO-LOG show in their products.

NEWS FROM THE ENGINEERING CAMPUS

AWARDS IN DESIGN

The judgments on problems in all grades of architectural design are as follows:

Grade III. Long Problem (A Commemorative Monument). Mentions: Dorothy Brink, Al Rigg, A. Jansma, McCoun. Credits: Kendall, Peterson, Lantz, Molander, Bross. Cond. Credits: Lumm, Frieburg, Frenzel.

Short Problem (A Garden Dining-Room). Mentions: W. A. Kendall, Dorothy Brink, George Frieburg, Al Rigg, A. Jansma, Gordon Lumm, A. S. Lantz, R. V. McCoun, Peter Bross. Cond. Credits: Everette Peterson, H. Frenzel, Ed Molander.

Grade II. Long Problem (A Country Court House). Mentions: G. Naslund. Credits: Kronick, Havens, Stageberg, Edwards, Melius, Potter. Cond. Credits: Dewey Gerlach, Clyde Lighter. Esquisse-esquisse, unjudged.

Interior Decoration. (A Sea Captain's Club Room). Mentions: Dorothy Mann, Rhoda Core. Credits: Verna Smith, Helen Parker.

Grade I. Long Problem (A Pavilion for a Library). Mentions: Paul Eaton, George Taylor.

Esquisse-esquisse (A Handicraft School). Con. Credits: L. B. Anderson, G. Cameron, J. Crimmons, Jones, N. Nelson, D. Snyder, M. Sullivan, R. Thorshov.

Freshmen who received the grade of 'A' on An Entrance to a Park, are: Esther Hargrave, Nathan Juran, George Crosby, J. Gingery, Alvah S. Bull, Bruce Church.

ENGINEERS BROADCAST

As a part of the publicity campaign for Engineer's Day, a program was broadcasted from WCCO Monday evening, April 6. Talent on this entertainment consisted of the University Concert Band of 50 pieces under the direction of Michael M. Jalma, a ten piece college orchestra under the leadership of Garvin Peterson, senior civil, selections by the Whip-poor-wills, campus singers, a talk by George Mork, chairman of the Day, a humorous speech by Joe Meagher, alias St. Pat, and complete knighting ceremonies and kissing of the Blarney Stone.

The program, which lasted from 8:45 till 10:15 P. M., was a complete success and scores of local and long distance telephone calls and telegrams were received. It was an innovation in broadcasting, being the first time that similar proceedings have been sent out through the ether.

CONSTANT PRESSURE TANK INSTALLED

The Experimental Engineering Laboratory has recently acquired a new pressure head tank for its hydraulics division. This tank has a head of about 25 feet, which is kept constant by having an overflow pipe as well as a supply pipe. The constant fluctuating of the city water pressure made this installation necessary.

SPRING TRIPS ANNOUNCED

The dope is out on the Miners' field trip for this spring. Blueprints with the details, rates, and stops were distributed in the Junior class, and the trip was outlined by Mr. Parker. The Miners and Metallurgists of the class of '26 will leave Minneapolis on May 15 for Colorado Springs, where they will visit a cyanide mill, and traveling by auto they will go on to Cripple Creek to examine several mills and mines. Cripple Creek is a gold telluride camp. Returning to Colorado Springs the men will leave by rail for Denver.

Rock Springs, Wyoming, will be the next stop, where a day will be spent studying coal mines. In Salt Lake City several large smelters will be the main attraction. From Salt Lake City several side trips will be made. Bingham and Garfield are the two most important. After leaving Salt Lake City, the students will go to Eureka, Utah, where there are mines and ore treating plants. The technical trip will end here, but the tickets bought at special excursion rates are good to Los Angeles, and to Los Angeles many of the boys plan to go. San Francisco will also be on the route of the majority.

Many intend to stay in the West for summer work. When returning, they have a choice of three routes through the Southwest, or for ten dollars more they may return over the Canadian Rockies. A side trip may be made without extra cost to Vancouver and Victoria in British Columbia.

The personnel of the trip will consist of Profs. Comstock, Pease, and Parker, of the departments of mine plant, metallurgy, and mining, respectively, together with 14 or 15 Junior Miners and Metallurgists. The Geologists, two Juniors and one Senior, will take the usual excursion into the Black Hills of South Dakota.

The Sophomore surveying trip has been changed from Crosby on the Cuyuna range, to Chisholm, on the Mesaba range. The geological work on the Sophomore trip will be on both the Mesaba and Vermillion ranges as usual.

STUDENTS HEAR COOLIDGE

A large assemblege of people crowded the electrical engineering auditorium March 4, the day of the national inauguration exercises, and listened to President Coolidge's Inaugural address as picked up and amplified by radio.

The address was broadcasted by a chain of several large stations over the country connected together by land wire. These various sets were so geographically located that it is estimated that their simultaneous program was heard by over 20,000,000 people in the United States.

The local reception was engineered by members of the radio staff of 9XI, the University station. A Zenith receiving set was used. The output from this was sent over the trunk lines to the auditorium where it was stepped up in volume and then made audible through a Magna-Vox

'U' GETS FORMER WCCO SET

With the completion of the new super power station near Anoka, WCCO, the Gold Medal Station owned by the Washburn Crosby company, will donate their former equipment to the University. This apparatus was used when the station was located at the Oak Grove hotel, and is similar to sets being used at many prominent broadcasting stations throughout the country.

New telephone lines are being installed in the electrical engineering building so that in case of emergency, programs can be relayed to the building and broadcasted from this set.

DRIPPINGS FROM THE OIL CAN

Mathematically Speaking

Two men, P and Q, are seated at a four-place table, in a cafe, Q drinking twice as much as P. It follows that Q's path will deviate more from a straight line than P's. Why?

At a given moment, at one extremity of the room, Cosine, the dancer, appears. She rotates on her axis and revolves about the room, disrobing as she goes. As she removes each parenthesis, she exchanges signs with the men located at different points in her locus. With each successive revolution she approaches nearer and nearer the table where P and Q are placed. P is in his normal form, but Q has an unknown expression on his face. Suddenly Cosine, plotting all the time, reaches the maximum point in her dance, remains stationary a moment, and then disappears. Q rises and traverses the same path, but with a more unequal slope, and comes to her dressing room. He knocks (u) times and then projects himself into the room.

Another man whom we will call Y is standing motionless at the point of intersection between Cosine's glance and Q's. He has a revolver in his hand whose angle is such that if the trigger were pressed, the projectile would intercept Q.

"L." mutters Q, "what's this man's function?"

"He is my husband," cries Cosine, "Go!"

"L." mutters Q again, "A relative error!" But instead of going, he moves forward one unit toward Cosine.

It is left as an exercise for the pupil to finish.—*The Transit.*

* *

Shaky Business

Stude—"May I be excused from cement lab. today? I don't believe I will be able to do anything."

Prof—"What's the matter?"

Stude—"I'm not feeling well. I'm trembling all over."

Prof—"Zat so? Well, you ought to go over and lend a hand with that seive analysis."

* *

Wooly

Prof—"Can anyone in this class tell me what steel wool is?"

Stude—"Sure, steel wool is the shearing from hydraulic rams."

Time Will Tell

Teacher—"Tommy, who was it that prompted you, then? I heard someone whisper that date to you."

Tommy—"Please, miss, I expect it was history repeating itself again."

Science Proves

To satisfy the age old question as to whether or not Minnesota's Blarney Stone is a part o' Blarney or a pebble from Saint Cloud, a miners' class in assaying recently found it to be genuine, proving without a doubt that the stone has *seen* Ellis Island. A chip of the stone was presented to the department of metallurgy, without telling the miners the source of the sample. The Engineer's Day committee is assured that the analysis was carefully run.

Here is the dope:

Constituent	*Oz. (troy) per ton*
Blarney	13,000
Murphys, alias spuds	1,000
Scotch Heather	None
County Cork	1,157
Shillalahey Grease	2,126
Fire Clay Confetti	5,298
Kraut	Trace
Garlic	None
Harp Cords	700
Snake Oil	None
Snoos	Trace
Dudeen	715
Total	23,996 Oz. troy per ton

A Thorough Job

A young man walked into a jeweler's shop and flung the beautiful diamond ring he carried on the counter.

"What on earth have you done to this ring?" he inquired angrily.

"Why, sir, aren't you pleased with it?" asked the jeweler, puzzled.

"Pleased with it!" snorted the young man, "I told you to engrave on it 'from A to Z'—from Arthur to Zena—and you've put in the whole alphabet."

* *

Art—"Are you doing any work in the nude these days?"

Tist—"No, but I will soon if I don't sell some of my pictures."

Mental Math

Sambo—"Why you scratching your haid, Rastus?"

Rastus—"I got arifmetic bugs in mah head."

Sambo—"What's arifmetic bugs?"

Rastus—"Dat's cooties."

Sambo—"Why do you call dem arifmetic bugs?"

Rastus—"Because dey add to mah misery, dey subtract from mah pleasure, dey divide mah attention, and dey multiply like de dickens."—*The Shamrock.*

* *

A Cutting Remark

Freshman—"Why is that milling machine squealing?"

Sophomore—"Because it's cutting its first tooth."

* *

An Elucidation

Bass—"Explain the formula $R = 1 - .00028\sqrt{L}$."

Wolf—"This formula, while strictly empirical, is sufficiently accurate for use as a criterion in the abstract determination of the relative coincidence of the maximum superficial run-off during a storm of maximum precipitation."

* *

Slight Mistake

Co—"I see you're having a new piano put in."

Ed—"That isn't a piano; that's my new radio set.".

* *

Oily

Catherine—"Have you ever been painted in oil?"

Louise—"Heaven's no! How do you get it off at night?"—*Notre Dame Juggler.*

* *

Lots of Crust

Papa, young William Thompson said,
What do they mean by college-bred?
Pa-pa, (Ha, Ha) he cocked his head:
It's a big loaf, he calmly said.
—*Dum Dum.*

* *

A Twist of the Tongue

He—"Pardon me, may I have this dance?"

She—"No, I'm too danced out."

He—"You're not too damned stout. You're just pleasingly plump."

ALUMNI AND FACULTY PERSONAL NEWS

It is with sorrow that we report the death of Mrs. Paul Rhame, the wife of former instructor P. W. Rhame, M. E. '20, at Flint, Michigan, Thursday, April 9. The funeral services were held at the University Baptist Church on Saturday, April 11. Mrs. Rhame, formerly Miss Edith Pope, is survived by her husband and a five year old son, David.

FACULTY

Joseph A. Wise, instructor in structural engineering, has been appointed to the corps of civil engineers, United States navy, ranked as lieutenant, junior grade, with orders to report at Washington April 20th. Mr. Wise is a graduate of the University of California and was formerly with the bureau of public roads, United States department of agriculture. He has been doing part time work on the co-operative drain tile investigation at the University Farm for the last 18 months.

ARCHITECTS

Graduate Architects Writes Unique Book.

"Portals, Doorways, and Windows of France," is the title of a book written by George L. Dahl, a graduate of architecture in 1921, which has been put on the market. The facts of this book were compiled by Mr. Dahl while touring Europe under the benefits of the Nelson Robinson traveling scholarship which he won under competition at Harvard in 1922. The fund allows the winner to spend 18 months in a tour of all of the European cities of importance in an effort to gain information along architectural lines.

The book contains much information in regard to old and new buildings, paintings and other works of art. There are 210 illustrations in the book, which is published by the Arch Book Co. of New York City.

CHEMISTS

Howard V. Merten, '14, writes us from London that his address has been changed from Jamshedpur, India, to Charles City, Iowa.

CIVILS

A. Dean White, '21, in a recent letter to Lawrence T. Robinson, junior civil engineer, says that he is now located in Detroit, Michigan and a registered civil engineer in that state. After graduation White worked with the U. S. Lake Survey, covering the great lakes and their connecting rivers. He has also done stream measurement work on the St. Lawrence Deep Waterways Project. For a short period of time he worked with a structural company. At present he is employed by a consulting civil engineer. White says that his latest branch of engineering endeavor is the art of typewriting. His address is 7385 Poe Avenue, Detroit, Michigan.

Carl Aslakson, '23, who is with the United States Coast and Geodetic Survey, was stationed on Lake Okeechobee from January, 1921, to May, 1924, engaged in triangulation. From May to July, 1924, he was at St. Augustine, Florida, on Hydrography and Topography and from July to December he was at Brunswick, Georgia, and from December, 1924, to March, 1925, at Savannah on the same work. He is now on a vacation, visiting friends in the Twin Cities. On May first he is leaving for Alaska where he expects to be engaged in Triangulation, Hydrography and Topography.

Mr. Aslakson gave a talk before the civil engineering sections of the Junior Class April 1st and 3rd.

L. H. Carlbom who graduated in March, 1925, is with a survey party in Mississippi.

M. V. Harrington, '24, has left the employ of the U. S. Army Engineer at Milwaukee, Wisconsin, and has gone to Texas to make his home.

F. H. Larson, a graduate of March, 1925, is in the maintenance of way department of the Santa Fe Railway with headquarters at Chanute, Kansas.

Geo. C. Mattison, '11, is in charge of a survey ship working in the Gulf of Mexico, along the coast of Texas.

Norman Moore, former advertising manager of the TECHNO-LOG and a graduate of March, 1925, is in the office of the Division Engineer of the Pennsylvania Railway at Chicago, Ill.

Rossel Moris is with a survey party in Kentucky. Mr. Moris was a graduate of March, 1925.

H. B. Palmer, '22, is engineer with the War Department, Milwaukee district, engaged in construction of dams, locks, canals, etc., on the Fox River, Wisconsin. He announces the arrival of a daughter, Roberta, November 15, 1924. Mrs. Palmer was Miss Viola Rood of the School of Education, Class of 1926. Mr. and Mrs. Palmer may be addressed at 809 E. Pacific Street, Appleton, Wisconsin.

E. H. Pagenhast, '05, is now director of the Hydrographic Division of the United States Coast Geodetic Survey with headquarters at Washington.

Clifford Stoner, '24, has returned from California, where he was employed by the Southern California Edison Company on construction, and has accepted a position in the engineering department of the Elgin, Joliet and Eastern Railway of Joliet, Illinois.

John J. Schlenk, '23, advises us that his address has been changed from Cloquet, Minnesota, to 1370 Fairmont Avenue, St. Paul. He is working with Schuett Meier Company, Structural engineers.

ELECTRICALS

Dean M. Barnes, '21, is with the Associated Telephone Company of Long Beach, California, engaged at the present time in cutting the exchange over from manual to automatic epuipment. His address has been changed from Compton to 640 10th St., San Bernardino, California.

William G. Briggs, '21, is employed in the electrical engineering department of the Commonwealth Power Corporation at Jackson, Michigan. His address has been changed and is now 200 B Wildwood Apartments, Jackson, Michigan.

C. M. Converse, '09, is with the St. Paul Electric Company, 145 E. 5th St., St. Paul. His home address is 1918 Goodrich Avenue, St. Paul, Minnesota.

J. W. Hornibrook, '09, is employed by the Westinghouse Lamp Company, in the Conway Building, Chicago. His mailing address is 111 W. Washington Street.

R. E. Waldron, '20, is at Marshfield, Oregon, with the Coos Veneer and Box Company, a concern engaged in the use of the byproducts of the lumber industry. They specialize in battery separators and other products made of white cedar, which grows only in that vicinity.

B. B. Walling, '09, realtor, announces the opening of an office at 1047 McKnight Building, Minneapolis. He will specialize in business and industrial properties. Mr. Walling is known to a lot of the older grads as the proprietor of the Co-operative Book Store on the corner of fourteenth avenue and fourth Street, which is now occupied by the College Toggery.

MECHANICALS

Sidney Acker, '24, is at Pasco, Washington, where he is working for the Northern Pacific Railway Company. He is also taking additional work for an M. E. degree "in absentia."

Harley Langman, '24, has moved and is now living in a cozy bungalow down in Kansas. His address is 200 South 15th St., Kansas City, Kansas.

Ralph Ransom, '23, is at Sioux Falls, South Dakota, working in a large packing plant. In a letter to Professor Martenis, he states that he is making good use of the knowledge he obtained from mechanical courses while at school in connection with his work on construction and refrigeration.

George Rathbun, '24, is at a Stevens Point, Wisconsin, Sanatorium. A classmate who saw him recently says that he is getting along in great shape.

Charles G. Sims, '24, is engineer in charge of a large power plant at Oshkosh, Wisconsin. He states that the addition of 10,000 K. W. is about to be realized.

Harry Woolman, '24, is with the United States Radiator Corporation at Cincinnati, Ohio. He states that he bumps into "Dinty" Moore quite frequently. "Dinty" is with the Hartford Boiler Inspection and Insurance Company.

GEAR STRIPPINGS

Then You Bring Home the Bacon

Bill—"That girl reminds me of a packing house."

Will—"How's that?"

Bill—"When you get your Armour 'round her, she's Swift & Company."
—*Calif. Engineer.*

* *

Where Ignorance Is Bliss

"Why are you marking all those empty envelopes?"

"I'm cutting classes in a correspondence school."

* *

Where Is She?

What has become of the girl who used to sing the old song, "Lips that touch liquor can never touch mine?"

At the Football Game

Anna—"Who is that man running around on the field blowing a whistle?"

Bell—"Oh, he's probably one of those Football Letter Men that Jack talks about."

* *

Misunderstood

Tramp—"I've seen better days, sir."

Business Man—"Yes, I suppose so, but I haven't time to discuss the weather with you now."

* *

Dogmatic—Pertaining to the culture of dogs.

Circle—A curved line with a hole in the middle.

* *

What Course

Professor—"You can't sleep in class."

Student—"I know it; I've been trying for half an hour."—*Washington Dirge.*

* *

The Irish Of It

An old Irishwoman sent a parcel to her son, in which she enclosed the following note:

"Pat, I am sending your waistcoat; to save weight I have cut off all the buttons. Your loving mother."

"P. S.—You will find them in the top pocket."

* *

A Good Model

Two men chanced to be sitting opposite to one another in a tube train. Presently one of them produced a notebook and proceeded to make a sketch of the other. After he had completed the drawing, he shut up the book and returned it to his pocket. The man opposite was both interested and gratified by this attention, and, leaning forward, he said, "You are an artist, I perceive, sir?"

"No," replied the other, "I'm not exactly an artist. I'm a designer of door knockers."

* *

Development

At first marriage is a partnership, then when six kids clutter up the place it becomes a corporation.

* *

The Progress of Education

As a frosh he entertains the "wimmin" with excerpts from "The Shooting of Dan McGrew." As a sophomore he brags of his standing on the campus. As a junior he quotes free verse to her. When he's a senior he tells her dirty jokes.—*Calif. Engr.*

St. Patrick's Soliloquy

(*Continued from page 15*)

Besides, the b'ys need the inspiration which ye will be afther givin' them. Shure an' how often I've seen it an' marveled at it that b'ys that wint through the school here for four and five or even six years as if they were tongue-tied gave ye one smack on St. Patrick's day and afterwards were able to talk longer than the Dean of our College. Shure an' meself it is that was the lucky lad. Whin I was a wee bit of a spalpeen me ould grandmother risked her neck bangin' by her toes a-holdin' me so that I could kiss the Rock that ye were chipped from. Shure an' ye were part and parcel o' the same Stone then. Faith and I may have kissed the spot from which ye were later stolen. Well, I know the worth of a bit o' blarney an' I wouldn't be havin' the b'ys miss it. So I think I won't be afther joinin' with these blackguard Miners afther all, but I'll help protect ye.

But ye must be doin' your dooty on the great day. I want ye to be fillin' the b'ys with a shpirit that will enable them to talk the professors out o' all cons and flunks and hard exameenations for the rist o' the year; I want ye to be fillin' them with the blarney that will enrapture and thrill the ladies; and I want ye to be fillin' them with the gift o' gab that can persuade the crool hard worrld to give them nice soft jobs. An' ye sit there not sayin' a word. Well, I'll take your silence for assent, and we'll part in peace. I'll be afther takin' care that your guard is doubled and we'll cilibrate together and share the honors betune us on April the twinty-fourth.

SWEDISH ENGINEER TALKS

Carl von Malmborg spoke on the uses and characteristics of dirigold at the regular A. S. M. E. meeting on March 14. Dirigold, a recent invention of Swedish engineers, is a combination of several well known metals, chiefly copper and tin, but its unusual properties are due to the process by which these metals are combined.

In outward appearance dirigold resembles 16 carat gold, and at the same time has the physical characteristics of steel. In addition it is highly resistant to corrosion. Sand castings can be worked and hardened the same as forgings.

Different grades of dirigold are produced by varying the relative amounts of the constituents. One of these lower grades, alcobronze, has somewhat greater strength, but more nearly resembles brass. Alcobronze is generally used for machine parts, while dirigold is made into jewelry and ornamental pieces.

Although at present dirigold is manufactured only in Sweden, plans are being made to start production in this country. Mr. von Malmborg, one of the co-inventors, has come to Minneapolis to assist in organizing a company here.

FOREIGN SCIENTIST HERE

Space and time, high speed steel, and some points of view on the kinetic constitution of matter, were discussed by Dr. Carl Benedicks, director of the Metallographic Institute, Stockholm, Sweden, in a series of lectures at the beginning of the spring quarter.

The lecture on high speed steel, of special interest to mechanical engineers, was given before a joint meeting of the Minneapolis section and the student branch of the A. S. M. E., at a banquet held in the Minnesota Union ballroom March 31.

THE LANCHESTER HARMONIC BALANCER

By Edward Nicholson

THE Lanchester Harmonic Balancer used in the new Willys-Knight four is a mechanical device for correcting the unbalanced inertia forces resulting from the shifting of the center of gravity of the reciprocating masses due to the irregularity in their motion. As the unbalanced force to be corrected is an alternate one acting up and down with twice the frequency of the reciprocation of a piston, it can be corrected by the action of a reciprocating mass moving in a vertical path and driven by a crank rotating at twice the shaft speed of the crankshaft of the engine.

Such a device would be mechanically clumsy, however, and Mr. Lanchester uses instead two unbalanced wheels which rotate in opposite directions at twice the speed of the engine. The heavy sides of these unbalanced wheels are timed to be low at the same time, when the engine is on dead center. When the engine is 90° from dead center, the heavy sides of these wheels are low. The vertical components of the unbalanced centrifugal forces of these wheels combine, and counteract the unbalanced inertia force of the reciprocating parts of the engine, while their horizontal components annul each other.

This device is in no way similar to the Lanchester Vibration Damper which is used on a number of high-grade multi-cylinder cars, including the Packard. The latter device is a friction driven flywheel, which damps out torsional vibration in the crankshaft just as an amortisseur winding damps out periodic speed undulations in an alternator or a synchronous motor.

"VEISHEA" CELEBRATION

Engineers will again have charge of the major activities of the 1925 Veishea as E. A. Vaubel, C. E. '25, has been recently appointed general manager. Cedric Fegtly, Arch. E. '25, is treasurer, J. J. Hinrichsen, M. E. '25, is chairman of the open house, and Marc Buettell, M. E., E. E. '25, the manager of last year's celebration, is the assistant secretary of the general committee.

The general committee of which J. E. Foster, dean of men, is secretary, is made up of one representative from each of the five divisions and one representative each from the Women's Guild and the Cardinal Guild.

Plans are already under way to make the coming celebration the best that Iowa State College has ever promoted. There will be no carnival this year, but instead the open house exhibit will be greater than ever before. This is a departure from the programs of previous celebrations, but it was felt that a change was needed.—*The Iowa Engineer.*

CHEMICAL WARFARE

(*Continued from page 13*)

No discussion of chemical warfare would be complete without mention of the development of the gas mask. The first British mask was no mask at all: merely a pad of cotton, chemically impregnated. Soon after they developed various helmets as phosgene and tear gases were introduced. These hot, cloth helmets were pulled down over the head and tucked in the blouse. The next British development was the box respirator, which had a separate canister containing absorbent charcoal, soda lime and potassium permanganate. It remained for the French to make the next advance. Their Tissot mask did away with the mouthpiece and noseclip, and allowed the incoming air to pass immediately over the eyepieces and thus keep them quite clear of moisture. The latest American mask resembles the French Tissot mask in many respects.

So much for chemical warfare as it was in the turbulent days in France. At the present, that dream of peace-loving theorists, regarding the abolition of chemical warfare, becomes more vague every day. True it is that at the Washington Conference in February, 1922, the use of toxic gases was abolished; but no agreement is binding without the signatures of all concerned; and France has not signed. Even this agreement allowed the manufacture of and research in both defensive and offensive chemicals. Who is going to be fool enough to imagine that any nation, facing a crisis in its conflict with some other power, will not resort to any means at its disposal? And why should it not use chemical warfare? The cry of "Inhuman," which was such excellent propaganda during the war-time days, falls down entirely in the face of actual statistics regarding casualties. For armies prepared for it, gas is the most humane type of warfare.

The United States was the first country to establish a Chemical Warfare Service on a permanent basis. Its peace-time activities alone justify its existence. Probably the best known of the problems it has tackled and solved is the application of chlorine to the cure of colds and influenza. There is quite a possibility that this development alone may save more lives than were destroyed by gases in France. Other important problems of the Chemical Warfare Service include the investigation of methods of protecting wooden structures in sea water, the fumigation of ships, the development of gas masks for firemen and industrial workmen, and automatic protective devices against burglary. These latter involve the use of tear gases. The latest activity is the attack on the boll weevil pest of the south. The service is also attempting to keep the soldiers and potential soldiers aware of the possibilities of chemical warfare, as demonstrations are given to the various groups receiving training in the summer camps.

The Chemical Warfare Service is attempting to carry out this program in the face of a steady decrease in its appropriations, which have dwindled from \$1,350,000 in 1922 to \$700,000 in 1925. A gleam of hope can be seen in the recent advancement of the chief of the Chemical Warfare Service to the rank of Major General, but congress must be awakened still farther. Chemical warfare is developing rapidly in Italy, England, Russia, Japan, Germany, and most probably in France. Germany alone is reported to have 500,000 newly manufactured gas masks, while the United States has but one modern mask per hundred enlisted men in the Regular Army and National Guard. Excellent propaganda, though it may have been to denounce chemical warfare when the Germans first introduced it, it is most assuredly not so excellent when it causes a nation to limit its expenditures for chemical warfare to \$700,000, while nearly twice that amount is spent for feeding the horses in its cavalry.

GRAD IN AFRICA

(*Continued from page 8*)

other black who held a grudge against him.

Shortly after LaTendresse started on his 1000 mile hike across the Congo, he met an American who loaned him enough money to get together a small safari. With half a dozen porters, he reached a Belgian post in the middle of the Congo at the same time that the local Belgian director of the colony was leaving for the South by car, carrying his baggage in two Ford trucks. Not knowing that Henry was a fugitive, he gave him a ride for 600 miles. This brought him to a railroad which carried him 200 miles further to the Rhodesian border.

LaTendresse is now in Rhodesia and has a very good position as geologist for an English firm there.

ST. LAWRENCE - SEA

(*Continued from page 12*)

haps \$100,000,000 to be expended in the Great Lakes for deeper channels, navigable passes and regulating works.

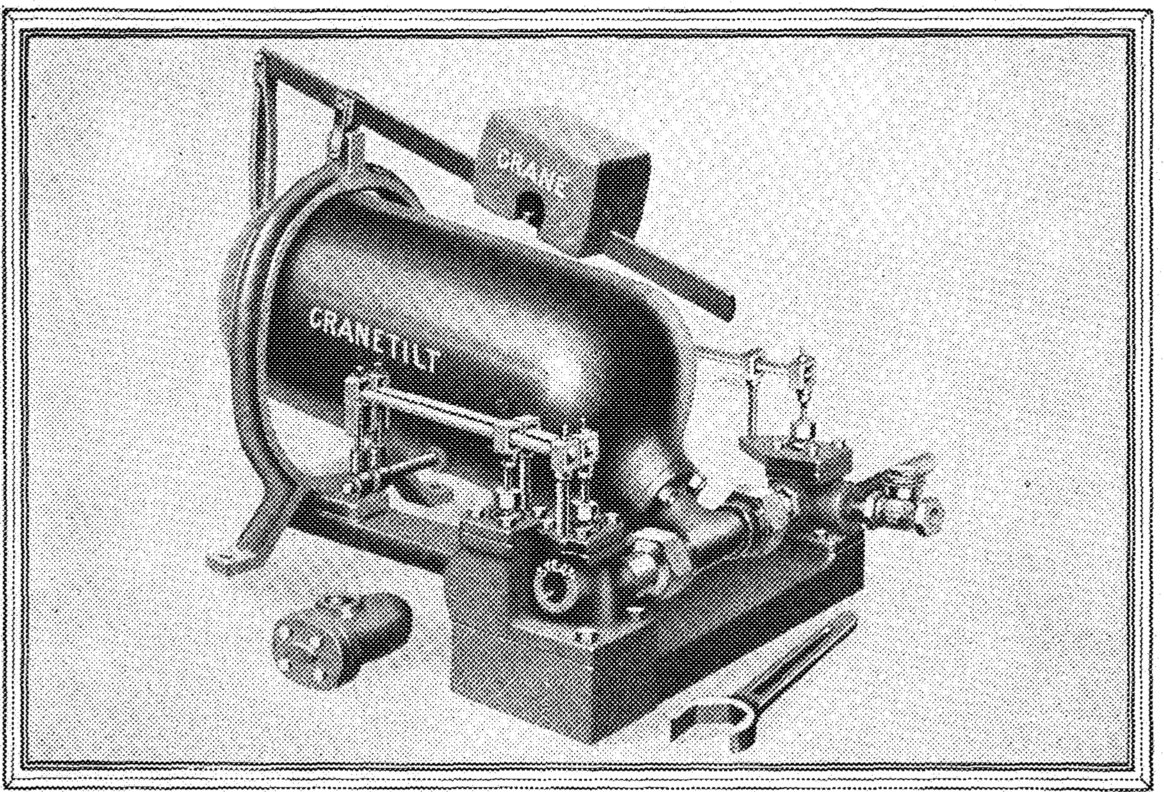
Bringing to a close this paper, the writer wishes to emphasize the magnificent reservoir capacity of Lakes Superior and Michigan-Huron—aggregating about 78,000 square miles. When these lakes are fully utilized, the excess water of years of plentiful supply will be stored, giving greater depths for navigation and providing against lean supply and depleted lakes such as exist in the present period. This will mean steadier flow in the Niagara and St. Lawrence Rivers and a much greater volume of continuous, dependable, prime electrical power. Where a continuous series of regulating works exist at the foot of the various lakes—Superior, Michigan, Huron, Erie and Ontario—water stored in Lake Superior at times of ample supply may be released by simultaneously opening gates in all these regulating works and delivering instantaneously water in the Niagara and St. Lawrence Rivers. And conversely when excessive water supply exists on Lake Ontario, by checking the outflow at the foot of Lake Erie and at the foot of Lake Huron, this water may be conserved in the Michigan-Huron reservoir against the hazard of low water years.

The project as a whole is magnificent, both from the point of view of navigation and of water power, and its consummation may be accepted as inevitable.

BELL REPRESENTATIVES HERE

A delegation from the American Telephone Company interviewed graduating seniors March 4 to 6. Two of these men were former Minnesota graduates, F. M. Williams, '05, of the Hawthorne branch of the Western Electric company, and M. F. Wichman, '22, of the local Bell company. Other members of the party were W. C. Hall of the Illinois Bell Telephone company, P. C. Hoernel of the New York branch of the A. T. & T. and R. E. Johnson of the local Northwestern Bell company.

As these various companies have consolidated many of the laboratories and systems, the above members of the delegation act together and offer in their interview the various branches of work that their distinct company has to offer.



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.

CRANE

GENERAL OFFICES: CRANE BUILDING, 836 S. MICHIGAN AVENUE, CHICAGO
CRANE LIMITED: CRANE BUILDING, 386 BEAVER HALL SQUARE, MONTREAL

Branches and Sales Offices in One Hundred and Forty-five Cities
National Exhibit Rooms: Chicago, New York, Atlantic City, San Francisco and Montreal
Works: Chicago, Bridgeport, Birmingham, Chattanooga, Trenton and Montreal

CRANE EXPORT CORPORATION: NEW YORK, SAN FRANCISCO
CRANE-BENNETT, Ltd., LONDON
C^{IE} CRANE: PARIS, NANTES, BRUSSELS

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%.

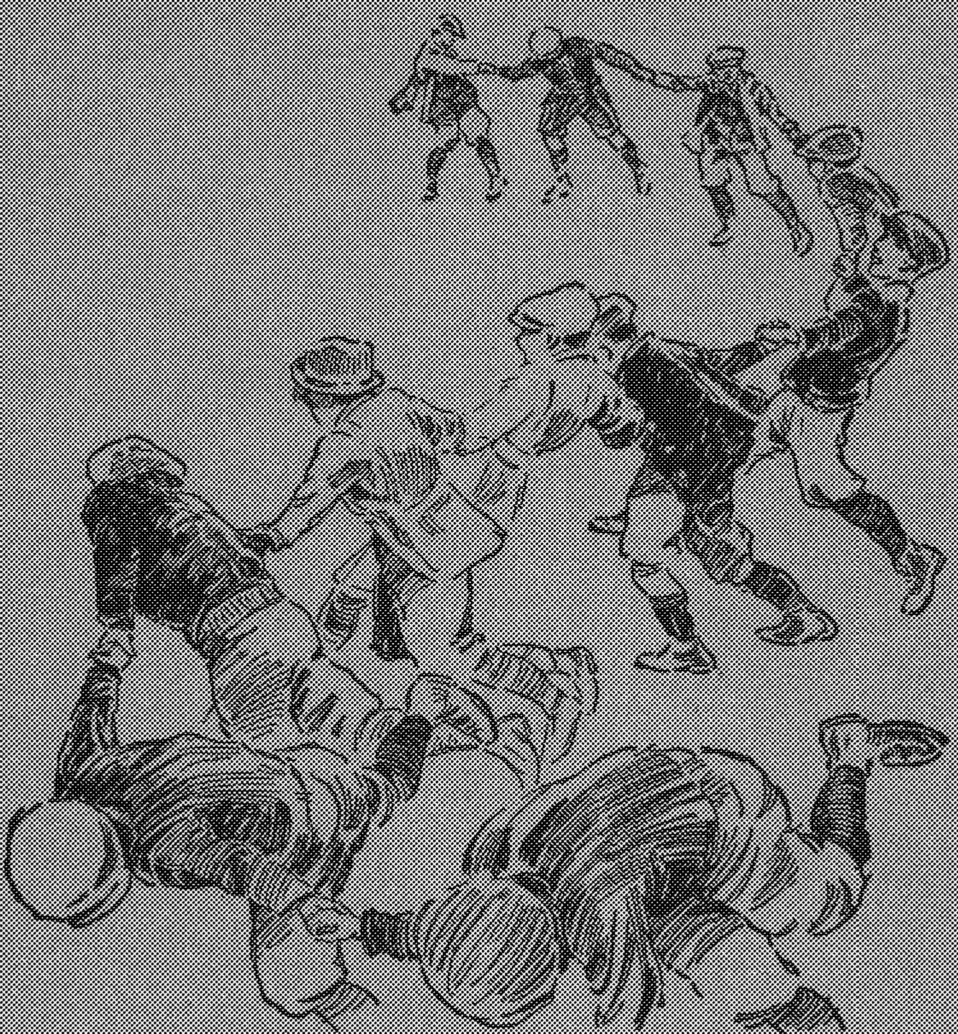
Good lighting, in addition to its other marked advantages, is a strong incentive towards keeping working places clean, for it clearly exposes any place where dirt or other material has been allowed to collect. White walls and clean windows glazed with Factrolite Glass will eliminate the sun glare and increase the illumination 25 to 50 feet from the window from 38% 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.

No. 6.



Motion from All Directions

The trouble is that the boy on the end, in "cracking the whip", cannot go two ways at once. He tries to follow the line 'round and 'round, but a force is created which flings him off sideways.

So do the wheels of your motor car try to go merely 'round and 'round, but sliding against them sidewise at the same time is the whole weight of the car, pushed over by the very slope of the pavement.

Or look at a moving street car, lunging from side to side against the wheels. And you also know that a belt which is driving machinery never seems to run quite true; you can see it weave always from side to side, whipping the pulleys while they revolve.

In fact, there is rarely, if ever, any revolving motion which does not involve some of the sidewise or pushing motion called Thrust, which must be taken care of by the bearing or else there is compromise!

You can be sure that bearing compromise is avoided in the motor car, farm implement or industrial appliance equipped with Timken Tapered Roller Bearings because Timken Tapered Roller Bearings are inherently dual duty bearings. Timken Dual Duty is the ability to carry the motion or load from both directions—from ALL directions—all at once.

THE TIMKEN ROLLER BEARING CO., Canton, Ohio

TIMKEN *Tapered Roller* **BEARINGS**

With Cap and Pipe

LEAN and tanned from work in the open, pipe in mouth, cap pulled well down—that's the erecting engineer, as pictured in the magazines, and generally as found on the job. In an organization like Westinghouse he occupies a pivotal place, being responsible for the erection of equipment in the field.

Take him in the electrification of the Chilean State Railway, for example—one of the outstanding electrical projects of recent years. It included not merely the electrification of 134 miles of steam lines, but also power and substation equipment to convert water power from the Andes Mountains into electric current.

In 1922 the first shipment of substation equipment departed—but ahead of it had already departed a force of Westinghouse erection engineers. They went to a country that was a stranger to railroad electrical operation, and to the installation of large electrical equipment. In the 134 miles of steam railway to be electrified they encountered every kind of topographical and engineering condition—curves, grades as steep as 2¼ per cent and as long as 12 miles, bridges extending to 440 feet, six tunnels, the longest 1,600 feet.

Today, two years later, these same erection engineers are returning—returning from a Chile, much of whose railway traffic is moved by its water falls; they are returning and promptly *departing* again on still other missions of electrical improvement, at home and abroad.

This advertisement is sixth in a vocational series, outlining the fields for engineering achievement in the Westinghouse organization. A copy of the entire series will be sent to anyone requesting it.

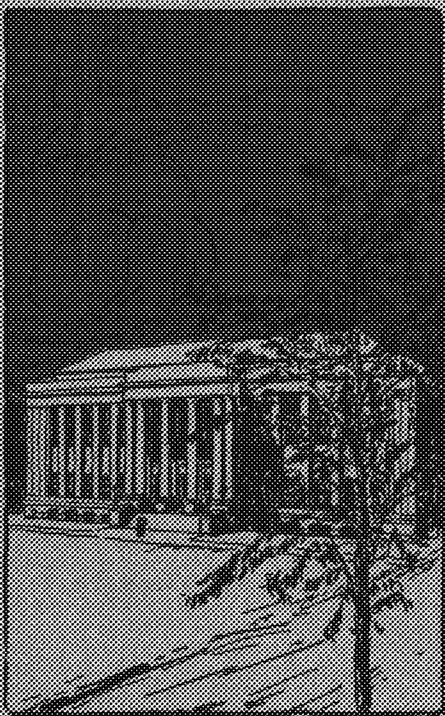
Westinghouse

ACHIEVEMENT & OPPORTUNITY

WESTINGHOUSE ELECTRIC

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

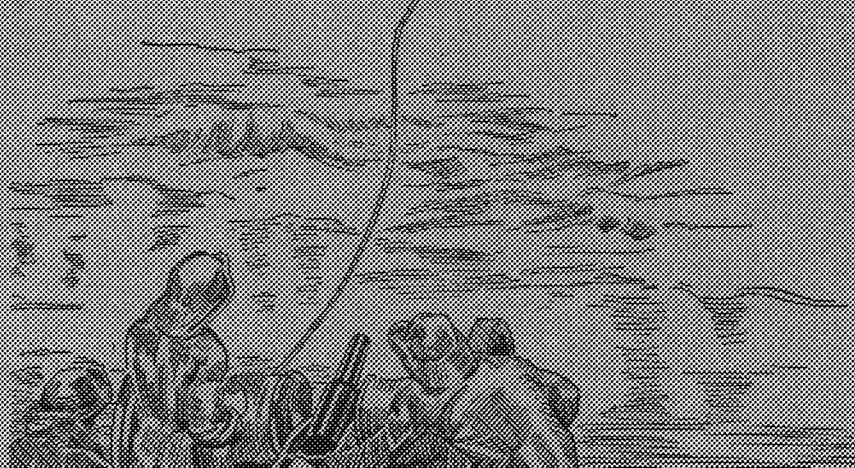


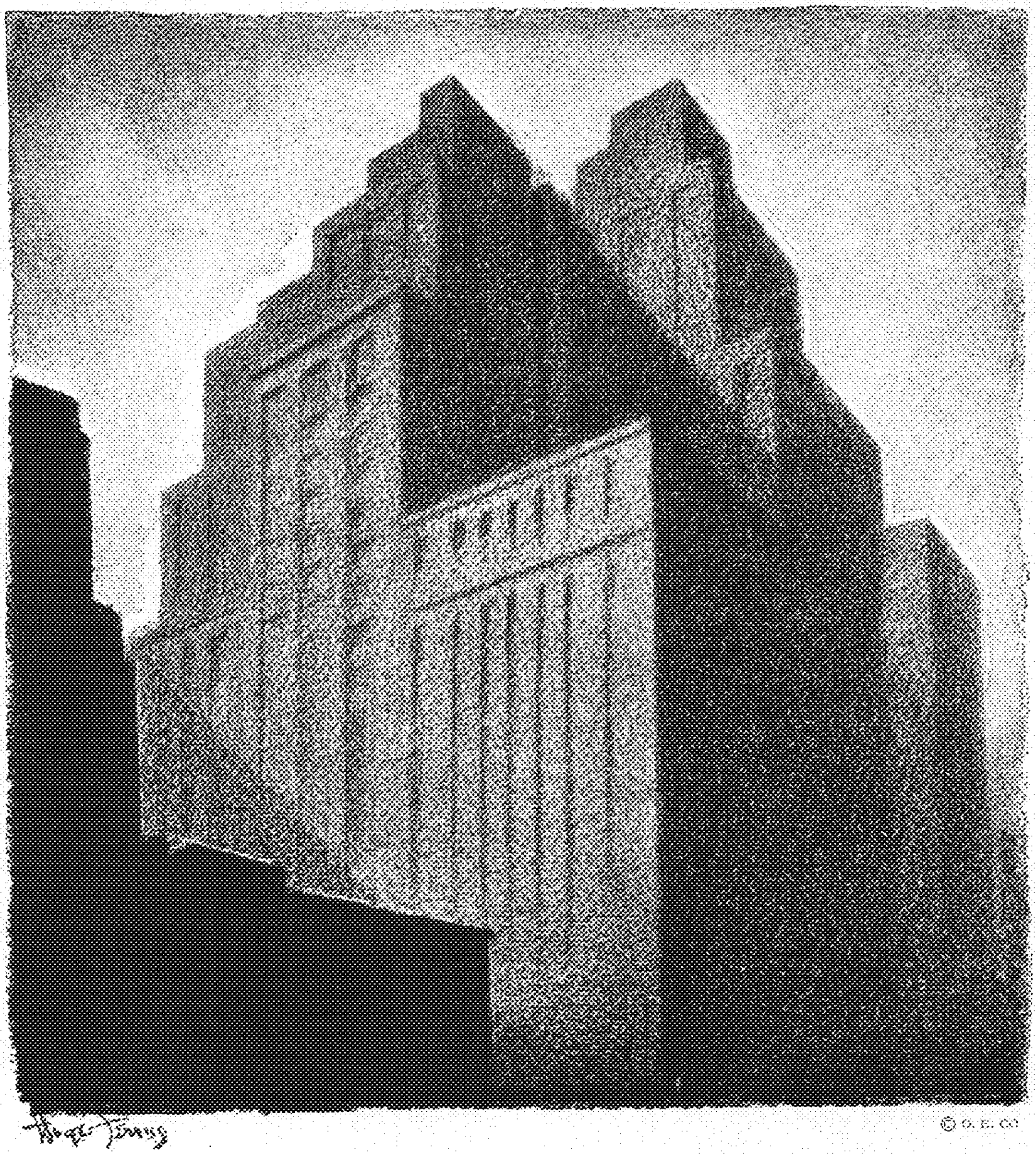
MAY
1925

Volume V 25 CENTS A COPY Number 8

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES





© O. E. CO.

The Garment Center Buildings
New York City
WALTER M. MASON, Architect
Drawn by Hugh Ferriss

"Towering Masses"

HERE the new architecture expresses itself in great vigorous masses which climb upward into the sky with a pyramidal profile—gigantic, irregular, arresting. An earlier, conventional building on the near corner is overshadowed, engulfed in towering masses of the newer building which are prophetic of an architecture of the future which is vividly stimulating to the imagination.

Certainly modern invention—modern engineering skill and organization, will prove more than equal to the demands of the architecture of the future.

OTIS ELEVATOR COMPANY

Offices in all the Principal Cities of the World

The MINNESOTA TECHNO-LOG

37 Electrical Building

UNIVERSITY OF MINNESOTA

HERMAN F. BESELER AND KENEFICK ROBERTSON, *Managing Editors*
RICHARD W. JONES, *Business Manager*

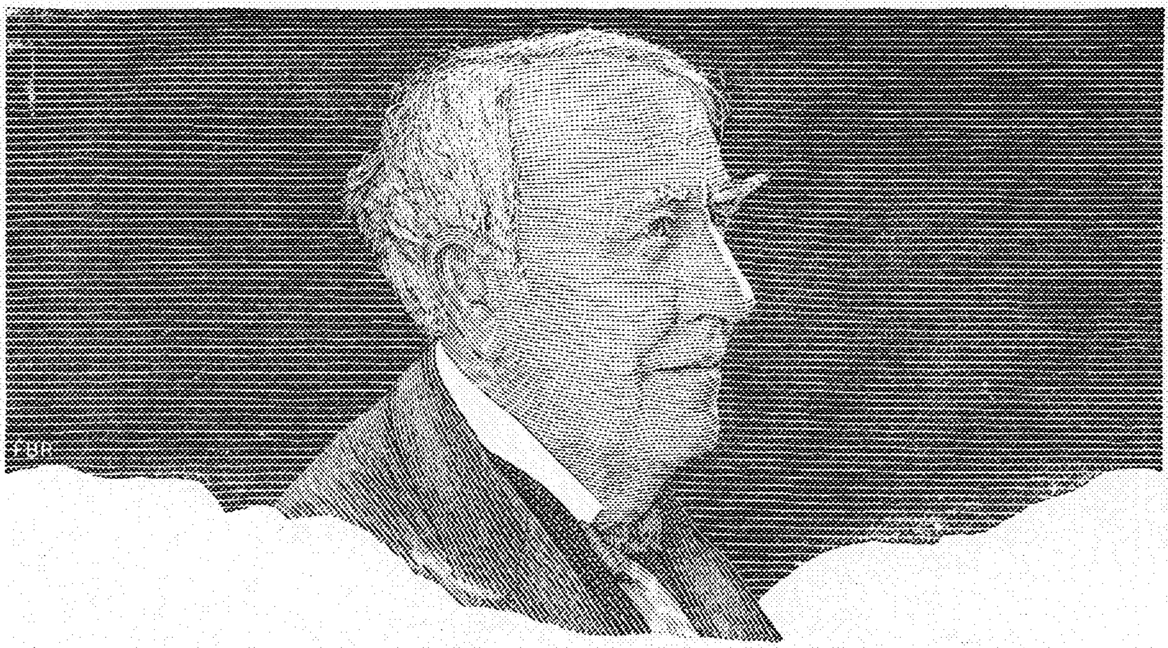
VOLUME 5 NUMBER 8

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

Entered as second-class matter, April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879.

TABLE OF CONTENTS

Cover Design by Joel S. Carlson.



And he has lived to see it

Back in 1885, Thomas A. Edison succeeded in transmitting electricity at 220 volts for one mile—an achievement and a promise.

The promise was fulfilled a few months ago, when electricity at 220,000 volts was transmitted two hundred and forty miles to supply Los Angeles with light and power.

Now five billion dollars are invested in electric power plants. A stupendous figure that testifies to the alertness of thousands of college-trained men who have been leaders in the production and use of electric power.

The electrical era has only dawned. Each year some new machine or discovery makes it possible to apply electricity in unexpected ways. The graduate of today will find electricity directly or indirectly a means for even greater accomplishments, no matter what his calling in life may be.

In 1881 Edison shipped to the Paris Exposition his "Jumbo" dynamo—eighth wonder of the world. It could light 1000 lamps. Now there are G-E generators large enough to supply current for over a million lamps, each with four times the candle-power of the lamp of 1881.

The General Electric Company produces other electrical apparatus which makes it possible to transmit power over great distances. It has put electricity in seven-league boots. In its laboratories, scientists are now experimenting with voltages ten times as great as the highest now in use.

If you are interested in learning more about what electricity is doing, write for Reprint No. AR391 containing a complete set of these advertisements.

27-44DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume V | MAY, 1925 | Number 8

MECHANICALS MAKE ROWBOAT MOTORS

By Theodore Corbett

Mechanical Editor, Minnesota Techno-log

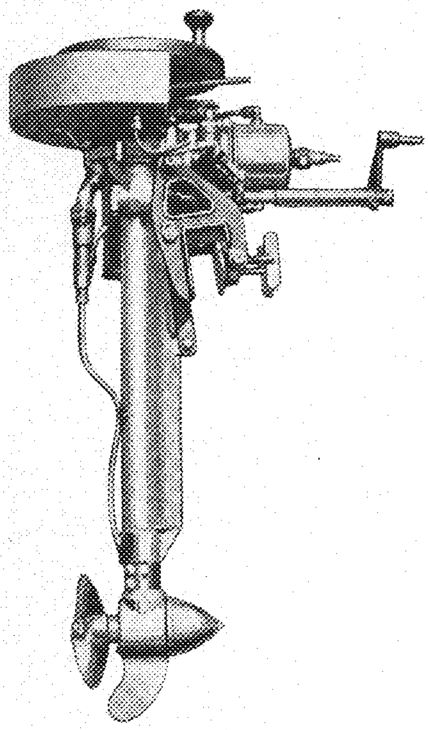
CONSTRUCTION of single cylinder rowboat motors gives mechanical engineering students at the University of Minnesota practical training in modern production methods. Except for a few minor accessories, the motors are made entirely by students, and are sold to the students for the actual cost of the raw materials used in the construction. A completed motor costs about twenty dollars, while a similar one sells for eighty dollars on the market. Work on the motors is done in the regular machine shop class, and each member takes some part in the construction, although every one is not required to complete a motor. Out of a class of 31 sophomores, 22 made motors this year.

The motor was designed by Prof. S. C. Shipley of the mechanical engineering department. It has a 2⅝ inch bore by 2½ inch stroke, and operates on the two stroke cycle. In tests made in the experimental laboratories, two and one-half horse power were developed at 800 r. p. m. The completed motor weighs 60 pounds and is capable of driving a small boat at a speed of 12 miles per hour.

The method of operating the water pump differs radically from the usual plan. In a two cycle engine of this type, gasoline vapor is drawn into the crank case when the piston is on the up stroke, and is forced into the cylinder on the down stroke. In the motor made here, the crank case pressure is used to drive the water pump. The water pump itself is made up of two small cylinders. In the first of these, crank case compression forces a piston forward, and a small spring returns it when the pressure is relieved. The reciprocating action of this piston is transmitted directly to a piston in the second cylinder which pumps water in the usual manner.

With the exception of the mixing valve, spark plug, and other minor accessories, every part of the motor is made wholly by students. All castings are made in the foundry as regular class exercises. Heat treatment of the crank shaft and piston pins is carried on in the forge shop. Jigs for the machine shop are made by the tool construction class.

Portions of the motor exposed to the weather are made of aluminum wherever possible in order to prevent corrosion. In this class are the crank case, shaft housing, cylinder, and flywheel. For mechanical reasons, however, it is necessary to make the cylinder and flywheel of cast iron. The cylinder water jacket is pressed from sheet aluminum.



The Gopher Rowboat Motor

Heat treatment, where necessary, is carried on in the forge shop under the direction of Mr. T. P. Hughes, forge shop instructor. Before any machine work is done on the piston and cylinder castings, they are annealed at a temperature of 1000 degrees fahrenheit to relieve casting strains and to facilitate machining. Piston pins and gears are machined from mild steel, and case hardened by carbonizing to a specified depth. After carbonization, they are heated to 1540 degrees and quenched in water. Crankshafts are made of chrome-vanadium steel, and are heat treated for the purpose of toughening rather than hardening. The treatment consists in heating to 1550 degrees, quenching in oil, and drawing to 600 degrees.

Although motors manufactured this year have been satisfactory from the operating standpoint, it has been found desirable to simplify the construction. For this reason the motor has been redesigned with a view towards decreasing the number of parts and making the construction less complex. Two of the newly designed motors are being constructed now, and will be tested this coming summer.

Alteration in the position of the cylinder is the chief modification embodied in the new motor. The old motor was constructed with the cylinder horizontal and the propeller shaft vertical. This arrangement necessitated gearing between the propeller and propeller shaft.

The new design places the cylinder in an upright position. Since the motor is above the water level, it is necessary to tilt the shaft slightly to submerge the propeller in water. The rudder is fixed on the shaft housing, and steering is accomplished by swinging the whole motor through a small angle. The motor is mounted on a swivel arrangement to allow for this motion.

A waterproof metal box to contain the spark coil is mounted directly above the cylinder. The battery is the only unit not directly attached to the motor, thus making it practically selfcontained.

The degree of simplification attained in the new motor may be seen readily from the fact that the new motor will have but one-hundred twenty parts as compared with two hundred seventy in the old motor. With the construction simplified to this extent it is expected that every student will make a motor next year.

WCCO—THE GOLD MEDAL RADIO STATION

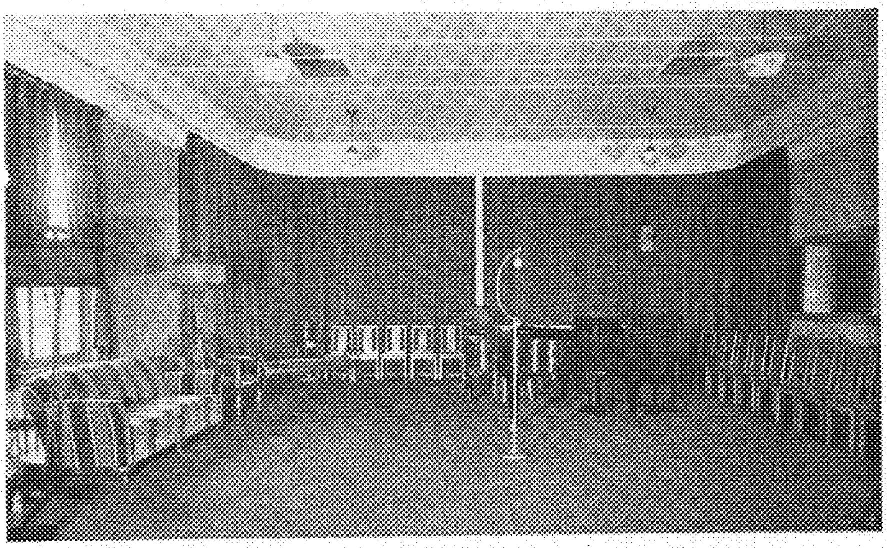
By Ray Sweet, E. E. '21

Chief Engineer, WCCO

THE other evening after dinner the family had started out for a short ride in the car. We drove south on Cedar Avenue, down into the Minnesota River Valley, across the river, and up into the hills on the southern side, then swinging westward and finally north, until we had made a complete circle and were back home. We had been out only an hour and a half, and I was somewhat surprised to notice that we had driven about forty miles. Nothing unusual today, of course, but 25 years ago it would have been considered an impossibility. A 40-mile drive would have been an all-day event, and a long day at that. The fact that we had traveled that distance just as a means of after-dinner relaxation is just another one of the marvels of the age in which we are living.

As we entered the house, I stepped over to the radio and turned the button. Out of the loud speaker came a popular tune broadcast by one of our most famous orchestras in a New York studio. It is something that I hear every week. It was scheduled on the program for the week, but somehow, thinking about the ride we had just enjoyed in such a short time and the nonchalance with which we in the Twin Cities accepted our entertainment from New York by the turning of a button, gave me quite a thrill. If anyone had tried to tell our grandfathers that such events would one day be commonplace, the prediction would have fallen on unbelieving ears.

Unquestionably, the last quarter of a century has seen more progress in science and mechanics than any other period in the world's history. And the beauty of this is that a large part of these discoveries and developments have been extremely practical and have been such that the public at large could enjoy them. Naturally one of the most wonderful of all of these is the radio, and it is to that that I gave my time and study in the days when I was a boy in school and operating and making valient attempts to operate a wireless outfit. It is a long cry from those days to the present day, which I think presents a field which holds wonderful possibilities for the young engineer. The industry is still in its infancy, and it provides a wonderful opening for the engineer with the inventive mind.



Studio A—On the Roof of the Nicollet Hotel, Minneapolis. Note the Heavy Carpets and the Deadening Curtains on Rails

RADIO is not new to the University of Minnesota, for the pioneer station of the Northwest, a small experimental transmitter, was installed there by Professor C. M. Jansky of the Engineering Department, the man who has taken such an active part in all work and study pertaining to radio that today he is considered one of the greatest national authorities on the subject.

I have been asked in this article to describe the Gold Medal Radio Station, St. Paul-Minneapolis, WCCO, which represents the last word in broadcasting equipment today. Five years from now our present equipment may be considered antique and obsolete, so rapid is the progress in radio, but today it is far above anything anticipated five years ago.

For the benefit of those unfamiliar with the history of WCCO, the Gold Medal Station, it is owned by Washburn-Crosby Co. and operated by them jointly with the business men of Minneapolis and St. Paul. In the summer of 1924 when the old Twin City Station, WLAG, went into the hands of receivers, Washburn-Crosby Company offered to buy it outright and contribute $50,000 annually for a three-year period towards its support, providing the business men of Minneapolis and St. Paul together would contribute a like amount for the same period. Washburn-Crosby Company also offered, if this proposition was accepted, to immediately place an order for a new 5,000 watt transmitter. The proposition was accepted and the plan has been carried out.

The new equipment of WCCO was formally introduced to the public on the morning of March 4th, when it was estimated that 750,000 persons throughout the Northwest, including all of the school children in the Twin Cities, listened in to the inaugural ceremonies at Washington as broadcast by the Gold Medal Station in the national hookup.

THE main transmitter of the station is on the East River Road, about 18 miles northwest of Minneapolis and St. Paul. The antenna is strung between two large three-legged steel towers, each 200 feet high and 400 feet apart. Each tower is set in concrete, and they are so constructed that they will withstand a wind pressure of 95 miles an hour with a strain at the top of 3,000 pounds. The antenna runs east and west, with the transmitting power house about 100 feet out from the east tower. An 80-ft. cage aerial is suspended by messenger cables between the tops of the two towers, with a cage downlead coming down into the west end of the house.

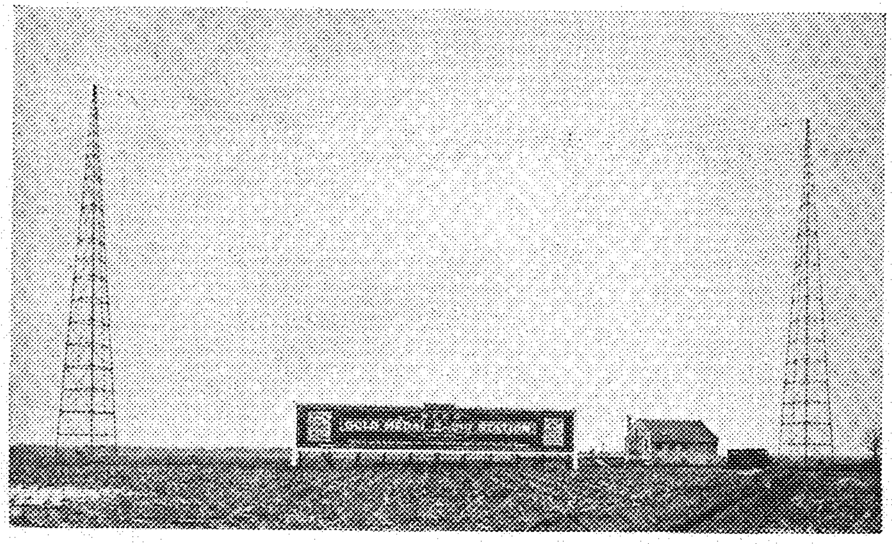
A large insulated counterpoise stretches from the house to poles a distance of about 300 feet. These two poles are approximately 175 feet apart, and the counterpoise wires are fastened to messenger cables stretched between the poles and are up just high enough to be out of reach.

At the entrance to the stationhouse is the office of the engineer. Directly ahead is the doorway leading into the main transmitting room where the large panels of the broadcasting equipment are situated. There are six large panels, on the face of which are many meters to indicate the different electrical currents in the circuits of the broadcaster. From left to right the panels are: the alternating current power panel, the direct current power panel, oscillator-modulator unit, rectifier panel, power amplifier panel, and antenna tuning unit panel. Behind the panels are such equipment as power transformers, filter condensers, protective gaps, and a special dummy antenna used whenever it is desired to test the equipment without putting the test on the air. All of this equipment is enclosed by a fine graded steel fence to protect operators and visitors from the terrific high voltage used in this powerful equipment.

In the next room are duplicate sets of the motor generators which supply the power to the control circuits and tubes of the transmitter. In one corner is a large charging and switching panel, with storage batteries on racks below.

Adjoining is another small room in which large radiators are installed. These radiators are used to cool the water circulating around the bases of the special water-cooled power tubes.

All programs from the St. Paul and Minneapolis studios come to the transmitting station over special telephone circuits. They are transferred into electrical energy at the studios, and this energy in turn is amplified before being sent over the special lines to Anoka. They are again amplified in the control room at the transmitting station and sent into the oscillator-modulator unit of the big broadcasting equipment, where they are further amplified and finally sent on to the aerial.



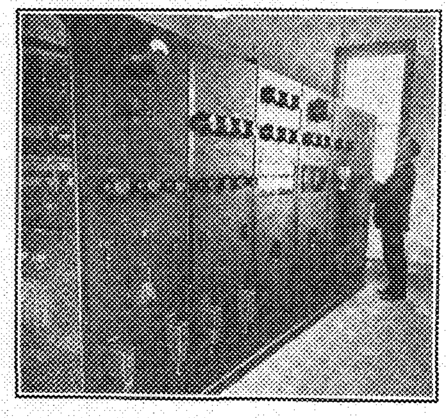
The Antenna System Supported Between the Two 200 foot Towers and the Stationhouse on the East River Road

THE new Minneapolis studios are in a specially constructed building on top of the Nicollet Hotel in Minneapolis. They consist of a reception room, small studio, and a large studio. Between the two studios are the operators' and announcer's rooms. Glass panels in the walls make possible a view of all operations from any point, and glass panels in one wall of the large studio make it possible for visitors passing up and down the promenade outside to watch the broadcasts, and at the same time hear them through loud speakers installed in the reception room. In each of the studios and in the announcer's and operator's rooms are loud speakers which automatically cut in and out between broadcast announcements. All are controlled by a speech amplifier panel which constitutes the only equipment in the operator's room.

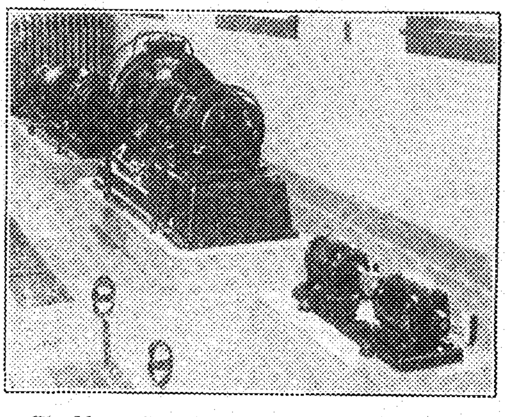
The construction of the studios proper is unique in that the ceilings are suspended and deadened, the walls insulated, the floor built upon cork, and in addition heavy green velvet drapes are hung from a track running about the walls, thus making possible acoustical control. The reception room and studios are elegantly furnished. On the floor in the reception room and promenade are Oriental rugs, while the studios are covered with extremely heavy padded carpeting. The furniture is all in colors and of a unique type. In fact, the studios have been pronounced by those who have visited broadcasting stations throughout the country to be unequalled in appearance and facilities for proper broadcasting.

The construction of the St. Paul studios, now under way, is practically identical. The location, however, is one of the most unique in the world for broadcasting stations. The studios will be in St. Paul's new Union Depot, with the main studio fronting on the concourse and separated only by glass panels through which all those passing to and from trains may watch the broadcasts.

The most noticeable result in the new Gold Medal Station is its greatly increased range. Reception is reported from both coasts practically every night during the cooler weather, and even in the summer weather it is expected that it will overcome static to a much greater extent than ever before.



The Control Panels of the Transmitter Set



The Motor Generator Sets in the Power Room

THE IRON RANGE IS BEING ELECTRIFIED

By Ikel C. Benson
Member of the Senior Electrical Class

NORTHERN Minnesota is well known as "The Iron Range" because of its large bed of iron ore which is being mined continually to supply the iron and steel demands of the many other industries. The iron mines are becoming more and more equipped with electrical apparatus and this should be of considerable interest to the young engineer. Iron ore is mined by the underground and by open pit methods, and the use of electricity in each method of mining points to the many future uses and applications of electricity.

In the underground method of mining, electricity is used to a certain extent in all mines and some have been fully electrified within the past three years.

The Minnesota Power and Light Company, which is financed by the Electric Bond and Share Company, furnishes practically all of the power necessary for the Range Districts. Its large capital enables it to develop large natural water power sources and build steam plant stations to take care of large demands of power. The power is sent to the mines at 22,000 volts, 3 phase, at 60 cycles per second. The line is connected to a bank of transformers which steps down the voltage to 440 or 220 volts. By means of a synchronous converter, the alternating current from the transformers is transformed into direct current at 250 volts. For variable speeds and loads, the direct current motor has the necessary characteristics for efficient operation. Hence the motors used in tramming ore on the subways and on the stockpile, are direct current motors running on 250 volts. The lighting in the main subways and drifts, and the underground fans also use direct current at 250 volts.

The hoist is generally run by an induction motor geared down considerably to the hoist drum. The cable is wound around the hoist drum and is used to hoist or lower the skips as wanted. A 220 H. P., 3 phase induction motor at 440 volts is often used. With twelve poles the synchronous speed is 600 and with full load the speed is about 585 revolutions per minute. The motor is connected to a panel board and controller having six notches which cuts out resistance as each step is taken. Time relays and other devices are used so that the motor cannot fail or stall under any conditions except that when the power goes off the high line.

The hoist is operated by a reversing lever and a controller which run the motor. A large hand brake is also used which, when applied, contracts about the hoist drum.

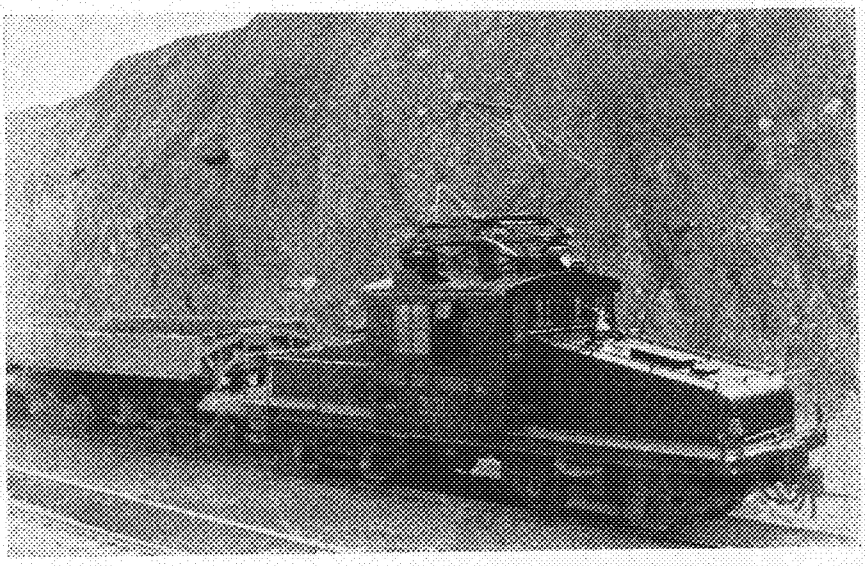
To enable the miners to work, the mine waters are pumped out by centrifugal pumps which are connected directly to A. C. induction motors. A pump which delivers 1500 gallons per minute requires a 150 H. P. induction motor with the following general characteristics: 440 volts, 60 cycles, 3 phase, and a speed near 1765 R. P. M. at full load. A starting compensator having two positions and an oil circuit breaker are used in connection with the induction motor. The operation of these pumps is simple and very effective which cannot be said of the old steam pumps.

Centrifugal pumps are effective in pumping the mine waters which contain sediment that is harmful to cylinders and piston heads.

The electric machine is ready to go at any instant. It takes no power when it is not running and does not require any attention or watching when idle. It is started in a few moments and ready to deliver full power. No ashes, soot, gases or other undesirable by-products result from the operation of the electric machine. Aside from all these favorable characteristics, the economics effected by the use of the electric machines, which mean so much in dollars and cents to the employer, have led to the extensive use of electric machines in every field.

Compressed air at about 90 lbs. per square inch pressure is used in drilling holes in the iron ore formations preparatory to blasting, and also in the hauling of ore to the chutes by means of scrapers driven by small air tuggers of about 5 H. P. capacity. An air compresser driven by an induction motor is used for this important source of power which is essential in the work of every miner. The size of the induction motor varies with the size of the air compressor, and this with the demands of the many miners in the mine; hence the size of the motor varies directly with the size of the mine. A 75 to 125 H. P. induction motor at 440 volts is used in most cases for driving air compressors.

Various small induction motors are used in the shops for driving lathes, saws, etc., and these are usually of the 3 phase, 220 volt design. A small internally-fired boiler furnishes the only steam used in the electrified underground mine. The steam at about 10 lbs. per square inch pressure furnishes the heat for heating the mine buildings and the water for washing purposes of the employees. The future may see the use of electricity for heating purposes also. By the use of the above mentioned electrical machines, many expenditures are eliminated and others



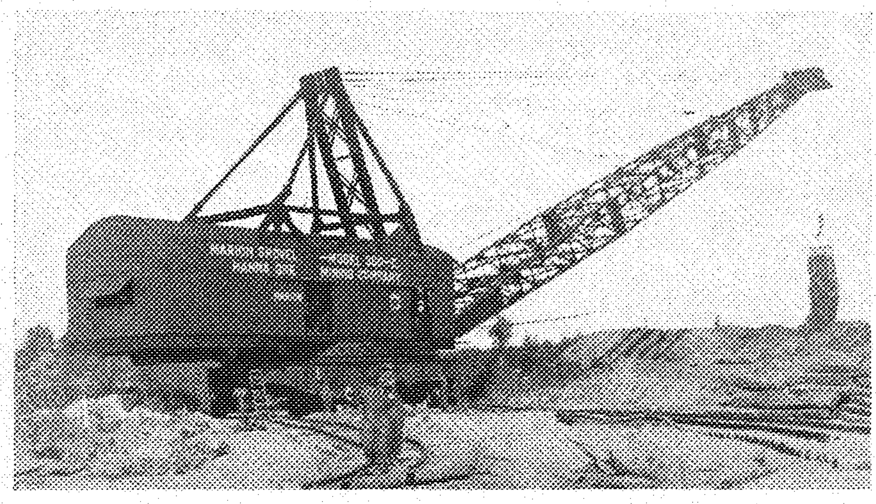
Electricity, Clean and Efficient; Doing the Work of Mules or Steam Locomotives on the Iron Range cut down a great deal. The result is that a ton of ore can be mined at a much lower figure than that which was obtained when using steam and hand power.

In the open pit method of mining, the Wabigon Mine at Buhl will be used as the illustration, as it is the first all-electric open pit in the world. The surface above the iron ore is first removed and access to the iron ore body is thereby obtained directly, from which it is loaded into steel cars and shipped to the furnace.

The shovels consist of one Marion type Model 300 E and one Bucyrus type Model 50 B. The large Marion shovel, generally known as the 300 ton electric shovel, has a dipper of eight cubic yards capacity for stripping purposes and another of six cubic yards capacity for loading iron ore. It can also be used with a drag line and thereby used for casting purposes, e. g. moving the material from one location to another by means of rotating the shovel only. The shovel has the field control system and is equipped with a 435 k. v. a. synchronous motor, a 250 k. w. hoist generator, a 50 k. w. swing generator and a 20 k. w. exciter. It has two 175 H. P. hoist motors, a 75 H. P. swing motor and a 75 H. P. crowd motor all operating at 230 volts. A triple conductor cable is connected to the synchronous motor by means of a reel so that the shovel may be moved without disturbing the electrical line connection. Regenerative braking is used as a means of saving power by allowing the weight of the dipper to fall and run the motors as generators, and thereby return power to the line. This shovel is generally used in the pit where the bank is high and the digging hard.

The small Bucyrus 50 ton shovel has a rheostatic control and is equipped with a 100 H. P. induction motor, a 65 k. w. generator, a 75 H. P. hoist motor, a 20 H. P. swing motor and a 13 H. P. crowd motor. This shovel is used for lighter work and on the dump for cutting trackways.

The locomotives used are manufactured by the General Electric Company and are made in the 50 ton type. The locomotive has four single gear, commutating pole railway motors rated at 158 amperes and 500 volts. The controller is of the multiple unit type with seven steps. A sliding pantograph or trolley pole is used as the collecting device. The pantograph is used on the regular runs where there is no interference; but where the shovel dipper must swing directly above the car, the trolley pole is extended from the opposite side and power secured therefrom. The locomotive, at a speed of eight miles per hour, has a tractive effort of 17,600 lbs. It may be of interest to know that on a test pull, the electric 60 ton locomotive will pull the 60 ton steam locomotive when both start together, each pulling in the opposite direction. By giving the steam locomotive a start (thereby running the motors as generators) and then opening up the controller, the steam will pull the electric. The reason for this is evident when we consider that the motors are working in the opposite direction as generators and thereby cannot obtain their normal motor power. In going up a grade, the electric motor is not as apt to slip and it does not require a running start to make the grade.



A Modern Electrical Shovel Scooping Ore in One of Minnesota's Famous Open Pit Mines

Each locomotive cab has two control stations from which the controller, brake equipment and car dump air valves are operated. The air compressor in the center of the cab has a capacity of 100 cubic feet per minute, when operating at a pressure of 130 pounds per square inch and 600 volts.

Another advantage of the electric locomotive is that its power output is not affected by the climate while the steam locomotive uses more fuel per horse power output during the winter months than in the summer.

In general the electrical apparatus is strong, durable, safe, clean, capable of carrying great overloads, and very economical when compared to the steam engines. The rising costs of coal and transportation with stronger competition has brought about a study of the elements in the costs of mining iron ore and the result has been that the use of electricity in the mining industry has increased enormously because of its economies. Actual figures show that mining by the use of steam is from two to three times as expensive as that by the use of electricity. It has brought about economics in many other industries and now it is doing the same in mining of iron ore, which is shown by the interest taken by various other mining companies by remodeling their mines to the use of electricity.

BOOKSTORE HEAD LEAVES

Howard C. Jacobson, present manager and organizer of the Engineer's Bookstore, recently announced his intention of entering other lines of business. Applications are being received now by the board of directors for his successor.

The Engineer's Bookstore is now in its fifth year of existence and has prospered greatly under his guidance. It is the only similar organization on the campus and is unique among other large engineering colleges. It is governed by the student board, whose members are elected every year.

Mr. Jacobson is a graduate electrical engineer of the class of 1921 and is a member of Tau Beta Pi, honorary fraternity. He plans to go into an engineering enterprise in this city.

George E. Swift, '23, is engineer for the Electric Mach. Mfg. Co., 14th and Tyler Sts. N. E., Minneapolis, Minn.

THE DETERMINATION OF POISSON'S RATIO

By George C. Priester

Assistant Professor of Mathematics and Mechanics

ONE of the mechanical properties of materials of engineering called Poisson's Ratio has received less attention in regard to its determination than most of the other properties, probably because for the design of ordinary structures and machines, approximations can be made so that it is not necessary to make use of this property. The author, therefore, desires to discuss this property and to give the results of some experiments carried out under his direction.

One may say that in those conditions in which only a simple axial stress exists there is no need for this ratio, but where there exists a bi-axial or a tri-axial state of stress this property often plays an exceedingly important role. By neglecting or even by assuming erroneous values for Poisson's Ratio in the more involved problems of elasticity, great divergence of results may occur and these may lead to long and bitter controversies as, indeed, they have in the past.

Poisson's Ratio may be defined as the ratio of the unit lateral deformation to that of the unit longitudinal deformation when a material has been subjected to an external force in the longitudinal direction only and the stress in the body in any direction does not exceed the proportional limit of that stress.

In Figure 1 the original shape of a bar subjected to a longitudinal force is shown by the full lines and the effect of this force is shown by the dotted lines. Since in the case of a longitudinal pull, the section shows a lateral contraction, many engineers think that there must exist a lateral stress to produce this deformation. However, since stress is defined as an internal force, no stress can exist in the lateral direction because the external force is perpendicular thereto. This may be proven from the general relations existing between stress and strain.

Therefore, in an uni-axial state of stress, it may be said that in the plane normal to this axis there may be strain and no stress. In other states of stress the strains are effected by stresses in proportion to Poisson's Ratio; and in order to obtain even ordinary approximate values of either the stress or the strain, this ratio may not be neglected.

TABLE

	E.	G.	P. R.
Mild Steel, rolled	29.40	11.87	0.24
Semi-Steel, cast	13.45	5.22	0.29
Cast Iron, cast	13.02	4.93	0.32
Aluminum, cast	5.02	1.91	0.32
Duralumin, rolled	10.41	3.85	0.35
Aluminum, rolled	10.38	3.74	0.38

NOTE: Values of E and G are to be multiplied by 10^6 and are given in pounds per square inch.

There are three common methods used to determine Poisson's Ratio, namely: 1. From the measurement of longitudinal and lateral strain; 2. From an elastic relation existing between the modulus of elasticity and the modulus of rigidity; 3. From a relation existing between longitudinal and lateral curvature of a rectangular beam.

The first method is probably the most direct, but it presents some difficulties. Since Poisson's Ratio is always less than one-half, it can easily be seen that the measurement of the lateral deformation in a uni-axial state of stress would require a very delicate instrument. However, such instruments have been made, and the results check those obtained by other methods.[2] The second method is probably used more than the others. It consists in determining the modulus of elasticity in tension or compression and the modulus of rigidity usually by torsion. Then Poisson's Ratio may be computed from the equation

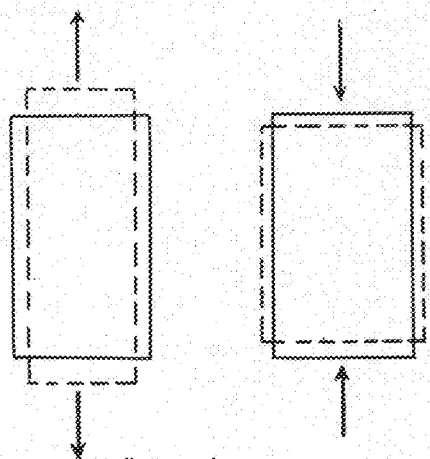


Figure 1.

$$K = \frac{E - 2G}{2G}$$

where K is Poisson's Ratio, E the modulus of elasticity and G the modulus of rigidity. Since E and G are often known or may be determined by a relatively simple experiment, this method lends itself admirably to the determination of this property. The third method consists in subjecting a rectangular beam to a uniform bending moment and by suitable instruments[3] measure the longitudinal and lateral radius of curvature of the beam. Poisson's Ratio is then obtained from the relation

$$K = \frac{R_1}{R_2}$$

where K is Poisson's Ratio, R_1 the longitudinal radius and R_2 the lateral radius.[4]

The author, being somewhat limited by equipment, chose the second method for determining the values of Poisson's Ratio given in the above table. Since the modulus of elasticity and modulus of rigidity were determined in some cases only to three significant figures and because of the relationship existing between them and Poisson's Ratio, the values for Poisson's Ratio is given only to two significant figures.

While the value of Poisson's Ratio for steel agrees with that of other investigators, some of the other values are somewhat higher than those usually given. This may be explained by the fact that the chemical composition of a metal and its microscopic structure may vary these values very much more in metals other than steel. Since steel in its widely varying composition gives nearly constant values for all the properties determined here and being in good agreement with other published results, it indicates that the method used is reliable.

The author wishes to acknowledge the valuable assistance of his two students, Mr. Potter and Mr. Jacobi, who performed the experimental work necessary in order to determine the above data.

1 See Prescott's "Applied Elasticity," Art. 33, Page 29.

2 Morrow "Phil. Mag.", 1903, Vol. VI, page 417.

3 See Batson and Hyde "Mechanical Testing," Vol. I, Art. 141, page 215.

4 See Prescott's "Applied Elasticity," Art. 39, page 37.

ESTHER KNUDSEN

Co-ed Engineers

Man's Domains are Again Invaded

By

Harold C. E. Peterson

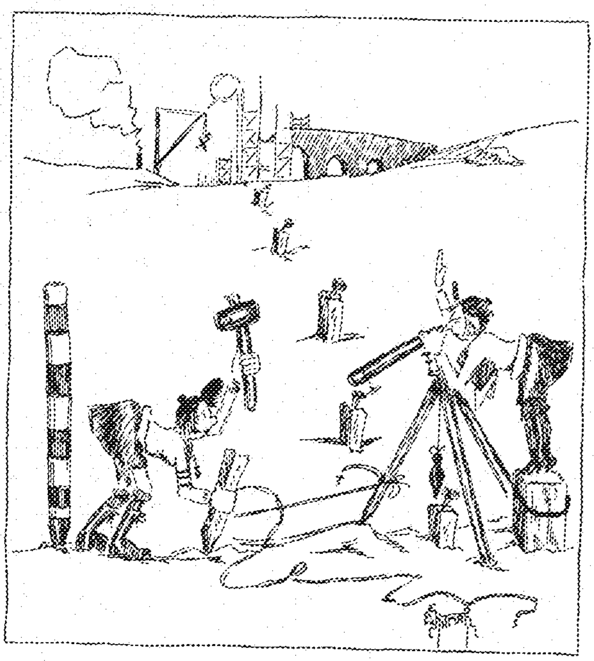
URSULLA QUINN

DURING the awful years of the war it became necessary for the patriotic woman of this country to don her manfolk's trousers and boots and stride forth to fill his place in industry as best she could. And she liked it. She enjoyed the new-found freedom of being able to kick up her heels, stick a cigarette in her mouth and walk into a barber-shop, saying, "A hair-cut, please, and make it snappy." For it was a chance to defy convention and laugh at grandmothers. And when the war was over, she refused to be displaced. Her freedom was not to be relinquished. And she had her way (witness any barber-shop) and continued to hold down her position as mechanic, street-car conductor, bookkeeper, bank president, senator, and whatnot. But certain fields were not open to her without years of preparation. She could not, at once, become an engineer. And investigating the possibities, she found that first that awful ogre, the Calculus, must be overcome. She found that Descriptive Geometry must be mastered; that Analytical Geometry, Mechanics, Strength of Materials, and Hydraulics stood between her and such absorbing subjects as Bridge Design, Heat Engines and Statically Indeterminate Structures. And she hesitated. But not for long.

* * *

For in the 1921 a new sound echoed and re-echoed up and down the long halls of Main Engineering. Hurrying students paused to listen to the click-click of woman's heels upon the tiles of man's last retreat at the University. The less bashful, thinking to perform an act of chivalry, hastened to guide the two co-eds to the building they were seeking, for this was Main Engineering. And the would-be Sir Walters were non-plussed—astounded—sunk. For in reply to their inquiries the delicious bits of femininity replied, "Main Engineering? Of course! That's where our classes are. We're to be engineers."

Courageous? Of course, all pioneers are courageous. Determined? Yes!! For in spite of all the predictions of the sceptics—predictions that allowed the girls from one quarter to a year at the outside to change their minds and leave the Engineering School to men alone, the Misses Esther Knudsen and Ursulla Quinn have at last reached the zenith of their school life and are soon to be graduated, whereas most of the sceptics have dropped by the wayside. Even the prospect of six weeks in summer camp with the so-called "hard-boiled engineers" failed to deter them.



Prepared? Again, Yes! A comparison of their marks of even the Tau Betes of the college will show just how well prepared the girls are. Not only have they shown their ability in the more theoretical phases of engineering, but in the more practical laboratory courses, in surveying, and in designing, they have displayed a most unusual aptitude.

It will be mighty interesting to follow their careers after graduation. And it is safe to predict that through their efforts, and their success, succeeding classes of engineering will have larger and larger quotas of girl students in the ranks. And Man's sacred domains will be sacred no longer.

Technical Students Recently Honored

Sigma Xi Awards

Sigma Xi, honorary research fraternity recently announced their awards for 1925 as follows:

Experimental Engineering

Frank A. Morris.

Electrical Engineering

L. J. Schnell, O. Heidelberger, W. F. Kannenberg.

Chemistry

L. H. Reyerson, L. T. Webber, E. E. Jewett, T. A. Childs, Rudolph Krantz.

Mines

Ralph L. Dowdell, A. J. Carlsen.

A. S. C. E. Makes Awards

The student branch of the American Society of Civil Engineers prize this year was won by:

Tied for 1st, John Swanberg, Frank Nichol; 2nd, T. P. Young.

Iron Wedge

Recently chosen members of Iron Wedge, senior honorary society are given as follows:

Bernard J. Larpenteur, W. Oswald French, Phillip F. Hartmann, Edward H. Hennen, Arthur C. Jacobson.

Silver Spur

George W. Mork, Elliot H. Griffith.

Grey Friars

Everett Van Duzee, Raymond Rasey, Elliot Griffith.

Publications Board

Paul B. Nelson, junior engineer is the representative on the student board of publications for the coming year. Clyde Lighter, Arch. '26, was the representative the past year.

A. S. M. E. Prize

The A. S. M. E. prize for the best essay on some subject directly connected to some field of mechanical engineering was this year won by William F. Donnelly.

Phi Lambda Upsilon

Sophomore Prize Winner

Carl J. Eide.

Juniors

Joseph H. Kugler, Marvin C. Rogers.

Seniors

Murray M. Sprung, Homer A. Hamm, Ralph J. Elsenpeter, Carl Eklund, G. P. Steinbauer, Harold P. Morris, Edwin J. Dahl.

Graduates

D. R. Briggs, J. R. Haag, G. B. Bodman, L. E. Swearingen, B. E. Sorenson, W. S. Dyer, L. B. Beckwith, D. E. Edgar, Albert Chaney, E. L. McMillan.

Phi Lambda Upsilon is a national honorary fraternity and election is based on scholarship, personality, and attitude towards a scholar's chosen work.

Tau Beta Pi

The Minnesota chapter of Tau Beta Pi, honorary engineering fraternity, held its thirty-second semi-annual banquet at the Radisson Hotel on April 28th. Twelve new members were formally initiated into the society at this time. They are as follows:

C. B. Feldman, L. R. Hafstad, A. A. Jakkula, L. S. Kleinfeld, K. A. Kobe, C. V. Lund, G. W. Mork, L. W. Neubauer, H. E. Rollin, R. E. Wiley, T. P. Young, C. R. Dickerson.

Prof. George C. Preister presided as toastmaster. J. A. Banovetz gave the speech of introduction of the initiates and the response was given by G. W. Mork.

Dr. W. K. Emmons delivered a very interesting address on the present conditions in northern China.

All-University Council

In the recent spring elections, Victor Etem, junior electrical engineer, was elected engineering representative on the All-University council. He succeeds Arthur C. Jacobson. The representative from the School of Mines is Elliot Griffith. The chemistry representative has not been elected as yet.

A. S. M. E. Chooses Heads

George Bohannon was elected president for the coming year of the A. S. M. E. at a meeting held on May 16. Other officers chosen at the same time are Paul Burt, vice-president; Kenneth Bros, secretary, and Leonard Kleinfeld, treasurer.

Plans for the annual picnic were also discussed at this meeting, and Saturday, June 6, was the date chosen. Jay Pike and Kenneth Bros were on the arrangements committee.

Eta Kappa Nu

The formal initiation of new members into the Eta Kappa Nu, honorary electrical engineering fraternity, was held May 6, at the Leamington Hotel. At a banquet held there that evening, Professor G. D. Shepardson, head of the electrical engineering department, spoke on "Standardization." The new members taken into the fraternity at that time were:

K. R. Ferguson, R. L. Christen, L. R. Hafstad, M. E. Fiene, W. J. Carman, C. B. Feldman, H. M. Bullard, C. R. Dickerson.

Chi Epsilon—Pi Tau Sigma

Prof. C. F. Shoop and assistant Prof. B. J. Robertson, were made honorary members of Pi Tau Sigma at an initiation banquet held jointly with Chi Epsilon at the Leamington Hotel May 5.

Prof. James Davies gave an address on "Good Reading," and Prof. J. J. Flather spoke on "Men I Have Known." A. D. Martino, senior mechanical, acted as toastmaster.

The initiates are:

Chi Epsilon

James R. Johnson, Raymond R. Kelley, Franklin J. Halbkat.

Pi Tau Sigma

Leonard S. Kleinfeld, Lawrence O'Donnel.

Architectural Awards

The following awards for honorary for work in various fields of endeavor have been announced as follows:

Moorman Prize—George Freiberg.

Minnesota Chapter of American Institute of Architects—$50.00 prize, P. P. Bross, '25; $25.00 prize, Mary Slocumb, '25.

Alpha Alpha Gamma Prize 1925—Gage Taylor, '27.

Magney and Tusler Prize 1925—Dorothy Brink, Gr., R. V. McCann, '26.

William A. French Prize 1925—Dorothy Mann, '25, Rhoda Cote, '25.

Membership in Tau Sigma Delta—Dorothy Mann, '25, Walter Kendall, '25, Lawrence Anderson, '24.

Bookstore Board

At the All-U elections held recently, the following juniors were elected to the Board of Directors of the Engineer's Bookstore:

Architecture, Robert Kranzfelder; Chemistry, Joseph Kugler; Civil, Edward Young; Electrical, Glenn Meader; Mechanical, Harold Rollin.

Arabs Elect Officers

The Arabs, the dramatic organization of the Engineering College, recently elected officers for next year. Those elected were: Kenneth Wells, president; Oswald Stageberg, vice-president; Allen Tyler, secretary, and Robert Towne, business manager.

A. S. C. E. Election

The student branch of the American Society of Civil Engineers elected the following officers for next year: T. P. Young, president; Carl Liese, vice-president; Paul C. Finton, secretary, and Barton Juell, treasurer.

PREPARATION OF ENGINEERING STUDENTS

By H. P. Hammond

From the Journal of Engineering Education

In connection with the quality of preparation it is to be noted that slightly over one-half of the students admitted to engineering courses in the fall of 1924 were honor students in high school or were in the upper third of their classes. Approximately 85 per cent of students who enter engineering courses receive their preparation in public high schools. The balance prepare in private preparatory schools, parochial schools, by private tutoring, and so forth.

The proper preparation of engineering students is felt principally in the mathematics courses and more time is required for review and drill than formerly. Other members of the faculty report less ability than formerly on the part of students in attacking and carrying through to solution problems requiring close thinking. Students, apparently, have not acquired good habits of work and the college instructors are obliged to devote considerable time to teaching the students how to study, and to helping them cultivate habits of thoroughness and accuracy.

Some years ago students were held to a more or less rigorous training in the elements of algebra and geometry. This has been replaced by a more or less superficial study of the elementary parts of a considerably wider range of mathematics. While this latter may be good or better for the general student, it is an impossible course for an engineering student. The engineering student must begin at the beginning again. He must learn the fundamentals of algebra, instead of learning to solve easy problems by imitative methods. A few high schools of the state sometimes have teachers who realize that an engineer must know fundamental algebra.

The average age of students who enter engineering courses is 18 years and 9 months. A decision to become engineers is reached by aproximately 55 per cent of the engineering students before they reach the last year of high school—at an age of 17 years and 6 months, or earlier. Slightly more than 85 per cent of engineering students definitely choose a particular field and course in engineering before entering college. Although less than one-fifth of the colleges require a selection of course at time of entrance, the great majority of students make such a choice before entering college and comparatively few change their decisions after entering. Nevertheless, less than 50 per cent of freshmen after from one to four months of a college course are able to give other than a vague and ill-founded statement as to the scope of engineering and the work of an engineer—nor do they (as far as the evidence is available from the present studies) have any adequate conception of the particular field of engineering which they have decided to enter. That there is a great need for sound advice to high school students in choosing careers is obvious, and it may be that the engineering colleges can assist high schools in furnishing students who contemplate taking an engineering course with the facts regarding engineering as a life work.

While the elimination of students from engineering courses is undoubtedly due to a combination of many factors, it seems clear that present methods of admission and the lack of valid vocational guidance of high school boys is to a considerable extent responsible for the very large shrinkage in classes pursuing engineering courses. Based upon the records of approximately 70,000 students admitted during the past 22 years it is found that for every 100 students admitted, 40 were graduated. The number of graduates includes men who required more than the normal period for the completion of their courses and also includes those admitted in advanced standing. The general tendency of the elimination ratio shows a gradual increase, though the increase is not especially large except during the abnormal conditions of the war period. At the present time, on the average, of every 100 persons who enter regularly and pursue regular courses, 62 begin the sophomore year, 43 begin the junior year, 33 begin the senior year and 30 graduate regularly with their class. The difference between the two figures (40 and 30) given for the number of students graduating is due to those who require more than the normal period to complete their course and to men admitted in advanced standing by transfer from other institutions or from other courses in the same institution. These figures are based upon returns from various types of institutions in all sections of the country.

Twenty institutions of various types situated in different parts of the country have furnished detailed statements of the causes of eliminations. It is to be noted that the number of cases definitely attributable to scholastic difficulty is nearly 50 per cent of the total. It is highly probable that a certain proportion of students who changed course or institution voluntarily were not in satisfactory scholastic standing, and it is no doubt true that among the 21.9 per cent of cases having unknown causes there are many who left because of scholastic failure or the likelihood of such failure in the future. On the whole it is probably not far from the truth to state that from 55 to 60 per cent of all cases of elimination of engineering students are due primarily to failure in scholastic work.

A. S. M. E. HEAD SPEAKS HERE

Dr. W. F. Durand, president of the American Society of Mechanical Engineers and noted inventor, author and lecturer, delivered two addresses on the campus Tuesday, May 26th. He was guest of the faculty at a noon luncheon at the Minnesota Union and spoke at an open meeting in the afternoon which was largely attended by students and faculty of the technical colleges.

Dr. Durand is a graduate of Annapolis Academy, and has been engaged in educational work as professor at Michigan and also Leland Stanford Universities. He rendered noteworthy service during the war as chairman of the National Advisory Committee for aeronautics and as vice-president of the National Research Council committee on engineering. He was also interested in foreign developments.

As an inventor, he is best known for his development of the three-point caliper for measuring circular contours and the radial planimeter. He has also written several text books and is a contributor to several scientific publications.

PROPOSED TECHNO-LOG CONSTITUTION

THE MINNESOTA TECHNO-LOG ASSOCIATION

We, the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines of the University of Minnesota, hereby associate ourselves for the observance and the enforcement of the following constitution and by-laws:

CONSTITUTION

ARTICLE I.

The name of this association shall be The Minnesota Techno-Log Association of the University of Minnesota.

ARTICLE II.

The purpose of this association shall be the publication of a magazine devoted mainly to engineering and scientific subjects.

ARTICLE III.

The name of this magazine shall be The Minnesota Techno-Log.

ARTICLE IV.

The membership of this association shall be composed of all undergraduate students registered in the College of Engineering and Architecture, the School of Chemistry and the School of Mines.

ARTICLE 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 folllows:

(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.

ARTICLE VI.

1. Each year at some time during the first half of the spring quarter, The Minnesota Techno-Log Board shall elect for the following year the managing editor, who shall be directly responsible to The Minnesota Techno-Log Board for the conduct of the magazine.

2. For just cause the Board may by a two-thirds vote make a recommendation of removal of any staff member to the deans of the College of Engineering and Architecture, the School of Chemistry and the School of Mines.

3. The appointment of the business manager by the managing editor shall be confirmed by The Minnesota Techno-Log Board by a majority vote.

4. The staff organization shall be under the direction of the managing editor.

5. All appointments to the staff by the managing editor shall be confirmed by The Minnesota Techno-Log Board by a majority vote.

ARTICLE VII.

The duties of The Minnesota Techno-Log Board in addition to those provided elsewhere in this constitution shall be:

(a) to receive and approve a tentative budget for The Minnesota Techno-Log from the managing editor for the periol of office for which he is elected and before he takes office;

(b) to receive and approve monthly reports from the managing editor;

(c) to receive and approve a tentative budget for each issue of The Minnesota Techno-Log before such an issue shall go to press;

(d) to receive and approve monthly a complete report of the finances of The Minnesota Techno-Log from the business manager;

(e) to determine the salaries of the managing editor, the business manager and other staff members upon recommendation of the treasurer of the board, the managing editor and the business manager;

(f) to audit all accounts of the magazine;

(g) to be responsible to the proper University authorities (Senate Committee) for all moneys and property of the magazine;

(h) to receive at the last meeting of the year a report from the managing editor on the progress of the work of the year, together with whatever suggestions he may make.

ARTICLE VIII.

Members of The Minnesota Techno-Log Board shall not be members of staff of The Minnesota Techno-Log.

ARTICLE IX.

Expenses of The Minnesota Techno-Log Board not to exceed two per cent of the gross receipts of The Minnesota Techno-Log, shall be paid by The Minnesota Techno-Log.

ARTICLE X.

This constitution may be amended by a majority vote of the members of The Minnesota Techno-Log Association after due notice has been given through the recognized channels of publicity.

ARTICLE XI.

This constitution will become effective immediately upon its adoption by a majority of the students voting in each of the three colleges concerned.

(*Continued on page 30*)

HOW MANY COLLOIDS DID YOU USE TODAY?

By V. N. Morris
School of Chemistry

NO one, who has been even a casual reader of chemical literature, can have failed to encounter more and more often of late the term "colloid." To the superficial reader this term may have had but very vague significance. Even if the reader be a well trained chemist, there is considerable likelihood that his conception of colloids does not pass beyond the realms of scientific speculation. But few are the chemists or physicists who realize the full connection between colloids and our daily existance. On the other hand, Wilder D. Bancroft, one of the most conspicuous figures in the chemical world today, has stated that "colloid chemistry is the chemistry of every-day life." In this article the writer will attempt to substantiate Bancroft's claim by describing from the colloid standpoint just how an American soldier spends a day.

FOR the benefit of any of my readers whose conceptions of colloids are not very well defined I will insert a brief explanation, using the substance, silver, as an example. We are all acquainted with silver in two states of subdivision or dispersion, as the colloid chemist speaks of it. In a piece of metallic silver, even if it is just a tiny piece which has been precipitated out of a solution, there is evidently an aggregation of a large number of minute molecules. In other words there exists a low degree of dispersion. This silver can be changed to a higher degree of dispersion by dissolving it in nitric acid for instance. In this case there is obtained a solution of silver nitrate, a rather common substance. The dispersion is now very high as each molecule is separate from the others. Having discussed both extremities in dispersion, it is easy to conceive of an intermediate stage, where the particles contain neither a vast number of molecules nor but a single molecule, but rather where each particle contains a relatively small number of molecules. It is not very difficult to prepare silver in this intermediate stage of dispersion. A colloid then may be most any substance which is in the proper state of subdivision.

An analogy may make the explanation clearer. Suppose a single molecule to be so magnified that its dimensions approach those of buck-shot. Colloidal particles then might vary in size from a marble to a tennis ball, and coarse suspensions and precipitates from a baseball on up. Since colloids will pass through filter paper and coarse suspensions will not, the holes in the paper must vary in diameter between those of a tennis ball and a baseball.

> The Third National Colloid Symposium, sponsered by the National Research Council, will be held at the University, June 17-18-19. Professor Herbert Freundlich will be the guest of honor at the symposium.
>
> Over twenty papers will be given by some of the most prominent scientists in different fields of colloidal chemistry. Among the faculty of the University of Minnesota Profs. L. H. Reyerson, L. S. Palmer, G. A. Richardson, W. B. Larson, R. D. Evans, H. O. Halvorson, F. J. Alway, and C. A. Mann will present papers. Other authors include professors of several noted American and foreign universities and colleges, as well as research engineers of large American chemical, electrical, photographic, and optical concerns.
>
> R. A. Gortner, of the chemistry faculty, is the Minnesota representative on the committee on the chemistry of colloids of the National Research Council.
>
> The staff of The Minnesota Techno-Log presents the accompanying popular article by Mr. Morris, believing that it will stimulate interest in the Symposium.

NOW, to get back to the major project, let us say that our hero, a member of Uncle Sam's army, has his dreams rudely shattered in the usual manner and at the usual hour. Cursing his luck, he soon deserts his downy bunk and reaches for—what? Nothing else but a handful of colloids, for his clothes, be they cotton or wool, are largely made up of colloidal particles. The clothing is colored of course, but whether a case of the black of his necktie or the blue of his denims, the dyestuff used was most probably colloidal. Not content with being wrapped in colloids he puts some more on under foot as he laces up his No. 11's, since the leather of his shoes is an animal gel closely resembling in structure the typical colloid, gelatin.

Reveille having been passed successfully, the next thing in order is a colloidal practice, that of washing, using soap, a substance full of colloids. He next combs his hair, but undoubtedly fails to see any connection between colloids and the gray hairs he combs out. Nevertheless, the color of those very hairs can probably be attributed to the presence in the hair of air bubbles of colloidal size. Moreover, the comb he is using, whether made of hard rubber, celluloid or some other plastic, is colloidal. Rubber illustrates very nicely that property of some colloids which is manifested by their ability to take up liquids or to swell. A rubber band dropped into benzine or other organic solvents will swell to several times its original size.

Having cleaned all the colloidal dirt off his hands and face, he is now ready for breakfast. The first thing he does on sitting down is to sip a little colloidal beverage, as coffee, tea and milk all swarm with colloids. Yes, even if he has a friend among the bootleggers and sneaks out after breakfast for something stronger, he will not even then escape from colloids. Supposing, however, that it was coffee he was served this morning, he will probably add a little sugar, the manufacture of which is tied up with colloidal processes. If he is fortunate enough to have cream, he really has an emulsified oil, and emulsions are merely colloidal liquids. With his coffee he is perhaps given toast, and where else could he come in more intimate contact with colloidal phenomena? Bread-making consists in the formation of a starch and protein gel of definite structure. A change in gel structure occurs when it gets stale, which change is in reality a decrease in the degree of dispersion and a loss of water or syneresis, if the colloid chemist's term be used. This syneresis can easily be demon-

(*Continued on page 26*)

The
MINNESOTA TECHNO-LOG
University of Minnesota

Managing Editors
HERMAN F. BESELER, KENEFICK ROBERTSON

Associate Editor, PAUL B. NELSON

Department Editors
WILLARD H. NORDENSON - - - - - Alumni Editor
CLYDE W. LIGHTER - - - - - Architectural Editor
JOHN B. MCKEE - - - - - Chemical Editor
HAROLD C. E. PETERSON - - - - - Civil Editor
CLARENCE A. JOHNSON - - - - - Electrical Editor
THEODORE R. CORBETT - - - - - Mechanical Editor
THOMAS F. ANDREWS - - - - - Mines Editor
RUSSELL S. GRANT - - - - - Humor Editor

Special Writers
Marshall H. Coolidge, Jr., Philip F. Hartman, Joseph E. Meagher, George M. Cornell, George Nelson.

Assistants
Erling A. Amundsen, Thor A. Gustafson, L. W. Cameron, John C. Marcroft.

RICHARD W. JONES - - - - - Business Manager
A. S. BULL - - - - - Circulation Manager
E. L. SLAGGIE - - - - - Sales Manager

Advertising
Hilder W. Bergman, James A. Helbling, Lowell Anderson.

Faculty Advisers
Prof. A. S. Cutler, Prof. C. A. Mann.

For the Greater Minnesota Technology, the institution which today is being constructed in mortar and brick, and which tomorrow will send into the world men recognized as the leaders of industry; for this THE MINNESOTA TECHNO-LOG stands, and to this end the staff devotes its thought and energy, always keeping foremost the welfare of the University.

The editors of The Minnesota Techno-Log wish to announce the election by the staff of Paul B. Nelson, junior electrical engineer, to the office of managing editor for the school year 1925-26. Mr. Nelson has been a special writer, electrical editor, at present is an associate editor on the staff. The magazine can congratulate itself on having a competent head for the succeeding issues.

CAP AND GOWN DAY

Foremost among the traditions at Minnesota is that of Cap and Gown Day. Each year on that day, announcement is made of the scholastic honors, scholarships, and prizes that have been conferred during the year upon those who have been outstanding in scholastic achievement. However, only a comparatively few are so honored on that noteworthy day. The large majority are "unhonored and unsung." Almost without exception, each one of that vast majority expresses his secret regrets for having spent his college career without having received any tangible reward for the hours spent "burning the midnight oil."

Scholarship is no criterion by which one's future success may be accurately predicted, yet the main mission for attending college cannot be neglected if the value of one's education is to be commensurate with its cost. Although scholastic honors should be sought, they are empty honors if attained at the expense of a broad, practical, and cultural education. Many of us, however, waste much time which, if applied to studies and worth-while activities, would yield returns in later life which would cause us to look back on our college career with pride and satisfaction. —H. F. B.

REASONS FOR THE CONSTITUTION

The question of adequate editorial and business control of The Minnesota Techno-Log has been raised repeatedly on the Engineering campus during the past few years. Its control has been declared outside the scope of the Technical Commission. Neither can the All-University Student Board of Publications assume its control. The present staff is without definite and concrete recognition from either the faculty or student bodies of the technical colleges in which it functions. This state of affairs has existed since the formation of the Technical Association.

It has been proposed, from time to time, to create a body which would assume the responsibilities of the technical magazine. With this idea in mind the present staff proposes the constitution printed on another page of this issue of The Techno-Log. The All-University council has granted a special election in the technical colleges concerned to vote on the constitution as proposed. This election will be held on Friday, May 29, in the College of Engineering and Architecture, the School of Chemistry, and the School of Mines.

In the development of this constitution the staff has tried to make a constitution that will insure, as near as possible, high editorial policy, a strong business foundation, intense student interest, and last, although not least, a desirable faculty support. It is thought that the proposed board, to consist of nine members, is the ideal governing body for the magazine in view of the necessary prerequisites of complete representation of each included group.

If the students of the three colleges adopt the constitution the board can be elected this spring or early next fall.

It will then become the body in control of The Minnesota Techno-Log. —K. R.

Freshmen, Sophomores, and Juniors who are going to gain some experience along various engineering lines during the summer vacation should arrange now to contribute an article on their work to The Minnesota Techno-Log after their return to school in the fall. Usually the magazine prints an illustrated article on one of the several summer camps or spring trips taken by different student groups. There are, however, many more students engaged in practical engineering work during the vacation whose experiences should be recorded to interest others.

If you are planning to work in an engineering field this summer talk it over with a staff member and arrange to have an illustrated article published next fall.

NEWS FROM THE ENGINEERING CAMPUS

1925 CIVILS ORGANIZE

Plans have at last been formulated and committees appointed for the organization of the 1925 Civil Engineering Class into a permanent organization, working for the betterment of the Engineering College by bringing the Alumni into closer contact with its affairs. Meetings will be held at least annually, and each grad will be in constant touch with the school through his particular committee head. The following chart shows the plan to be followed in detail:

A—*Executive Committee*
- 1—4 members
  - a) General chairman
  - b) 3 others
- 2—Appointed by president
  - a) Affirmed by class vote
- 3—Duties
  - a) Appoint general chairman
  - b) Appoint substitute when incumbent resigns
  - c) Arrange for Homecomings and Reunions
    - aa) Appoint Twin City Committee
  - d) Act as auditing committee for funds handled by general chairman

B—*General Chairman*
- 1—One member
- 2—Appointed by Executive Committee
- 3—Duties
  - a) Correspond with sub-chairmen
  - b) Assemble data of sub-chairmen
  - c) Publish semi-annual letter to members
  - d) Keep record of each man—his work and location
  - e) Handle finances

C—*Sub-Chairmen*
- 1—13 members
- 2—Appointed by Executive Committee
- 3—Duties
  - a) Correspond with given list of men
  - b) Accumulate facts of interest concerning these men
  - c—Report these facts to General Chairman for Semi-annual letter

D—*Every Class Member*
- 1—Duties
  - a) Correspond faithfully with sub-chairmen
  - b) Facts of interest concerning himself
  - c) Facts of interest concerning other class members

E—*Financing*
- 1—Small fee to pay for cost of semi-annual letters, postage, etc.

FIVE CYLINDERS IN LINE

By Edward Nickerson

If the crankshaft of a vertical engine of the conventional type used in automobiles have *five* throws, set at 72° intervals, and the order of these crank throws be such as will give 1, 2, 4, 5, 3, or 1, 3, 5, 4, 2, as a firing order with the conventional four-stroke cycle, and if the spacing of the cylinders in line be such that the center-to-center distance of the cylinders will be those of five points obtained by projecting the corners of a regular pentagon on a line parallel to one of its sides, it will be found that the balance of the reciprocating parts will be somewhat superior to that of a conventional four cylinder engine. (I assume, of course, that the five pistons are duplicates, that the connecting rods are duplicates, and that the cranks are of equal eccentricity.) For the proof of this statement, see Cormac's *Engine Balance Using Exponentials.* A ten-cylinder V type engine with a 90 V angle may have the cranks set to give 1, 4, 3, 2, 5, or 1, 5, 2, 3, 4, as the firing order of the cylinders in either block. The cylinder spacing should be the same as with five cylinders. The reciprocating parts will be out of inertia balance but in such a way that their unbalance will be counteracted by unbalancing the crankshaft, as in the Cadillac V-63 or the new Peerless Eight. With this ten cylinder type of engine, if Knight sleeve valves are used, the valve sleeves will be in approximate inertia balance. The balance of this form of engine follows from the approximate balance of the five just as the balance of the Cadillac and Peerless Equipoised Eight follows from the approximate balance of the four. The reader will not find it hard to develop the proof for himself.

MAIN MOTOR BURNED OUT

The 150 horse-power synchronous motor used in the double direct current generator system recently burned out due to carelessness in leaving field switch open when starting. The tremendous voltage induced in these windings as the machine starts caused a voltage surge which gradually broke down the insulation.

Experts from the Westinghouse company at East Pittsburgh are now at work disassembling the motor and it will be repaired and again put in service.

CHEMISTRY STUDENTS BURNED

Kenneth Kobe, Marvin Rogers, and several other students of the College of Chemistry, were burned last Engineer's Day when a stunt they were in charge of in a float exploded. This stunt, which was a chemically loaded spittoon, which blazed forth flame upon expectoration, was faulty with the result that Kobe was burned about the face, and Rogers injured with burns on the hands.

They were immediately taken to the health service and are now able to attend school. The burns will leave no scars.

AMPLIFIERS PURCHASED

The University recently purchased from the Western Electric Company amplifying apparatus valued at more than $10,000 which will be used in various open air performances given in the new stadium. By means of their use, a speaker will be clearly understood by every one of the audience. The equipment is also arranged so that it can be used for other purposes such as monitor system and an amplifying device for radio concerts.

Permanent wiring is being installed consisting of lead sheated cable. It is planned to eventually have the entire campus so interconnected that by this system a speaker can be heard in every part.

Warning

If every woman's face were her fortune, some would be arrested for counterfeit.

DRIPPINGS FROM THE OIL CAN

Then War Started

Wife: "It says here that a giraffe's tongue is eighteen inches long."

The Husband: "Well, you needn't get jealous, dear."

* *

A Timely Testimonial

"Your corn plasters did not give me any relief. I only took one and that was so tough that I could hardly chew it."

* *

Domestic Troubles

One Cannibal: "S'matter, stomach-ache?"

Two Cannibal: "Yes, my wife disagreed with me."

* *

Hazardous Jobs

Window cleaners aren't the only ones whose occupation is hazardous. The other day an editor dropped eleven stories into a waste basket.

* *

Not Her Fault

"I wish to complain," said the bride haughtily, "about that flour you sold me. It was tough."

"Tough, madam?"

"Yes, tough. I made a pie with it and my husband could hardly eat it."

* *

Sure Thing

A prospectus from California says that lilac bushes there grow forty feet high. It must be a great country where they can lilac that.

* *

No Dirty Work for Him

She (at dinner table): "For goodness sake, Gerald, don't wash your silver in the finger bowl. What will people say?"

He: "Well, I'm not going to put it into my pocket dirty."

* *

Tragedy

I felt the beating of her heart,
So close was hers to mine;
We could not wrench ourselves apart,
Her presence was like mine.
But still the girl I couldn't win,
So near and yet so far,—
For that's the way with strangers in
A crowded street car.

* *

In Days of Old

In the good old days he won his bride by applying stone to her head instead of to her finger.

That Little Hand

Last night I held a little hand
So dainty and so neat.
I thought my heart would surely break,
So wildly did it beat.
No other hand into my soul
Can greater solace bring
Than the *one* I held last night—
Four aces and a king.

* *

That's Why

Smith: "It seems to me that your wife has been wearing a strange expression lately."

Jones: "Yes, she's trying to resemble her latest photograph."

* *

How Easy

Doctor: "If as you say, you wake yourself up through snoring, why don't you sleep in another room?"

* *

Too Much Efficiency

"Mr. Wampus, I fear you are ignoring our efficiency system."

"Maybe so, Mr. Gump," responded the clerk addressed, "but somebody has got to get the work done."

* *

Culture

Rastus: "They'se a lot of vice versa in this beah publicashun."

Sambo: "What you mean, 'vice versa'?"

Rastus: "What, you mean to tell me you don't know that 'vice versa' is high hat for bum poetry?"

* *

HOW TO HANDLE A WOMAN ELECTRICALLY

When a woman is bored........................exciter
If she gets too excited........................controller
If she won't come when you want her to ....coaxer
If she is willing to come half way..........meter
If she is willing to come all the way ....receiver
When she gets there ....osculater
If she was too fast to stop........................dispatcher
If she is an angel ....transformer
If she is a devil ....converter
If she tries to double cross you..........detecter
If she proves your fears are wrong, compensator
If your fears are right........................arrester
If she goes to pieces ....coherer
If she goes up in the air ....condenser
If she is hungry ....feeder
If she sings foully ....tuner
If she gets cold ....heater
If she gets too hot ....cooler
If she is a "nice" girl ....shaker
If you have one just like her..........alternator
If she is too fast ....reducer
If she fumes and sputters........................insulator
If she becomes upset ....reverser
And when you get tired of her....electrocutor

Columbia students have a rollicking time on the subway travesting yells of their school. One goes:

Baseball! Feetball! Svimming in de tanks!
Ve've got money, but ve keep it in de banks.
Collech! Collech, Oi, Oi!

And here is another:

Hooray! Hooray! Ve von! Ve von!
Vat?
Ve lost?
Dey cheated!

* *

The fashionable young actor was explaining the family prejudices which he had to overcome before he could adopt the stage for a career. "Never an actor among my people before—always the Bar, or at least Medicine, you know. Matter of fact, my family offered me five thousand dollars not to become an actor."

Then the unshaven old Thespian in the corner quietly inquired, "And how did you spend the money?"

* *

Back to the Practical

Mr. Sapp—"I've a great mind to rock the boat and frighten you."

Miss Sweet—"Once before a young man like you tried that and the boat upset."

Mr. Sapp—"And what did you do?"

Miss Sweet—"I swam to shore and called the coroner."

* *

Dumbells

The guy who spent half a day trying to find "Hampdon Roads" on a highway map.

The guy who wanted to know if Marion Ohio was a toe dancer.

The guy who thought the Marine Corps was a dead sailor.

The guy who thought Sherlock Homes was a building addition.

The guy who wanted to know if the Mexican border paid rent.

The guy who thought logarithms were songs from the lumber camp.

* *

The Old Game

As Eve said to Adam: "You're so original."

* *

An Example

Broadmindedness is the ability to grin when another fellow dances all the time with the girl you took to the party.

The Rollers That Put The Roll In Rolling Stock

WITH the advent of the automobile, Hyatt roller bearings became essential parts in promoting continuous ease of running and freedom from repairs for transportation and farm equipment. The Haynes-Apperson, credited as the first commercial gasoline car, had Hyatt bearings built into it.

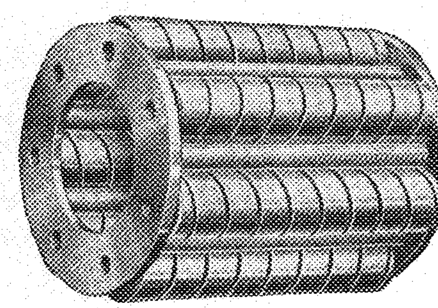
The development of the automobile industry and the increase in the use of the automobile has been rapid, and equally rapid has been the multiplication of uses and applications where Hyatt bearings play an important part.

From the humble lawn mower to the haughty motor car, from the finely adjusted motor to the rough and ready logging block and ore conveyor, from the lightly turning windmill to the pounding railroad car, in all fields of activity, Hyatt bearings are vital factors for efficient and economical operation.

The simple, sturdy construction of these bearings gives long life free from worry about breakdowns or replacements. The easy rolling motion and absence of rubbing friction eliminate the danger of overheating and insure longer life to the bearings and enclosing parts. At the most they require oiling only three or four times a year, permitting not only worthwhile savings in oil but also maintenance and inspection costs.

Steady advances are being made in the application of Hyatt bearings to every field where uninterrupted and economical production are important factors. Our engineering and research departments are always ready to cooperate with you in solving your bearing problems. Make a note of our address now for future reference.

HYATT ROLLER BEARING COMPANY
NEWARK, NEW JERSEY



If you will drop us a line, mentioning the name of your college, we will send you a small Hyatt bearing which you may use as a paper weight or a pocket piece. This will give you a clearer idea of the unique construction which makes the Hyatt roller bearing durable and reliable.

ALUMNI AND FACULTY PERSONAL NEWS

FACULTY

Mines—E. W. DAVIS, director of the school of mines experiment station at the University, and H. H. WADE, also of the station, left March 7 for Spain, to conduct investigations into the development of important deposits of low grade iron ore in the northwest of that country. Their studies will be made in connection with the work of a commission appointed by Primo de Rivera, president of the Spanish council and dictator of the country, to determine the practicability of government subsidizing of the iron ore industry. The problem presented in fixing upon the value of the Spanish ore deposits is similar to that offered by the low grade hematite ore in northern Minnesota which produces a large percentage of the iron ore used in the United States.

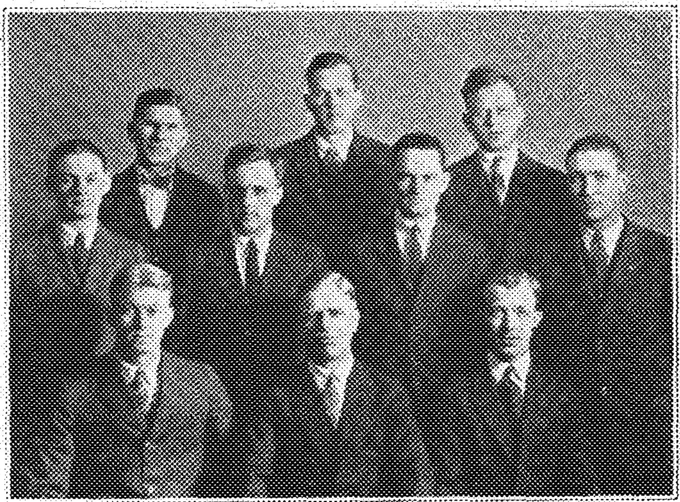
ARCHITECTS

DONALD CAMPBELL HEATH and Harriet Olivia Dunn, '20, were married August 30, 1924. Mr. Heath has been teaching in the architecture department at the University this year.

CHEMISTRY

LESLIE R. OLSEN, '15, chief chemist of the International Milling Company of Minneapolis, was elected vice-president of the American Association of Cereal Chemists at the Tenth Annual Convention which was held in Minneapolis last summer.

Power Company Claims Electricals



Top row, left to right: Lloyd Pelley, T. Lobeck, H. Brown, N. D. U.
Center row: J. R. Furber, L. K. McLeland, B. Trcka, F. McGregor.
Bottom row: M. B. Munsen, H. O. Mangney, I. B. Garthus.

Last year, the Minneapolis Division of the Northern States Power Company inaugurated a Student Training Course for Engineering graduates of Universities. The first class in this course had in it twelve young men, most of whom came from the Electrical Engineering Department of the University of Minnesota.

Of the twelve, all have stayed with the company with the exception of C. W. Teal, who has accepted another position. H. W. Hecht was transferred to the Southwestern Division as superintendent last fall. J. R. Furber, L. L. Pelley, and L. K. McLeland were transferred permanently to the sales department during the early part of this year, and the other men are still continuing the student courses, which they will complete in the early part of April.

The course was divided into two parts, one of which was designed to train men for the sales department and the other to provide training for the distribution and generation departments. The men were about equally divided between these two sections.

The course seems to have worked out very satisfactorily, both from the point of view of the men who took the course and from the company's standpoint, and it is planned to take a similar group of men into the organization during the coming year, on the same basis.

CIVIL

MR. and MRS. OSCAR L. ROSENTHAL, '19, announce the birth of a son, Mark William, January 31. Mrs. Rosenthal was formerly Miss Eunice Duff of San Antonio, Texas. They were married in New Braunfels, Texas, April 23, 1923. At present they are living at 5707 Carthage Avenue, Norwood, Ohio.

More and more engineers are being attracted by the oil fields in the southwestern part of the United States. JAMES H. WERDENHOFF, '21, is construction engineer with the Pierce Petroleum Corporation of Sand Springs, Oklahoma. He states that Minnesotans are very scarce in that part of the country.

"I like the company and the work, but not the country," NEAL BARTHOLOMEW, March '25, says frankly, in a recent communication which tells us that he has been working as chainman on construction work with the Illinois Central Railroad in Illinois since his graduation in March. He expects to stay there for two years, however.

HARRY J. BEEMAN, '21, has strayed from engineering and is now a real estate broker specializing in downtown Chicago property. He moves so fast we can hardly keep track of him, but the latest address he submitted was 422 N. Parkside Avenue, Chicago.

CLARENCE W. BLUE, of the March '25 class, is now Assistant City Engineer of the city of Austin, Minnesota. Blue was an officer of the student branch of the A. S. C. E. until he graduated.

MARK HAIMA, March '25, is in the maintenance of way department of the Northern Pacific Railway Co. with headquarters in St. Paul.

O. M. SKRUKRUD, March '25, is with the U. S. Army Engineers at Milwaukee, Wisconsin.

ARTHUR C. ZIMMERMAN, '23, is with the U. S. Army Engineers as inspector on the construction of a concrete breakwater at Two Harbors, Minn.

ROCKWOOD C. NELSON, Ex. 1912, has left the employ of the Froelich & Emery Engineering Company of Detroit, Mich., and is now associated with the Realty Trust Company of Detroit in their mortgage and investment department.

ELECTRICALS

Arthur L. Abbott, '97, who is now technical director of the Electragists-International with his office at the headquarters of the organization, 15 West 37th street, New York City, has completed a valuable treatise on armored cable wiring. In compiling this work Mr. Abbott visited cities in all parts of the country securing first hand information on methods and time of installation. His services are much in demand by the electragists of the larger cities, according to Arthur P. Peterson, '19, and arrangements are now being made whereby he will conduct classes in estimating of electrical construction work, the course lasting one week. He is also conducting a series of lessons on estimating in the pages of the Electragist, which began with the January number. Mr. Peterson says that Mr. Abbott enjoys the distinction of being one of the foremost authorities on the subject of estimating electrical construction work in the country.

Mr. Peterson is secretary of the Association of Electragists, and last year covered 30 states by automobile with a total mileage of 20,000, in their interest. He has organized the electrical contractors and dealers of eight states, given over 100 talks before men of the electrical industry, and assisted in the passing of rigid inspection laws in several cities.

Berger W. Nordlien, '22, is now in Chicago where he is working as engineer for the Westinghouse Electric Company. Formerly he was located at Pittsburgh as a tester for this same company.

Harold C. Marcroft, '24, is in Dixon, Ill., where he is working as assistant system operator for the Northern Illinois Utilities Company. He was assigned to this position this spring after completing a fifteen months course under the Chicago Central Stations Institute.

Since oil burners have come into the limelight as popular heating machines, it is interesting to know that Charles H. Chalmers, '94, who invented one of the most successful domestic oil burners, was elected president of the National Association of Oil Burner Manufacturers at their recent meeting in Chicago. The association embraces a membership not only from the United States, but also from Canada, so that the confidence placed in Mr. Chalmers as a leader in this field is of particular significance.

From 1897 until 1910 Mr. Chalmers was vice president and general manager of the Electric Machinery Company in Minneapolis, but left this position to become connected with the U. S. treasury department during the war. Since the armistice he has been working on his oil burner which has now reached a high state of development.

MECHANICAL

On January 31, J. H. Czock, '20, was married to Mildred Pestell, a graduate of Jackson University, class of '22. They are making their home at 4 Wolcott Park, West Medford, Mass., where Mr. Czock says the latch string is always out for Minnesotans who may wander into that corner of the states.

Some time before graduation Charles P. Hiers, '24, had accepted a position on the sales force of the United States Radiator Corporation, and he left for Detroit immediately after graduation. He stayed there for a short time and was then sent to New York and later to a territory in southern Connecticut with headquarters at New Haven where he is still located.

Roy V. Wright, '98, and wife went abroad last June to attend the World Power Conference at London, sailing on the Scythia with a large group of engineers. Mr. Wright is managing editor of Railway Age, and an authority on railway problems. After the conference in London they went on through Holland and Germany to attend the International Management conference at Prague, where Mr. Wright presided at one of the sessions and presented a paper on "Some of the Problems of American Railway Management."

About 40 Americans attended this conference and were given a royal reception, culminating in a tour through the republic. Mr. and Mrs. Wright left the party in eastern Czecho-Slovakia and went on into Poland, spending some time there studying the Polish railways, particularly those north and east of Warsaw. They returned west by way of Vienna, northern Italy, Switzerland and France, getting back to the United States on Labor Day.

Low Bridge

Editor—"Where did you get this joke?"

Us—"It ran across my mind."

Editor—"You had better elevate the crossing."

How Many Colloids Did You Use Today?

(Continued from page 15)

strated by feeling the moisture inside a bread-box. In roasting, this process of syneresis has been unduly hastened, so that the resulting product not only tastes different, but is structurally different from stale bread.

BUT I am digressing, so to get back to the story, I will assume our hero has finished breakfast and is starting out to report for drill. I have mentioned how he was all clothed and shod in colloids, but at least it would seem that his hands and face must be free from these omnipresent substances. Even they, however, are surrounded by air, and the air is full of colloidal particles of dust and moisture. Even the blue of the sky depends on these particles in the air. The white light from the sun is in reality a mixture of light waves of different lengths and consequently of different colors. Of this mixture, only the shorter waves or the blue light waves are deflected appreciably by the small colloidal particles, so that when the sky is observed from below only the blue is seen, while the red end of the spectrum goes by overhead. In the evening in passing through the thick layer of colloids, all of the short wave lengths are scattered, and the longer red waves alone are transmitted to the observer.

Without taking time to more than mention the vast supply of colloids in the ground upon which he is walking, I will say our soldier has reached the drill field. There he finds the initial drill is not an ordinary one, but is a gas mask drill instead.

MENTIONING the gas mask introduces a whole new field of colloidal discussion. The prime requisite of a mask is that it be very efficient. The material in the canister must be capable of reducing the concentration of toxic material in the 0.1 second of passage from 1,000 parts per million by volume to 1 p. p. m. The charcoal now used in gas masks accomplishes this reduction readily.

In order to explain this remarkable property of charcoal, a brief discussion of adsorption is in order. All solids have a tendency to condense or concentrate gases on their surfaces. This property is called adsorption. It should not be confused with absorption, which implies a chemical reaction or at least a solution of a gas by some other substance. It can easily be seen that the greater the surface per unit volume the greater will be the absorbing power. Charcoal owes its usefulness to the multitude of fine capillary pores which virtually divide the charcoal into a mass of colloidal particles and so increase its surface that one cubic centimeter of active war charcoal, according to Lamb, Wilson and Chaney,* has about 1,000 square meters of surface. While this adsorbtive action of charcoal is selective all of the gases used to any extent during the war were adsorbed by it. No better proof of the increasing reliance upon charcoal during the war is possible than a review of the German mask development, as discussed in Lefebure's "The Riddle of the Rhine." Their first mask protected against chlorine only, and even when they first introduced phosgene, charcoal was merely powdered over a mass of chemicals. In 1916 the Germans introduced the three layer drum, the middle layer consisting of granulated adsorbent charcoal. During 1917 the layer of charcoal was increased at the expense of the others, and in 1918 the other two layers were abandoned altogether in favor of "A" charcoal, a particularly efficient form, never equaled by the Allies, according to German claims. This ability of Germany to produce excellent colloids enabled her to retain the German type of mask instead of changing to the English type, and thus the war was prolonged.

Not only the defense in chemical warfare, but the offense as well, delved into the realm of colloids. When the Germans introduced their Blue Cross Shells, they expected a production of solid particles of arsenic compounds so small in size that they would penetrate the masks mechanically, and cause irritation and nausea. What success they did achieve along this line can be attributed, according to Bancroft, largely to the fact that the particles did not touch the mask in passing through it as they had adsorbed a protective layer of air around themselves. The fact that the German success along this line was so limited was due to the great difficulty of reducing a substance to colloidal dimensions upon bursting the shell without at the same time decomposing the substance.

I have only gone an hour or two into the soldier's day, and yet I have shown how he has encountered colloids on every hand. Perhaps the reader is already wondering why it is that he has heard so little of colloids before. This question is rather easily answered, however. Physicists have for centuries been interesting themselves in the properties of matter in mass. On the other hand, the smallest particles of matter, atoms and molecules, have long held the interest of chemists. Not until recently, therefore, have we entered into what Ostwald right justly calls, "The World of Neglected Dimensions"—or in other words, the colloid realm.

Time and space are lacking to carry this account any further. Its broad possibilities are apparent if we consider the role colloids play in such processes as cooking, dyeing and printing, and in such industries as that of the manufacture of aluminum, inks, pencils, textiles, paper, cement, pottery, glass, oils and many others. In fact I must leave the subject almost undeveloped, but at least I will, perhaps, prevent the reader from regarding that interrogator as insane who might ask him, "How many colloids have you used today?"

*Jour. Ind. Eng. Chem., 11, 420 (1919).

OIL AND GAS WEEK FEATURED

L. A. Baudoin, of the Sinclair Oil Company, spoke on "The Story of Oil" at the joint meeting of the student branch and the Minneapolis section of the A. S. M. E., held in the Main Engineering Auditorium on April 24. A film showing modern oil drilling and refining methods was presented before the lecture.

This meeting was part of the local observance of Oil and Gas Power Week, which was designated by a group of engineering societies to focus nationwide attention of technical men on the problem of conserving oil and gas for power uses.

* *

Stationary Engine

Rub: "Bet that car sticks to the road all right."

Dub: "You're right. It stuck to it for five hours this morning before I could move it."

* *

The Substitute

A synonym is a word you use when you can't spell the other one.

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.

No. 7.

POWER STATION CONTROLLED BY RADIO

Apparatus has recently been perfected by means of which a complete power station can be operated by means of radio. The station is located at Tipton, Indiana, near Indianapolis, and supplies power to 10,000 persons. The apparatus was designed by the Westinghouse company. The apparatus consists of a transmitter which is arranged so as to be operated by a dial telephone system, a five-tube receiver, and the necessary relays which in turn operate the huge oil circuit breakers.

An advantage of this system is that it is entirely reliable as compared to a wire system, which is subject to breakdowns in storms. This system works with extreme accuracy and will prove very practical, as it will cut down the number of operators needed at a distant point.

Proposed Techno-log Constitution

(*Continued from page 14*)

BY-LAWS

ARTICLE I.

Robert's rules of order shall be observed at all times.

ARTICLE II.

1. The officers of The Minnesota Techno-Log Board shall be president, vice-president, secretary and treasurer.

2. The duties of the officers shall be as follows:

President: To preside at the meetings of the board; to appoint all committees other than the standing committees; to interpret the constitution, the by-laws and the rules of order, subject to an appeal to the board where a majority vote shall rule; to sign all documents of the board; to recall any or all appointments made by him.

Vice-President: In the absence of the president to assume his duties.

Secretary: To keep a permanent and well-ordered record of all proceedings of the meetings of the board; to keep on file copies of the constitution and by-laws of the association and such other documents as the president shall designate; to carry on the correspondence of the board; to give notice to all members of the board at least 24 hours in advance of regular and special meetings; to handle the publicity of the board at the direction of the president.

Treasurer: To be chairman of the finance committee; to receive, account for and disburse all finances of the board.

ARTICLE III.

1. The following standing committees shall be maintained by the board:

(a) auditing committee;

(b) finance committee.

2. The standing committees shall be constituted as follows:

(a) the chairman and two other members of the auditing committee shall be elected by the board;

(b) the chairman of the finance committee shall be the treasurer of the board, and two other members shall be elected by the board.

3. The duties of the standing committees shall be as follows:

(a) the auditing committee shall audit all accounts of The Minnesota Techno-Log at the end of each quarter and shall present a report on the audit at the last meeting of the quarter;

(b) the finance committee shall draw up a financial statement of the Minnesota Techno-Log at the end of each quarter and shall present the statement at the last meeting of the quarter.

ARTICLE IV.

1. Regular business meetings shall be held on the first and third Wednesdays of each month.

2. The president may call special meetings on 24 hours' notice.

3. Two-thirds of the members of the board shall constitute a quorum, provided that one faculty representative is present.

4. In case a quorum is not present at any meeting, the members present may resolve themselves into a committee to care temporarily for important business, this action to be later ratified by a quorum.

ARTICLE V.

These by-laws may be amended by a two-thirds vote of the board provided the proposed amendment has been proposed and read at the two meetings immediately preceding the one at which the vote is taken.

GEAR STRIPPINGS

As a Man Thinketh

The Aunt—"Yes, with the new thought one can accomplish anything. For instance, I don't even have to rouge. I can simply think a flow of color into my cheeks."

The Niece—"Gracious! I'm glad I don't have such thoughts as that."

* *

Unnecessary

"Jane," inquired the mistress suspiciously, "did you wash this fish carefully before you baked it?"

"Lor', ma'am," replied Jane, "what's the use of washing a fish that's lived all his life in the water?"

* *

Observation

She—"What is the surest cure for love at first sight?"

He—"Second sight."

* *

True

White—"What is a sense of humor?"

Black—"A sense of humor is that which makes you laugh at something that happens to somebody else which would make you angry if it happened to you."

* *

Softly, Softly

Newlywed Boss (to secretary)—"Now take down a letter to my wife."

Secretary—"Just wait a minute till I get my soft pencil."

* *

Smoked Out

"Which is proper: Prince Albert or Tuxedo at a social function?"

"Say, leave your pipe at home."—*Nebraska Awgwan.*

* *

Musical Golf

High-brow Musician: "I've just been playing Chopin."

Golf Enthusiast: "Oh, indeed, and have you beaten him?"

* *

A Short Sentence

"How long you in jail fo', Mose?"

"Two weeks."

"What am de cha'ge?"

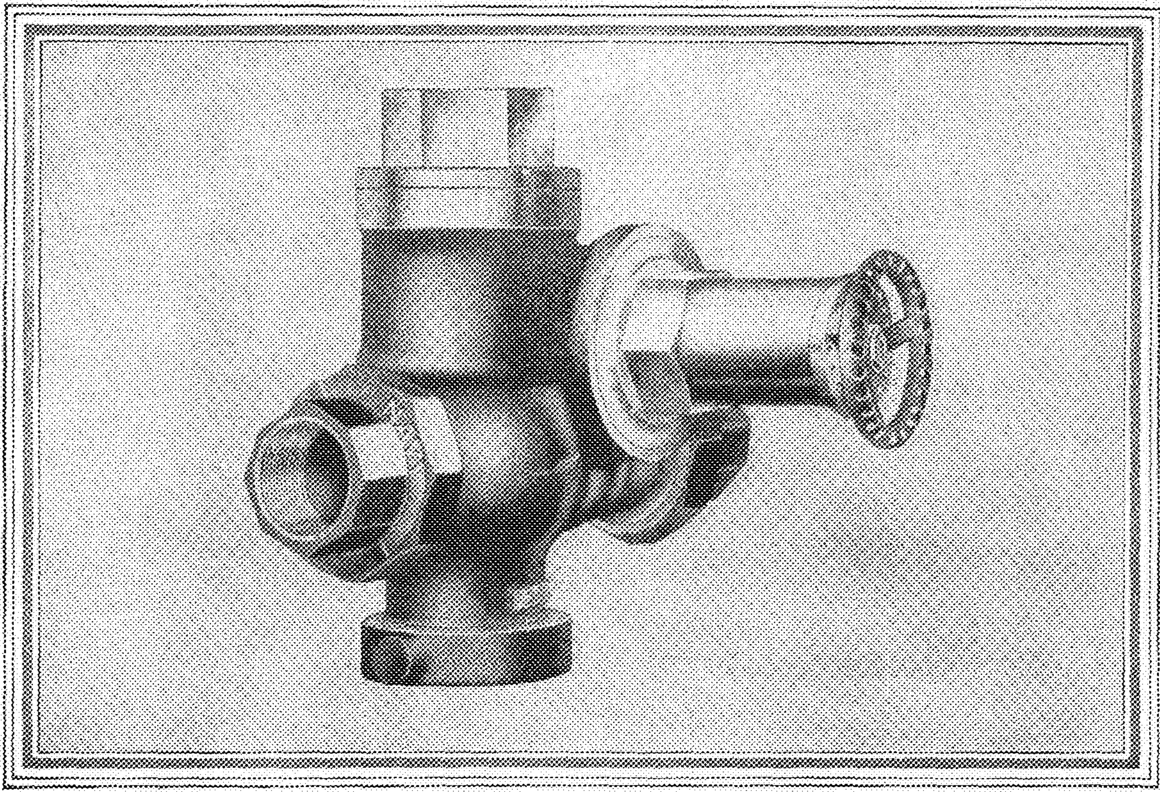
"No cha'ge. Everything am free."

"Ah means what has you did?"

"Done shot mah wife."

"You all killed yo' wife and only in jail fo' two weeks?"

"Dats all—then ah gets hung."



A CRANE PRESSURE REGULATOR WHICH TRANSFORMS HIGHER PRESSURES TO ANY CONSTANT PRESSURE

THE FLAME THAT FIRES

COLLEGE athletic teams illustrate forcibly one truth—men achieve by inspiration. The bleachers' cry of "Hold 'em; Hold 'em!" has kept many a goal line uncrossed. "Touchdown! Touchdown!" has scored countless victories.

In an engineering organization like Westinghouse, this inspiration comes from engineering executives—men who correlate, organize, administrate, and inspire. They are engineers first, but engineers with the power to enlist the best of other men.

Many derived their own first inspiration from the Founder, George Westinghouse himself. He took a contract for electrifying the New Haven Railroad, for example, before the apparatus had even been designed.

"Now I've dropped you into the middle of the pond", he told his engineers. "It's up to you to swim out".

There was plenty of swimming—but Westinghouse knew his swimmers.

As has been true since organization began, the demand for men who can develop into leaders is far, far short of the supply. Westinghouse welcomes them. All industry welcomes them. Organizations lead because men, in turn, lead them.

This advertisement is seventh in a vocational series, outlining the fields for engineering achievement in the Westinghouse organization. A copy of the entire series will be sent to anyone requesting it.

Westinghouse

WESTINGHOUSE ELECTRIC

ACHIEVEMENT & OPPORTUNITY

The 1925 Alumni Directory

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA
MINNEAPOLIS

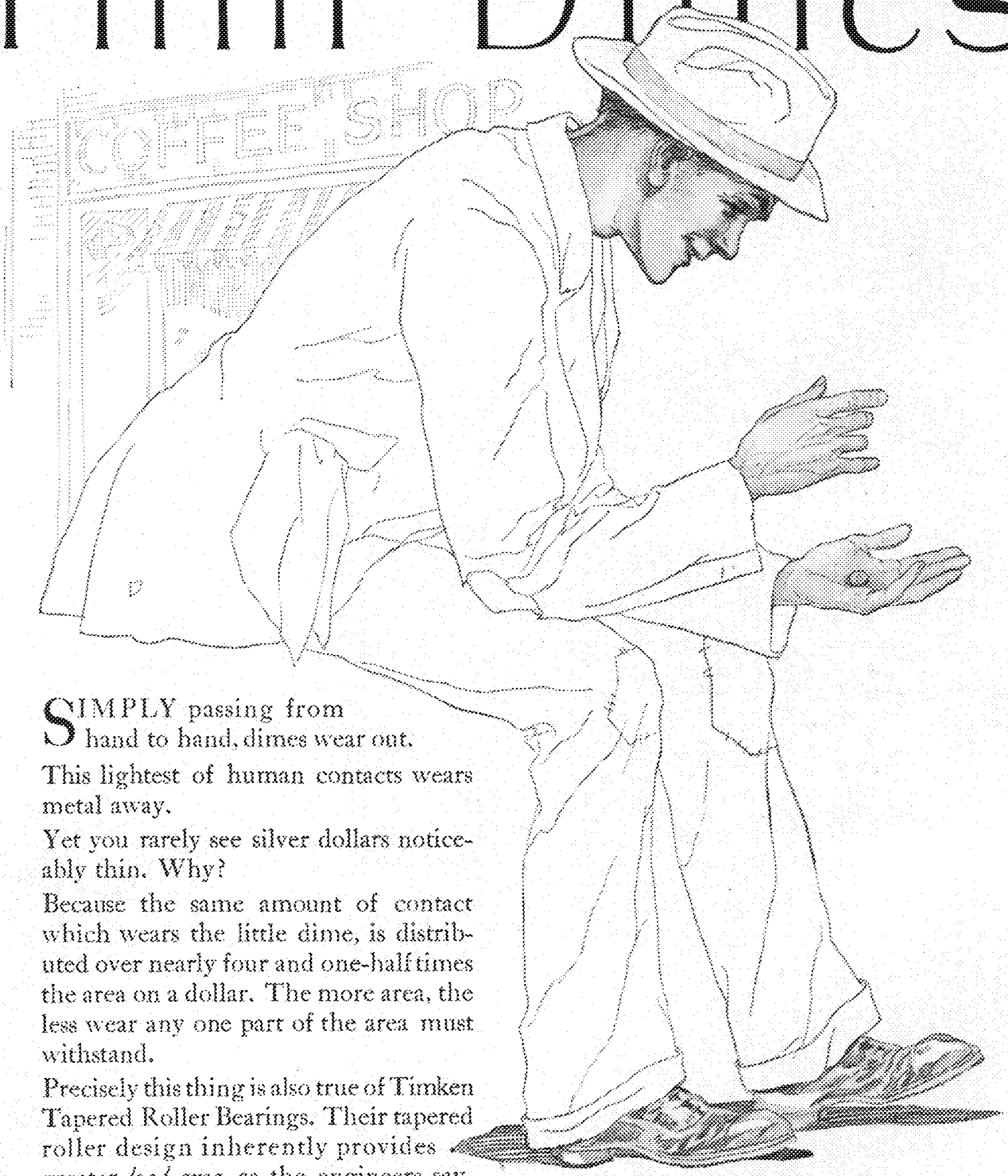
JUNE, 1925

Volume V — 25 CENTS A COPY — Number 9

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED MONTHLY BY THE TECHNICAL COLLEGES

Thin Dimes



SIMPLY passing from hand to hand, dimes wear out.

This lightest of human contacts wears metal away.

Yet you rarely see silver dollars noticeably thin. Why?

Because the same amount of contact which wears the little dime, is distributed over nearly four and one-half times the area on a dollar. The more area, the less wear any one part of the area must withstand.

Precisely this thing is also true of Timken Tapered Roller Bearings. Their tapered roller design inherently provides greater *load area*, as the engineers say.

That is how Timken Bearings, made of Timken steel, enable Timken-equipped cars, trucks, tractors, and machinery to last so very much longer. THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

The MINNESOTA TECHNO-LOG

37 Electrical Building

UNIVERSITY OF MINNESOTA

HERMAN F. BESELER AND KENEFICK ROBERTSON, *Managing Editors*
RICHARD W. JONES, *Business Manager*

VOLUME 5 NUMBER 9

Published monthly from October to June, inclusive, by the students of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. Price, $1.50 a year; 25 cents a copy.

The 1925 Alumni Directory

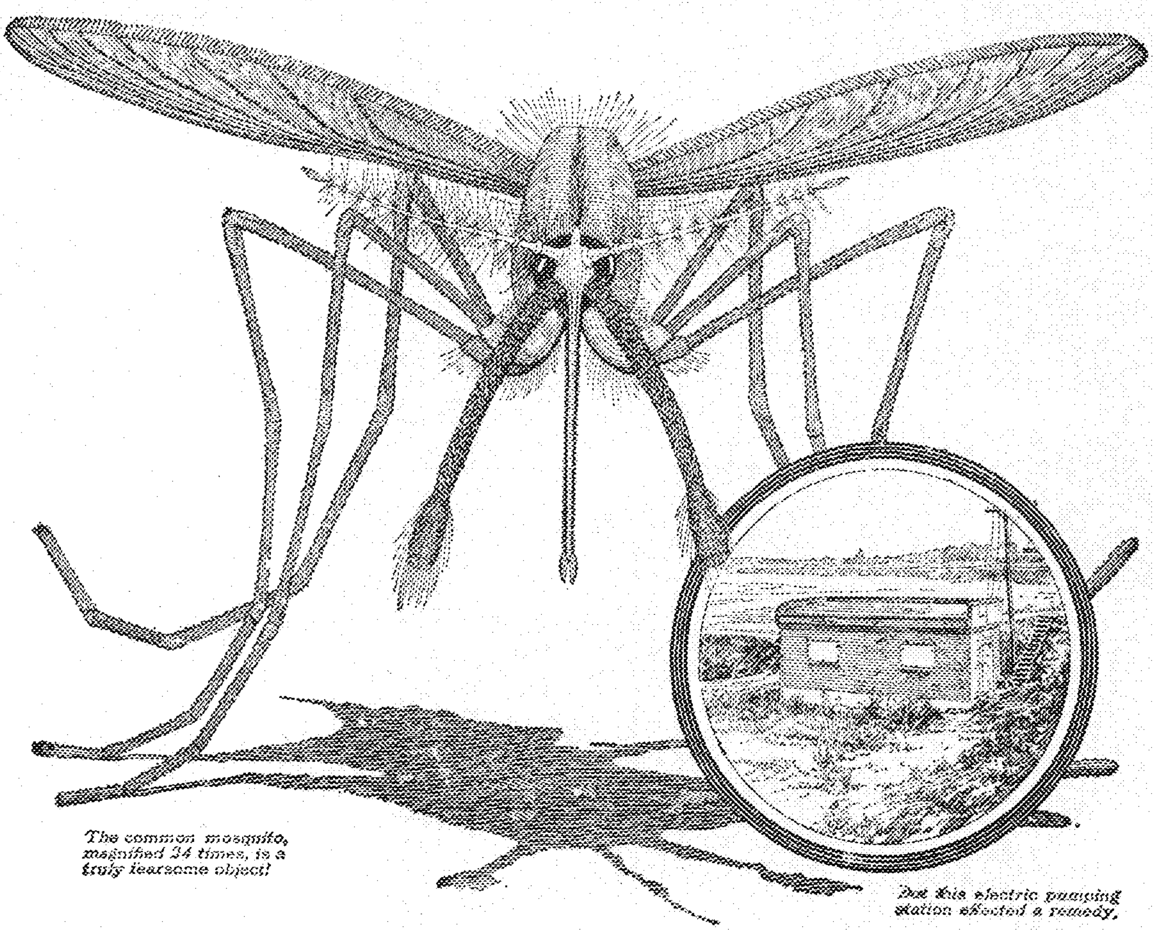
Last year, the first alumni directory of the three technical colleges appeared in the June number of the MINNESOTA TECHNO-LOG. This was so enthusiastically received that it was decided to continue the issue in coming years.

The 1925 directory differs somewhat from the previous one inasmuch as the names are classified by years and departments rather than in a straight alphabetical list. In addition, this year's directory also contains a geographical classification which, we think, will be very convenient.

Although an earnest effort has been expended to make the directory accurate to the last detail, many errors undoubtedly appear, due to the failure of alumni to answer the questionnaire sent out by the deans of the colleges and to errors made in compiling the 2,000 names. It is our hope that all corrections will be sent in to us or to the Dean's offices. These corrections will be published as received in the alumni section of regular issues.

The editors wish to thank Dean Leland, Dean Appleby, and their assistants, together with the staff members of the magazine for their untiring efforts in making this issue a success.

KENEFICK ROBERTSON,
HERMAN F. BESELER,
Managing Editors.



The common mosquito, magnified 34 times, is a truly fearsome object!

But this electric pumping station effected a remedy.

Do what Toledo did

Once Toledo had a nuisance, a tract of swamp land near the lake, a breeder of mosquitoes, foul odors and fogs.

But an automatic pumping station, equipped with motors made by the General Electric Company, turned the swamp into dry land—and abolished the menace to the city.

This is one example of what electricity can do. As you meet life's problems, think of electricity as a valiant and ever-ready ally.

Study what electricity is doing to make a better and happier America; remember that you will live in an electrical age, full of surprises, and full of new services to humanity. The monogram "G-E" which you see above is placed on the epoch-making products of the General Electric Company.

If you are interested to learn more about what electricity is doing, write for Reprint No. AR391 containing a complete set of these advertisements.

GENERAL ELECTRIC

The MINNESOTA TECHNO-LOG
University of Minnesota
Volume V JUNE, 1925 Number 9

THE 1925 ALUMNI DIRECTORY

*Deceased.

The College of Engineering and Architecture

Graduates in Architecture

1877

*Walter Stone Pardee

1886

*Charles Comstock Woodmansee

1892

Leo Goodkind
6th and E. Robert Sts., St Paul, Minn. Sec. and Treas.
George Taylor Plowman
99 Garden St., Cambridge, Mass. Artist Etcher.

1893

George Hart Morse
112 Market St., Harrisburg, Pa. Elec. Eng. with Public Service Commission of Pa.
Frank Hart Morse
Address unknown.
Delos Cuyler Washburn
Mpls. Steel & Mach. Co., Minn. Structural Eng.

1916

*Pierce Allbee
Donald Campbell Heath
U. of M. Instr. in Arch.
Jacob Josephus Lienbenberg
617 McKnight Bldg., Mpls., Minn. Liebenberg & Kaplan, Arch.
Louis William Tannehill
912 Black Bldg., Los Angeles, Cal.

1917

Floyd Wilson Brown
831 1st Nat'l Soo Line Bldg., Mpls., Minn. Draftsman. A. R. Van Dyck Architecture.
Donald Henry Buckhout
601 Gardner Bldg., Toledo, O. Arch. Draftsman.
Howard Bertram Gilman
3417 Park Ave., Mpls., Minn
Linton Herrmann Kreinkamp
Walker & Eisen, Los Angeles, Cal Draftsman.
Walter R. Mixer
Univ. Main Campus, Mpls., Minn. Asst. Bldg. Supt.
George Frederick Poulsen
Paul Steenberg Constr. Co., Builders Exch., St. Paul. Asst. Mgr.
George Henry Prudden
Stout Metal Airplane Co., Detroit, Mich. Chief Eng.
George March Riedesel
Opera Bldg., Crookston, Minn.

1918

Enock E. Forsberg
1009 Metropolitan Bk. Bldg., Mpls., Minn. Draftsman. F. M. Mann, Architecture.
Seeman Kaplan
617 McKnight Bldg., Mpls., Minn.
Harvey M. King
The Methodist Episcopal Church, Louisville, Ky. Arch. Sec., Board of Church Extensions.
Albert Juon Moorman
600 Chamber of Commerce Bldg., St Paul, Minn. Gen. Partner, Moorman & Co.

1919

Edgar Buenger
692 Endicott Bldg., St. Paul, Minn. Designer.
George Brooks Deane
Croft & Boerner, 1006 Marquette Ave., Mpls., Minn. Draftsman.
David Joseph Deneen
Care of R. C. Beeck, Inc., Duluth, Minn. Arch. Supt.
George Chase Emery
Boston, Mass. Frohman, Robb & Little, Arch.
George Fraser
Cornell University, Ithaca, N. Y. Dept. of Arch.
Jefferson Merritt Hamilton
510½ Franklin St., Tampa, Fla. Partner. Franklin & Adams, Jr. Architecture.
Ralph Warner Hammett
Care of American Academy, Rome, Italy. Traveling.
John Saul Schwartz
5834 Calumet Ave., Chicago, Ill.
Stewart Vern Wright
715 Capital Bank Bldg., St. Paul, Minn. Arch. Draftsman, C. H. Johnston.

1920

Milton J. Anderson
421-22 Bradley Bldg., Duluth Minn. Draftsman. W. C. Agnew, Arch.
Florian Arthur Kleinschmidt
Kan. St. Agric. Coll., Manhattan, Kan. Assoc. Prof. of Arch.
Harry Joseph Korslund
888 Mass. Ave., Cambridge, Mass. M. C. A. Harvard.
Glenn H. Lyon
919 Michigan Trust Bldg., Grand Rapids, Mich. Arch. Draftsman, H. H. Turner.
Arnold Ingram Raugland
Lang, Raugland & Lewis, Mpls., Minn. Member of Firm.
Shu Ming Lin
Peking, China.
Edwin Maxwell Loye
4216 Dupont Ave. S., Mpls., Minn.

1921

Milton J. Anderson
421-22 Bradley Bldg., Duluth, Minn. Draftsman.
Rheuben Penn Damberg
Virginia, Minn.
Carl Henry Gewalt
101 Park Ave., New York City. Dir. of Arch. Serv. Dept.
George Dahl
Hiberai Ave., Los Angeles, Cal. Myron Hunt, Arch.
Edwin Larson
692 Endicott Bldg., St. Paul, Minn. Draftsman.
Albin Reinhold Melander
Duluth, Minn. Office of German Jenssen.
Olaf Thorshov
1028 Andrus Bldg., Mpls., Minn. Mbr. of Firm, Long & Thorshov, Arch. and Eng.
Arthur Douglas Willis
1028 Andrus Bldg., Mpls., Minn. Draftsman and Designer.

1922

Edna Kathryn Croft
1004 Marquette Ave., Mpls., Minn. Draftswoman. Croft & Boerner.
Lawrence H. Bakken
1026 McKnight Bldg., Mpls., Minn. N. W. Lumbermen's Assoc.
Paul Siebert Damberg
E. H. Berg, Arch., Eveleth, Minn. Draftsman.
John W. Dawson
Hewitt & Brown, Inc., Mpls., Minn. Draftsman.
Henry C. Gerlach
Architecture Toof Bldg., Mankato, Minn.
Donald T. Graf
888 Mass. Ave., Cambridge, Mass. Harvard University.
Stanley W. Hahm
New York City. Care of John Russell Pope, Arch.

Howard N. Haines
Oakland, Iowa. Principal. Public School.
Herbert A. Kreinkamp
2104 Lakeshore Ave., Los Angeles, Calif.
Alice V. Little
631 Oak St. S. E., Mpls., Minn.
Frank S. Moorman
A. Moorman & Co., Arch., St. Paul, Minn. Purchase Agent.
Catherine Smit
Box 624, Carmel By the Sea.
George A. Stewart
207 Pittsburgh Bldg., St. Paul. Minn.
William E. Willner
Stewardson & Page, Philadelphia, Pa. Draftsman.

1923

Wilburg August Backstrom
210 New York Life Bldg., Mpls., Minn. Assoc. Arch. Eng.
Edward Obert Holien
Instructor, N. D. Agri. Coll., Fargo, N. Dak.
Elving Latimer Johnson
210 Mason St., Milwaukee, Wis. Architecture Draftsman.
Miner John Markuson
Virg. Polytechnic Institute, Blacksburg, V. Instructor, Ext. Specialist

Eunice Virginia Nielson
Lang, Raugland & Lewis. Mpls., Minn. Draftswoman.
Theodore L. Sime
Pa. State College, Pa.
Instructor of Arch.
Arthur Strom
Carl W. Westerling, Arch., Chicago, Ill. Draftsman.
John Albert Walquist
616 N. W. Bank Bldg., Mpls., Minn. Architecture Draftsman.

1924

Emil Fredric C. Backstrom
1026 McKnight Bldg., Mpls., Minn. N. W. Lumbermen's Assoc.
Charles Ronello Barnum
Bradley Polytech. Inst., Peoria. Ill Instr. of Arch. Drawing.
Wallace C. Bonsall
888 Mass. Ave., Cambridge, Mass.
Edward W. Hawkins
159 E. Ontario St., Chicago, Ill. Draftsman.
Charles H. Hinman
190 North State St., Evanston, Ill. C. W. & George L. Rapp. Arch.
Anton Johnson
Address unknown.
Edwin William Kraft
Address unknown.

Herbert A. Magoon
2 W. 47th St., New York City. Draftsman. Bertran Governor Goodhue Assoc.
Mark L. Nelson
209 East Rice St., Owatonna Minn
Paul Edward Nystrom
1529 University Ave. S. E., Mpls., Minn.
Rahel Rosenberg
425 Lyndale Ave. N., Mpls., Minn.
Isadore Woodner Silverman
1147 Girard Ave. N., Mpls., Minn.

Architectural Engineering

1923

Clarence H. Loedeman
Holaberd & Roche, Arch. & Eng. Structure Eng.
Samuel Joseph Sutherland
F. M. Mann. Mpls., Minn. Draftsman.

1924

Otto C. Person
Duluth, Minn. City Planning Commission.
Frank Russell Root
1117 Chapline St., Wheeling, W. Va. Contractor's Supt.
Lawrence Ardean Tvedt
1208 2nd Ave. S., Mpls., Minn. Estimator.

Civil Engineering

1875

Henry Clay Leonard
Santa Anna, Cal., Route 1, Box 65.
Samuel Addison Rank
1929 Walnut St., Boulder, Colo.

1876

Charles Edward Thayer
447 Security Bldg., Mpls., Minn. Vice-Pres. Electric Steel Elevator Co.

1879

William Sanborn Dawley
St. Louis, Mo. Consulting Engr.

1883

William George Peters
Real Estate and Mortgage Broker. Tacoma, Wash.
Louis Orville Smith
LeSueur, Minn.

1884

Wm. Richertson Hoag C. E. 1888
1219 4th St. S. E., Mpls., Minn.

1885

Albert Irving Reed
W. S. Engr's Office, Milwaukee, Wis. Assistant Engr. Q. M. C., U. S. A.

1887

Fremont Crane C. E. '98, B. S. '86
G. M. C., U. S. A.
C. E. and Supt. Constr.

1888

Christian Anderson
U. S. Bureau Public Road. Sen. Highway Engr.

1889

Clarence Stanley Coe
Jacksonville, Fla.,
County Engr., Duval County.

1890

John Lucious Burt
Gudalajara, Mexico.
Biscuit Manufacturer, Cia Galletera Nacional.
Wilbur Wainright Dann
Ashland, Ore.
Civil Engineer and Rancher.
Williston Wirt Greenwood
1754 Phillips Way, Los Angeles, Cal.
John Foot Hayden
Wadena, Minn.
Officeman. Highway Dept.
John Turner Higgins M. D. 1894
3138 Cedar Ave., Mpls., Minn.
Wm. Hausmer Hoyt C. E. 1898
403 Wolvin Bldg., Duluth, Minn. Chief Engr., D. M. & N. Ry.
Birney Elias Trask C. E. 1894
305 Oneida Bldg., Mpls., Minn. Mgr. Trash Construction Co.

1891

Walter Abram Chowen
216 Pine St., San Francisco, Cal. Mgr., Calif. Inspection Rating Bureau.
Fred Luke Douglass
Covina, Cal. City Engineer.

1892

John Jay Kankenson
Glencoe, Minn.
Contractor, Ajox Dredge Co.
Elvin Lydiard Higgins
Hutchinson, Minn. Civil Engr.

1893

Fred Maynard Mann
Prof. of Arch., U. of M., Mpls., Minn. Practicing Archt., 1009 Met. Bk. Bldg., Minneapolis, Minn.
Hiram Patrick Hoyt
Monnoch Bldg., San Francisco, Cal. Contracting Engr.

1894

Andrew Oswald Cunningham
St. Louis, Mo.
Consult. Engr., Wabash R. R.
James Beatty Gilman
Minneapolis Steel & Mach. Co. Chief Engineer.
Noah Johnson
St. Louis, Mo.
Valuation Engr., Wabash Ry.
William Charles Weeks
Manila, P. I.

1895

John Adam Bohland
G. N. Ry., St. Paul, Minn. Bridge Engr.
Leslie Howard Chapman
N. P. Ry., St. Paul, Minn. Civil Engr.
Francis C. Shenehon C. E. 1900
839 Met Bank Bldg., Mpls., Minn. Consult., Hydraulic Engr.

1896

Albert Morgan Burch
Minneapolis Steel Constr. Co., Mpls., Minn. President.
Fred Winston Long
Jacksonville, Fla.
Asst. Engr., G. & S. Railway Co.

1897

Engbret A. Lee
704 Equitable Bldg., Denver, Colo. Chief Engr., Am. Smelting & Refining Co.

Frank Bates Walker
Eastern Mass. Street Ry. Chief Engr.

Howard Howe Woodman
315 Commerce Bldg., Puttsburg, Kan. Coal Operator.

1898

Clifton Ashley Glass
Kansas City, Mo. Care of Kansas City Structural Steel Co., Sales Mgr.

Edward Walter D. Taylor
Pomona College, Claremont, Calif. Assoc. Prof. of Mechanics.

1899

John Gunerius Anderson
M. St. P. & S. Ste. M. R. R., Mpls., Minn. Asst Engr. Structural Design

1900

Edwin Norrell Grime
N. P. Ry. Co., Jamestown, N. Dak. Supervisor, Bridges & Bldgs.

Edward Augustus Whitman
1659 W. Minnehaha St., St. Paul, Minn. Chief Eng., Soo Line.

1901

James Wright Everington
531 No. Louis St., Glendale, Calif. Retired.

Paul Iver Gunstad
Detroit, Minn. County Highway Engineer.

Frank Henry Klemer
Faribault Woolen Mills Co., Faribault, Minn. President.

John Quense M. E. 1902
1322 East 63rd St., Seattle, Wash.

Thomas Henry Strate
802 Chicago Union Station, Chicago, Ill. Engr. of Track Elevation, C. M. & St. P. Ry.

1902

David Arthur Allee
Gen. Elec. Co., Schenectady, N. Y. Constr. Eng. Dept.

Richard Lawrence Beaulieu
Am. Pile Driving Co., Everett, Wash. Mgr.

Christian Hallan
3933 Blaisdell Ave., Mpls., Minn.

George Sommerville Houstan
Brotherhood's Nat'l. Bank, Mpls., Minn. Bond Dept., of Trans.

*Warren C. Knowlton

Fred Theodore Lambert
Zumbro Falls, Minn. Highway Dept.

Charles Rogers Shepley
3908 Garfield Ave. S., Mpls., Minn. General Contractor and Engr.

William Show Weston
Chester, Wis. Nurseryman and Landscape Gardner

1903

Harry Elmore Barlow
C. St. P. M. & O.Ry. Chief Engr.

Walter James Bennet
G. N. Ry., Seattle, Wash. Asst. Engr., Bridge Dept.

Theodore Alexander Beyer
405 Keans Bldg., Salt Lake City, Utah. Vice-President, Burke & Co.

Harvey Chandler Carr
McKnight Bldg., Mpls., Minn. Wells-Dickey Co.

Joseph Henry Davison
Brainerd, Minn. Engr. of Bridges and Bldgs.

Harry Allen Grow
Minneapolis Steel & Mach. Co. Structural Engineer.

Francis Madden
Dubuque, Iowa.

*Ole Steffanson Novig

Charles Albert Oltman
275 East Fourth St., St. Paul. Ass't Engr., C. St. P. M. & O. Ry.

Arthur A. Prendergast
3050 4th Ave. S., Mpls., Minn. Constr. Engr., Sanitor Constr. Co.

Orison Benjamin Robbins
13th St. and Pa. Ave., Wash., D. C. Southern Railway

Leighton Herbert Smith
Ottumwa, Iowa. Pacific Mutual Life Ins. Co.

Paul Sherburne Smith B. S. 1901
Strathmore, Cal., Box 15. Orange Ranch.

Clarence Hockaday Stewart
Duluth, Minn. Chas. Foster, Consult. Engr.

1904

Nathan Herschel Bouge
Washtucna, Minn.

Frank Eugene Downing
The Cherokee Coal & Iron Co., Gadsden, Ala. Field Engr.

Frank Osborne Fernald
Dallas, Texas. Supt. (Operating Dept.) The Pullman Co.

*Jay Clark Holland

Nels Benoni Nelson
Minneapolis Steel & Mach. Co. Sales Manager.

Paul Rothi
Mitchell, Neb. U. S. Reclamation Service.

1905

Elmer Bisbee
San Francisco, Cal. Masonic Club, Palace Hotel.

Roydon Ray Brockway
N. P. Railway, St. Paul, Minn. Bridge Engr's. Office.

Roy L. Burke
Bowe & Burker, 515 Sellwood Bldg., Duluth, Minn. Member of Firm. Mine Operation.

Alvin S. Cutler
College of Engineering and Architecture, U. of M. Prof. of Civil Eng.

William Henr Feyder
N. P. Ry. Co. Asst. Engr., Valuation Dept.

Joseph Edward Finley
5238 Xerxes Ave. S., Mpls., Minn.

George Lewis Gillette
Minneapolis, Minn. Vice-President Minneapolis Steel & Mach. Co.

Albert Manus Hopeman
922 18th St. So., Moorhead, Minn. President, Hopeman Material Co.

John Arthur Jensen
219 City Hall, Mpls., Minn. Supervisor, City Water Works Dept.

Nels Johnson
1520 Soo Line Bldg., M. St. P. & S. Ste. M. R. R. Co., Minneapolis. Draftsman

Wesley Eugene King
Toltz, King & Day, Inc., St. Paul, Minn. Engr.

Franklin R. McMillian
Lewis Institute, Chicago, Ill. Struct. Material Research Lab.

Oliver Mattison
924 Met. Life Bldg., Mpls., Minn. President, Mpls. Bridge Co.

*Henry John Mueller

Oscar Benjamin Nelson
Charles L. Pillsbury Co., 1200 2nd Ave. S., Mpls. Designing Engr.

Donald Todd Smith
Dallas, Texas. 1003 T. & P. Ry. Bldg.

1906

Elmer Ellsworth Adams
1918 2nd Ave. N., Great Falls, Mont. Dist. Engr., G. N. R. R. Co.

Bannona Gerhardt Alrick
627 1st Ave. N., Mpls., Minn. Asst. Engr., C. A. P. Turner Co.

Ernest Benhow Alsop
Morrison-Knudsen Co., Arling, Ida. Engr. and Supt.

Fred Pabst Bowen
Seattle, Wash. Structural Draftsman, City Eng. Office.

Hervey Bulter Childs
Anoka, Minn. County Highway Engr., Court House.

John Chauncey Childs
The Austin Co., Bulletin Bldg., Philadelphia, Pa. District Sales Mngr.

Tresham Dames Gregg
B. S. M. E. 1905, B. S. 1905
Newark, N. J. Member of Gregg & Co.

Monroe H. Hanauer
Los Angeles, Cal. 1029 Chapman Bldg.

George Irving Hayward
N. P. Ry. Co. Asst. Dist. Engr.

Charles James Malley
Vorhees & Canfield-Traders Blk., Spokane, Wash.

John Hays Murray
Flint, Mich. 312 Genesee Bank Bldg.

Arthur Lathrop Reed
Reed & Sherwood Mfg. Co., Anoka, Minn. President.

Frederick Edward Wiesner
712 1st Nat'l Bank Bldg., Great Falls, Mont. Office Engr., G. N. Railway.

1907

Lewis E. Ashbaugh B. S. M. E. 1900
Sessions Eng. Co. of Chicago. Civil Engr., Consulting Practice.

Charles Drewry Batson
Mobile, Ala. Local Mgr., Republic Creosoting Co.

Hjalmar Frederick Blomquist
Cedar Rapids, Ia. Supt., City Water Works, City Hall.

Clyde M. Cram
725 Central Bldg., Los Angeles, Cal. U. S. Asst. Engr.

(*Civils—Continued*)

*Joe Dogherty

John A. Dunham
Gen. Elec. Co., Schenectady, N. Y. Railway Equipment Dept.

Fred H. Green
Atlas Heating & Ventilating Co., 557 4th St., San Francisco. Secretary and Treasurer.

Henry David Haverson
Havre, Mont. Care of G. N. Ry.

Walter Beal Hobart
306 Phoenix Bldg., Mpls., Minn.

David Bartholomew Huston
143 14th Ave. N. E., Mpls., Minn.

Lewis Allen Jones
U. S. Dept. of Agr., Washington, D. C. Senior Drainage Engr.

Earl Wallace Kelley
322 Lyceum Bldg., Duluth, Minn. Private Practice, E. W. Kelly Co., Engineers.

Chas. Aug. Swenson L. L. B. 1910
Atwater, Minn. Practicing Att.

Mandel George Tondel
505 Manhatton Bldg., Duluth, Minn.

Horatio Phillips Van Cleve
J. Edward Ogden Co., Bayonne, New Jersey, Box 15. Chief Engr.

Louis Yager
N. P. Ry. Co., General Office, St. Paul, Minn. Asst. Chief Engineer, System.

1908

James Wesley Ash
206 E. Grand Ave., Des Moines, Ia. Landscape Archt., American Horticulture Co.

LeRoy F. Borrowman
Winnipeg, Canada.
Member of Sutherland Constr. Co.

Harry E. Brenchley
Minneapolis Steel & Mach. Co.
Mgr., Structural Sales.

John Walter Comstock
Petaluma, Calif.

Arthur Norman Dallimore
Pueblo, Col. 447 Thatcher Bldg.

William Fred Doeltz, Jr.
305 Glen Ave., Portland, Ore.

Henry Knox Dougan
G. N. Ry. Bldg., St. Paul, Minn.
Asst. Valuation Engr.

Douglas R. Fleming
Marreno, La.
Land and Cattle Business

Pierce Powers Furber
Wiseman & Furber, Danville, Va.
Constr. Engr., Louis F. Dow Co.

Hugh Newton Gage
920 Guardian Life, St. Paul, Minn.
Engr. State Highway Dept.

Andrew P. Hustand
126 So. 9th St. President, The Hustand Co., Consulting Engrs.

Herbert Hamilton Knowlton
Apishapa Irrigation Project, Fowler, Col. Superintendent.

William Louis Krauch
George J. Grant Constr. Co., Exchange Bk. Bldg., St. Paul, Minn. Structural Engr.

Fred C. Lang
Engr. of Tests and Inspection, Minn., St. Paul. Dept. of Highway.

Dwight Webster Longfellow
Elk River, Minn. Secretary and Treas. of the Elk River Concrete Products Co.

Harry John McCall
Jamestown, N. D.
Roadmaster, N. P. Ry., Dak. Div.

Andrew A. McCree
315 Hackney Bldg., St. Paul.
Vice-Pres., McCree, Moos & Co.

Clarency Ward Mowery
Curtis Hotel, Mpls., Minn. Supt.

Lewis Magnus Norelius
Majestic Furnace & Mfg. Co., Seattle, Wash. Vice-President.

Day Ira Okes
1501 Merchants Bk. Bldg., St. Paul, Minn. Partner Hanlon & Okes.

Melvin Samuel Olsen
City Hall, Mpls., Minn.
Engr., Board of Education.

John L. Quinn
212 Court House, Duluth, Minn.
Bridge Engr., St. Louis County.

Charles Robertson
New Ulm, Minn.
Highway Eng. of Brown Co.

Edward Charles Schlattman
Alberta, Minn. Farming.

George William Walker
Buhl, Minn.
Cashier Buhl State Bank.

Gustaf Frederick Widell
1100 N. Clark St., Chicago, Ill.
Lanquist & Illsley.

Roy Willis
Dept. of Public Work, St. Paul, Minn. Asst. Engr.

Oscar Frederick Woodrich
808 Met. Life Bldg., Mpls., Minn.
Owner, Woodrich Construction Co.

Robert John Schmid
Union Bank & Trust Co.
Appraiser.

1909

James Alanson Childs
State Board of Health, U. of M., Mpls. Engr.

Charles P. Clarke B. S. M. E. 1906
Milwaukee, Wis.
Draftsman. Warden-Allen Co.

Jay T. Ellison
State Highway Commission, St. Paul, Minn.

Nels William Elsberg
Mpls., Minn. City Engr.

Frank F. Esser
105 Lincoln St., Mankato, Minn.
Contractor (Private Practice).

Frederick William Fiske, Jr.
Geo. Grant Construction Co., St. Paul, Minn. Engr.

Arthur Bernard Fruen
B. S. in Eng. 1908
45 Chamber of Commerce, Mpls., Minn. Pres. & Treas. Fruen Milling Co.

Robert Thorold Hubbard
Madison, Wis.
Asst., Bank of Wis. Bldg.

Simon Ingberg
Bureau of Standards, Wash., D. C.
Physicist, Dept. of Commerce.

Robert Jaques
411 Lonsdale Blad., Duluth, Minn.
Lawyer.

Lawrence Watson King
St. Paul Fire & Marine Ins. Co., St. Paul, Minn. Chief Clerk.

John B. Mitchell
1233 Great Northern Bldg., St. Paul, Minn. Asst. Engr., G. N. Ry. Co.

Edward Severy Nelson
715 Capital Bank Bldg., St. Paul, Minn. Architectural Mngr.

Sidney R. Okes
338 Lumber Exchange, Mpls., Minn.

Frederick Thornton Paul
City Engineer's Office, 204 City Hall, Mpls.
Asst. Engr.

Fred Will Sheffield
Fargo, N. D.
Vice Pres., Fargo Bridge & Iron Co.

George M. Shepard
1000 Guardian Life Bldg., St. Paul, Minn.
City Engr.

Andrew Samuel Siverts, Jr.
300 Building Exchange Mpls.
Consulting Engr.

Eliakim Torrance, Jr.
Thorpe Bros. (Realtors), 206 Andrus Bldg., Mpls.
Dept. Mgr.

1910

Benjamin W. Adams
Seattle, Wash.
Asst. Engr., M. of W.

Hans J. Asleson
Mpls. Steel & Mach. Co.
Engr., Sales Dept.

Ole Martin Bolme
c/o Robins Cons. Belt Co., 13 Park Row, New York City.
Designer and Estimator.

Benjamin C. Boyum
Peterson, Minn.
Archt. and Engr.

Otto Ellsworth Brownell
State Board of Health, Mpls.
Asst. Engr., Division of Sanitation.

Burton L. Chapman
Rock Island, Ill.
Rock Island Bridge & Iron Works.

Philip Louis Dahlquist
118 N. LaSalle St., Chicago, Ill.
Partner, Peterson-Dahlquist, Engr.

Class Theodore Ekman
302 Phoenix Bldg., Mpls.
Engr. and Arch.

George M. Garen
Dept. of Public Works, St. Paul, Minn.
Asst. Supt of Constr.

Alfred Calvin Godward
341 City Hall, Mpls.
City Planning Engr.

George W. Jevne
847 N. Coronado St., Los Angeles, Cal.
Engr., Reinforced Concrete Design & Eng. Sales.

Edward William Leach
Bennett, Minn.
General Supt., Western Dist., Pickands, Mather & Co.

Carl F. Meyer
410 Court House, Mpls.
Deputy Co. Surveyor, Hennepin Co.

Charles Leopold Motl
Minn. Highway Dept., St. Paul, Minn. Division Engr.

GEORGE LESTER NASON
Morell & Nichols, Inc., Landscape Architects, St. Paul and Mpls.
Supt. of Parks of St. Paul.

HARLEY G. OVERHOLT
St. Thomas College.
Prof. of Structural Eng.

ARTHUR OSCAR OLSEN
Redfield, Ia.
Sales Mgr., Redfield Brick & Tile Works.

EMERSON D. SAWYER
409 Spruce St., Sault St. Marie, Mich.

ADOLPH A. SOMMERFELD
1319 Edmund St., St. Paul, Minn.

WILLIAM DANIEL TIMPERLEY
1229 Tyler St. N. E., Mpls.
Sales, Mgr.

1911

ARTHUR FREDERICK AINSLIE
Staples, Minn.
Asst. Engr., N. P. R. R.

HERBERT P. ARNESEN
c/o Toltz, King & Day, 1410 Pioneer Bldg., St. Paul, Minn.
Estimator.

FRANCIS C. BOERNER
1006 Marquette Ave., Mpls.
Arch. and Engr.

WILLIAM P. COTTINGHAM
City Hall, 7th Ave. and Mass. St., Gary, Ind.
City Engr.

ERNEST B. CROFT
1006 Marquette Ave., Mpls.
Croft & Boerner.

AXEL EVALD ELFSTRUM
City Engr. Office, San Francisco, Cal.
Structural Eng. Bureau.

EDWARD HENRY ENGER
Board of Education.
Architecture Engr.

DAVID PINKUS FIELDMAN
1931 West Superior, Duluth, Minn.
Ladies' Furnishings.

RALPH MEYERHODD HODNETT
St. Paul, Minn.
Water Dept.

MICHAEL J. HOFFMAN
State Highway Commision, St. Paul, Minn.
Asst. Maintenance Engr.

CARL J. JOHNSON
LaMoure, N. D.
Local Mgr., Dakota Utilities Co.

INGWALD KVITRUD
The Kvitrud & Madsen Co., Builders Exchange, Mpls.
General Contractor.

GEORGE ALFRED MANEY
Univ. of Minn., Mpls.
Asst. Prof.

REUBEN ANDREW MARK
Brookings, S. D.
Partner of the A. M. Wold-Mark Constr. Co.

GEORGE CARL MATTISON
Ranger, St. Thomas, Virgin Islands.
Commanding C. & G. Survey Steamer.

CLYDE METHVEN
1246 Univ. Ave., St. Paul, Minn.
Div. Engr., State Highway Dept.

ERVIN MILLER
Highway Dept., St. Paul, Minn.
Asst. Bridge Engr., Minnesota.

MARTIN J. ORBECK
Ann Arbor, Mich.
Poin. Asst. Engr., Holland, Ackerman & Holland.
Consulting Engr.

LEWIS MITCHELL ROTH
514 Merchants Bank, St. Paul, Minn.
Sales Mgr., Kalman Steel Co.

SIGVEL JOHN SIVERSON
c/o W. L. Johnson Co., 1612 Pioneer Bldg., St. Paul, Minn.
Contractor and Engr., S. J. Siverson Co.

SIDNEY H. SMITH
Mitchell, S. D.
City Engr.

MARCUS ROY SWEDBERG
1415 8th St. S. E., Mpls.
Contracting Engr., W. D. Lovell, General Contractor.

ARTHUR CARL WALBY
1006 Marquette Ave., Mpls.

1912

JOHN WALKER ADAMS, JR.
Hennepin Holding Co. & Realtor.
Secretary.

THOMAS HENRY CURTIS
Jones & Curtis, Fairmont, Minn.
Member of Firm.

AUGUST LEROY FLYGARE
1st Natl. Bank Bldg., Minn. Highway Dept., Fergus Falls, Minn.
Div. Engr.

RALEIGH WILLIAM HOSFIELD
Faribault, Minn.

ROBERT WILLIAM WEST
(Address unknown.)

HARVEY B. ANDERSON
Hopkins, Minn.

*WILLIAM HENRY BAILEY C. E. 1913

WILLIAM JOSEPH BINGEN C. E. 1913
Andover, S. D.

ELMER FOSTER CUMMINGS C. E. 1913
Luverne, Minn.
Engr. and Contractor.

HARVEY GROVER DIMOND
Truscon Steel Co., Mpls.
Des. and Est. Engr.

MARCUS OLIVER GIERTSEN C. E. 1913
1246 Univ. Ave., St. Paul, Minn.
Asst. Bridge Engr.

EDWARD LOUIS HABERLE C. E. 1913
Great Northern Ry Co., St. Paul, Minn.
Asst. Engr., Bridge Dept.

CHARLES ROBT. D. JORGENS C. E. 1913
(Address unknown.)

ROY JOHN KAPPHAHN C. E. 1913
R. J. Kapphahn Contracting Co., Mpls.
General Contracting.

FOREST VOLNEY KING C. E. 1913
1129 Met. Life Bldg., Mpls.

JOSEPH JOHN KRIZ C. E. 1913
1105 Old Colony Bldg., Chicago, Ill.
Robins Conveying Belt Co.

CLARENCY C. PAGENHART
(Address unknown.)

RAYMOND A. PEASE C. E. 1913
Minot, N. D.

BARNEY J. PETERSON C. E. 1913
U. S. Geol. Surv., Washington.
With Dept. of Interior.

LOREL S. RYAN C. E. 1913
111 1st N. E., Little Falls, Minn.
Mgr., Wholesale and Retail Hdwe.

WILLARD A. SOUTH C. E. 1913
621 S 3rd St., Mpls.

MORTON EDWIN SOUTHER C. E. 1913
1193 Univ. Ave., St. Paul, Minn.
Souther MacIntyre Co.

HJALMER SEYMOUR SWENSON C. E. 1913
The Hustad Co., 126 S. 9th St., Mpls.
Sales Engr.

IRVING EUGENE TORGERSON
Southern Pacific Co., San Francisco, Cal.
Asst. Engr., Bridge Dept.

OSCAR HENRY WANGAARD C. E. 1913
Mpls. Public Schools.
Arch. Engr.

ARTHUR GUSTAF WELIN C. E. 1913
L. P. Wolff Co., St. Paul, Minn.

HENRY ERNEST WOLFF C. E. 1913
914 Beech St., St. Paul, Minn.

1913

JOHN EMIL BERGQUIST
Old Colony Bldg., Chicago, Ill.
Designer, Robins Conveyor Belt Co.

BYRON HARRY BRADLEY C. E. 1914
Logan, Ia.
Office and Field Engr.

EDWARD GUMMER CHILTON C. E. 1914
Minn. Highway Dept., Callaway, Minn.
Resident Engr.

BENJAMIN JOHN CURTIS C. E. 1914
125th St. and Cottage Grove Ave., Chicago, Ill.
Engr., T. J. Forschner Contracting Co.

MAURICE WM. HEWETT C. E. 1914
Dept. of Public Works, St. Paul, Minn.
Sr. Asst. Civil Engr.

WALTER EDWIN KOEPKE C. E. 1914
Kalman Steel Co., New York City.
Sales Engr.

HELMER VICTOR KRUSE C. E. 1914
United Verde Copper Co., Jerome, Ariz.
Constr. Engr.

HARRY DOUGLAS LOVERING C. E. 1914
1854 Laurel Ave., St. Paul, Minn.
Construction Engr., Lovering-Longbotham Co.

GEORGE HART MORSE C. E. 1914
10 So. 16th St., Philadelphia, Pa.
Grant Power Survey.

ARTHUR WARREN QUIGGLE C. E. 1914
428 1st St. No., Mpls.
Gen. Mgr. of The Creamette Co.

WEST ALFRED ROLFE
(Address unknown.)

HAROLD HUTCHINS THURSTON C. E. 1914
Rubicon, Wis.
Constr. Supt., Colburn, Thurston Co.

DONALD WM. WEBSTER C. E. 1914
Minn. Highway Dept., St. Paul, Minn.
Asst. Constr. Engr.

BENJAMIN WILK C. E. 1914
1528, 210 So. LaSalle St., Chicago, Ill.
Asst. Western Mgr., Universal Portland Cement Co.

(*Civils—Continued*)

Albertus Montgomery
418 First Natl. Bank Bldg., Oklahoma City, Okla.
Field Engr. of Portland Cement Assn.

1914

Albin Larson
University Farm, St. Paul, Minn.
Asst. Prof. of Ag. Botany.

Walter C. Brenchley C. E. 1915
222 Dooly Bldg., Salt Lake City, U.
Sales Engr.

Harold Vivien Burnett
526 McKnight Bldg., Mpls.

Harvey Girard Dimond
G. N. Ry. Bldg., St. Paul, Minn.
Eng. Dept.

William Y. Doolittle
277 Wilder Ave, St. Paul, Minn.

Carl Edwin Ekberg C. E. 1915
N. P. Ry. Co., Mpls.
Draftsman, Bridge Dept.

John Carroll Hustad C. E. 1915
917-918 Andrews Bldg., Mpls.
Consulting Engr.

Edgar Wm. Johnson C. E. 1915
Water Works Dept., 209 City Hall, Mpls.
Engr.

Maurice Bernhart Lagaard C. E. 1915
Univ. of Minn.
Prof.

Louis J. Larson C. E. 1915
Coll. of Eng., U. of Ill.
Associate Prof.

Lester Morris Mitchell C. E. 1915
Duluth, Minn.
Engr. and Estimator, Naufts & Bergstrom, Gen. Contrs.

Carl Theodore Nordstrom
U. S. Bureau of Public Roads.
Assoc. Highway Engr.

Leonard Eugene Ott C. E. 1915
Calumet, Minn.
c/o A. Guthrie & Co., Inc.

John Roger Price
Fulda, Minn.

Renville S. Rankin
6 N. Michigan Ave., Chicago, Ill.
First Asst. Engr., Pearse, Greley & Hansen.

Harvard Seldon Rockwell
1611 Pioneer Bldg., St. Paul, Minn.
Struc. Engr.

Dow Irving Sears
Ironwood, Mich.
Supt., Water & Gas Dept.

Cedric Stanley Weatherill C. E. 1915
M. & St. L. R. R.
Asst. Engr.

Howard Nelson Weigel C. E. 1915
542 Builders Exch.
Contracting Engr.

1915

George Cottingham, Jr.
Chicago Great Western R. R.

Christopher Aasland
Miles City, Mont., Box 996.
Resident Engr., Montana R. R. Co.

George Theorodore Anderson
Chisholm, Minn.
City Engr.

Hilmar Barman Christianson
C. M. & St. P. Ry., Beloit, Wis.
Asst. Engr.

Thomas LeRoy Croswell
Twin Valley, Minn.
Pres., Croswell Power Co.

Wm. Arthur Cuddy C. E. 1916
Madras, India.
Traveling Auditor, Foreign Staff.

John George Dorsey
Pastoret Constr. Co., Duluth, Minn.
Contractor, Partner.

Charles E. Hanoschu
Mora, Minn.

*Stanley H. Haynes B. S. 1917

Dan S. Helmick
1200 2nd Ave. So., Mpls.
Hydraulic Engr.

Alexander Benjamin Johnson
Maynard, Minn.

Philip Johnson Laurence
750 Builder's Exchange, Mpls.
Contractor.

Ivor Vaugham Jones
25 Harrison Ave., Springfield, Mass.
Supt. of Constr.

Ralph James Knight
Druar & Milinowaki, St. Paul, Minn.
Civil Engr.

Thomas Kenneth Leonard C. E. 1916
1410 Pioneer Bldg., St. Paul, Minn.
Supt., Tolfz, King & Day.

Earle Douglas McKay
Universal Portland Cement Co., 836 Security Bldg.
Engr., Service Bureau.

Olaf Lauritz Oustad
Burbank, Cal.
c/o Elmer Dill, R. R. 3, Box 167.

Benjamin Arlee Pratt
South High School, Mpls.
Teacher.

Olav Martin Rupsvold C. E. 1916
Minn. State Highway Dept. St. Paul, Minn.
Bridge Designer.

Elmer Clarence Scott C. E. 1916
Bloomingham, Minn.
Ford Dealer.

Peter Skurdalsvold
Twin City Rapid Transit Co., Mpls.
Traffic Engr.

Oscar Emanuel Swenson C. E. 1916
Lackawanna Bridge Works Coop., Buffalo, N. Y.
Chief Engr.

John Clement West
St. James, Minn.
Highway Contr. and Civil Engr.

Carl Daniel Wild C. E. 1916
Janesville, Ia.
Cashier in Bank of Janesville.

Warren Withee
605 Temple Court Bldg., Chattanooga, Tenn.
Asst. Engr.

1916

Thomas Archer Askew, Jr.
Plainview, Minn.
Partner, Thomas Askew Co.

William Frank Biskup
Mpls. Steel & Mach. Co.
Concrete Reinforcing Dept.

Hjalmar Nels Bruce
608 1st Ave. No., Mpls.
Mgr., A. C. Chester Prtg. Co.

Anders John Carlson C. E. 1917
School of Mines, U. of M., Mpls.
Asst. Prof. of Mine Plant and Mechanics.

Carl Larson
1521 Soo Line Bldg., Mpls.
Structural Draftsman.

Arthur Ernest Lux
224 Aurora Ave., St. Paul, Minn.

Bruce Murdock McCullough
Litchfield, Minn.
Minister of Presbyterian Church.

Sylvester Emery Nortner
Office of Chief of Engrs., U. S. Army, Washington, D. C.
Capt., Corps of Engrs.

Wen Ping Pan
Hibbing, Minn.
Oliver Iron Mining Co.

Harold Leon Peterson
847 N. Broad St, Philadelphia, Pa.
Gen. Mgr.

William W. Peterson
City Hall, Minot, N. D.
City Engr.

Fred O'Conner Watson
618 Natl. Bldg., Mpls.
Sec., Madsen Construction Co.

Ernest H. Weinke C. E. 1917
Jamestown, N. D.
Asst. Engr.

Charles Alfred Williams
2910 West 45th St., Mpls.

Charles Edw. Doell C. E. 1917
Mpls. Board of Park Commisisoners, 325 City Hall.
Asst. to Sec.

Robert Walker Grow
Cavalry School, Fort Riley, Kan.
Capt., Cavalry, U. S. A.

*Ralph Estes Johnston C. E. 1917

Warren Olavus Kivley
State Highway Commission, Mont.
Asst. Office Engr.

Archibald Christian Knauss C. E. 1917
Madison, Wis.
Forest Products Laboratory.

Norman Everard Hendrickson
Kalman Steel Co., Mpls.
Estimator.

Elmer Ellingston
103 E. 16th St., Mpls.

1918

Leon E. Battles
Oliver Mining Co., Coleraine, Minn.
Mining Engr.

*Herbert Dell Chamberlain

Richard Elliott Deutsche
809 E. 14th St., Mpls.

Sigurd Elliassen
Chihli River Commission, Tientsien, China.
Acting Engr. in Charge, Survey Dept.

*Reed Douglas Gould

Nicholas Konstantinopoulos
1473 Carmen Ave., Chicago, Ill.

Neal Clinton Nickerson
Carlton, Minn.
Carlton Co. Engr.

CEDRIC BURNETT SMITH B. A. 1914
Chicago Bridge & Iron Works, Chicago, Ill.
Adv. Mgr.

MARTINIAN G. SMOLENSKY
(Address unknown.)

1919

EDWARD HAROLD COE
U. S. Army, Fort Humphreys, Va.
2nd St. Corps of Engrs.

RUDOLPH TILDEN ELSTAD
Coleraine, Minn.
Mining Engr.

HENRY IRWIN HAWLIK
c/o Park Hotel, Chattanooga, Tenn.
Engr., Western Factory Ins. Assn.

OSCAR LEONARD ROSENTHAL
The Londen Mach. Co., Cincinnati, Ohio.
Sales Engr.

HARRY MICHAEL SUSHANSKY
367 Fulton St., Brooklyn, N. Y.
Engr. and Arch.

1920

GEORGE DEWEY ALEXANDER
816 6th Ave. S., Mpls.
Municipal Work.

WALTER EDWARD BENEKE
L. A. Refinery, Wilmington, Cal.
Fieldman, Union Oil Co.

KARL ABEL EDNER BERG
N. P. R. R. Co., Billings, Mont.
Asst. Geologist.

HANS EDWARD BERNT
Minn. Steel Co., Duluth, Minn.
Field Civil Engr.

DONALD J. BLEIFUSS
Phoenix Utility Co., Duluth, Minn.

FRANCIS ALBRIGHT DEVER
1013 Penn Ave., Pittsburgh, Pa.
Asst. on Engr. Corps, Penn. R. R.

WILLIAM JOHN FITZGERALD
City Hall, Duluth, Minn.
Field Engr.

FLOYD MANLEY FRIAR
925 6th St. S. E., Mpls.

ROY GILBERT
U. of Mich.
Senior Medical Student.

EDWARD SPALDING GOULD
500 Delaware St. S. E., Mpls.
Real Estate.

CARL CHRISTOPHER HANKE
910 Michigan Ave. S.
Sanitary District of Chicago.

CARLOS C. HANSEN
Highway Dept., Grove, Minn.
Instrumentman.

EDWIN RICHARD HOLM
Wisc. Highway Commission, Eau Claire, Wis.
Engr.

BYRON FILLMORE JOHNSON
U. S. S. Utah, New York City.
1st Lieut., U. S. Marines.

AMANDUS CHESTER LARSON
Morell & Nichols, Landscape Architects, Mpls.
Engr.

HENRY MARTIN LENDE
325 City Hall, Mpls.
Board of Park Com.

VICTOR ANDERS MALMBERG
Winthrop, Minn.

DONALD ORELUP NELSON
Thompson & Kerby Sts., Portland, Ore.
Junior Engr.

EARLE LAVERNE NEVILLE
Gilfillan Bldg., St. Paul, Minn.
Field Engr.

ARNOLD GOTTLEIB M. PLESS
C. W. Squire, Albert Lea, Minn.
Asst. Highway Engr.

IRVING BREWARD PURDY
601 Metropolitan Bank Bldg., Mpls.
Chief Engr.

ERNEST WARREN SEEMANN
Joliet, Ill.
Office of Chief Engr., Elgin, Joliet & Eastern R. R.

EDWARD BURDEET SHERWOOD
Minn. State Highway, Hutchinson, Minn.
Sub. Resident Engr.

GILBERT COBB STAEHLE
529 2nd Ave. So., Mpls.
Cons. Engr.

CARL E. LEBECK
The General Fireproofing Co., 1020 Builders Exch., Mpls.
Sales Engr.

1921

HAROLD ALVAH BARBER
Southern Cal. Edison Co.
Camp 62, Big Creek, Cal.

HUGH WESTCOTT CARPENTER
3725 E. 4th St., Long Beach, Cal.

RICHARD TIMOTHY DALY, JR.
Paul J. Kalman Steel Co., 42nd St., New York City.
Office Mgr.

ELTOR ALBERT DEHN
763 Dayton Ave., St. Paul, Minn.
Toltz, King & Day.

CARLOS WERTER DEL PLAINE
346 Endicott Bldg., St. Paul, Minn.
Gen. Engr.

FRED AUGUST ENKE
St. College, Brookings, S. D.
Coach and Asst. in Mathematics.

EARL HENRY GROCHAU
Gauger Korsmo Construction Co., Tammpa, Fla.
Cost Engr.

LESLIE LLEWELLYN HALLADAY
325 City Hall, Mpls.
Board of Park Commissioners.

EDWIN LEWIS HANSEN
2700 S. Clameda St., Arcade Sta., Los Angeles, Cal.
Eng. Salesman, Ger. L. Eastman Co.

GEORGE M. CHRISTILAW
Minn. Highway Dept., Glenwood, Minn.
Instrumentman.

ROBERT WALTER MUESSEL
South Bend Toy Mfg. Co., South Bend, Ind.
Asst. Supt.

BURT CHARLES HENRY
Gauger & Korsmo Construction Co., Ranville, Minn.
Estimator.

CYRIL DEWEY JENSEN
Mpls.
Northern States Power Co.

ALPHONSE NELS JOHNSON
308 Lincoln Bank Bldg., Mpls.
Northern States Power Co.

CARL SIGFRID JOHNSON
c/o Lackawanna Bridge Works Corp., Buffalo, N. Y.
Detailer.

EVERETT JAMES MCCUBREY
New Ulm, Minn.
Minn. State Highway Dept.

WILLIAM STRATHERN MACKINTOASH
Minn. Highway Dept., St. Paul, Minn.
Inspector.

RICHARD ROY SIMMONDS
Mich. St. Highway Dept., 1st Natl. Bank Bldg., Escanaba, Mich.
Resident Engr.

LEIF JOHN SVERDRUP
Mo. Highway Comm., Jefferson City, Mo.
Chief Bridge Engr.

WALLACE DUDLEY WEIS
Cameron Joyce Smith Elder Co., Pontiac, Ill. Foreman.

JAMES HENRIC WERDENHOFF
Roxana Petroleum Co., Arkansas City, Kan.
Supt. of Mech. Instrument.

1922

NELS SEVRIN ANDERSON
Board of Education, Mpls.
Draftsman.

HARRY J. ANDRUS
1868 Commonwealth Ave., Brookline, Mass. Forestry Dept.

GEORGE R. BAILEY
Smiths Inventions, Inc. 2730 4th Av. S. E., Mpls. Industrial Engr.

HUBERT J. BERDAN
Chippewa Falls, Wis. Field Engr.

WALTER K. COOK
Joliet & Eastern R. R., Joliet, Ill.
Engineer Dept.

MAURICE C. CHERNUS
524 McKnight Bldg., Mpls., Minn.
Mpls. Bridge Contractors.

SEYMOUR R. CRAY
Chippewa Falls, Wis. City Engr.

HARRY ERNEST CRIBBS
Bridge Engineers Office, N. P. Ry., St. Paul, Minn. Draftsman.

EDWIN C. O. ERICKSON
Soo Line, Eng. Office., Mpls., Minn.
Structural Design. Engineers Dept.

MAX FEDER
1016 Humboldt Ave. No., Mpls., Minn.

CARLISLE GILMAN FRASER
810 Guardian Life Bldg., St. Paul, Minn. Engineer.

HERBERT JOHANNES FROST
R. D. Thomas, Mpls., Minn.
Instrumentman.

ARTHUR E. HORSTKOTTE
Fresno, Calif. Supt. of Constr., Sugar Pine Lumber Co.

ALEXANDER A. LEVENS
College of Eng., U. of M.
Instructor.

EARL H. LUND
U. S. Government, Milwaukee, Wis.
Inspector.

DEWEY F. MATTSON
1200 2nd Ave. S., Mpls., Minn.
Civil Engineering.

ELLSWORTH JOHNSON
Sheridan, Wyo. Instrumentman.

(Civils—Continued)

Jasper Francis Keeler
G. N. R. R. Bridge Dept.

Christian Orrin Markson
Minn. State Highway Dept.
Instrumentman.

John E. Morrison
Northern States Power Co., Mpls., Minn. Field Engr. on Construction.

Lester Wayne Newbery
Farmington, Minn.
Draftsman, Minn. Highway Dept.

Roland E. Ost
Mason City, Ia. Care of Northwestern States Portland Cement Co.

Charles Herman Palda
Winnebago, Minn. Material Cost.

Thorwald S. Paulsen
Foley Bros., Lake Johanna, St. Paul, Minn., Engr.

Howard B. Palmer
406 Federal Bldg., Milwaukee, Wis. Inspector, U. S. Eng. Office.

Neander Eberhard Peterson
Illinois Central R. R.
Instrumentman.

Lawrence F. Pineka
L. P. Wolff, Construction Engr.
Draftsman.

John Melvin Reardon
Butler Bros. Bldg. Co., St. Paul, Minn. Engr.

Paul Rosenthal
Minn. Highway Dept., Sauk Center, Minn. Bridge Inspector.

Emil Mark Silverman
Dixon, Ill. Highway Engr.

Edward Joseph Soshnik
Mpls., Minn. Struct. Engr.

Loring Slade
Minn. Highway Dept., Cannon Falls, Minn. Draftsman.

Oliver Andrew Stoutland
807 Newhouse Bldg., Salt Lake City, Utah. Mpls. Steel Mach. Co.

Clifford LeRoy Swanson
Corrugated Bar Co., Inc.
Designer & Estimator.

Lawrence E. Tebero
G. N. R. R., St. Paul, Minn.
Designer and Draftsman.

Claudius A. Thompson
Minn. Highway Dept., Barnesville, Minn. Resident Engr.

Festus P. Tierney
Stillwater, Minn.

Arden Dean White
Charles E. Knight, Civil Engr., Detroit, Mich. Asst. Engr.

Charles Albert Wilson
Minn. Highway Dept., Totte, Minn.
Draftsman.

Victor Russell Wood
Farmington, Minn. Resident Engr.

William Park Tarbell
City Eng. Dept., Fargo, N. Dak.
Asst. Engr.

William Kelley
Long Lake, Minn. Landscape Engr.

Edward L. Espenett
Mo. State Highway Cms'n., Jefferson City, Mo. Project Engr.

Neander Eberhard Peterson
Ill. Cen. R. R. Instrumentman.

1923

Arne Aasland
620 So. 4th St., Mpls., Minn.
Salesman.

Harry William Abramson
Ill. Highway Dept., Springfield, Ill.
Asst. Engr. of Materials.

Louis Wylie Aldrich
Cal. Highway Coms'n., San Bernardino, Calif.

Carl Ingman Aslakson
U. S. Coast and Geodetic Survey, Washington, D. C. Deck Officer.

Swan Peter Berg
Soo Line Bldg., Mpls., Minn.
Field Engr.

Leo Buhr
Danbury, Wis.
Northern States Power Co.

Frank B. Chrislies
Fairbanks, Morse & Co., St. Paul, Minn. Oil Engine Dept.

Byron K. Curry
Geglas Constr. Co., St. Paul, Minn.
Constr. Engr.

James Engle Darrell
N. S. Pleo Bruce, Wis.
Instrumentman.

Paul R. DeFreece
Minn. Power & Light Co., Duluth, Minn. Hydraulic Engr. Dept.

Edward C. Dindorf
601 Met. Bank Bldg., Mpls., Minn.
Designing & Est. Engr.

Lester Bergford
Portland Cement Assn., Minneapolis, Minn. Field Engr.

Richard H. Flindt
Croft & Boerner, Archts. Asst. Engr.

George Otto Guesmer
Northern States Power Co., Mpls., Minn. Draftsman.

Hibbert M. Hill
U. of M., Mpls., Minn.
Instructor, Civ. Eng.

Walter G. Hiner
1450 Van Buren, St. Paul, Minn.

Orville H. Hosmer
City Planning Dept., Mpls., Minn.
Asst. Civil Engr.

Albert Warren Johnson
Kalman Steel Co., Chicago, Ill.
Draftsman.

Nels Johnson
1520 Soo Line Bldg., Mpls., Minn.
Draftsman.

Maurice D. Judd
North Ia. Brick and Tile Co., Mason City, Ia. Sales Engr.

Walter E. Kotz
G. N. R. R. Computer.

Morris William Lazerowitz
Mpls. Steel & Mach. Co., Mpls., Minn. Structure Draftsman.

Aubrey C. Leonard
Rochester, Minn.
Olmstead Co. Highway Dept.

Walter L. Maiser
Care of Foundation Co.
Designing Eng. Chicago, Ill.

Henry J. Manget
Northern States Power Co., Monticello, Minn. Draftsman.

George Meskal
Minn. State Highway Dept., Frontenac, Minn. Instrumentman.

Lloyd S. Mitchell
Ward & Weighton, Contractors, Sioux City, Ia. Engr.

Elmer A. Nelson
1112 Metropolitan Life Bldg., Mpls., Minn. Asst. Engr.

Glenn Nelson
Municipal Eng. Dept., Los Angeles, Cal. Subdiv. work, E. E. Mix. Engr.

Carl Odquist
Kalman Stee. Co., Chicago, Ill.
Eng. Dept.

Elmer J. E. Olson
Chisholm, Minn., 513 W. Hemlock St. Mining Engr.

Lloyd Peck
National Assoc., Drawer 200, La Salle, Ill. Dir. of Eng. Dept.

Arthur Albert Sauer
Toltz, King & Day, Inc.
Draftsman.

George C. Schaller
James Leck & Co., Mpls., Minn.
Timekeeper.

John J. Schlenk
286 Knapp St., Milwaukee, Wis.
Draftsman, U. S. Eng.

Abraham M. Sclarow
1402 8th Ave. N., Mpls., Minn.

Raymond D. Spencer
San Bernardino, Cal.
Eng., Calif. Highway Cms'n.

Clifford S. Stephens
Venice Art Marble Co., Nicollet Is., Mpls., Minn. Estimator & Bus. Mgr.

Paul H. Swanson
Concrete Eng. Co., Chicago, Ill.
Draftsman.

Carl H. Tennstrom
Duluth, Minn.
Minn. Power & Light Co.

Everett Thompson
H. R. Bradley & Co., Mondanock Block, Chicago, Ill. Draftsman.

Walter F. Villaume
R. J. & E. Ry. Co. Draftsman and Designer.

Arthur C. Zimmerman
U. S. Coast and Geodetic Survey, Washington, D. C. Deck Officer.

1924

Edwin T. Bergquist
Moorhead, Minn.
Minn. Highway Dept.

Philip L. Bergquist
G. N. R. R. Co., Willmar, Minn.

George C. Bestor
Empire Gas & Fuel Co., Barttesville, Okla. Junior Engr.

Edward Braddock
Care of Kass Constr. Co., Mendota, Minn. Asst. Engr.

Everard J. Bullis
Farm, U. of Minn. Asst. in Agr. Eng. Coop. Drain Tile Lab.

Samuel Caryl Chapin
Ill. Highway Dept., Peoria, Ill.
Jr. Highway Eng.

Richard J. Dedic
Old Custom House, Detroit, Mich.
U. S. Lake Survey.

(*Civils—Continued*)

CARL E. ERICKSON
2249 West 13th St., Duluth, Minn.

GEORGE V. GUERIN, JR.
G. N. Ry., Gen. Office Bldg., St. Paul, Minn. Bridge Engr.

REUBEN WILLIAM GUSTAFSON
Bridge Dept., G. N. Ry., St. Paul, Minn. Draftsman.

SANDFORD HERBERG
1236 Plymouth Bldg., Mpls., Minn. Gen. Inspection.

LAURENCE E. HOLDER
Court House, St. Paul, Minn. Transitman, Dept. of Public Works.

RAYMOND V. JOHNSON
Gaylord, Minn.

HERBERT W. LIESE
209 Gilfillan Block, St. Paul, Minn. Foley Bros. Constr. Co.

ARCHIE R. McCRADY
Div. 25, Patent Office, Washington, D. C. Asst. Ex. of Patents.

LLOYD L. H. PETERSON
Northern States Power Co., Fargo, N. D. Combustion Engr.

WAINO M. SOMERO
E. J. & E. Ry. Co., Joliet, Ill. Draftsman.

ARTHUR W. TEWS
Lake City, Minn. State Highway Dept.

THEODORE S. THOMPSON
Minnesota Highway Dept., Canby, Minn. Inspector.

CLARENCE VELZ
Chicago, Ill. La Salle St. Sta.

WALTER E. WILSON
1320 7th St. S. E., Mpls., Minn.

Electrical Engineering

1891

GEORGE PHILIP HUHN
319 12th Ave. S. E., Mpls.
Real Estate and Insurance.

1892

EDWARD PARISH BURCH E. E. 1898
1729 James Ave. S., Mpls.
Consulting Engr.

WILLIAM HENRY BURTIS
Main St., Armour, S. D.
Manager, Consumers Utility Co.

WILLIAM IRVING GRAY E. E. 1898
209 Globe Bldg., Mpls.
Manufacturers' Agent.

MONROE SHERMAN HOWARD
Waukon, Iowa.

1893

FRANK ERVIN REIDHEAD E. E. 1898
213 City Hall, Mpls.
City Building Inspector.

GEORGE H. MORSE E. E. 1911
10 S. 16th St., Philadelphia, Pa.
Electrical Engr.

FRANK WESLEY SPRINGER E. E. 1898
Univ. of Minn.
Prof. Electrical Eng.

JOHN D. GUTHRIE M. D. 1897
3669 Interlake St., Seattle, Wash.
Physician.

CHAS. HENRY CHALMERS E. E. 1903
1234 Central Ave. N. E., Mpls.
Owner, Chalmers Oil Burner Co.

1895

GEORGE F. ADAMS
25 Church St., New York City.
Electrical Engr.

*ADAM E. BISHMAN

HORACE T. EDDY E. E. 1896
Omaha Tech. H. S., Omaha, Neb.
Auto Mechanics Instructor.

ROBERT E. FORD E. E. 1903
100 N. 7th St., Mpls.
Partner, Luther Ford & Company.

FRED M. ROUNDS
Western Indemnity Bldg., Dallas, Texas.
Buildings and Supplies Supt.

FREDERICK VON SCHLEGELL
Allis-Chalmers Co., Chicago, Ill.
Mgr., Chicago Branch.

*HARRY L. TANNER

1896

HENRY ANTON ERIKSON PH. D. 1908
Univ. of Minn.
Prof. of Physics.

CHARLES EDWARD MAGNUSON M. S. 1896, E. E. 1897
Univ. of Washington, Seattle, Wash.
Dean of College of Eng.

*HERBERT WHEELER

1897

ARTHUR LAURIE ABBOTT
15 W. 37th St., New York City.
Technical Director.

GEORGE L. CHESTNUT
Western Electric Co., Houston, Tex.
Sales Engr.

TRUMAN HIBBARD
14th Ave. and Tyler St. N. E., Mpls.
Sec. and Chief Engr.

OLAF G. MARKHUS
Idaho Railway Light and Power Co., Boise, Idaho.
General Mgr.

*WILLIAM LOTT MILLER

MORTIMER MYERS
112 W. 103 St., New York City.
Maintenance Company.

1898

*HANS F. M. DAHL

CHARLES CHANDLER GILCHRIST
Western Electric Co., Chicago, Ill.
Hawthorne Station.

FRANK WOODMAN McKELLIP
525 3rd St. S. W., Faribault, Minn.
General Engineer Practice.

ADOLPH WAGNER
612-14 N. Capital Ave., Indianapolis, Ind.
Member of firm.

1899

EMMANUEL ARTHUR ARTZ
Electrical Construction Co., Sioux City, Iowa.
Proprietor.

VERNEY GRALINO
Niagara Falls, New York.
Operating Dept., N. F. P. Co.

HENRY A. G. HILDEBRANDT
Univ. of Minn.
Supt. of Bldgs. and Grounds.

MILTON B. HUNTOON
1365 Cass Ave., Detroit, Mich.
Telephone Engr., Bell Tel. Co.

ELWOOD MANSFIELD MACKUSICK
904 Forum Bldg., Sacramento, Cal.

ARTHUR CLARENCE PRATT
817 Diamond St., Butte, Mont.
Chief Operating Electrical Engr., The Montana Power Co.

1900

JAMES CHASE DOW
Montana Power Co., Great Falls, Mont.
Operating Engr.

*FRANK E. JOHNSON

WILLIAM LEONARD KINSELL
409 E. 18th St., Mpls.
Garage Owner and Auto Dealer.

ERNEST JAIRUS SHUMWAY
Robbinsdale, Minn.
Contracting for wiring.

WILLIAM STUSSY
Montana Power Co., Butte, Mont.
Engr.

JAMES AUKEN THALER
Bozeman, Mont.
Prof. of Electrical Eng., State College of Agriculture and Mechanic Arts.

ROY EDWIN THOMPSON
San Diego, Calif.
Purchasing Agent, San Diego Gas and Electric Plant.

*FRED G. TRACY

EDWARD WILTGEN
(Address unknown; information requested.)

HARLEIGH PARKHURST
Fort Sill, Okla.

1901

MARTIN E. ANDERSON
601-610 Interstate Trust Bldg., Denver, Colo.
Patent Attorney.

HENRY BLAKE
Lightcap, S. D. Ranching.

JAKE DANNER
1505 Race St., Philadelphia, Pa.
Supt. of Installation Division No. 3, Western Electric Co., Inc.

GUY J. HOUTS
Western Electric Co., Chicago, Ill.
Telephone Engr.

AMOS DWIGHT HOULTON
Minneapolis Tribune, Mpls.
Plating and Grinding Press Rolls.

CHAS. E. TULLAR
General Electric Co., Schenectady, New York.
Patent Attorney.

STYRK G. REQUE
802 Hamilton St., Allentown, Pa.
Chief Engr., Pennsylvania Power & Light Co.

1902

Harvey Lynn Burns
268 W. 36th St., New York City.
Methods and Planning Engr., Western Elec. Co.

Edwin Linton French
5 Burns Ave., Niagara Falls, Ont.

W. B. McPherson
Minnesota By-Product Co., St. Paul, Minn.
Engineer.

Wilhelm Nilson
R. F. D. No. 1, Box 77, Twin Valley, Minn. Farming.

William James Spence
348 Hingston Ave., Montreal, Can.
Engr., Northern Elec. Co., Ltd.

1903

George Frederick Benedict
Puget Sound, Wash.
U. S. Navy Yards, Mechanical Engr.

Barry Dibble
128 Sunnyside Ave., Redlands, Cal.
Consulting Engr.

Otto Emmanuel Eberhardt
Capouse Ave. and Ash St., Scranton, Pa.
Pres., Eberhardt Elec. Co.

Carl Gunnard Erickson
6325 39th St. S. W., Seattle, Wash.

Roy Rowell Ireland
Western Electric Co., N. Y. City.
Engineer.

Lee Rush Laird
463 West St., New York City.
Engineering Dept., Western Elec. Co.

*Lucius W. Miller

Mark Lyman Page
Mare Island, Calif.
Radio Electrician, U. S. Navy.

Louis Gilbert Rask
General Electric Co., Schenectady, N. Y.
Engineer, Marine Eng. Dept.

Ingwald A. Rosok
P. O. Box 795, Bisbee, Ariz.
Mgr., Bisbee Improvement Co.

John Henry Schumacher
187 Portage Ave., Winnipeg, Can.
Mgr., Schumacher Gray Co.

Jay Carter Vincent
203 City Hall, Mpls.
Electrical and Mechanical Engr., City of Mpls.

1904

Bernhard Martin Bouman
463 West St., New York City.
Equipment Engr., Bell Telephone Laboratories, Inc.

Edward Joseph Cheney
61 Broadway, New York City.
Consulting Engr.

George Crabbe
250 11th Ave., New York City.
Electrical Engr., Otis Elevator Co.

Victor Earl Goodwin
General Elec. Co., Pittsfield, Mass.
Mgr., Lighting Dept.

*Frank C. Helms

John Howatt
650 S. Clark St., Chicago, Ill.
Chief Engr., Board of Education.

Harry Garfield Morton
Northwestern Bell Co., Mpls.
Traffic Engr.

Fred Arthur Otto
Stewart P. Browne Mfg. Co., New York City. Sales Engr.

*Peter A. M. Rosok

Robert Baird Taplin
(Address unknown; information requested.)

L. C. Tomlinson M. S. 1909
454 Lincoln St., Franklin, Mass.

John Wicks
Automatic Elec. Co., Chicago, Ill.
Development Engr.

1905

William Charles Adams
121 Shearer St., Montreal, Quebec, Can.
Chief Engr., Northern Elec. Co., Ltd.

Emil Anderson
240 Plymouth Bldg., Mpls.
Secy., Standard Elec. Service Co.

Louis Scoville Billau
Baltimore, Md.
Asst. Elec. Engr., Balt. & Ohio Ry.

Carl E. Boman
Bell Telephone Laboratories, Inc., New York City. Engr. in charge of machine switching telephone, Central Office Equipment Designs.

Frank D. Coleman
Billings, Mont.
Mgr., Billings District of Mont. Power Co.

Charles A. Davis
1764 Ashland Ave., St. Paul, Minn.
Partner in Davis-Reiners Paper Co.

Irving Robinson Ely
New York Navy Yard, Brooklyn, N. Y.
Engr., Machinery Div.

John Joseph Frankoviz
Fergus Falls, Minn.
Pres. of Frankoviz Hardware Co.

Charles B. Gibson
Westinghouse Elec. & Mfg. Co.
Mgr., Metal Mining and Chemical Sec.

Earle Daniel Jackson
403 Endicott Bldg., St. Paul, Minn.
Consulting Engr.

Raymond Leslie Jones
Pac. Tel. & Telg. Co., San Francisco, Calif.
Telephone Engr.

Milton J. Kochendorfer
Andrew Schoch Grocery Co., St. Paul, Minn.
Foreman, Garage.

Edmond J. LeBlond
76 W. 3rd St., St. Paul, Minn.
Supt. of Elec. Dept., Northern States Power Co.

Edward Harold LeTourneau
26 Broadway, New York City.
Asst. Supt., C. and R. Div.

Reuben Alvin Lundquist
U. S. Dept. of Commerce, Washington, D. C.
Chief, Elec. Div.

Robert Morris
(Address unknown; information requested.)

William Thomas Ryan
Univ. of Minn., Mpls.
Prof. of Elec. Engr.

*Clinton Besly Smith

Karl Albert Simmon
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. Railway Dept.

John William Wood
Medford, Oregon.
California-Oregon Power Co.

1906

George M. Albrechte
Allis Chalmers Mfg. Co., Milwaukee, Wis.
Asst. Patent Attorney.

Paul Fay Bunce
N. W. Telephone Co., Fargo, N. D.
Div. Supt. of Traffic.

John Peter Calmeyer
389 Snelling Ave., St. Paul, Minn.

Nathan Cohen
466 H St. S. W., Washington, D. C.

Leo Henry Cooper
Frank Adam Elec. Co., St. Louis, Mo.

Martin Cornelius
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. Elec. Engr.

Andrew Paul Dunn
Los Angeles, Calif.
Contracting.

Charles F. Englin
Connolly Shoe Co., Stillwater, Minn.
Sales and Credit Mgr.

Jacob Oscar Finchy
(Address unknown; information requested.)

Henry Hopson Glascock
New London, Mo.
Prop. and Gen. Mgr. of New London Tel. Co.

*Albert Nelson Gunther

Elmer Harvey Haeberle
New Ulm, Minn.
Mgr., New Ulm Ice Co.

Christopher Hoff
65 E. Water St., St. Paul, Minn.
Vice Pres., Lee-Hoff Mfg. Co.

Clarence E. Hokanson
463 West St., New York City.

Robert Thorold Hubbard
Bank of Wis. Bldg., Madison, Wis.
Asst. Consulting Engr.

Charles Arthur Lang
226 Lumber Exchange Bldg., Mpls.
Engr. of Constr., C. F. Hagelin & Sons.

Harry Wheelock Mowry
268 W. 36th St., New York City.
Chief of Machine Switching.

Harold Gould Payne
517 Park Square, Boston, Mass.
Engr. with Jackson & Moreland, Consulting Engrs.

Otto Bismarck Roepke
U. S. Patent Office, Washington, D. C.
Principal Examiner.

Walter Frederick Schwedes
714 Wolvin Bldg., Duluth, Minn.
Elec. Engr., Oliver Iron Mining Co.

Gordon Russell Shuck
Univ. of Washington, Seattle, Wash.
Asst. Prof.

*Harry Albert Schow

Laurence A. Stenger M. S. 1916
616 Sugar Bldg., Great Western Sugar Co., Denver, Colo.
Engr., Research Dept.

(Electricals—Continued)

Harris Garfield Stone
Hollywood, Calif.
Electrical Contractor and Dealer.

Carl Mugg Ungerman
4516 Zenith Ave. S., Mpls.
Switchboard Engr., Boustead Elec. & Mfg. Co.

Erwin L. F. Weber
723-724 Seaboard Bldg., Seattle, Wash.

Gerald Graham Wiggins
270 Madison Ave., New York City.
Asst. Elec. Engr., Transit Commission.

William Arthur Zimmer
209 S. 33rd St., Omaha, Neb.
Local Traffic Engr., N. W. Bell Tel. Co.

1907

Herbert Dennett Alton
2004 Sprague St., Spokane, Wash.
Elec. Contractor.

Raymond Edward Baer
1370 Thomas St., St. Paul, Minn.
Car Starter, St. Paul City Railway.

Raymond Joel Andrus
131 State St., Boston, Mass.
Vice Pres., Twin State Gas & Elec. Co.

Peter Frederic Countryman
R. R. 1, Ontario, Oregon.
Rancher.

Lynne Walter Eddy
Cleveland, Ohio.

Albert Royal Fairchild
114 12th Ave., Huntington, W. Va.
Dist. Central Station Engr., Westinghouse Elec. & Mfg. Co.

Ralph W. Kerns
Clarksdale, Arizona.

Arthur Floyd Norcross
280 Madison Ave., New York City.
Inspecting Engr., N. Y. Steam Co.

John Henry Pearce
Thompson Falls, Montana.

John Joseph Rezab
72 W. Adams St., Room 1340, Chicago, Ill.
Asst. Engr., Elec. Distribution, Public Service Co.

William P. Schow
8809 17th Ave. S. W., Seattle, Wash.

Byron Elton Smith
Granite Gold Mining Co., Valdez, Alaska.
Chief Engr.

John Edward Smitheson
601 State St., Hood River, Ore.
Pres. and Gen. Mgr., Oregon-Washington Tel. Co.

Carl Stenberg
1714 Elliot Ave. S., Mpls.
Electric Machinery Co.

George Walter Uzzell
Casper, Wyoming.
Ohio Oil Co.

William L. Woehler
3929 Portland Ave., Mpls.
Mgr., Elec. Dept., Harris Bros.

1908

Frank Arthur Anderson
1322 Wisteria Ave., Portland, Ore.
Mgr., National Appliance Co.

Alfred Bachrach
724 S. Spring St., Los Angeles, Calif.
General Electric Co.

George J. Brown
27 New Parliament Bldg., Winnipeg, Man., Can.
Engr. of Mechanical Services, Province of Manitoba.

Robert J. S. Carter
4041 Dupont Ave. S., Mpls.
Vice Pres. and Sales Mgr., Carter Mayhew Mfg. Co.

James William Casberg
Wyburn, Sask., Canada.

Neil Currie, Jr.
61 Taconic St., Pittsfield, Mass.
Engr., Power Motor Dept., Pittsfield Works.

Alfred R. Frahm
2-4 S. Berstram, Eau Claire, Wis.
General Supt. of the electric and gas properties of the Northern States Power Co. in Eau Claire.

Glenn H. Hoppin
146 Davison Ave., Highland Park, Mich.

*Henry Hovelson

Roy Kauffman
Bisbee, Arizona.
Improvement Co.

Alfred B. King
52 Vanderbilt Ave., New York City.
Eastern Sales Mgr., Elec. Mach. Mfg. Co.

Allan L. McAfee
Tualatin, Oregon.
General Merchandise, Harrisburg, Ore.

Frank Joseph Pancratz
Perham, Minn.

Clarence Alfred Peterson
1830 K St., Washington, D. C.
Engr., Office of Supervising Architect.

Robert Shaffer Prentice
618 Davison St., Indianapolis, Ind.
Res. Engr.

William F. H. Schildt
1001 Electric Bldg., Buffalo, N. Y.
General Electric Co.

Alfrd W. Schoepf
519 Prospect Ave., Fairmont, W. Va.
Monongahela West Pa. Public Service Co.

Francis George Scobie
Philadelphia & Reading Coal Co., Superior, Wis. Master Mechanic.

Percy Granville Sturtevant
934 W. 31st, Erie, Pa.
Operating Director, Erie County Elec. Co.

George Peter Svendsen
16-18 E. Hennepin Ave., Mpls.
Pres. and Gen. Mgr. Boustead Elec. & Mfg. Co.

Frank Swanstrom
4017 Oakland Ave., Mpls.
Chief Engr., Electric Machinery Co.

Oliver Sweningsen
3819 Chestnut Ave., Long Beach, Calif.
Gen. Plant Supervisor, Southern Calif. Tel. Co., Los Angeles, Calif.

William Mathias Weibeler
2466 N. 47th Ave., Omaha, Neb.
Equipment Engr., N. W. Bell Tel. Co.

Louis Peter Zimmerman
Waseca, Minn.
Farmer.

1909

Walter Clarence Beckjord
120 Broadway, New York City.
Chief Engr., American Light & Traction Co.

Alvah E. Brockway
Box 18, Route 1, Medford, Oregon.

Rollo J. Cobban
Westinghouse Elec. & Mfg. Co., Portland, Ore.
Branch Mgr.

Clovis Miller Converse
145 E. 5th St., St. Paul, Minn.
Mgr., Power Apparatus Dept., St. Paul Elec. Co.

Ralph Morris Davies
1051 Chamber of Com., Mpls.
Grain Salesman.

Joel Archer Fitts
613 Marquette Bldg., Chicago, Ill.
Engr., Elec. Storage Battery Co.

Lester Hunder Gadsby
807 S. Encina St., Visalia, Calif.
City Engr.

Fred R. Grant
13 Irving Road, Scotia, N. Y.
Gen. Elec. Co., Schenectady, N. Y.

Clayton Harris
504 Magnolia Bldg., Dallas, Tex.
Westinghouse Elec. & Mfg. Co.

*Albert J. Hitzker

Mark Luman Hopkins
Mpls. Board of Education, Mpls.
Bureau of Buildings.

James W. Hornibrook
111 W. Washington St., Chicago, Ill.
Sales Dept., Westinghouse Lamp Co., Conway Bldg.

Bernard George Japs
522 W. 21st St., University Place, Neb.
Dairy and Poultry Business.

Herman Richard Johnson
499 51st St., Milwaukee, Wis.
Sales Engr., Westinghouse Elec. & Mfg. Co.

George A. Kristy
508 S. Dearborn St., Chicago, Ill.
Mgr., Brilliant Search Light Mfg. Co.

Charles Gustav Lindelef
867 W. 5th St., Riverside, Calif.
Chief Engr., Yellowstone Park Hotel Co., Yellowstone Park, Wyo.

Lauren F. McKensie
304 R. R. Ave., S. Seattle, Wash.
Dist. Sales Mgr., Linde Air Products Co.

Frederic Edward Murrish
1015 Security Bank Bldg., Los Angeles, Calif.
Asst. to Vice Pres., Pan-American Petroleum Corp.

Orson B. Poore
Federal Dam, Cass Co., Minn.
Research Engr.

Archer R. Robison
43 Exchange Place, New York City.
J. G. White Eng. Corp.

Marcus H. Stillman
87 Main St., St. Johnsburn, Vt.
Asst. Factory Supt., E. & T. Fairbanks & Co.

(Electricals—Continued)

M. Eugene Todd
Univ. of Minn., Mpls.
Asst. Prof., Elec. Eng. Dept.

Leslie Elliott Turner
923-53 W. Jackson Blvd., Chicago, Ill.
Mgr., Master Heat Regulator Co.

Theodore Vita
Indepence, Calif.
Dept. of Public Service, City of Los Angeles.

Benjamin Bennett Walling
1047 McKnight Bldg., Mpls.
Realtor.

Fred Mortimer Williams B. A. 1905
444 S. 7th Ave., La Grange, Ill.
Tel. Engr., Western Elec. Co., Hawthorne Station, Chicago, Ill.

1910

Oscar Peter Anderson
17 Yale Terrace, West Orange, N. J.
Edison Lamp Works, Harrison, N. J.

Oscar Victor Anderson
82 Indian Road Crescent, Toronto, Ont.
Supt. TNP. Div., Gen. Eng., Toronto Hydro Elec. System.

Vernon S. Beck
1150 Plymouth Bldg., Mpls.
Gen. Contractor.

Wilfred E. Conley
17019 Hillsboro Road, Cleveland, Ohio.
National Lamp Works, Nela Park.

Raymond Esthon Dahlstrom
309 W. 52nd St., Mpls.
District Toll Traffic Chief, N. W. Bell Tel. Co.

Walter J. Finke
Charles City, Iowa.

*Herbert E. Hagstrom

Christian Hansen
15 S. 5th St., Mpls.
Mpls. Gen. Elec. Co., Asst. Auditor.

Byron P. Hustad
305 First National Bank Bldg., Duluth, Minn.
Gen. Contractor, Klepen & Hustad Co.

Clarence M. Jesperson
112 E. 5th St., Anniston, Alabama.
Federal Phosphorous Co.

Leonard T. Johnson
1250 N. Lockwood Ave., E. Cleveland, Ohio.
Grasselli Chemical Co., Cleveland, Ohio.

Eliot Bryant Josephson
215-219 Bush St., Red Wing, Minn.
Retail Clothier.

Arvid Gilbert Landeen
463 West St., New York City.
Western Elec. Co.

Carl Hugo Nelson
1029 Drexel Bldg., Philadelphia, Pa.

Ray R. Phelps
Fifth and Oak Sts., Kelso, Wash.
Propr. Motor Inn Garage.

James William Powles
928 Osceola Ave., St. Paul, Minn.
Science Teacher, Humboldt High School.

Harry Alexander Reid
Cleveland, Ohio.
National Elec. Lamp Assoc.

Ernest E. Skytte
Pittsburgh, Pa.
Westinghouse Elec. & Mfg. Co.

1911

Roy H. Ashworth
519 Kearns Bldg., Salt Lake City, Utah.
Asst. to Gen. Mgr., Utah Power & Light Co.

Robert Penn Burrows
680 Folsom St., San Francisco, Cal.
Pacific Coast Representative, Western Elec. Co.

George William Blossom
Loma Portal, San Diego, Calif.
3113 Goldsmith St.

Allan Coffman Butterworth
Montreal, Wis.
Elec. and Mech. Engr., Montreal Mining Co., Hurley, Wis.

Arthur Garner Chapman
77 S. Munn Ave., East Orange, N. J.
Amer. Tel. & Telg. Co., New York City.

Charles Sidney Demarest
195 Broadway, New York City.
Elec. Engr., Dept. of Development and Research, American Tel. & Telegram Co.

Leon R. Drinkall
105 Sheridan Ave. N., Mpls.
Head of Elec. Dept., Dunwoody Inst.

Lynn A. Emerson
217 West Park Ave., Joliet, Ill.
Supervisor of Vocational Ed., Joliet Township H. S.

Peter William Forsberg
Grosvenor Square, Schenectady, N. Y.
Railway Equipment Eng. Dept., Gen. Elec. Co.

Harry B. Fredrickson
80 Park Place, Newark, N. J.
Asst. Plant Engr., Public Service Elec. Co.

Maurice James Hansen
425 E. Waters St., Milwaukee, Wis.
Mgr.

Henry Clay James
1104 Northern Pacific R. R. Bldg., St. Paul, Minn.
Asst. Supt., Telegraph Dept.

John E. Johnson
(Address unknown; information requested.)

Watkin W. Jones
399 N. 6th St., Price, Utah.
Consulting Engr., Cons. Eng. Coal Mines and Irrigation.

Dartt Hendrickson Lyford
1221 Hollinsworth Bldg., Los Angeles, Calif.
Engr., Research and Development Dis., Union Oil Co. of Calif.

Ira Clark McCoy
317 N. Eastern Ave., Joliet, Ill.
Instructor, Joliet Township High School.

Raymond Eugene McQuillen
Ft. Leavenworth, Kansas.
Student Officer, The General Service School.

Oscar S. Markuson
463 West St., New York City.
Engr., Bell Tel. Laboratories, Inc.

Albert H. Mittag
Room 449, Bldg. No. 2, Schenectady, N. Y.
Eng. Dept., Gen. Elec. Co.

Walter Harry Nebel
70 Westland Ave., Boston, Mass.

Raymond J. O'Brien
New York City.
Sales Engr., Westinghouse Elec. & Mfg. Co.

Joseph Hill Pengilly
607 East 4th St., Los Angeles, Calif.
Partner, Brown & Pengilly Co.

Louis H. Riegel
908 E. Henry St., Savannah, Ga.
Sales Agent, Savannah Elec. & Power Co.

Donald Dayton Shephard
143 Lafayette Blvd., Detroit, Mich.

Joseph Henry Soulek
Montgomery, Minn.
General Merchandise Business.

Will V. Stinson
Pittsburgh, Pa.
Westinghouse Company.

William A. Walker
910 S. Mich. Ave., Chicago, Ill.
State Rep. of the Chicago District Office.
Gilbert & Barker Mfg. Co.

Glenn William Wilson
275 Castro St., Mountain View, Cal.
Proprietor, Valley Elec. Co.

1912

Arthur R. Anderson
1114 Mission St., San Francisco, Cal.
Salesman, Lundstrom Hat Works.

*Samuel Lee Avis

Earl McMaster Bill
62 Baker Ave., Schenectady, N. Y.
Ry. & Tr. Eng. Dept., Gen. Elec. Co.

Albert Pellet Dorrance
2824 Univ. Ave., Mpls.
Salesman, White Co.

Harry C. Streich
25 E. 5th St., St. Paul, Minn.
Dayton's Bluff Station, R. 2.

Charles N. Young
Washington Park, Newark, N. J.
Engr. and Insp. Dept., Globe Indemnity Co.

Claude Frances Benham E. E. 1913
530 Bush St., San Francisco, Calif.
Great Western Power Co.

William Edw. Brewster E. E. '13
658 Union Trust Bldg., Cleveland, Ohio.
Mgr. Adv., The Christian Science Monitor.

H. Arno Daum
1649 Hague Ave., St. Paul, Minn.
Mgr. of Salesmen, Webb Publishing Co.

Ernest A. Hedenstrom
1441 Van Buren, St. Paul, Minn.

Raymond R. Herrmann
Univ. of Minn., Mpls.
Asst. Prof. of Math. and Mech.

Charles K. Hillman
(Address unknown; information requested.)

(*Electricals—Continued*)

FREDERICK WILHELM HOORN E. E. 1914
Ann Arbor, Mich.
Captain, Signal Corps, U. S. Army, Univ. of Mich.

CONRAD D. HOVDEN E. E. 1913
St. Paul, Minn.
Asst. Chief Engr., Swift & Co.

LESTER HOWARD KNAPP
807 Jefferson Ave., Paducah, Ky.
Paducah Elec. Co., Sales Mgr.

ROBERT CARL MATHES E. E. 1913
66 Broad St., New York City.
Photo radiogram engr., Radio Corps of America.

ELMER WILLIAM MERRILL E. E. 1913
Broadway and Jackson N. E., Mpls.
Asst. Mgr., Mazda Lamp Div. of G. E. Co.

GEORGE ARTHUR NELSON E. E. 1913
507 Roosevelt St., Enderlin, N. D.
Dentist.

CHARLES ALBERT PARDEE E. E. 1913
14 E. Monroe St. and 69 W. Jackson Blvd., Chicago, Ill.
Automotive Accessory Manufacturer.

*LELAND E. PURVES

IVAN GEORGE RINGSTROM E. E. 1913
1524 Albany St., St. Paul, Minn.
Water Dept., St. Paul.

THEODORE MINER SWENSON
108 Leech St., St. Paul, Minn.
Statistician, Office of Pres., N. P. Ry.

ALBERT LAURIS THURAS E. E. 1913
463 West St., New York City.
Research Engr., Western Elec. Co.

NEAL CRANDALL TOWLE E. E. 1913
209 South Ave., Wilkinsburg, Pa.
Salesman, Westinghouse Elec. Co.

1913

ALLEN GUTHRIE DEWARS E. E. 1914
Sixth and Cedar St., St. Paul, Minn.
Electric Distribution Engr.

CLARENCE ARTHUR DOW E. E. 1914
1509 Wilson St., Eau Claire, Wis.
Asst. to Mgr., Northern States Power Co.

RUDOLPH CONRAD GOEBEL E. E. 1914
706 Essex St. S. E., Mpls.
Mech Engr., Andrews Heating Co.

RALPH LEON GOETSENBERGER E. E. 1914
11 E. Highland Ave., Chestnut Hill, Philadelphia, Pa.
Consulting Engr., U. S. A. Frankford Arsenal.

ALLEN KELLOG HAINES
417 N. 8th St., East St. Louis, Ill.
Sales Mgr., The Dick X-Ray Co.

VINCENT HERBERT IRWIN E. E. 1914
139 Queen Ave. N., Mpls.
Asst. Chief Engr., Elec Power Co., Guild, Tenn.

ALEXANDER T. LAGAARD E. E. 1914
709 Globe Bldg., Mpls.
Patent Attorney.

WILLIAM LOUIS MAHONEY E. E. 1914
216 Oaklawn Ave., Grand Rapids, Mich.
Gen. Supt., Consumers Power Co.

HOLLIS DEWITT MILLER
Westwood, Calif.
Principal of High School—Mech. Arts.

THEODORE DEERTZ RAMM
2135 Logan Ave., Youngstown, Ohio.
Asst. Elec. Engr., Penna-Ohio Power & Light Co.

LYMAN DAVID TAYLOR E. E. 1916
2700 East 79th St., Elec. Controller & Mfg. Co.
Consulting Engr.

CHARLES WEBSTER WHITE
(Address unknown; information requested.)

LESLIE WILLIAM WILCOX
Sixth and Cedar St., St. Paul, Minn.
Supt. of Elec. Distribution.

WILLIAM EVERETT E. E. 1915
2949 Portland Ave., Mpls.
Wells-Dickey Co.

1914

PETER P. BISEK
Williston, N. Dak.
Asst. Supt., U. S. Reclamation Service.

EUGENE H. ADLER E. E. 1915
1220 Nicollet Ave., Mpls.
Salesman, Spector Apt. Co.

WENDELL PHILIPS CHAPMAN
1246 Univ. Ave., St. Paul, Minn.
Division Engr., Minn. Highway Dept.

ROY OWEN DUNHAM E. E. 1915
No. 3 Randolph Road, Schenectady, N. Y.
Elec. Engr., Railway Equipment Dept., Gen. Elec. Co.

A. DOUGLASS ELLIOTT E. E. 1915
927 Met. Life Bldg., Mpls.
Elliott Equipment Co.

EUGENE LUCIAN FALLON E. E. 1915
147 Milk St., Boston, Mass.
Stone & Webster, Inc.

*CARL A. GUNNARSON

ANDREW MORTON PETERSON
1196 DeSota St., St. Paul, Minn.

HAROLD RUSSELL HARRIS E. E. 1915
927 Met. Life Bldg., Mpls.
Elec. Manufacturer's Agent.

OTTO EMANUEL JACKSON E. E. 1915
Eureka, South Dakota.

CARL JOHN JOHNSON E. E. 1915
La Moure, N. D.
Local Mgr., Dakota Utilities Co.

ELMER W. JOHNSON E. E. 1915
2880 James Ave. S., Mpls.
Instructor, Eng. College, U. of M.

GEORGE RAY JONES E. E. 1915
3917 Thomas Ave. S., Mpls.
Industrial Electric Co.

ARTHUR LOUIS LAYDEN E. E. 1915
1306 Vista St., Hollywood, Calif.
Real Estate Broker.

KARL JOHN MERTZ
1753 Marshall Ave., St. Paul, Minn.
Elec. Engr., St. Paul Gas Light Co.

HERBERT WALTER MEYER
15 S. Fifth St., Mpls.
Statistical Engr., Northern States Power Co.

JOHN HOWARD PUTZ E. E. 1915
(Address unknown; information requested.)

BURTON ROBERTSON E. E. 1915
18 Barton Ave. S. E., Mpls.
Asst. Prof. M. E., Univ. of Minn.

CARL WM. SCHROEDER E. E. 1915
(Address unknown; information requested.)

EVERETT SPENCER TALLMADGE E. E. 1915
382 Robert St., St. Paul, Minn.
Pres. and Treas., Commonwealth Appliance Co.

HUGH BROWN WILCOX M. S. 1916
3400 E. Fiftieth St., Mpls.
Asst. Prof., College of Eng., U. of M.

HENRY S. LOEFFLER
1723 La Fond St., St. Paul, Minn.
Asst. Engr., Great Northern Ry.

*KARL FRED WUEST

1915

JOSEPH WILLIAM ANDERSON
420 Third Ave. S., Mpls.
Engr., N. W. Bell Tel. Co.

HENRY C. T. EGGERS E. E. 1916
2100 31st Ave. S., Mpls.
Inst., College of Eng., U. of M.

HARRY MERLE HJERMSTAD
(Address unknown; information requested.)

*ELTING W. HOUGHTALING

ROBERT A. JONES E. E. 1916
O. C. S. B. Bldg., Syracuse, N. Y.
Engr., Gen. Elec. Co.

SCOTT WALTER LAWRENCE E. E. 1916
Montevideo, Minn.

RICHARD E. LUTZ
335 Hampshire Arms, Mpls.
Civil Engr., R. D. Thomas Cons. Engr.

CLIFFORD EUGENE OLAISON E. E. 1916
1206 LaSalle Ave., Mpls.
Mgr., Radio Dept., Western Motor Supply Co.

RUTCHER SKAGERBERG E. E. 1916
11 South First, Chicago, Ill.
Sales Engr., American Paper Drying Systems & Heating Inc.

HARRY THOMAS THOMPSON E. E. 1916
162 Bedford St., Mpls.
Sales Engr., Wagner Elec. Mfg. Co., Cleveland, Ohio.

ROY HAZELTON TURNER E. E. 1916
2919 Como Ave., Mpls.
Engr., Woolery Machine Co.

HALSEY HAMMOND WILCOX
3610 Lincoln Blvd., Omaha, Neb.
Distr. Equip. Supervision, Western Union Teleg. Co.

1916

AMOS HERBERT ABBOTT E. E. 1917
1854 Grand Ave., St. Paul, Minn.
Supt. Gas Distribution, St. Paul Gas Light Co.

FRANK LAWRENCE ANDERSON
1416 N. Snelling Ave., St. Paul, Minn.
Engr., Maintenance & Constr., Anderson Co., Farm Implement Mfgr.

TIMOTHY GEORGE ARENSON
The Leamington, Mpls.

GEORGE WRIGHT BLEECKER
4944 Russell Ave. S., Mpls.
Estimating Engr., Sterling Elec. Co.

EVAR HARRY BLOMBERG E. E. 1917
Eagle Bend, Minn.
Evangelist.

LOUIS MARSTON BROWN
126 Ave. F., East Pittsburgh, Pa.
Switchboard Engr., Westinghouse Elec. Co.

(Electricals—Continued)

Fred Richard Burt
209 Colonial Apts., Hay and Rebecca Streets, Wilkinsburg, Pa.
Gen. Eng. Dept., Westinghouse Elec. & Mfg. Co.

Russell Irvin Butterworth E. E. 1917
118 E. Seventh St., Sedalia, Mo.
Gen. Engr., City Light & Traction Co.

Russell Oliver Covell
463 West St., New York City.
Tel. Engr., Western Elec. Co.

Daniel Robbins Croswell
Brainerd, Minn.

William Gould Dow E. E. 1917
707 Univ. Ave. S. E., Mpls.
Westinghouse Electric Co.

Philip Edelman E. E. 1917
9 Church St., New York City.

Selmer Ellefson
Huron, S. D.
N. W. Public Service Co.

Karl D. Fastenau
(Address unknown; information requested.)

Danforth K. Gannett E. E. 1917
195 Broadway, New York City.
Tel. Engr., A. T. & T. Co.

*Walter S. Garvey

George Albert Hult
718 W. 8th St., Sioux Falls, S. D.
Gen. Supt., Northern States Power Co.

Frank Harold Irwin E. E. 1917
4013 12th Ave., Mpls.
Estimator, Pierson-Wilcox Electrical Co.

Donald Palmer Love E. E. 1917
195 Broadway, New York City.
Engr., American Tel. & Tel. Co.

Carl Austin Russell
(Address unknown; information requested.)

Elton Albert Schulz
(Address unknown; information requested.)

Walter Wallenau Simons
158 N. Walnut St., E. Orange, N. J.
Sales Dept., Western Elec. Co., N. Y.

Hiram Tallmadge E. E. 1917
Grand Rapids, Mich.
Construction Engr., Mich. Constr. Co.

Ernest John Tebbe E. E. 1917
72 W. Adams St., Chicago, Ill.
Lighting Sales Engr., Public Service Co. of Northern Illinois.

Jesse Lysander Thompson E. E. 1917
1423 Pacific St., Bakersfield, Calif.
Insp. of Sub Stations, San Joaquin Light & Power Corp., Southern Div., Bakersfield, Cal.

Axel Albin Turnquist E. E. 1917
404 Washington St., North Hibbing, Minn.
Gen. Foreman, Transmission Dept., Minn. Power & Light Co., Hibbing, Minn.

Walter William Wentz E. E. 1914
3120 Bryant Ave. S., Mpls.
Inst., Elec. Dept., Dunwoody Inst.

1917

Nathaniel R. Mori
(Address unknown; information requested.)

Ward Edwin Becker
3715 R St. N. W., Washington, D. C.
1st Lieut., Ordenance Dept., U.S.A., Chief of Bomb Section, Ammunition Division, Manufacturing Service, Office of Chief of Ordnance, Washington, D. C.

Irvin Boyum
2303 Kennedy St. N. E., Mpls.
Switchboard and Service Dept., Westinghouse Elec. & Mfg. Co.

Chauncey Martin Carlson
1618 Charles St., St. Paul, Minn.
Elec. Distribution Engr., St. Paul Gas Light Co.

Lemuel James Dunlap
315 First Central Building, Madison, Wis.
Syndicate Sales Rep., Westinghouse Elec. Co.

Solomon Bernhard Ebert
New Haven, Conn.
1st Lieut., A. S., U. S. Army, Yale University.

Everett Erle Eckenbeck
108 N. State St., Chicago, Ill.
Whitacre-Gree Fire Proofing Co.

Arthur Ray Jacobs
604 Holly Ave., St. Paul, Minn.

Edwin Christian Juvrud
Rothsay, Minn.
Willys Farm Lighting Plants

Clarence Lilly
4226 First Ave. S., Mpls.
Engr. of Design, Minn. Highway Dept., St. Paul.

*Roy McKibben

Axel Ludwig Malmstrom
2000 Second Ave., Detroit, Mich.
Distribution Engr., Detroit Edison Co.

Einar Christopher Melby E. E. 1917
(Address unknown; information requested.)

Willard Warren Scott
(Address unknown; information requested.)

George Warren Swenson E. E. 1921
99 Bedford St., Mpls.
Inst., U of M., Elec. Engr. Bldg.

William Albert Thomas
1685 Ashland Ave., St. Paul, Minn.
Mech. Elec. Engr., Toltz, King & Day Inc.

Herbert Hughey Wheeler
195 Broadway, New York City.
Western Union Tel. Co., Eng. Dept.

Frederick John Williams
(Address unknown; information requested.)

Benjamin Sutton Willis
312 East St., Washington, D. C.
Asst. Physicist, Bureau of Standards.

1918

Harold Lee Brooke
2642 E. Grand Blvd., Detroit, Mich.
Sales Engr., The C. G. Spring Co.

Clayton Tupper Gibbs
912 Black Bldg., Los Angeles, Calif.
Consulting Engr., Holmes & Sanborn.

Henry Edward Hartig
Robbinsdale, Minn.
Inst., College of Engr., U. of M.

Fred Wesley Hotchkiss
1331 Tyler St. N. E., Mpls.
Sales Engr., Elec. Mach. Mfg. Co.

Jake Mose Levin
3043 2nd Ave. S., Mpls.
Levin Bros., Inc., Asst. Foreman.

Russell Harding Ross
Duluth, Minn.
Eng. Dept., Minn. Power & Light Co.

Hugo Schlenk, Jr.
616 Wisconsin St., Milwaukee, Wis.
Draftsman, U. S. Engineers.

Donald Smith
400 Oak Cliff Blvd., Dallas, Tex.
T. & P. Ry Bldg.

Hugh Adams Smith
1208 E. Jefferson St., Boise, Idaho.
Div. Engr., Idaho Power Co.

Thomas Franklin Talbot
2408 S. Figueroa St., Los Angeles, Calif.
Designing Engr., Southern Cal. Edison Co.

1919

Edgar William Christensen
612 N. 33rd St., Omaha, Neb.
Transmission Engr., N. W. Bell Tel. Co.

Ernest Harold Cotton
1688 Berkeley Ave., St. Paul, Minn.
Supt. of Stations, St. Paul Gas Light Co.

John Freeman Drinkall
Nela Park, Cleveland, Ohio.
Exp. Engr., National Lamp Works.

George Robertson Duncan
4111 Terrace St., Oakland, Cal.
Salesman, Gen. Elec. Co., San Francisco, Cal.

David Grimes
151 Bay St., Jersey City, N. Y.
Chief Engr., David Grimes, Inc.

Walter King Hartman
1931 Burnham Bldg.
Century Electric Co.

Robert Heinemann
405 Becker St., Schenectady, N. Y.
Designing Engr., Gen. Elec. Co.

Frank William Jordan
52 E. Broadway, Butte, Mont.
Sales Engr., Westinghouse Elec. & Mfg. Co.

Frederick Klass
4501 Grimes Ave., Mpls.
Salesman, Gen. Elec. Co., First Nat. Bank Bldg.

Harold Severin Langland
Grand Rapids, Mich.
Engr., Dr. Delos F. Wilcox.

Oscar Clarence Lee
1499 Hythe St., St. Paul, Minn.
Inst., Math. and Mech., College of Engr., U. of M.

Donald Eddy Marshall
8354 Burns Ave., Cincinnati, Ohio.
Supervisor of Mfg., Procter & Gamble Co.

Gustav Adolph Nelson
29th Ave. S. and Marshall St. N. E., Mpls.
Clerk, Northern States Power Co.

(Electricals—Continued)

RICHARD H. OLSON
6529 San Bonita Ave., St. Louis, Mo.
District Mgr., Elec. Mach. Mfg. Co., Ry. Exchange Bldg.

ALBERT EDWARD PETERSON
3417 W. Adams St., Apt. No. 2.
Asst. Boiler Room Engr., Commonwealth Edison Co., Fiske St. Station, Chicago, Ill.

ARTHUR PERRY PETERSON
15 W. 37th St., New York City.
Association of Electagists, Room 602.

ALFRED CARL PETRICH
San Diego, Calif.

JOE WILLARD PIERSON
1165 S. Oak Park Ave., Oak Park, Ill.
Asst. Engr., Boiler Room, Commonwealth Edison Co., Quarry St. Station, Chicago, Ill.

CHARLES HUBERT REEVE
Instructor, Hibbing High School and 2109 10th Ave., Hibbing, Minn. Junior College.

THEODORE SANDER, JR.
459 Fuller Ave., St. Paul, Minn.
Student, Harvard Graduate School of Business Administration.

EDWIN WALTER SWANSON
Hopkins No. 3, Minn.
Control Engr., Elec. Mach. & Mfg. Co.

1920

IRVING ELSWORTH ASKE
3161 Hiawatha Ave., Mpls.

RUBEN BERNARD BAUER
1312 Leland Ave., Chicago, Ill.
Engr., Western Elec. Co.

VICTOR HARRY CARLSON
Tocopilla, Chile, S. A., via Antofagasta.
Junior Elec. Engr., Chile Exploration Co.

CHARLES DEROY ELLSWORTH
St. Louis, Mo.
Sales Engr., Century Electric Co.

VICTOR EMANUEL ENGQUIST
931 Clark St., St. Paul, Minn.
Engr., St. Paul Gas Co.

HAROLD ROY GOSS
125 W. 2nd St., Mansfield, Ohio.
The Ideal Elec. & Mfg. Co.

ARTHUR WILLIAM GROTH
331 North Grove Ave., Oak Park, Ill.
Circuit Engr., Western Elec. Co.

GATES ENSIGN HUNT
50 Church St., New York City.
Sales Engr., Cutler Hammer Mfg. Co.

WILLIAM HENRY J. JANZEN
Avery, Idaho.
Foreman, C. M. & St. P. R. R.

HAROLD ARNESON JULES
2011 Farmers Bank Bldg., Pittsburgh, Pa.
Sales Engr., Cutler-Hammer Mfg. Co.

NORMAN WILLARD KINGSLEY
2734 Bauman St., Omaha, Neb.
N. W. Bell Telephone Co.

EVERETT HOWLAND KNOWLES
Chuquicamata, Chile, S. A., via Antofagasta.
Jr. Elec. Engr., Chile Exploration Co.

ORLIN OSCAR KRUSE
122 S. Michigan Ave., Chicago, Ill.
Industrial Sales Engr., Peoples Gas Light & Coke Co.

WALTER JOHN LARSON
1816 E. 45th St., Cleveland, Ohio.
Quality Engr., Mazda Lamp Div., Gen. Elec. Co.

WALTER JULIUS LEE
14926 Terrace Road, East Cleveland, Ohio.

RAYMOND ALBERT LOCKWOOD
1567 Osceola Ave., St. Paul, Minn.
St. Paul Ass'n., 4th and Cedar.

LEONARD FRANCIS MCKENZIE
1542 W. 16th St. Los Angeles, Cal.
Draftsman, So. Cal. Edison Co.

ALBERT FERDINAND MAYER
191 Hamline Ave. N., St. Paul, Minn.
T. E. Olen Co.

GEORGE WALLACE MILLER
2145 Palace St., St. Paul, Minn.
Supervising Engr., Commonwealth Elec. Co.

ALEXANDER CUTHBERTSON MITCHELL
195 Broadway, New York City.
Am. Tel. & Tel. Co.

NELS SVERDRUP MOLSKNESS
2954 Bryant Ave. N., Mpls.

CLARENCE LEONARD NELSON
535 Ashland Ave., St. Paul, Minn.
Valuation Engr., St. Paul Gas & Light Co.

CLAY WRIGHT NOEL
Sherman Apts., Mansfield, Ohio.
E. Engr., The Ideal Elec. & Mfg. Co.

PETER IRVIN PETERSON
315 Ninth St., Willmar, Minn.
Jr. Member, P. C. Peterson & Sons.

RICHARD MILTON PETERSON
76 W. 3rd St., St. Paul, Minn.
Northern States Power Co.

VANCE CLIFFORD PETERSON
3493 Brookline Ave., Cincinnati, Ohio.
Engr., Proctor & Gamble Co.

CLARENCE RUSSELL PRICE
134 Jefferson St., Milwaukee, Wis.
Sales Engr., Century Elec. Co.

CHESTER WILLIAM SIEGMANN
2651 13th Ave. S., Mpls.

RUSSELL ADOLPH STROTHMAN
195 Broadway, New York City.
Amer. Tel. & Tel. Co.

RALPH HAMILTON TRIEM
Ottumwa, Iowa.
New Bus. Mgr., Northern States Power Co.

RUSSELL ELMER WESTBERG
1312 2nd Ave., Seattle, Wash.
Asst. Engr., Westberg & Childs, Inc.

RALPH EMERSON WALDRON
Marshfield, Oregon.
Coos Veneer & Box Co., Elec. Maintenance.

1921

EDWARD SIGFRID ANDERSON
International Falls, Minn.
Elec. Construction Engr., Minnesota & Ontario Paper Co.

DEAN M. BARNES
640 Tenth St., San Bernardino, Cal.
Wire Chief, Associated Telephone Co.

ALBERT E. BEARDMORE
6 Rugby Road, Schenectady, N. Y.
Designing Engr., Induction Motor Dept., Gen. Elec. Co.

SAMUEL ARNOLD BERG
55 Hanson Place, Brooklyn, N. Y.
Westinghouse Elec. Co., East Pittsburgh, Pa.

LAUREN GILBERT COLSON
845 Lakeside Place, Chicago, Ill.
Jr. Engr., Commonwealth Edison Co.

ROBERT E. DONAHOE
Little Falls, Minn.
Division Engr., Minnesota Power & Light Co., Cuyuna Division.

ALECK ADELORD HAMMERSTROM
3717 Rendle Ave., Duluth, Minn.
N. W. Bell Tel. Co.

LAURENCE WILLIAM HAYWARD
1140 W. 6th St., Cleveland, Ohio.
Benjamin Eng. Co.

SANDER HOUGAN
1304 Seventh Ave. N., Great Falls, Mont.

EDGAR FREDERICK JOHNSON
502 Wood St., Waseca, Minn.
Member of firm, Elec. Construction Co.

CHARLES KINSELL JOHNSTON
2100 Lyndale, Minneapolis.
Kinsell Auto Sales.

LUDVIG CONRAD LARSON
225 Clifford Court, Madison, Wis.
Instr., Dept. of E. E., Univ. of Wis.

PERCIVAL ELLIOT LOYE
406 Cowper St., Palo Alto, Cal.
Const. Engr., Pacific Gas & Elec. Co., San Francisco.

LLOYD S. MCKIBBEN
131 S. Seventh, Mpls.
Langford Elec. Co., Estimator and Job Supt.

NORMAN STUART MCVEAN
30 Oliver St., Boston, Mass.
New Eng. Tel. & Tel. Co.

BASIL CLAIRE MAINE
38 Glenwood Blvd., Schenectady, N. Y. Gen. Elec. Co.

EMANUEL CARL MANDERFELD
364 West St., New York City.
Bell Tel. Lab., Inc.

ELMER JOHN MANGNEY
15 S. 5th St., Mpls.
Salesman, Northern States Power Co.

ANDREW LINCOLN MILLER
Boston U., School of Theology, Boston, Mass.
Instructor in Elec. Eng.

ROY ARCHIBALD PALMER
15808 Euclid Ave., Cleveland, Ohio.
Editor, Technical Publications, National Lamp Works of G. E. Co.

HAROLD WALDEMAR PETERSON
(Address unknown; information requested.)

JOHN PODOSIN
533 Park Ave., Omaha, Neb.
Night Supervisor, N. W. Bell Tel. Co.

ROY HERBERT SATORI
Schenectady, N. Y.
Engr., Testing Dept., Gen. Elec. Co.

GABE SHOIRMAN
910 Minnesota Ave., Bemidji, Minn.
Minnesota Elec. & Power Co.

(Electricals—Continued)

GODFREY STANIUS
Newton, Iowa.
Machine Designer, Parsons Co.

RAY RENNINGTON SWEET
1234 Nicollet Hotel, Mpls.
WCCO, Gold Medal Station.

HUGO WILLIAM WAHLQUIST
809 Lincoln Bank Bldg., Mpls.
Northern States Power Co.

GEORGE WESSALE
Waconia, Minn.
Asst. Supt., Sorghum Mills.

P. RAYMOND WILSON
Room 1319, Telephone Bldg., Omaha, Neb.
Engr., N. W. Bell Tel. Co.

JOSEPH FELIX SANNICOLO
Virginia, Minn.
Asst. to Civil Engr.

PAUL D. AUSTIN
15 S. 5th St., Mpls.
Northern States Power Co.

HAROLD L. BARGER
420 N. 5th St., Minneapolis.
Elec. Engr., Ford Motor Co.

WILLIAM G. BRIGGS
1318 Wildwood Ave., Jackson, Mich.
Elec. Eng. Dept. of the Commonwealth Power Corp.

RICHARD L. NELSON
(Address unknown; information requested.)

C. PHILLIP CARLSON
Chuquicamata, Chile, S. A.

CHARLES W. PEARSON
1814 Diamond St., Philadelphia, Pa.
Constr. Foreman, Gen. Elec. Co.

1922

DAVID AULTFATHER
Chicago, Ill.
Equipment Engr., Western Elec. Co.

MARLOW BERGSTROM
921 Security Bldg., Minneapolis.
Sales Engr., J. E. Sumpter Co.

BERTIN BISBEE
Austin, Minn.

EARL BJONERUD
725 O'Farrell St., San Francisco, Cal. Sales Agent, Gen. Elec. Co.

GERALD BOCKUS
825 4th Ave. S., Minneapolis.
Wholesale Grocery.

W. C. BOSSHARDT
473 Cleveland Ave., St. Paul, Minn.
Fosston Manuf. Co.

RICHARD CARLSON
1634 S. 48th Court, Cicero, Ill.
Production Course, Western Elec. Co., Chicago, Ill.

GILBERT COOLEY
401 Herschel Ave., St. Paul, Minn.
Northern States Power Co.

HJALMER DAHL
585 Celeron St., Wilkinsburg, Pa.
Graduate Student, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

HENRY DROST
(Address unknown; information requested.)

JOHN DOWNIE
Edison Club, Schenectady, N. Y.
Gen. Elec. Co.

ORNEY DUNNUM
1783 E. 11th St., Cleveland, O.
Wallene Engineering Co.

I. M. ELLESTAD
509 Beacon St. S. E., Mpls. Maintenance Dept., N. W. Bell Tel. Co.

ARNE ENGER
2106 Dupont Ave. N., Minneapolis.

H. C. FISKE
921 Security Bldg., Minneapolis.
Elec. Engr., J. E. Sumpter Co.

H. C. FORBES
25 S. Tyson Ave., Floral Park, L. I., N. Y. Colonial Radio Corp.

ROY J. HEIDELBERGER
Wheaton, Minn.

LAWRENCE HAGELIN
1401 Russell Ave. N., Minneapolis.

A. B. HENDRICKSON
1126 Pacific Finance Bldg., Los Angeles, Cal. Petroleum Engr., Cal. Bureau of Mines.

JOHN E. KING
5341 W. 22nd St., Cicero, Ill.
Equipment Engr., Western Elec. Co., Hawthorne Station, Chicago, Ill.

C. H. LINHOFF
242 Union St., Schenectady, N. Y.
Gen. Elec. Co.

JOHN McEACHIN
725 E. 7th St., Duluth, Minn. Division Engr., Minn. Power & Light Co.

JOHN E. MAGNUSON
720 W. 3rd St., Duluth, Minn.
Relief Foreman, Minnesota Power & Light Co.

CLARENCE MENTZER
4735 Colfax Ave., Mpls. Engr. Dept., Stockland Road Mach. Co.

ALVA MERRITT
Robbinsdale, Minn. Farmer.

NATHANIEL MINTZ
1419 Cedar St., Milwaukee, Wis.
Production Engr., Cutler-Hammer Mfg. Co.

BERGER NORDLIEN
314 Biddle Ave., Wilkinsburg, Pa.
Tester Westinghouse Elec. & Mfg. Co., East Pittsburg, Pa.

WALTER NIELSEN
214 Walnut St. S. E., Mpls., Minn.
Teaching Fellow, Physics Dept., U. of M.

ARNIM OLSON
114 N. Oak Park Ave., Oak Park, Ill. Field Engr., Public Service Co.

G. L. PANGBURN
4 N. Lavergne Ave., Chicago, Ill.
Equipment Engr., Western Elec. Co.
Hawthorne Station.

H. C. PLANK
Summit Hospital, Oconomowoc, Wis.
Supt., Mechanical Dept.

G. B. RANSOM
311 W. Washington St., Chicago, Ill.
Engr., American Tel. & Tel. Co.

R. C. ROME
1101 Telephone Bldg., Omaha, Neb.
Traffic Engr., N. W. Bell Tel. Co.

A. E. ROOD
202 Milwaukee St., Whitewater, Wis. Substation Operator, Wisconsin Gas & Light Co.

KARL SELANDER
212 W. Washington St., Chicago, Ill.
Engr., Ill. Bell Tel. Co.

JOHN SORENSON
722 13th Ave. S. E., Mpls., Minn.

R. A. STEFFENS
327 Pitt St., Wilkinsburg, Pa.
Student Grad. Course, Westinghouse Elec. Co., East Pittsburgh, Pa.

MERLE A. TUVE
Homewood Dormitory, John Hopkins University, Baltimore.
Instructor in Physics.

MARTIN P. WICHMAN
420 3rd Ave. S., Mpls., Minn. Division Interference Engr., N. W. Bell Tel. Co.

ARTHUR C. WILLARD
701 Duquesne Bldg., Pittsburgh, Pa.
Technical Asst., Substation, Duquesne Light Co.

PERCY H. WILLIAMS
423 3rd Ave. S., Mpls., Minn.
Engr., Am. Tel. & Tel. Co.

A. W. WILSON
Devils Lake, N. D. Mgr., Ramsey County Implement Co.

1923

VERNON MATHIAS BABCOCK
506 Hofman Bldg., Detroit, Mich.
Sales Engr., Cutler-Hammer Mfg. Co.

OTTO THEODORE BOUQUET
619 11th Ave. S. E., Mpls., Minn.
Salesman, North'n States Power Co.

RENE A. BRADEN
3620 Iron St., Chicago, Ill. Research Engr., Chicago Radio Laboratory.

LOUIS T. BUMGARDNER
312 Hackney Bldg., St. Paul, Minn.
Partner L. A. Bumgardner Co., Railroad Contractors.

CHARLES MARTIN BURRILL
Pittsfield, Mass. Transformer Engr. Dept., Gen. Elec. Co.

GERALD FOSTEN CASE
Chisholm, Minn.
Oliver Mining Company.

ELMER W. CLAUSEN
Chicago, Ill.
Commonwealth Edison Co.

RALPH BURTON DUNNAVAN
1283 Osceola Ave., St. Paul, Minn.
Engr., St. Paul Gas Light Co.

DANIEL HENRY ELWOOD
Decatur, Ill.

ELMER WILLIAM ENGSTROM
1 Willow Ave., Schenectady, N. Y.
General Elec. Co., Schenectady, Radio Eng. Dept.

GEORGE WESLEY FAIRBANKS
144 Chippewa St., Eau Claire, Wis.
Northern States Power Co.

WAYNE IRVIN FEENEY
1103 Fifth St. S. E., Mpls., Minn.
Legal Valuation Dept., G. N. Ry., St. Paul.

HAROLD WOUTAT FISCHER
4210 Dupont Ave. N., Mpls., Minn.
Plant Dept., N. W. Bell Tel. Co.

EDWIN AUGUST FRIEDMAN
315 Garfield St., Hibbing, Minn.
Construction Foreman, Oliver Iron Mining Co.

MAURICE G. GOLDBERG
711 Dayton Ave., St. Paul, Minn.
Owner, Beacon Radio Service.

LEROY ATWOOD GRETTUM
561 W. Fifth St., Winona, Minn.
Elec. Engr., Wis. Ry. Lt. & Power Co.

(*Electricals—Continued*)

Robert Avery Hargarves
1820 Woodland Ave., Duluth, Minn.
Minnesota Power & Light Co.

Harvey C. Hawkins
623 26th Ave. N., Mpls., Minn.
Switchboardman, N.W. Bell Tel. Co.

Otto Heidelberger
1331 N. E. Tyler, Mpls., Minn.
Engr., Electrical Machinery Co.

William F. Helwig
4308 W. 22nd St., Chicago, Ill.
Student Engr., Western Elec. Co.

Gustaf Adolph Johnson
806 6th St. S. E., Mpls., Minn.
Transmission Engr., N. W. Bell Tel. Co.

James Percy Johnson
3220 Poppleton Ave., Omaha, Neb.
Asst. to Com'l Survey Engr., N. W. Bell Tel. Co.

Walter Frederick Kannenberg
230 Thomas, St. Paul, Minn.
Engr., N. W. Bell Tel. Co., Mpls.

Adrian Albert Kearney
340 Seventh Ave. S., St. Cloud, Minn.
Sales Engr., St. Cloud Public Service Co.

Karl L. Koch
650 St. Peter St., St. Paul, Minn.

Horace Henderson Lambie
52 Forest Ave., River Forest, Ill.
Ill. Bell Tel. Co.

Carl W. Lauritzen
3136 Minnehaha Ave., Mpls., Minn.

Henry Lieberman
407 W. Central Ave., St. Paul, Minn.
Tri-State Tel. & Tel. Co.

John V. Lundquist
North Hibbing, Minn.

Robert Thomas McCullough
119 Fourth Ave., Bay Shore, N. Y.
Field Engr., Long Island Lighting Co.

Ralph Harold Meserve
Y. M. C. A., St. Paul, Minn.
Engr., St. Paul Gas Light Co.

Gerardo Moreno
P. O. 234, Manila, P. I.

Russell Orvin Nash
2024 30th Ave. S., Mpls., Minn.
Deerlodge, Mont., C. M. & St. P. R. R.

John Milton Newman
651 Astor St, Milwaukee, Wis.
Cutler-Hammer Mfg. Co., Engr. Dept.

Glen W. Nordvall
420 3rd Ave. S., Mpls., Minn.
Engr., N. W. Bell Tel. Co.

Henry A. Olin
328 N. 60th Ave. W., Duluth, Minn.
Wireman, Minn. Steel Co.

Roy H. Olson
533 Met. Bank Bldg., Mpls., Minn.
Patent Office, Bradbury & Caswell.

Harold A. Pause
599 Fuller Ave., St. Paul, Minn.
Tri-State Tel. & Tel. Co.

Richard Fillmore Pulver
Y. M. C. A., Duluth, Minn.
Power Sales Engr.

Harvey C. Rath
2304 Hoagland Ave., Fort Wayne, Ind. Transformer Engr., General Electric Co.

Howard E. Reeve
802 Locust St., Des Moines, Ia.
Engr. Electric Light Co.

Winfred W. Russel
4518 No. Racine Ave., Chicago, Ill.
Transmission Tester.

Robert Marcus Ryan
Northern States Power Co., Mpls., Minn. Engr. Dept.

Clifford L. Sampson
Minneapolis, Minn.
Teaching Fellow, Univ. of Minn.

George Jesse Schottler
U. S. Patent Office, Washington, D. C. Examiner, U. S. Patent Office.

Clifford Charles Schweiso
Care of Northern States Power Co.

Herbert Leslie Scott
Mpls., Minn. Exchange Engr., N. W. Bell Tel. Co.

Edwin Charles Sickel
St. Paul Gas Light Co.
Engr. Dept.

George Earl Swift
Electric Machine Mfg. Co.
Test Course.

Alfred Mayhew Shuey Trask
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. Railway Contract Section.

Donald E. Thorne
Western Union Tel. Co.
Eng. Apprentice.

Alvin C. Ward
Western Electric Co., Chicago, Ill.
Equipment Engr.

Walton Wellisch
South Park Foundry & Mach. Co.
Secretary.

John Booth Wiggins
Western Electric Co.
Equip. Eng. Branch. Cicero, Ill.

Roy Neill Williams
Gen. Elec. Co., Mpls., Minn.
Sales Agent.

David Charles Wills
Western Electric Co. Equip. Engr.

Frank Winfield Wilson
Gen. Elec. Co., 230 So. Clark St., Chicago, Ill. Construction Foreman.

Clarence R. Zimmerschied
Electric Mach. Co., Mpls., Minn.
Eng. Dept.

1924

Emil G. Anderson
Standard Electric Service Co.
240 Plymouth Bldg.

Fayette C. Anderson
Edison Club., Schenectady, N. Y.

Matthew A. Anderson
3416 3rd Ave. S., Mpls., Minn.

Frank C. Appleman
Illinois Bell Tel. Co., 212 W. Washington St., Chicago, Ill. Student Eng.

Leonard O. Arstad
N. W. Bell Tel. Co., Mpls., Minn.

Warren E. Carlson
1929 Elliot Ave. S., Mpls., Minn.

Hoyt R. Cass
Ft. Wayne, Ind. Gen. Elec. Co.

Walter J. Cassidy
Eyota, Minn.

Harold W. Dahl
Elec. Mach. Co.
1110 St. S. E., Minneapolis, Minn.

Morton J. Diment
2021 15th Ave. S., Mpls., Minn.

George Martin Dunlap
Independence, Ia.

Curtis R. Eckberg
Winthrop, Minn.

Leonard M. Frazee
Schenectady, N. Y. Gen. Elec. Co

J. Roscoe Furber
15 South 5th St., Mpls., Minn.
Northern States Power Co.

Ira B. Garthus
Northern States Power Co., Mpls.

Alfred B. Greene
Glenn Lake Sanitarium.

Chauncey L. Green
Princess Theatre, Minneapolis.
Projectionist.

Walter A. Geettum
987 18th Ave. S. E., Mpls., Minn.

Russel A. Harrington
C. M. & St. P. R. R.

Henry W. Hecht
Gaylord, Minn.

Reuben Heggen
36 W. 14th St., Chicago Heights, Ill.

John I. Holbeck
30 So. Superior St., Duluth, Minn.
Minnesota Power and Light Co.

Gislie E. Huseby
Hawthorne State, Chicago, Ill.
Western Electric Co.

Frank H. Jacobson
1090 10th Ave. S. E., Mpls., Minn.

Ivar W. Johnson
Schenectady, N. Y.
Testing Dept., Gen. Elec. Co.

Joseph Juran
Hawthorne Station, Chicago, Ill.
Western Electric Co.

Frederick R. Kapple
420 3rd Ave. S., Mpls., Minn.
N. W. Bell Tel. Co.

Jozef J. Kater
Schenectady, N. Y.
Gen. Elec., Testman

Frank William Kline
N. S. P. Co., Mpls., Minn.

Fred E. Krause
Waconia, Minn.

Murray Lampher
Power Sales Dept. Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

Carl W. Lauritzen
3136 Minnehaha Ave., Mpls., Minn.

John G. Lewis
Alexandria, Minn.

LeRoy C. Little
LeSueur, Minn.

Torarin E. Lobeck
800 5th St. S. E., Mpls., Minn.

Leonard E. J. Mabbott
Northern States Power Co.
Sales Department

Hilding O. Magney
Northern States Power Co.
Sales Department.

Harold C. Marcoft
Northern Utilities Co.
Asst. System Operator

Irving H. Marshman
Asst. Patent Att., General Electric Co., 1 Willow Av., Schenectady, N.Y.

Richard F. Mathes
Minneapolis, Minn.
Radio Corp. of America

Joseph S. Mayer
St. Paul Gas & Electric Co., St. Paul. Engr.

(*Electricals—Continued*)

Edmond S. McConnell
C. M. & St. P. Ry., Tacoma Shops, Tacoma, Wash. Special Apprentice.

Fraser A. McGregor
1125 5th St. S. E., Mpls, Minn.

Lyle K. McLeland
2016 Aldrich Ave. S., Mpls., Minn.

Archibald T. Miller
Int. Paper Co., Glens Falls, N. Y. Bureau of Tests.

William J. Miller
Page, N. D.

Manley A. B. Monsen
2719 8th St. S., Mpls., Minn.

Ingwald T. Monseth
Westinghouse Elec. & Mfg. Co., East Pittsburg, Pa. Eng. Dept.

Lysle W. Morton
Gen. Elec. Co., Schenectady, N. Y. Testing Department.

Harold E. Nee
Rothschild, Wis.
Marathon Paper Mills Co.

Edgar M. Nelson
407 Clark St., Mankato, Minn.

Lloyd L. Pelley
Northern States Power Co., Mpls., Minn. Sales Engr.

Theodore F. Schilling
725 7th St. S. E., Mpls., Minn.

Garfield G. Schow
Wells, Minn.

Harvey Z. Sheekman
184 Saratoga Ave. N., Mpls., Minn.

Charles T. Skarolid
415 Kindred St. N. E., Brainerd, Minn.

Henry W. Strege
Bellingham, Minn.

Donald C. Swift
St. Paul Gas & Light Co., St. Paul.

George C. Taplin
1201 5th St. S. E., Mpls., Minn.

Clarence W. Teal
345 McKnight Bldg., Mpls., Minn. Engineering Appraisal Co.

Benjamin C. Trcka
306 Lincoln Bank Bldg.

Robert H. Tunell
Bell Telephone Laboratories. Circuit Laboratory Engr.

James A. Tyvand
Barton, N. D.

Arnold A. Waligoski
Western Electric Co., Chicago, Ill. Equipment Engr.

Lawrence C. Warren
G. E. Test. Edison Club, Schenectady, N. Y.

Hanard P. Weber
1515 W. Monroe St., Chicago, Ill.

General Engineering

1918

Harold Robert Peterson
N. P. Ry., Granite, Ida.
Bridge Inspector.

George William Putman
State Board of Health, Jefferson City, Mo. State Sanitary.

1919

Hiram Kenneth Briggs
3800 5th St. N. E., Mpls., Minn.
Metallurgist.

Harry James Gee
923 Lumber Exchange, Mpls., Minn.
Acct. J. K. Roylan & Co.

Ernest Harvey Kapphahn
Wells Engineering Co., Geneva, Ill. Resident Eng.

Herbert Andrew Kroeze
Mississippi State Board of Health Jackson, Miss. Eng.

Carroll Eugene Lewis
Address unknown.

Eugene Lilly
312 Endicott Bldg., St. Paul, Minn
Northern States Contracting Co.

1920

Olav Madsen
Address unknown.

Theodore Leif Vallacher
Ralph D. Thomas, Mpls., Minn.
Field Draftsman.

Lawrence Theodore Wyly
N. P. Ry., St. Paul, Minn.
Structure Draftsman.

Philip Henry Dibriksen
St. Louis, Mo. Scullin Steel Co.

Edmond Constantine Hanrahan
628 2nd Ave. N. W., Faribault, Minn. Asst. City Eng.

Clarence F. Moore
1701 Broadway N. E., Mpls., Minn
Berger Mfg. Co.

Gustav A. Swenson
2842 31st Ave. S., Mpls., Minn.

Nathan Harris
Dakota Co. Highway Dept. Hastings, Minn. Draftsman.

1921

Edward Hayford Adams
401 Essex Bldg., Mpls., Minn
E. H. Adams Constr. Co.

Harry John Beeman
1246 University Av., St. Paul, Minn. State Highway Dept. Insp. of Pavements.

Richard Paul Carlton
791 Forest St., St. Paul, Minn.
Eng. Minn. Mining & Mfg. Co.

Clifford Cecil Cowin
Spokane, Wash.
Western Lumber Products, Inc.

Lyle Alger Dills
Minnesota Highway Dept., St. Paul, Minn. Structural Steel Inspector.

Howard Carey Jacobson
1090 10th Ave. S. E., Mpls., Minn. Manager.

Kenneth A. Godwin
Address unknown.

Ralph Wesley Liddle
Commonwealth Edison Co., 1827 Edison Bldg., Chicago, Ill. Editor "Edison Round Table."

Glenn Dwight McMeekin
72 A. Adams, Chicago, Ill. Engineer Public Service Co. of Northern Ill.

Curtis Richard Martin
Waconia, Minn. Supt. of Public Schools.

John Frithiof Noble
Noble Realty Co., Mpls., Minn. Member of Firm.

Roy Oliver Papenthoen
Merrill Bldg., Milwaukee, Wis. Architect.

Milton Duncan McLean
Yale Divinity Hall, New Haven, Conn. Graduate Student.

Joseph E. Young
St. Paul, Minn.
City Architect Office.

1922

Harry E. Brown
LeRoy, Minn.

Donald Walker Capstick
American Blower Co., Mpls., Minn. Sales Engineer.

William O. Forssell
Brooks Bros., Inc., St. Paul, Minn. Yard Man.

Rudolph Ernest Meili, Jr.
Cedar Lake Shops, Mpls., Minn. Mech. Dept., M. & St. L. R. R. Co.

Mechanical Engineering

1878

Charles Spencer Bushnell
Shell Oil Co., Seattle, Wash.
Constr. Eng.

1883

John Henry Barr M. E. '88
Barr Morse Corp., Ithaca, N. Y.
Consulting Eng.

1885

Elbert Ellsworth Bushnell
Los Angeles, Cal.
Mfg. Typewriter Supplies.

1887

George Cutler Andrew:
2529 University Ave. S. E., Mpls., Minn. President.

1888

Eric Haldorson Loe
Odin Club, Mpls., Minn.

John E. Morris M. E. '09
817 McKnight Bldg., Mpls., Minn. Sec. and Treas.

1890

Martin H. Gerry, Jr. B. E. E. '91
Leamington Hotel, Mpls., Minn.

Thorwald Eid Nelson
720 Phoenix Bldg., Mpls., Minn. Real Estate.

Herbert Milton Woodward
Mechanic Arts Sch., Boston, Mass. Teacher of Math.

1891

Baxter Martin Aslakson
342 Monadnock Bldg., Chicago, Ill. Cons. Eng.

(*Mechanicals—Continued*)

1892

RALPH POTTER FELTON
635 Temple Court, Mpls., Minn. Constr. Work.

JAMES HERBERT GILL M. E. '94
Eng. Coll. of West Va.
Prof. of Machine Construction.

1893

HENRY BRINCKERHOFF AVERY M. E. '98
511 Globe Bldg., Mpls., Minn.
Salesman and Apple Grower.

GEORGE B. COUPER
Standard Appraisal Co., Portland, Ore. Office Eng.

1894

*GEORGE EBEN BRAY M. E. '04

1895

BURCHARD POST SHEPARD
609 Morgan Bldg., Broadway and Wash., Portland, Ore. Osteopath.

*WILLIAM MAGNUS TOLDERQUIST

ALBERT C. WEAVER
Address unknown.

1896

CLIVE HASTINGS
The Railway Specialty Co., Atchison, Kan. President.

CHARLES DUTTON HILFERTY
E. 42nd St. 17, New York City.

*VICTOR HUGO

JAMES SHERBURNE LAND E. E. '97, M. E. '99
5 Park Square, Boston, Mass.
J. S. Lang Eng. Co.

1897

ROBERT PENNELL BLAKE
N. P. Ry., Livingston, Mont.
Div. Master Mech., Mont. Div.

ROBERT CRAIG
907 Schwind Bldg., Dayton, O.
Engineer.

ROLAND E. CROSS
581 Portland Ave., Mpls., Minn.

JAMES HENRY LONIE
Western Electric Co., Chicago, Ill.

EDWARD SNOAD SAVAGE
Shinola Co., Rochester, N. Y.
Mechanical Engineer.

HENRI DICKINSON SILLIMAN
Seattle, Wash. City Eng. Office.

1898

JOHN ERWIN O'BRIEN
Seaboard Air Line Ry., Norfolk, Va
Mgr., Mechanical Dept.

MANTON FLETCHER WILLSON
Address unknown.

ROYDON VINCENT WRIGHT
Simmons-Boardman Pub. Co., New York City. Secretary.

FRANK ZELENY
C. B. & Q. R. R., Aurora, Ill.
Engineer of Tests.

1899

HARRY CORNELIUS BAYLESS
330 S. Dearborn St., Chicago, Ill.
Western Mgr., Bus. Training Corp.

WILBUR PERCY RICHARDSON
P. & L. E. Ry., Pittsburgh, Pa.

ELIAS CARL WENNERLUND
Address unknown.

1900

DANIEL THOMAS LESTER
East Pittsburgh, Pa., Box 793.

CHARLES CAMPBELL HIGGINS
Address unknown.

WILLIAM WOOD JOHNSTON
Address unknown.

WILLIAM BARRETT NEWHALL
Instr., Edison High School.

LEWIS E. ASHBAUGH
296 Broadway, New York City.
Civil Eng., Cons. Practice.

1901

CHARLES EDWARD TULLAR
Gen. Elec. Co., Shenectady, N. Y.
Patent Attorney.

ELIEL F. WILSON E. E. '02
Address unknown.

1902

WILLIAM EDWARD ACOMB
American Steel & Wire Co., Waukegan, Ill. Supt.

WILLIAM LLOYD BEAN
N. Y. N. H. & H. R. R. Co., New Haven, Conn. Mech. Asst. to Pres.

ROBERTSON COOK
Portland Gas & Coke Co., Portland, Ore. Service Eng.

WILLIAM ELWOOD GRIMSHAW
1014 Securities Bldg., Seattle, Wash.
Real Estate.

CARL ALBERT HERRICK
U. of Minn Asst. Prof. of Math.

EDWARD CARL RAMSTAD
Address unknown.

MELVIN OSCAR STONE
Address unknown.

EDWARD LAWRENCE SUDHEIMER
1006 Guardian Life Bldg., St. Paul, Minn. President.

RALPH GEORGE TAYLOR
Address unknown.

1903

FRANK CHARLES HUGHES
2053 Jackson Blvd., Chicago, Ill.
President.

INGRAHAM G. KJOSNESS
825 Main St., Lewiston, Idaho.
Vice-President and Treasurer.

EDWARD HALE WILLIAMS
S. G. Flagg Mfg. Co., Stoew, Minn.
Cons. Eng.

1904

SIMON RUDOLPH FAGER
13 East 36th St., Mpls., Minn.
Western Heating Co.

ROBERT WALTER OTTO
Andrews Heating Co., Mpls., Minn.
Treasurer.

RAYMOND EDWARD STANTON
615 Ryan Bldg., St. Paul, Minn.
R. E. Stanton Equipment Co.

GILBERT N. DAVIS
Dispatch & Pioneer Press, St. Paul, Minn. Pressman.

1905

GEORGE L. ANDREWS
R. F. D. 2, Canterburg Road, Euclid, Ohio.

ALBERT HENRY BATES
Emerson Brantingham Co., Mpls., Minn. Works Mgr.

CARROLL DALE CLIPFELL
Redwood Falls, Minn. Farmer.

FRANCIS CHARLES COTTER
Lima Locomotive Works, Inc., Lima, O. Asst. to Vice-President.

HARRY ELDON GERRISH
800-6 La Salle Ave., Mpls., Minn.
President.

SIGMUND HARRIS
1025 Washington Ave. S. E., Mpls., Minn. President.

AUSTIN G. JOHNSON
D. & I. Range R. R. Co., Two Harbors, Minn. Mech. Eng.

*ERNEST PRESCOTT JOHNSON

EDWARD B. LEWIS
619 Washington Ave. So., Mpls., Minn. Engineer.

ALEXANDER PANCRATZ
Fairbanks, Morse & Co., St. Paul, Minn.

FRANCIS G. A. RYDEEN
Knob Lick, Mo. General Store.

LEONARD BOYD SPERRY E. E. '08
606 S. Michigan Ave., Chicago, Ill.
Chief Engineer.

GEORGE ALBERT TUCK
557-567 4th St., San Francisco, Cal.
President.

1906

THOMAS STANLEY ARMSTRONG
1416 2nd Ave. N., Great Falls, Mont.

WALLACE T. CRAWFORD
Faribault, Minn.
Garage and Welding Shop.

GABRIEL EVERETT GARBER
4201 Colfax Ave. S., Mpls., Minn.
Broker, Specializing in Iron and Steel Scrap.

BENJAMIN WHIPPLE LOVE
4647 Wesson Ave., Detroit, Mich.
Supt., Detroit Insulated Wire Co.

FRANK ELMER MATTESON
410 E. Sycamore Ave., Eagle Rock City, Calif.

ARTHUR CHRISTIAN RINGSRED
Clyde Iron Works, Duluth, Minn.
Eng. Dept.

NORMAN W. ROSE
Minn. Steel Co., New Duluth, Minn.

1907

MAURICE DWIGHT BELL
Washburn-Crosby Co., Mpls., Minn.
"A" Mill Office.

OSCAR BERNARD BJORGE
555 Thurman St., Portland, Ore.
Treas. and Chief Eng.

*OLIVER LINDLEY BROWN

PAUL S. BUHL
244 Madison Ave., New York City.
Turner Constr. Co.

LORING DUNHAM BURWELL
Westinghouse Elc. Mfg. Co., Lester, Pa. Stoker Dept.

ERNEST FRANKLIN FEE
Zenith Cedar Co., Duluth, Minn.
Sec. and Treas.

GEORGE RICHARD GESSERT
Dept. of Public Works, St. Paul, Minn. Estimator.

NICHOLAS A. GILMAN
North Yakima, Wash.
Yakima Valley Transp. Co.

WALTER G. KRAG
23 Columbia Court, Columbus, O.

JAMES M. MEANY
101 First St., Portland, Ore.
Charge of Sales.

(*Mechanicals—Continued*)

John W. Nekola
Denver, Colo.

Ralph Harvey Rawson
622 Yeon Bldg., Portland, Oreon. Goss & Rawson, Cons. Timber Eng., Member of Firm.

Willis Ware Spring
Northern Nat. Bank, Duluth, Minn. Mgr., Service Dept.

*Elmer Neill Stacy

Oliver H. Stephenson
Washburn-Crosby Milling Company. Mpls., Minn. Supt. of Maintenance.

Oliver George Turby
Eng. Foundation Co., 58 Sutter St., San Francisco, Cal.

Otto H. Wagner
Stacy-Bates Co., 817 McKnight Bldg., Mpls., Minn. President.

1908

Ole Andreas Anderson
Hawley, Minn.

Stanley Eugene Bingham
857 Grand Ave., St. Paul, Minn. Bingham & Norton, Inc.

Halstad Powell Councilman
Rosenberg Bros. Co., Fruit Packers, Fresno, Cal. Supt., Mech. Dept.

Richard Ferguson Cox
4th Coast Art. Dist., Fort McPherson, Ga. Headquarters.

Harvey Cole Estep
Penton Publishing Co., London, England. European Mgr.

Frank R. Fleming E. E. '09
Pacific Railway, St. Paul, Minn. Valuation Eng., Mech. Branch.

*Hobart Dickinson Frary M. E. '09

Stanley Gordon Harwood
Winget Kickernick Co., Mpls., Minn. Treas.

Percival Hetherton
The Longview Co., Longview, Wash Mgr., Industrial Div., Real Estate Dept.

Thomas Carlyle Morris
Lockwood, Greene & Co., Detroit, Mich. Eng.

Emil Francis Norelius
Ord. Dept., Rock Island Arsenal, Davenport, Ia. Automotive Eng.

Clyde Wood Norton
857 Grand Ave., St. Paul, Minn. Vice-Pres., Bingham & Norton, Inc.

George T. Peterson
Two Harbors, Minn. Supt. of Apprentices, D. & I. R. R.

George Walter Priedeman
143 27th Ave. S. E., Mpls., Minn. Vice-Pres. and Sec.

James Walsh E. E. '09
Address unknown.

Charles P. Clarke C. E. '09
Warden-Allen Co., Milwaukee, Wis Draftsman.

1909

Charles Benton Beery
1220 La Salle Ave., Mpls., Minn.

*John Bernhard Bieri

Zingel Cecil Judah Birnberg
Carnegie Steel Co., Youngstown, O. Checker.

Frederick William Buck
Stryker Manley & Buck., Duluth, Minn. Secretary.

John Edward Buhl
Turner Constr. Co., 244 Madison Ave., New York City. Eng.

Donald M. Forfar
1004 Marquette Ave., Mpls., Minn. Engineer.

Charles E. Holmgren
Instr., Kenmare High School, Kenmare, N. D.

Frank J. Kircher
Montevideo, Minn.

George A. Kircher
Hudson, Wis.

William R. Knopp
Dayton, O. Representative of Delco.

Edwin M. Lambert
U. of M., Mpls., Minn. Prof., Sch. of Mines.

Walter J. Mark
A. M. Wold-Mark Construction Co., Brookings, S. D. Constr. Eng. and Supt.

John E. Morris
Stacy-Bates Co., 817 McKnight Bldg., Mpls., Minn. Sec. and Treas.

Malcolm Bridgeman Moyer
Cities Service Oil Co., Davenport, Ia. Mgr., Tri Cities Division.

Frank L. Nemic
Fegles Constr. Co., Mpls., Minn. Mech. Eng.

Willis Shippman
Major, Coast Art. Corps, U. S. A.

William Henry Soura
707 Whalen Bldg., Port Arthur, Ont., Can. Partner, C. D. Howe & Co., Cons. Eng.

Howard M. Starrett
Fairmont, Minn. Supt., Fairmont Railway Motors, Inc.

Carl Deloss Udell
207 S. Broadway, Los Angeles, Cal. Bureau of Power and Light

Wilbur Stewart Williams
Laundryette Mfg. Co., Chicago, Ill. Western Field Mgr.

Harris H. Wright
1627 Main St., Kansas City, Mo. Owner.

1910

*William B. Atkinson

Fred Rundle Comb
2113 Chicago Ave., Mpls., Minn. Owner.

Harry C. Cook
Red Wing Iron Works, Red Wing, Minn. Owner.

George A. DeToit, Jr.
North. Mach. Co., 501 S. 6th St., Mpls., Minn. Treas.

Laurence Trent Fleming
706 Hurley-Wright Bldg., Washington, D. C. Asst. Eng. of Equip., U. S. R. R. Adm.

Johness Boughton Frear
Am. Radiator Co., Buffalo, N. Y. Mech. Eng.

Eugene Victor Kaplan
Eng. Westinghouse Elec. & Mfg., East Pittsburgh, Pa.

Wallace Hope Martin
Ore. Agr. Coll., Corvallis, Ore. Prof. of Heat Eng.

Bernard Alexander Meixner
R. B. Mitacre & Co., St. Paul Minn. Sales Eng.

Amos F. Moyer
3042 Snelling Ave., Mpls., Minn. Consulting Eng.

Browning Nichols, Jr.
Canal Constr. Co., Memphis, Tenn. Engineer.

Maynard W. Pease
Address unknown.

Donald McDernid Wesbrook
Chicago Pneumatic Tool Co., 25 St. Antoine St., Montreal. Gen. Mgr.

1911

Marvin Colver Barnum
Northern Mach. Co., 503 So. 6th St., Minneapolis. President.

Ira Lynn Bishop
Clyde Iron Works, Duluth, Minn Gen. Supt.

Julian Perkins Farnam
753 Plymouth Bldg., Mpls., Minn. Practicing Arch.

Walter F. Kasper
Fairmont Railway Motors, Inc., Fairmont, Minn. Chief Eng.

Martin S. Larson
Flaxlinum Insulating Co., St. Paul, Minn.

Oscar Arthur Olstad
Little Bldg., Boston, Mass.

Robert C. Oram
314 San Fernando Bldg., Los Angeles, Cal.

Leo Edwards Owens
63 Park Row, New York City. Asst. Mach. Supt. of New York World.

Jack Stickney Sneve
J. S. Sneve & Co., Packard Motor Car Co., Duluth, Minn. Owner and Manager.

Joseph Cushman Woodman
817 McKnight Bldg., Mpls., Minn. Vice-President.

1912

Leonard Frank Boyce
Boyce Greeley Bldg., Sioux Falls, S. D. Pres., Sioux Falls Constr. Co.

William Penn Brown
223 Main St., San Francisco, Cal. Partner, Brown Bros. Welding Co.

William Gibson Clark
The Pure Oil Co., Columbus, Ohio Chief Automobile and Lubricating Engineer.

Eugene C. Crane
Cleveland, Ohio.
C. O. Bartlett and Snow Co.

Allen Seymour Crawford
Webb Publishing Co., 58 E. 10th St., St. Paul, Minn. Sales Mgr., Circulation Dept.

Arthur Thurston Dinsmore
Klearflax Linen Looms, Inc., West Duluth, Minn. Contr. and Builder.

Frank Arthur Donaldson
Donaldson Co., St. Paul, Minn. President.

Clark Wm. Hirleman M. E. '13
Mpls., Minn. Mechanical Director of City Hospitals.

*Frank Johnson E. E. 1900

Martin A. Mikesh M. E. '13
Paper & Textile Mach. Co., Sandusky, O. Plant Eng. & Eng. of Designs.

(*Mechanicals—Continued*)

HAROLD SYLVANIUS MORTON M. E. '13
North-Western Fuel Co., St. Paul Minn. Eng. of Tests.

LARS RAND M. E. '13
800 Marquette Bldg., Detroit Mich Field Supt.

ALBERT E. RUEMUELE M. E. '13
Straus Bld., Chicago, Ill. Designing Eng.

HERBERT LESLIE THOMPSON
Rio de Janeiro, South America. International Steam Pump Co.

1913

ALBERT BUENGER M. E. '14
715 Capitol Bank Bldg., St. Paul, Minn. Mech. and Elec. Eng.

EDW. FOWLER CRITCHETT M. E. '14
Standard Oil Co., Mpls., Minn. Salesman.

FLOYD ALLEN McCARTNEY
535 Hamm Bldg., St. Paul, Minn. Field Asst., Equitable Life Assurance Society of the U. S.

MELVIN OVESTRUD M. E. '14
Twin City Forge & Foundry Co., Stillwater, Minn. Asst. to President.

*SOREN MARTIN ROBERTSON

BERT RAYMOND SAUSEN
108 N. Jefferson St., Chicago, Ill. Sales Mgr., Peerless Pneumatic Systems, Inc.

1914

EDWARD KOPPER, JR. B. S., M. E. '16
343 Endicott Bldg., St. Paul, Minn. Partner, H. C. McNair Co., Ry. & Mill Supplies.

JAMES ALBERT COLVIN M. E. '15
15 S. 5th St., Mpls., Minn. Supt of Generation. Northern States Power Co.

WILLIAM RIPLEY DORR
Wilshire Presbyterian Church, Los Angeles, Cal. Organist and Choirmaster.

JOHN HENRY GAMMELL M. E. '15
610 Donaldson Bldg., Mpls., Minn Doctor of Medicine.

LAURENCE D. HAMMOND M. E. '15
2015 Aldrich Ave. S., Mpls., Minn. Mechanical Equipment Constr.

JAMES LEO HARTNEY M. E. '15
Northern States Power, Mpls., Minn. Riverside Station.

ARTHUR CHAS. HUBBELL M. E. '15
3951 Canal St., Chicago, Ill. Supt., American Can Co.

HARRIS J. MAYER M. E. '15
900 Builders Exch., Mpls., Minn. Asst. Supt. Constr.

JOHN S. PEOPLES
Western Electric Co., Hawthorne Works, Chicago, Ill. Eng. Development Branch.

ALBERT L. PETERSON M. E. '15
Fargo, N. Dak.

FLETCHER ROCKWOOD M. E. '15
G. N. Ry. Co., St. Paul, Minn. Valuation Attorney.

CLARENCE J. SNOW M. E. '15
411 Cedar Ave., Mpls., Minn.

PAUL W. THAYER M. E. '15
American Gas Constr. Co., Newton, Ia. Eng.

1915

RALPH R. BOYLES M. E. '16
American Hoist & Derrick Co., St Paul, Minn. Designing Eng.

MILTON ELWOOD CROSBY
John S. Metcalf Co., Ltd., Eng. & Contractors, Australia. Asst. Chief Eng.

DAVID MURRAY GILTINAN M. E. '16
Eskew, Smith & Cannon, Charleston, W. Va. Asst. Sales Mgr.

ABNER WALDO HOLMBERG M. E. '16
McKinney Steel Co., Bessemer, Mich. Engineer.

CLINTON B. KERNS
U. S. Metals Refining Co., Carteret, N. J. Engineer.

GEORGE MILTON ORR
G. M. Orr Co., 816 2nd Ave. So., Mpls., Minn. Cons. Eng.

EARL HOVEY ROBERTS M. E. '16
216 W. Water St., Milwaukee, Wis. Sec. Seefeld Investment Co.

HERMAN WM. SKON M. E. '16
Minn. Mining & Mfg. Co., St. Paul, Minn Mechanical Eng.

CHARLES EDWARD TUPPER
N. W. Ice Cream Co., Mpls., Minn. Ass. Treas.

WILLIAM SAMUEL WOLFF M. E. '16
811 15 E. 7th St., St. Paul, Minn. Owner.

1916

JOHN CORSER
Soo Line, Mpls., Minn. Mechanical Draftsman.

HARRY SAMUEL DRESSER
405 Plym. Bldg., Mpls., Minn.

IRA LEROY JOHNSON M. E. '17
801 16th Ave. S. E., Mpls., Minn.

*ARTHUR PEARSON MASON

WILLIAM CHARLES MILLER
Address unknown.

CHESTER SHERMAN MOODY M. E. '17
C. L. Best Tractor Co., San Leandro, Cal Metallurgical Eng.

JOHN REID RITCHIE M. E. '17
1611 Central Ave., Mpls., Minn. Supt. Imperial Machinery Co.

GEORGE ALFRED SMART
814 Farree St., Cavapolis, Penn.

CHAS. WILLINGTON STONE M. E. '17
616 N. W. Bank Bldg., Mpls., Minn. Draftsman.

1917

EDW. IGNATIUS ANDERSEN M. E. '19
Westinghouse Elec. & Mfg. Co., Attica, N. Y. Asst. to Works Mgr.

CHARLES BOEHNLEIN M. E. '19
Coll. of Eng., U. of Minn. Instr. in Math. and Mech.

ERNEST THEODORE BROS
William Bros Boiler & Mfg Co., Mpls., Minn. Eng.

HOMER L. BROWN
C. B. & Q. R. R. Lab., Aurora, Ill. Inspector.

ARVID PAUL CARLSON
St. Paul Gas Light Co., 6th and Cedar, St. Paul, Minn. Eng Electric Distribution Division.

GUSTAF ALBIN EK
2522 E. 24th St., Mpls., Minn.

IRVING NELSON EUSTIS M. E. '18
Fairmont Railway Motors, Inc. Fairmont, Minn. Asst. Eng.

HENRY CARL GERLACH
I. O. O. F. Bldg., Mankato, Minn Architecture.

CHARLES F. GUGGISBERG
M. St. P. & S. Ste. M. Ry., Mpls., Minn

JOEL HEKTNER
Freight Car Design, C. M. & St. P Ry. Asst. Eng.

ARTHUR GUSTAVE HOLMSTINE
2919 Como Ave. S. E., Mpls., Minn. Woolery Machine Co.

FREDRIK W. HVOSLEF M. S. '19
127 Campbell Ave., Detroit. U. S Rad. Corp., Experimental Eng.

EDWIN FRANCIS JONES
716 Capital Bank Bldg., St Paul Minn. Mechanical Eng.

HARRY KNUTSON
Clyde Iron Works, Duluth, Minn. Chief Draftsman.

VICTOR FRITJOF LARSON
Nat. Iron Co., W. Duluth, Minn. Mechanical Draftsman.

JOHN HAYS MURRAY
312 Genesee Bank Bldg., Flint, Mich

OTIS STANLEY NELSON
Central Y. M. C. A., Mpls., Minn.

CIRILO LUIS ROMERO M. E. '18
Cuba Cane Sugar Corp., Havana, Cuba. Asst. to Division Eng.

ABRAHAM EDWARD ROSENBLOOM
Address unknown.

CLARENCE Q. SWENSON M E. '20
555 Beaufait, Detroit, Mich.

DUANE LEROY TAYLOR
Care of Postmaster, San Francisco, Cal. Lieut., U. S. N., U. S. S. Idaho.

1918

HOWARD BENJAMIN ABRAHAMSON
St. Paul Gas Light Co., St. Paul, Minn. Eng.

HILDER ALVIN ANDERSON
Mahr Mfg. Co., Mpls., Minn Chief Engineer.

GEO. HENRY BIERMAN M. E. '19
White Motor Co., Cleveland, Ohio Tech. Asst. to Supt. of Heat Treating.

PAUL EDGERTON FRANCIS
Northwestern Fuel Co., St. Paul Minn. Field Eng.

MORRIS GREENBERG
15 E. 9th St., St. Paul, Minn. Mechanical Eng.

OLIVER SUMMERS HAGERMAN
St. Paul Gas Light Co., St Paul, Minn. Distribution Eng.

RAY CHARLES KIVLEY
Western Electric Co., Chicago, Ill. Eng.

CARL CHRIST MULLER
Standard Conveyor Co., No. St. Paul, Minn. Checker.

1919

ARTHUR WARD BAKER
C. M. & St. P. Ry., Spirit Lake, Ida. Spec. Appr.

RAYMOND JOSEPH BROS M. E. '20
William Bros Boiler & Mfg. Co., Mpls., Minn. Eng.

RICHARD ALEXANDER COSH
Illinois Glass Co., Alton, Ill. Mach. Designer.

(Mechanicals—Continued)

Archie Joseph Dowd
Western Electric Co., Hawthorne Sta., Chicago, Ill. Develop. Eng.

Harry Cass Elliott
Packard Motor Car Co., Detroit, Mich. Designing Eng.

Ross Milton Foltz
Obenberger Forge Co., West Allis, Wis. Sales Mgr.

Edward Maxwell Hartzberg
Los Angeles Gas and Electric Co., Los Angeles Cal. Concrete Eng.

Geo. Nichol Moffat M. E. '20
Ohio State University, O. Instr.

William Joseph Pavek M. E. '20
Western Electric Co., Chicago, Ill. Investigating.

Arthur Howard Williams
Zeder Skelton Breer Eng. Co., Newark, N. J. Research Eng.

Milton S. Wunderlich M. E. '20
Flaxlinum Insulating Co., St. Paul, Minn.

1920

Helmer Nicholai Anderson
220 E. 5th St., Minneapolis, Minn. Sales Eng., Worthington Pump & Machine Corp.

Hampton B. Ball
Troy, Mo. Farmer and Poultryman.

Glen Cray Cerney
Care of Standard Oil Co. of New York, Bombay, India. Lubricating Eng.

Ezra Benham Curry
C. M. & St. P. Ry. Co., Green Bay, Roundhouse Foreman.

Jacob Henry Czock
Worthington Pump & Machinery Corp., E. Cambridge, Mass. Diesel Engineer on Experimental Work.

Fridtjof Storjohann Egilsrud
Power Plant, South St. Paul, Minn. Armour & Co.

Harry G. Fortune
Factories Bldg., Toledo, O. Industrial Training Dept.

Theron Gardner Gerow
Republic Coal Co., Mpls., Minn. Eng.

Edward James Hayes
J. G. Robertson, Power Plants, St. Paul, Minn. Electing Engineer.

William Franklyn Joachim
Langley Field, Hampton, Va. Eng., National Advisory Committee for Aeronautics.

Lewis Edwin Merrill
Mpls. Steel and Machinery Co. Second Asst. Credit Mgr.

Harold Thurston Odegaard
C. M. & St. Paul R. R. Shops, Green Bay, Wis. Ass. Gen. Foreman.

Knox Archibald Powell
South Philadelphia Works, Lester, Pa. Draftsman, Westinghouse Electric and Mfg. Co.

*Clayton Madison Reasoner

Paul W. Rhame
A. C. Spark Plug Co., Flint, Mich. Supt. of Inspection.

Hiram R. Shellenberger
Care of Standard Oil Co. of Bombay, Ind. Lubricating Eng.

George Lew Tuve
Montana State Coll., Bozeman. Asst. Prof of Mech. Eng.

John Elmer Wallfred
Northwestern Tel. Co., Omaha, Neb. Eng.

Fred A. Waterous
80 E. Filmore Ave., St. Paul, Minn. Sales Mgr. Waterous Fire Engine Works.

Myrl J. Williams
Washburn Co., Chicago, Ill. Asst. Supt. of Planning.

1921

Lloyd Olaf Arneson
Cleveland, O. Eng., Bailey Meter Co.

Lloyd Armstrong Elmer
Bell Telephone Co., 463 West St., New York City. Design Eng.

John Wesley Farmer
Nott Contracting Co., Mpls., Minn. Estimator.

Elmer John Forsberg
St. Paul Gas Co., St. Paul, Minn. Electric Destribution Dept.

Maurice Sven Gjesdahl
Board of Education, 305 City Hall, Mpls., Minn. Statistical Eng.

Lehan Hamer Hamlin
Proctor & Gamble, Ivorydale, O. Eng.

Carl Albert Johnson
1600 15th St., Denver, Colo. Branch Mgr. for Minneapolis Steel & Machinery Co.

Lewis Reese Lewis
1623 University Ave., St. Paul, Minn. Salesman.

Alexander Walker Luce
Y. M. C. A., Omaha, Neb. High School Secretary.

Peter Theodore Reuter
Bailey Motor Co., Cleveland, O. Cadet Engineer.

Milo Chapin Roy
Care of Fairbanks, Morse & Co., St. Paul, Minn. Representative.

Frank Umbehocker
Public Service Co., Northern Illinois, Joliet, Ill. Boiler Room Eng.

Sven Alfred Vaule
Met. Bldg., Mpls., Minn. Vice Pres., Grice Associated Industrial Engineers.

Herbert Hugo Von Rohr
1234 Central Ave., Mpls., Minn. Chalmess Oil Burner Co.

1922

Roy Aure
N. P. Ry., St. Paul, Minn. Draftsman.

Chester W. Bros
William Bros Boiler & Mfg. Co., Mpls., Minn.

Ernest Frederic Carlson
High Bridge Steam Plant, St. Paul, Minn. Boiler Room Eng.

John S. D. Clark
N. W. Bell Telephone Co., Mpls., Minn. Engineer.

Verne F. Curtis
203 City Hall, Mpls., Minn. Asst. Mechanical Engineer.

Clarence J. Eddy
Pressman. Minneapolis Tribune.

Frank Fahland, Jr.
F. E. Christofferson Co., Inc., Duluth, Minn. Salesman.

Clayton E. Hemsey
Carolina Power & Light Co., Raleigh, N. C. Designer.

Richard Harold Hoffman
The Empire Companies, Bartlesville, Okla. Clerk in Auto Service Dept.

Victor Theodore Holmstene
Alphons Custodis Chimney Constr. Co., Chicago, Ill. Estimator.

Calvin K. Katter
Dispatch Printing Co., St. Paul, Minn. Radio Expert.

Reuben L. Katter
E. E. Atkinson & Co., Mpls., Minn. Asst. Credit Mgr.

Howard Christian Kelsey
16th & Rockwell Sts., Chicago, Ill.

Armin R. Kleinschmidt
C. R. Meyer & Sons Co., Winters, Wis. General Constr.

Arthur W. Kumm
Houston, Tex. Instr. of Mech. Eng., Rice Institute.

Edward S. Mikesh
Crane Co., St. Paul, Minn. Heating & Sales Engineer.

Arnold Nordenson
Diamond Iron Works, Mpls., Minn. Sales Engineer.

Charles Floyd Olmstead
Mahr Mfg. Co., Mpls., Minn. Asst. Eng.

Walter Charles Peters
Janesville, Minn.

*Olaf Tjelle Rood

Harold R. Rosendahl
Mahr Mfg., Mpls., Minn. District Manager.

Ralph Hilgedick
Address unknown.

1923

Sidney Harold Acker
N. P. Ry. Co., Pacca, Wash. Engineer of Tests.

Lee Leonard Amidon
West Virginia University. Instr., Steam and Exp. Eng.

Raymond Christopher Ascher
Bethlehem Steel Co., Lackawana Plant, New York City. Asst. Billet Yard Foreman.

Graydon A. Bachman
Legal Valuation. G. N. R. R., St. Paul, Minn.

Grant C. Bergsland
Wis. Ry. St. & Power Co., LaCrosse, Wis. Master Mechanic.

Ben M. Bros
William Bros Boiler & Mfg. Co., Mpls., Minn.

Edward Venuste Brossard
St. Paul Gas & Light Co., St. Paul, Minn. Sales Eng.

Floyd E. Copeland
72 W. Adams St., Chicago, Ill. Electric League Representative. Public Service Co.

Roland E. Cross
581 Portland Ave., Mpls., Minn.

Elmer H. Eige
Western Electric Co., Chicago, Ill. Technical Training Course.

(Mechanicals—Continued)

ARTHUR GILSTAD
Standard Conveyor Co., North St. Paul, Minn. Supt. of Erection.
HERBERT OLIVER HALDEN
Minnesota Power & Light Co. Asst. to Efficiency Engineer.
SHELDON SAMPSON HIBBARD
Clyde Iron Works, Duluth, Minn. Designing Mechanical Eng.
KARL WESLEY KEISER
U. of M. Post-Graduate in ME.
RUDOLPH H. KUHLMAN
Delos F. Wilcox, Mpls., Minn. Valuation Eng.
GLEN M. LARSON
Stockland Road Machine Co., Mpls., Minn. Eng. Dept.
ENGEN LINDELIEN
Western Electric Co., Chicago, Ill. Equipment Eng.
CHESTER R. MARSHALL
Northern States Power Co., Mpls., Minn. Field Eng. Riverside Sta.
HAROLD D. MESSER
Commonwealth Edison Co., Chicago, Ill. Engineer.
ORRIN G. PARKIN
Pine Island, Minn.
HAROLD E. PECKHAM
St. Paul Gas & Electric Light Co., St. Paul, Minn. Constr. Eng. Gas Distribution Division.
RALPH W. RANSON
John Morrell Packing Plant Sioux Falls, S. D. Asst. Eng.
ARTHUR W. SEAR
Nordberg Mfg. Co., Milwaukee Wis. Draftsman.
PHILIP GREGOR SWANSON
Eng. Chicago Pneumatic Tool Co 5th Ave. and 5th St. S., Mpls.
DELTON THOMAS WABY
Chicago Central Station Inst. Graduate Course.

1924

JOSEPH A. ANDERSON
A. C. Spark Plug Co., Flint, Mich.
GEORGE F. BERRY
623 E. 4th St., Duluth, Minn.
CHARLES R. BLODGETT
Ivorydale, Ohio.
Proctor & Gamble Co.
WELLINGTON LYLE BORST
1910 Franklin Avenue S. E., Mpls. Minn.
PAUL M. BOYD
Dayton, O.
Care of Johnson Airplane Supply Co.
NORMAN STUART COLLIS
Northern States Power Co., St. Paul, Minn.
DALLAS WILLIAM DALE
The Cadillac Motor Car Co., Detroit, Mich. Tool Designer.
WILLIAM JOSEPH DARMODY
Northern Fire Apparatus Co., Mpls., Minn.
DONALD E. EARL
2023 2nd Ave. S., Mpls., Minn.
HARRIS STEVENS ENGH
Rushford, Minn.
ROBERT K. ERSKINE
1780 Goodrich Ave., St. Paul, Minn.
CLYDE FREDERICK ESTABROOKS
Mpls., Minn. Joseph Leck Co.
LLOYD P. GROBEL
Schenectady, N. Y. Gen. Elec. Co.
CHARLES RUSSELL HIERS
436 Elm St., New Haven, Conn.
RALPH D. HOLSTINE
Western Electric Co., Chicago, Ill. Production Engineer.
FRANK C. KIESNER
Buffalo, N. Y. American Radiator Company.
EDWIN FREDERICK KOEHLER
1253 Pierce Bldg., St. Louis, Mo. Hartford Insurance Co.
GEORGE LANGFORD, JR.
2300 South Western Ave., Chicago, Ill. Asst. Plant Eng.
HARLEY R. LANGMAN
Proctor & Gamble Mfg. Co., Kansas City, Kan.
JOHN FRANKLIN LOGUE
Stone & Webster, High Dam Ford Ford Plant, Mpls., Minn. Pipe Dept.
BEHARI LALL MEHANDRU
226 S. Observatory St., Ann Arbor, Mich.
RALPH M. MONTGOMERY
Bucyrus Co., Milwaukee, Wis. Draftsman.
JOHN HENDLY MOORE
Cincinnati, O.
1416 First National Bank Bldg.
FRANK A. MORRIS
2137 Commonwealth Ave., St. Paul, Minn.
EDWARD KRISTEN NELSON
2225 W. 4th St., Duluth, Minn.
EINER NELSON
2225 W. 4th St., Duluth, Minn.
*HAMLET C. OLIEN
ARTHUR LEONARD OLSON
4709 W. 4th St., N. Duluth, Minn.
ARTHUR S. PETERSON
Northern States Power, Minneapolis, Minn. Rates & Contracts.
GEORGE A. RATHBURN
Stevens Point, Wis. Sanatorium.
KENNETH ROBERTS ROSS
General Electric Co., Schenectady, N. Y. Test Dept.
CLIFTON C. ROSSEAU
Crosby, N. Dak.
ARTHUR ODELL SEBO
Belford, Ind.
Milwaukee Railway Headquarters.
PAGE M. SARTELL
Address unknown.
ARTHUR ODELL SEBO
Bailey Meter Co., Mpls., Minn. Service & Sales Engineer.
GUNNAR SESSENG
Nicollet and Franklin Aves., Mpls., Minn. American Plumbing & Heating Co.
CHARLES GUY SIMMS
Oshkosh, Wis.
Wis. Public Service Corp.
GILBERT C. STAEHLE
529 2nd Ave. S., Mpls., Minn. Consulting Engineer.
EDWARD L. STAUFFACHER
Care of Empire Companies, Bartlesville, Okla. Engineer.
W. ALLEN THOMAS
3001 Wells St., Milwaukee, Wis.
STANLEY B. TUTTLE
1259 Delaware, St. Louis, Mo. Fulton Iron Works Co.
JOHN W. WAGNER
A. C. Spark Plug Co., Flint, Mich. Test Eng.
STUART V. WILLSON
Northern States Power Co., St. Cloud, Minn.
HARRY DOWNS WOOLMAN
643 Forest Ave., Avondale, Cincinnati, O.

THE 1925 ALUMNI DIRECTORY

The School of Chemistry

1897

Chemical Engineering

*Chapin, Lewis Paul
Hamilton, Herbert Clifton
160 Webb Ave., Detroit, Mich. Chemist and Pharmacologist, Parke, Davis & Co.
Linton, James H.
2422 5th Ave. S., Seattle, Wash. Prop. of Pacific Coast Testing Lab.
Webber, Frederick Walter
2728 Humboldt Av. S., Mpls., Minn. Deputy Collector, U. S. Customs.

1902

Chemistry

Lando, Maxmillian Nandor
Address unknown.
Rice, Edgar Whitman
117 Radford St., Yonkers, N. Y. Chemist, Nat. Sugar Refining Co.

Chemical Engineering

Benner, Raymond Calvin
Bayside, N. Y.
General Chem. Co., New York City

1903

Chemistry

Bakke, Oliver M.
5320 Willis Ave., Dallas, Texas. Chief Chemist, Water Purification Plants.

1904

Chemistry

Grout, Frank Fitch
504 University Ave. S. E., Mpls., Minn. Prof. of Geology, U. of M.
Gutsche, Edward J.
5869 W. Lafayette Blvd., Detroit, Mich. Prod. Mgr., Roberts Brass Mfg. Co.
Hopkins, Joseph Irwin
R. R. 1, Mpls., Minn. Farming.
Rose, Anton Richard
500 Undercliff Ave., Edgewater, N. J. Chemist, Prudential Insurance Co., Newark, N. J.

1905

Analytical Chemist

Borrowman, George L.
9 S. Clinton St., Chicago, Ill. Analytical and Consulting Chemist.
Frary, Francis Cowles
1218 Hulton Road, Oakmont, Pa. Director of Research, Aluminum Co. of America, New Kensington, Pa.
Longworth, Fred James
Address unknown.
Poore, Charles Delos
Glendale, Calif.

Chemistry

Dahlberg, Arnold V.
Newfolden, Minn. Farming and working as Fieldman for Northern Sugar Corp.
Jackson, Myron Bangs
Williston, N. D. Treas., Credit Mgr., Williston Grocery Co.
Pennock, Edward McMaster
2206 Doswell Ave., St. Paul, Minn. Vice-Pres. G. H. Tennant Co., Mpls.

1906

Analytical Chemist

Bernhagen, Lewis Otto
Y. M. C. A., Beaumont, Tex. Director of Sanitation, City of Beaumont.

1907

Chemistry

Doran, James M.
5520 13th St. N. W., Washington, D. C. Chief, Industrial Alcohol and Chem. Div., Internal Revenue Bureau, Treas. Dept.
Halverson, John Oliver
110 Wakefield Ave., Raleigh, N. C. Feed Inspection, Control and Investigations in Nutrition, Agricultural Experiment Station.
Kennedy, William W.
1866 Marshall Ave., St. Paul, Minn. Mnfr. of Mayonnaise Products.
Manuel, Earle V.
Address unknown.
Von Kuster, Edith I.
(Mrs. W. Johnson)
44 Adelaide Ave., New Brunswick, N. J.

Chemical Engineering

Davies, Edwin T.
5057 Upton Ave. S., Mpls., Minn. Chem., City Engineer's Dept.

1908

Chemistry

Anderson, Edward X.
417 N. 6th St., Grand Forks, N. D. Asst. Prof. of Chem., U. of N. D.
Badger, Walter Lucius
917 Church St., Ann Arbor, Mich. Prof. of Chem. Eng., U. of Mich. Director of Research, Swenson Evaporator Co., Harvey, Ill.
*Cressy, Charles R.
Lowe, John M.
6412 N. 11th St., Oak Lane, Philadelphia, Pa. Asst. Sec.-Treas., Bisbee Linseed Co.
McBride, Russell S.
20 Hesketh St., Chevy Chase, Washington, D. C. Consulting Chem. Eng., Colorado Bldg.
Porter, Allen Harold
266 Prospect Road, Mountain Lakes, N. J. Flour Brokerage, Harry E. White, 89 Broad St., New York.
Whited, Oric Ogilvie
4432 Dupont Ave. S., Mpls., Minn. Realtor.

1909

Chemistry

Alves, Eva (Dresser)
799 Faxon Ave., San Francisco, Cal. Asst. Chem., U. S. Customs Service.
Bacon, Charles B.
President, Write, Inc.
405 Lexington Av., New York, N. Y.
Curtiss, Faith (Sterling)
Maplewood, Ore. Housewife.
Keuffner, Otto Karl
814 Fairmont Ave., St. Paul Minn. Chem., State Dairy and Food Dept., St. Paul.
Selvig, Walter A.
235 S. Millvale Ave., Pittsburgh, Pa. Assoc. Chem., U. S. Bureau of Mines
Walker, George Warren
9601 American Ave., Detroit, Mich. Metallurgist Hupp Motor Car Corp.

Chemical Engineering

Barnaby, William E.
926 Selby Ave., St. Paul, Minn. Automobile dealer.
Morey, George W.
2801 Upton St. N. W., Wash., D. C. Physical Chem., Geophysical Lab., Carnegie Institution.
Roehrich, Victor
25 E. 5th St., St. Paul, Minn. Director of Bureau of Municipal Testing Laboratories.

1910

Chemistry

Bicknell, Henry R.
20 East Acacia St., Stockton, Calif. Chem., Sperry Flour Co.
Daniels, Farrington
Madison, Wis. Assoc. Prof. of Chem., U. of Wis.
De Witt, Joseph Henri
966 Dayton Ave., St. Paul, Minn. State Parole Agent for Minn. Prison and Reformatory.
Dietrichson, Gerhard
Urbana, Ill.
Asst. Prof., U. of Ill.
Finke, Wilbur W. M.
Address unknown.
*Peterson, Andrew Peter
Pettijohn, Earl
1384 Grant St., Akron, O. Plating Foreman, Lamson & Sessions, Kent, Ohio.
Rockwood, Ralph H.
210 Vernon Ave., St. Paul, Minn. Chief Chem., City of St. Paul.
*Smith, Carolyn Harriet
*Stone, George H.
Taylor, Carl A.
4800 Forbes St., Pittsburgh, Pa. Explosives Chem., U. S. Bureau of Mines.
Tronson, Carl A.
Rigby, Ida.
Supt., Beet Growers Sugar Co.
Woolett, Guy Haines
University P. O.
Assoc. Prof. of Chem., U. of Miss.

Chemical Engineering

DAHLBERG, HENRY W.
1558 Monaco Parkway, Denver, Col. Mgr., Research Dept., Great Western Sugar Co.
GUTSCHE, FRANK CARL
611 No. Waiola Ave., LaGrange, Ill. Chem., Western Electric Co., Chicago, Ill.
SMITH, SHELDON HALLOWAY
994 Grand Ave., St. Paul, Minn. Advertising Mgr., Nicols, Dean & Gregg.

1911

Chemistry

CANTWELL, WILLIAM F.
International Falls, Minn. Physician and Surgeon.
HALVORSON, HENRY A.
452 N. Fairview St., St. Paul, Minn. Chem., Division of Feed Inspection.
HARTNETT, JOHN G.
Edgewood, Md. Assoc. Chem., Civil Service, Edgewood Arsenal.
HENNESSY, HUGH J.
1864 Marshall Ave., St. Paul, Minn. Chief Inspector, Division of Feed Inspection, Minn. Dairy & Food Dept.
JOHNSON, EINER
901 Selby Ave., St. Paul, Minn. Chem. and Pharmacist, The LaSalle Co.
LEAVENWORTH, FRANCIS MAURY
East Pittsburgh, Pa. Research Dept., Westinghouse Elec. & Mfg. Co.
MCMILLER, PAUL RAYMOND
726 11th Ave. S. E., Mpls., Minn. Asst. Prof. of Soils, Agricultural Exp. Sta., U. Farm, St. Paul.
OLSON, ARTHUR O.
3431 Tyler St. N. E., Mpls., Minn. Analyst, State Dairy and Food Commission, St. Paul.
STOPPEL, ERNEST ALBERT
789 St. Mark's Ave., Brooklyn, N.Y. Chief Research Chem., Valentine & Co.

Chemical Engineering

BAKER, RUSSEL E.
191 Macalester Ave., St. Paul, Minn. Sec., C. H. Young Co.
*HOLTON, JOHN B.
CALLAWAY, R. S.
4037 Abbott Ave. S., Mpls., Minn. Purchasing Agent, U. of M.

1912

Chemistry

BRINTON, PAUL H. M. P.
1112 6th St. S. E., Mpls., Minn. Prof. of Analytical Chem., U. of M.
DANIELS, ELMER ANSON
R. F. D. 2, Hinsdale, Ill. Development Engr., Western Electric Co., Hawthorne Sta., Chicago.
EDWARDS, JUNIUS DAVID
536 6th St., Oakmont, Pa. Asst. Director of Research, Aluminum Co. of America, New Kensington, Pa.
GOLDSTEIN, MILTON M.
4600 1st Ave. S., Mpls., Minn. Architect and Builder.
HARSHAW, JOHN RIPPEY
Address unknown.
HOFFMAN, HENRY JOSEPH
St. Paul, Minn. Chem., State Dairy and Food Dept.
KARATZ, LUCIAN
Mpls., Minn. Chem., International Sugar Feed Co.
*MCLEOD, JOHN RODERICK
MITCHELL, RALPH WALLACE
1317 Second St., Menomonie, Wis. Sec., American Bakery Materials Co.
NESSE, CHARLES OSCAR
Address unknown.
PARKIN, GUY GEORGE
2162 Stratford Ave., St. Paul, Minn. Prop., Columbia Shop, Phonographs.
ROBINSON, RHEA BENEDICT
4237 Washburn Av. S., Mpls., Minn.
SCHMIDT, GEORGE HERMANN
Address unknown.
*SPRIESTERSBACH, DAVID OSCAR
WANLESS, LYNN ALLISON
3101 E. 31st St., Mpls., Minn.

Chemical Engineering

BRUNKOW, HERBERT E. C.
Delano, Minn. Mgr.-Owner, Brunkow Pickling Co.
MARTIN, EDMUND W. H.
927 Blackhawk St., Chicago, Ill. Mgr., Midland Linseed Products Co. (Crescent Works).

1913

Chemistry

FELION, ARTHUR J.
4628 33rd Ave. So., Mpls., Minn. Asst. Chem., N. P. Ry., Como Shops, St. Paul, Minn.
KATZ-NELSON, WILLIAM
Address unknown.
MASTIN, MARION GORDON
Canajoharie, N. Y. Chief Chem., Beech-Nut Packing Co.
MILLER, RALPH HARRISON
Address unknown.
O'CONNELL, THOMAS CHARLES
618 Walnut St., Donora, Pa. Chem., American Steel and Wire Co.
OTTERSTEIN, EARL FRANK
2316 Aldrich Ave. S., Mpls., Minn. Mgr., Hospital Service Co.
PETERSON, HENRY
Address unknown.
SUTTER, HEDWIG MELANIE (MRS. ROGER WILSON)
2629 Humboldt Av. S., Mpls., Minn.
TAYLOR, CYRIL STEAD
Aluminum Club, New Kensington, Pa. Physical Chem., Research Bureau, Aluminum Co. of America.
YNGVE, VICTOR
116 Appleton St., Cambridge, Mass. Director Research, Manhattan Electrical Supply Co.

Chemical Engineering

ANDERSON, FREDOLF THEODE
Address unknown.
KERN, HERBERT A.
2014 Home Ave., Chicago, Ill. Gen. Mgr., Chicago Chemical Co.
PORTER, RALPH ELMER
234 Hampton St., Ashland, Ken. Chemist, Ashland Leather Co.

1914

Chemistry

GAUGER, A. W.
Westend, San Bernardino Co., Cal. Mgr., Burnham Chemical Co.
JUVRUD, INGVALD OLIVER
722 E. 74th St., N. Portland, Ore. Chief Chem., Balfour, Guthrie & Co.
MERTEN, HOWARD VINCENT
Charles City, Iowa.
TIBBLING, ERNEST F.
3919 Sunrise Drive, Kansas City, Mo. Chemist, Washburn Crosby Co.

Chemical Engineering

BIERMAN, HARRY C.
Clover Club, Wilkinsburg, Pa. Patent Att., Westinghouse Elec. and Mfg. Co., Pittsburgh.
MAY, DARWIN R.
211 E. 46th St., Indianapolis, Ind. Chem. Engr. Republic Creosoting Co.
TINKHAM, WILLIS M.
3641 Colfax Ave. S., Mpls., Minn. Mill Chemist, Washburn-Crosby Co.

1915

Chemistry

FEGAN, ELMER THOMAS
900 30th Ave. S., Mpls., Minn. Head of Bakery Service Dept., Royal Milling Co., Great Falls, Mont.
OLSEN, LESLIE RAYMOND
4836 Garfield Ave., Mpls., Minn. Chief Chem., International Milling Co., Flour Exchange Bldg.
RINGSTROM, HUGO
Appraiser's Bldg., San Francisco. Junior Chem., Internal Revenue Bureau.
TONCHEFF, STANIL T.
Chem., N. W. Blau Gas Co., St. Paul, Minn.

Chemical Engineering

MORSE, GUILFORD A.
Boise, Ida. Lumberman.

1916

Chemistry

DUNNIGAN, MERTON A.
5045 Oliver Ave. S., Mpls., Minn. Mgr., Lubricating Dept., White Eagle Oil and Refining Co., St. Paul.
MORROW, LEON WALKER
67 Hughes St., Quincy, Mass. Asst. Production Mgr., National Leather Co., Boston, Mass.
SOUTHER, BENJAMIN L.
Address unknown.

Chemical Engineering

BELL, ALEXANDER DEWEY
1805 Portland Ave., St. Paul, Minn. Vice-Pres. and Chem., Van Cleve Laboratories, Inc., Mpls.

1917

Chemistry

CORSON, BENJAMIN I.
2916 Constitution Rd., Camden, N. J. Chemist, R. M. Hollingshead Co.
DOMOVSKY, AARON
Address unknown.
DURHAM, SAMUEL W.
2001 E. Slauson Ave., Los Angeles, Cal. Woodard-Durham Mfg. Co.
*ECKMAN, LAWRENCE R.

(Chemists—Continued)

*Egge, Walter

Markus, Benjamin
426 Lincoln St., Hibbing, Minn.
Sec.-Treas., Purity Ice Co.

Marr, Horace Sinclair
427 5th St., Niagara Falls, N. Y.
Research Engr., American Magnesium Corp.

Marshall, Olive Wadleigh
4150 Nicollet Ave., Mpls., Minn.
Chem., Inyo Chemical Co., Cartago, Inyo Co., Calif.

Owens, Jay Clyde
1221 Harvard Ave., Chicago, Ill.
Chief Chem., Sherwin-Williams Co.

Rask, Olaf S.
Stanford U., Cal. Research Fellow, Food Research Institute.

Strong, Frank Dufresne
1935 Summit Ave., St. Paul, Minn.
Capt., U. S. Marines, Marine Barracks, Quantico, Va.

Washburn, Frederick M.
7267 Coles Ave., Chicago, Ill. Chief Chem., Coke Plant, Wis. Steel Co.

Chemical Engineering

Burningham, F. A.
25 Ninth St., Berlin, N. H.
Research Chem., Brown Co.

Higburg, William
4340 Winthrop Ave., Indianapolis, Ind. Chem. Engr., Republic Creosoting Co.

Kuentzel, Ward Edward
1471 Irving St. N. W., Wash., D. C.
Asst. Chem. Engr, Fixed Nitrogen Research Lab., Dept of Agriculture.

Luft, Oscar Wilhelm v. d.
18 Norwalk Ave., Buffalo, N. Y.
Technical Development Dept., Nat. Aniline and Chemical Co.

Widell, E. Gideon
967 Burr St., St. Paul, Minn.
Research Chem. Westinghouse Lamp Co., Bloomfield, N. J.

1918

Chemistry

Joselowitz, Goodwin
2555 Bryant Ave. S., Mpls., Minn.
City Chem., Div. of Public Health.

Kesselman, Leo
Address unknown.

Pan, Wen Ping
Hibbing, Minn. Mining Engineer, Oliver Iron Mining Co.

Chemical Engineering

Donauer, Max
1911 Ingleside Ave., Sioux City, Ia.
Supt., Robb-Ross Co.

Hogness, Thorfin Rusten
1405 Spring Way, Berkeley, Cal.
Instructor in Chem., U. of Cal.

Johnson, Donald Lee
2357 Carter Ave., St. Paul, Minn.
Chem., Washburn-Crosby Co., Mpls., Minn.

Kessel, Herbert
Los Angeles, Cal. Credit Dept., Broadway Dept. Store.

Neilson, Chris
1029 S. Front St., Mankato, Minn.
Florist.

1919

Chemistry

Beckel, Arthur C.
604 Oak St. S. E., Mpls., Minn.
Asst. in Chem., U. of M.

Brooks, Leslie C.
713 E. 15th St., Mpls., Minn.
Welsh Tie Co.

Engstrom, Leslie G.
1645 K. St., Washington, D. C.
Corp. Auditor, U. S. Government.

Greenlaw, Charles E.
Address unknown.

Heck, Frank J.
418 Rice St., St. Paul, Minn.

Thorson, Stuart John
University Hospital, Mpls., Minn.
Medical Student, U. of M.

Chemical Engineering

Fischer, Earl B.
1010 W. 43rd St., Mpls., Minn.
Instr., Coll. of Pharmacy, U. of M.

Koch, Arthur Louis
1748 Wellesley Ave., St. Paul, Minn.
Supt., Twin City Brick Co.

Reu, Albrecht H.
Brunswick, Ga. Shift Supervisor, Hercules Powder Co.

Winslow, Raymond Martin
4609 Blaisdell Ave., Mpls., Minn.
Grice Associated Industrial Engr.

1920

Chemistry

Hammer, George E.
331 11th St. N. E., Portland, Ore.
Salesman, Mutual Life Insurance Co. of N. Y.

Hoff, John Edgar
4505 Grand Ave., Duluth, Minn.
Chem., The Klearflax Linen Looms, Inc.

Korfhage, Roy F.
246 S. Albert Ave., St. Paul, Minn.
Graduate Student, U. of Wis.

Matthews, Glenn Earl
409 Raines Park, Rochester, N. Y.
Photographic Research Chem., Eastman Kodak Co.

Mitchell, Donald Francis
1000 W. Franklin Ave., Mpls., Minn.
Clerk, Pure Oil Co.

Pippel, Herbert August
1802 Ridge Ave., New Kensington, Pa. Research Chem., Aluminum Co. of America.

Chemical Engineering

Anderson, M. M.
1006 24th Ave. S. E., Mpls., Minn.
Mgr., Minnesota Union, U. of M.

Busch, John S.
Oconto Falls, Wis.
Chemist, Falls Mfg. Co.

Fieger, Ernest A.
423 Toronto Ave., St. Paul, Minn.
Asst. Prof. in Chem., Louisiana State University.

Jones, Ernest Joseph
4533 30th Ave. S., Mpls., Minn.
Teaching Fellow in Physics, U. of M.

Kracek, Frank C.
2951 Tilden St. N. W., Washington, D. C. Physical Chem. at the Geophysical Lab., Carnegie Institute.

Parrett, Arthur N.
305 Thaw Hall, U. of Pittsburgh, Pittsburgh, Pa. Instructor.

Pearson, Elmer A.
Ely, Minn. Science Teacher, Aurora, Minn. Chem., Oliver Iron Mining Co., Virginia, Minn.

Sternberg, Heime A.
1714 Elliot Ave. S., Mpls., Minn.
Machine Operator, G. H. Tennant Co.

Stoppel, Arthur E.
511 Ontario St. S. E., Mpls., Minn.
Instr. in Chem., U. of M.

Wallfred, Carl Luther
4554 Wentworth Ave So., Mpls., Minn. Chem. Engr., Mines Exp. Sta., U. of M.

Weber, Ludwig J.
1081 23rd Ave. S. E., Mpls., Minn.
Instr. in Metallography, U. of M.

1921

Chemistry

Cobl, Cady S.
5316 York Ave. S., Mpls., Minn.
Asst. Chem., Minn. Dairy and Food Dept., St. Paul

Epstein, Hymen
2816 Wells St. Milwaukee, Wis.
Production Mgr., Lavo Co. of America.

Kryger, Edward R.
931 Clark St., St. Paul, Minn.
Chem., National Lead Battery Co.

Nygard, Edwin Marcus
3037 Fifth Ave. S., Mpls., Minn.
Asst. Chem., Mines Exp. Sta., U. of M.

Riley, Philip J.
Round Lake, Minn. Asst. in Chem., U. of M.

Seymour, Merrill Wilmer
596 Augustine St., Rochester, N. Y.
Research Photographic Chem., Research Lab., Eastman Kodak Co.

Westerberg, Carl George
3948 Ewing Ave. S., Mpls., Minn.
Chem., Mpls. Brewing Co. and Koonz Preparation Co.

Chemical Engineering

Aronovsky, Samuel Isaac
1008 Carlton Ave., Cloquet, Minn.
Chem. Engr., The Northwest Paper Co.

Boxell, Morris L.
Oleum, Cal. Research Chem., Union Oil Co. of California.

Cornell, Reuben Willett
Y. M. C. A., Red Wing, Minn.
Chem. Engr., Pittsburgh Plate Glass Co.

Lee, Melville Richard
707 8th Ave. S. E., Mpls., Minn.
Salesman, Smith's Inventions.

Leerskov, Gerhard Wilhelm
4404 Curve Ave., Mpls., Minn.

Nicholson, Harry G.
Crookston, Minn. Concrete Inspector, Minn. Highway Dept.

Peterson, Marshall A.
1618 Charles St., St. Paul, Minn.
Chem., Minn. Highway Dept.

Ramsey, Selmer
Address unknown.

(Chemists—Continued)

RECK, ROBERT CARLYLE
1222 Beacon St., East Chicago, Ind. Chief Chem., U. S. Lead Refineries, Inc.

RIDDINGTON, FREDERICK W.
1522 Highland Ave., Detroit, Mich. Asst. Foreman in Plating Dept., Ainsworth Mfg. Co.

ROBERTS, WESLEY J.
1425 Cedar St., Milwaukee, Wis. Asst. Chem., Patton-Pitcairn Div., Pittsburgh Plate Glass Co.

RUCHHOLT, CLARENCE
Address unknown.

SCHERMER, OSCAR C.
707 University Ave. S. E., Mpls., Minn. Chem., F. W. Bliss Lab.

SWART, RICHARD HOUGHTON
2285½ Gordon Ave., St. Paul, Minn. Ives Ice Cream Co.

1922

Chemistry

DARLING, STEPHEN F.
Crosby, Minn. Graduate Student, Harvard. 3 Shepard St., Cambridge, Mass.

ELLESTAD, REUBEN B.
700 15th Ave. S. E., Mpls., Minn. Asst. in Chem., U. of M.

HAMMOND, KATHRYN D.
2556 Aldrich Ave. S., Mpls., Minn. Education Student, U. of M.

SULLIVAN, BETTY
1014 17th Ave. N., Mpls., Minn. Chem., Russell Miller Milling Co.

TAPPAN, RUTH W.
Milwaukee Co. Hospital, Wauwatosa, Wis. Technician.

Chemical Engineering

BARRETT, JOSEPH O.
1494 Capitol Ave., St. Paul, Minn. Chem., St. Paul Water Dept.

BUSCH, WILLIAM A.
5005 Lyndale Ave. S., Mpls., Minn.

CASSEL, NORMAN S.
763 McMakin Ave., Winton, Minn. Cincinnati, O. Chem. Div., Proctor and Gamble Co., Ivorydale, O.

CHADBOURNE, L. RODNEY
Curtis Hotel, Mpls., Minn.

HALVORSON, HALVOR ORIN
64 Melbourne Ave. S. E., Mpls., Minn. Graduate Student, U. of M.

LANGSETH, AXEL O.
1005 Jessie St., St. Paul, Minn.

LIVERMORE, HARVEY J.
535 Asbury St., St. Paul, Minn. Engr., National Lead Battery Co.

LUGER, KARL E.
Aluminum Club, New Kensington, Pa. Sales Apprentice, Aluminum Co. of America.

MANUEL, DOUGLAS R.
114 Orlin Ave. S. E., Mpls., Minn. Chem. Engr., Republic Creosoting Co., St. Louis Park.

MORIN, WILLIAM TRUESDELL
1037 S. Los Angeles St., Los Angeles, Cal. Sales Engr., Refractory Div., Pacific Abrasive Supply Co.

MORKEN, CARL H.
3159 Park Ave., Mpls., Minn. Engr., The Photoplating Co.

SCHWARTZ, MARCEL
Y. M. C. A. Hotel, Chicago, Ill. Chem., Commercial Testing and Engr. Co.

STONE, LESLIE F.
613 Oak St. S. E., Mpls., Minn. Asst. in Chem. U. of M.

WYMAN, LEROY LINWOOD
271 Parker St., Newark, N. J. Metallographist, Edison Lamp Wks., Gen. Elec. Co., Harrison, N. J.

1923

Chemistry

ANDERSON, WINSLOW M. S.
12 Enterprise St., Raleigh, N. C. Instr. in Chem., N. C. State College, State College Station.

BAKKEN, A. C. M. S.
Aluminum Club, New Kensington, Pa. Research Chem., Aluminum Co. of America.

KAMPA, EDMUND P.
613 Oak St. S. E., Mpls., Minn. Salesman, Cities Service Oil Co., St. Paul.

KESTER, ERNEST B. M. S.
904 Judson Ave., Evanston, Ill. Public Health Institute Fellowship in Arsenic, Northwestern U.

PAGEL, H. ARMIN M. S.
La Crescent, Minn. Instr. in Chem., Park Region Coll., Fergus Falls.

WEBSTER, CORA HELEN
3008 Fremont Ave. S., Mpls., Minn. Chief Chem., Minneapolis Steel and Machinery Co.

Chemical Engineering

BOSTWICK, ROSS D.
E. 2428 Diamond Ave., Hillyard Sta., Spokane, Wash. Graduate Student, U. of Cal.

BRUCE, G. NORMAN
Address unknown.

ECK, LESTER JOHN
700 Cromwell Ave., St. Paul, Minn. Chief Chem., Mpls. Gas Co.

ERNST, ROBERT C. M. S.
500 Delaware St. S. E., Mpls., Minn. Instr., School of Chem., U. of M.

EDGAR, DONALD E.
60 Melbourne Ave. S., Mpls., Minn. Asst. in Chem., U. of M.

FIRTH, CHARLES V.
1322 Douglas Ave. S., Mpls., Minn. Laboratory Asst., Mines Exp. Sta., U. of M.

FREDERICKSON, HUBERT M.
527 5th Ave. S. E., Mpls., Minn. Salesman, Cities Service Oil Co., St. Paul.

HATCH, LLOYD
Chief Chem., Minn. Mining Co., St. Paul, Minn.

MCMILLEN, ELLIOT L.
1830 Lincoln Ave., St. Paul, Minn. Asst. in Chem., U. of M.

PAULSON, PAUL M.
300 Barclay St., Perth Amboy, N. J. Roessler and Hasslacher Chemical Co., Patent Dept.

PETERSON, CLIFFORD E.
1715 18th St., Milwaukee, Wis. Chem. Engr., Wm. O. Goodrich Linseed Oil Co.

RADEMACHER, RICHARD L.
4412 W. Lake Harriet Blvd., Mpls., Minn. Chem. Div., Republic Creosoting Co., St. Louis Park.

SORENSON, BEN EDMUND
613 Oak St. S. E., Mpls., Minn. Asst. in Chem., U. of M.

THORDARSON, WILLIAM
Research Chem., Empire Gas & Fuel Co., Oil Hill, Kan.

WHITE, ROBERT H.
4316 Fremont Ave. S., Mpls., Minn. Asst. Sec., White Price Co.

1924

Chemistry

FREDRICKSON, EDNA
Address unknown.

HUMPHREY, GERTRUDE J.
3728 Elliot Ave., Mpls., Minn. Post-Graduate, U. of M.

LUDVIG, LLEWELLYN G.
1801 Humboldt Av. S., Mpls., Minn. Harvard Graduate School of Business Adm., 33 Perkins Hall, Cambridge, 38, Mass.

Chemical Engineering

BACHE, EDMUND
642 Portland Ave., St. Paul, Minn. Research Chem. Engr., Waldorf Paper Products Co.

DAHLEN, MILES
1362 Simpson Ave., St. Paul, Minn. Asst. in Chem., U. of M.

FUHRMAN, ALVIN O.
E. 1023 14th Ave., Spokane, Wash. Engr., Western Distr. Co., El Dorado, Kan.

GLENN, HARRY W.
518 Carlton Ave., Cloquet, Minn. Works Chem., Northwest Paper Co.

KRANTZ, RUDOLPH W.
1875 Laurel Ave., St. Paul, Minn. Graduate Student, U. of M.

LAVINE, IRVIN
1312 12th Ave. N., Mpls., Minn. Asst. in Chem., U. of M.

LUFT, HANS LAWRENCE
607 N. Central Ave., West Duluth, Minn. Production Clerk, Klearflax Linen Looms, Inc.

PAUL, KARL F.
2508 Dupont Ave. S., Mpls., Minn. Empire Refineries, Inc., Okmulgee, Okla.

ROQUE, FELICIANO T.
No. 36 Naval St., Malabon, Rizal, P. I. Philippine Govern. Employe, care of Bureau of Science.

ZIMA, ALBERT G.
316 6th Ave. S. E., Mpls., Minn. Chem., Western Crucible Steel Casting Co.

THE 1925 SCHOOL OF MINES DIRECTORY

1894

PETER CHRISTIANSON E. M.
217 Union St. S. E., Mpls., Minn. Prof. of Met., Minn. Sch. of Mines.

1895

CHARLES D. WILKINSON E. M.
Goldfield, Nev. Consulting Engr., Diamondfield Black Butte Mining Co.

1896

ALBERT E. MAY E. M.
10 Beals St., Brookline, Mass Mining Engr.

WALLACE N. TANNER E. M.
520 Hennessy Bldg., Butte, Mont. Mech. Eng.

1897

GEORGE BECKER E. M.
Box 504, Morenci, Ariz. Min. Engr.

EUGENE C. MILLS E. M.
Sacramento, Cal. Cons. Engr., Irrigation and Drainage.

ROLAND T. WALES E. M.
2 Sylvan Place, New Rochelle, N. Y. Liomin & Wales Co., Inc., of New York City.

1898

CYRIL BRACKENBURY E. M.
St. Maur, Newton Abbot, Devonshire, England. Joint Mgr., Devon & Courtenay Clay Co.

JOSEPH B. MCINTOSH E. M.
Suite 6, 121 E. 6th St., Los Angeles, Cal. The Moran Co., Eng.

CLINTON L. WALKER E. M.
650 Highland Ave., Piedmont, Oakland, Cal. Capt., Eng., U. S. R.

1899

WILLIAM C. BASS E. M.
Smith, Emery Co., Los Angeles, Cal.

ANDREW Y. PETERSON E. M.
Coleraine, Minn. Gen. Supt., Canisteo Dist., Oliver Iron Mining Co.

FRANK M. WARREN E. M.
3427 Humboldt Ave. S., Mpls. Cons. Engr.

1900

WILLIAM L. CAMPBELL E. M.
Davenport, Wash. Owner and Operator, Farmers' Store.

EUGENE D. CHANDLER E. M.
Casa Grande, Ariz. Safety engr., Inspiration Consolidated Copper Co.

OLIVER J. EGLESTON E. M.
Kennett, Cal. Mgr., Mammoth Plants, U. S. Smelting, Refining & Mining Co.

WALTER E. HUNT E. M.
411 Fairview Ave., Glendale, Cal. Min. Engr., E. J. Longyear Co.

EDWARD P. MCCARTHY E. M.
Laramie, Wyo. Prof. Min. Eng., U. of Wyo.

HAROLD W. TEAGUE E. M.
310 Oak St., Detroit, Minn.

RENSSELAER H. TOLL E. M.
1970 Atlantic Ave., Long Beach, Cal.

1901

THOMAS O. BURGESS E. M.
Porteau, B. C. Supt., The Deeks Gravel & Rock Co.

W. HOWARD CLAPP E. M.
Pasadena, Cal. Prof. of Mechanism and Machine Design, Cal. Inst. of Technology.

ARTHUR L. GHOLZ E. M.
2005 James Ave. S., Mpls. Mining Engr.

HENRY S. SANDERSON Met. E.
406 Interstate Bldg., Denver, Col. Cons. Min. Engr. and U. S. Mineral Surveyor.

ELMO V. SMITH Met. E.
1610 Walker Bank Bldg., Salt Lake City, U. Contracting Mgr., American Bridge Co.

HOVAL A. SMITH E. M.
Warren, Ariz. Min. Engr.

JOHN TARESH E. M.
Rio Oso, Cal. Engr. and Sec., Reclamation District No. 1001.

1903

SAMUEL W. COHEN E. M.
Dominion Express Bldg., Montreal, Can. Cons. Min. Engr.

EDWARD M. FIELD E. M.
804 Metropolitan Life Bldg., Mpls. Mechanical Service Company.

JOHN G. FLYNN E. M.
El Oro, Ostado de Mexico, Mex. Supt., El Oro Min. & Railway Co.

HAROLD J. HOARD E. M.
Care of U. G. I. Contracting Co., Sioux City, Ia. Steam Power Plant Constr. and Hydroelec. Investigation.

HENRY H. HOLDEN Met. E.
4027 Goldfinch St., San Diego, Cal.

DONALD M. RAIT E. M.
Box 744, Warren, Ariz. Asst. Supt. of Mines, Calumet and Arizona Mining Co.

FRANKLIN W. SMITH E. M.
Box 919, Bisbee, Ariz. Smith & Ziesemer, Bisbee.

LAWRENCE K. SOWLE E. M.
219 Union Mortgage Bldg., Cleveland, O. Real Estate and Mortgage Securities.

WILLIAM H. TRUESDALE E. M., M. S.
Ray, Ariz.

EUGENE E. WHITELEY E. M.
Box 705, Warren, Ariz. Supt. of Mines, Calumet & Arizona Min. Co.

ARNO WINTHER E. M.
Comstock, Nev. Mgr., United Comstock Mines Co.

1904

FRANK A. BOWMAN E. M.
Bellflower, Cal. Min. Engr.

HAROLD I. BROSIUS Met. E
Minas de Oro, Honduras, C. A. Examining Min. Prop. in Honduras.

FRANCIS C. DEVEREUX E. M.
Minas-de-Matahambre, Province Pinar-del-Rio, Cuba.

WILLIAM H. HALE E. M.
607 5th Ave. S., Mpls. Pres. & Treas. Wm. H. Hale & Co

LEWIS K. HOULTON E. M.
Elk River, Minn. Real Estate and Banking.

AMOR F. KEENE E. M.
233 Broadway, N. Y. City. Cons. Min. Engr.

MERTON S. KINGSTON E. M.
Eveleth, Minn. Operating Kingston Min. Co., Rutland Min. Co., Fault Min. Co.

ANDREW L. MCCARTY E. M.
Silver City, N. M.

LUCIEN MERRITT E. M.
428 Met. Bank Bldg., Mpls. Contractor.

SYDNEY L. SHONTS E. M.
Wallace, Ida. Cons. Min. Engr.

1905

HARRY H. ANGST E. M.
Chisholm, Minn. Supt., Moroco Mine, Ironton, Minn.

ROBERT R. BOYD E. M.
Box 376, Beverly Hills, Cal. Min. Engr.

W. CHAUNCEY CADWELL E. M.
Box 143, Anaconda, Mont. Supt., Surface Dept., Washoe Smelter, A. C. M. Co.

ALLAN B. CALHOUN E. M.
Burma, India. Mine Mgr., Burma Corp., Ltd., Bawdwin, Burma.

DUNCAN E. CURRY E. M.
122 Hart Ave., Ocean Park, Cal.

THOROLD F. FIELD E. M.
Care of Mr. Chester A. Congdon Estate, 807 Lonsdale Bldg., Duluth. General Cons. Engr.

HERVEY GULICK E. M.
273 Redondo Ave., Long Beach, Cal.

ORRIN E. M. KELLER E. M.
1621 Kincaid St., Highland Park, Ill. Mgr., Feed Dept., J. J. Badenock Co., Chicago.

HENRY E. LOVE E. M.
Hibbing, Minn. Asst. Chief Engr., Hibbing District, Oliver Iron Mng. Co.

WALTER W. LYTZEN E. M.
Prescott, Ariz. Min. Engr.

HENRY S. MCKAY E. M.
Cananea, Sonora, Mex. Gen. Supt., Calumet & Sonora of Cananea Min. Co.

ROBERT S. MERRIAM E. M.
Wallace, Ida. Chief Engr., Callahan Zinc-Lead Co.

EMIL G. MINDER E. M.
Slayton, Minn. Cons. Engr.

ERICK J. SCHRADER E. M.
Reno, Nev. Cons. Engr.

RALPH A. ZIESEMER E. M.
Box 394, Bisbee, Ariz. Member of Firm of Smith & Ziesemer, Bisbee.

1906

JOHN BRANDT E. M.
Hibbing, Minn. Dept. of Mines and Mineral Lands, State of Minn.

LESTER L. CLEMENT E. M.
928 Clarke Ave., Ames, Ia. Dist. Engr., Ia. Highway Coms'n.

(*Miners—Continued*)

GUY F. HARRINGTON E. M.
Box 709, Santa Fe, N. M. Dist. Engr., Gen. Land Office, Interior Dept.

FRANK T. HOWES E. M.
1472 Ashland Ave., St. Paul, Minn. Asst. Engr., Northern Pacific R. R.

PAUL S. KURTZMAN E. M.
Box 627, Hibbing, Minn. Supt., Albany Mine, Pickands, Mather & Co.

WILLIAM F. MOENKE E. M.
Box 69, Sunrise, Wyo. Geologist.

CHARLES MORGAN E. M.
2019 Clarendon Ave., Bessemer, Ala. Supt., Brown Ore Mine, Woodward Iron Co.

BERTHOLD R. NEUSTADT E. M.
634 2nd St., LaSalle, Ill. Merchant.

EDWARD S. O'CONNOR E. M.
P. O. Box 696, Mayville, Wis. Mine Supt., The Mayville Iron Co.

HORACE C. RAWSON E. M.
2015 W. 49 St., Mpls. Bldg. Constr.

WILLIAM A. ROSE E. M.
Duluth, Minn. Asst. Gen. Mgr., Pickands, Mather & Co.

GEORGE W. WALLACE E. M.
1222 23rd Ave., Oakland, Cal.

WALTER H. WHEELER E. M.
1110 Met. Life Bldg., Mpls. Special Engr. for Hennepin County.

1907

ROBERT H. BASSETT E. M.
Care of Hanna Ore Min. Co., Hibbing, Minn. Chief Engr., Hanna Ore Min. Co.

JAMES COWIN E. M.
526 McKnight Bldg., Mpls. Pres., Cowin & Co., Ltd., Winnipeg, Man., and Cowin & Co., Inc., Mpls.

SILAS L. GILLAN E. M.
203 W. Maple St., Glendale, Cal. Min. Engr. Specializing in the Valuation of Oil Land and Mines.

CHARLES F. JACKSON E. M.
Skouriotisca, Nicosia, Cyprus. Supt., Cyprus Mines Corp.

RANDOLPH J. MCRAE E. M.
315 W. 98th St. New York City.

ANTON C. OBERG E. M.
316 Sellwood Bldg., Duluth, Minn. Cons. Min. Engr.

HENNING E. OLUND E. M.
615 A. G. Bartlett Bldg., Los Angeles, Cal. Cons. Min. Engr.

WALTER H. PARKER E. M.
Sch. of Mines, U. of Minn., Mpls. Prof. of Mining, School of Mines.

ELMER A. PROBST E. M.
Amalfi, Colombia, S. A. Mgr., La Viborita Co., Amalfi, Colombia, S. A.

OLAF ROED E. M.
2818 10th Ave. S., Mpls., Minn.

EDGAR W. SMITH E. M.
3520 W. Lake Calhoun Blvd., Mpls. Engr., Winston Bros. Co.

CHARLES W. STEELE E. M.
Elec. Steel Foundry, Portland, Ore. Sales Engr., Elec. Steel Foundry.

KARL P. SWENSEN E. M.
51 Chambers St., New York City. Oriental Mgr., Allied Mach. Co. of America.

MICHAEL A. WIEST E. M.
311 Phoenix Bldg., Mpls. Dist. Mgr., Mutual Life Ins. Co. of New York.

HARRY M. ZIESEMER E. M.
Box 394, Bisbee, Ariz. Chief Engr., Phelps-Dodge Corp.

1908

PATRICK J. BOYLE E. M.
Eveleth, Minn. Garage Prop.

JAMES A. CULLYFORD E. M.
Box 56, Route 2, Lodi, Cal. With Southern Pacific Co.

WILLIAM A. DEICHEN E. M.
Ironton, Minn. Inland Steel Co.

FRANK R. EDWARDS E. M.
Oklahoma City, Okla.

WILLIAM R. GOODWIN E. M.
2552 Aldrich Ave. So., Mpls. Engr. of Timber Preservation, Soo Line R. R.

JOHN A. GRIMES E. M.
510 Treasury Annex No. 1, Washington, D. C. Chief of Metals Valuation Section, Eng. Div., Income Tax Unit.

OLE G. HOASS E. M.
Care of Federal Power Cmsn., Room 1215, Interior Bldg., Washington, D. C. Min. Engr., Federal Power Cmsn.

JOHN J. KENNEDY E. M.
14th Floor, 11 Broadway, N. Y. City. Export Mgr., Ingersoll-Rand Co.

ARTHUR K. KNICKERBOCKER E. M.
610 Sellwood Bldg., Duluth, Minn. Min. Engr., Stanley Mining Co.

ALFRED M. LOCKE E. M.
Waterloo Ia. Research Engr.

JOHN S. OLMSTEAD E. M.
Ajo, Ariz. Leaching Dept., New Cornelia Copper Co.

JOSEPH S. PETERSON E. M.
Smuggler, Col. Asst. Gen. Mgr., Tomboy Gold Min. Co.

JOHN L. STRONG E. M.
615 Wolvin Bldg., Duluth, Minn. Min. Engr., Oliver Iron Min. Co.

1909

WILLARD A. COLE E. M.
710 Security Bldg., Mpls. Dist. Engr., E. J. Longyear Dev. Co.

JAY CROWLEY E. M.
Grafton Cal. Chief Engr., Reclamation Dist. Nos. 1500 and 1660.

LAWRENCE T. GAVIN E. M.
710 Providence Bldg., Duluth, Minn. Vice-Pres., Wm. H. Ziegler Co., Inc.

ROY C. GRANT E. M.
66 rue des Colonies, Bruxelles, care of Forminiere. Min. Engr., Companhia de Diamantes de Angola.

GEORGE B. HOGNASON E. M.
Minneota, Minn.

SAMUEL L. HOYT E. M.
Gen. Elec. Co., Schenectady, N. Y. Metallurgist. Research Lab. of Gen. Elec. Co.

LYNN ROOD E. M.
Care of Chas. Weinhagen & Co., St. Paul, Minn. Sec. and Treas., Chas. Weinhagen & Co.

JULIUS H. SANTO E. M.
Ely, Minn. Dean of Junior College, Ely, Minn.

HAROLD G. TAYLOR E. M.
1046 McKnight Bldg., Mpls. Northwestern Sales Engr., Permutit Co.

HOMER A. WILLIAMS E. M.
883 Lakeview Ave., St. Paul, Minn. Valuation Engr., D. F. Wilcox Co.

1910

HARRY R. BISCHOFF E. M.
Box 354, Haileybury, Ont., Can. General Mining Work.

CHARLES R. CONKEY E. M.
706 First Ave. N., Mpls. Asst. Gen. Mgr. and Director, Fegles Constr. Co.

LAWRENCE DEVEREUX E. M.
1004 19th Ave. S. E., Mpls. Private Engr. Work.

KENNETH J. DUNCAN E. M.
Ely, Minn. Supt., Zenith Mine for Vermilion Mining Co.

HENRY E. FARNAM E. M.
405 Builders Exch., Duluth, Minn. General Contractor.

ERNEST A. FRITZBERG E. M.
Phillipsburg, Mont.

GEORGE M. GILTINAN E. M.
Care of Autin Co., E. Cleveland, O.

NORMAN P. GOODRICH E. M.
Gold Hill, Nev. Asst. Mill Supt., United Comstock Mines Co.

BENJAMIN G. HARMON E. M.
1201 Tower Bldg., 6 N. Michigan Ave., Chicago, Ill. Dist. Mgr., Mahr Mfg. Co.

CLARENCE L. HEATH E. M.
Box 6, Kirkland Lake, Ont., Can. Engr. and Assayer, Wright-Hargreaves and Sylvanite Mines.

C. SUMNER HEIDEL E. M.
Helene, Mont. State Engr. of Montana.

WILLIAM E. HERRING E. M.
Easton, Minn.

FREDERICK W. HOLLER E. M.
LaSalle, Ill. Gen. Mgr., Matthiessen & Hegeler Zinc Co.

ALGOT F. JOHNSON E. M.
912 Plymouth Bldg., Mpls. Senior Member of Johnson, Drake & Piper, Inc.

PHILO E. JONES E. M.
509 Oak St., Kelso, Wash. Memer, Consolidated Constr. Co.

CLARENCE L. LARSON E. M.
427 North "O" St., Muskogee, Okla. Pres., Ilex Southern Mills Lbr. Co.

FOREST M. LEONARD E. M.
United States Tariff Cmsn., Washington, D. C. Special Expert, U. S. Tariff Cmsn.

JAMES R. MCKENZIE E. M.
Care of Macdonald Eng. Co., Chicago, Ill. Supt. on Constr., Macdonald Eng. Co.

REVILLO G. MOODY E. M.
3439 10th Ave. S., Mpls. Eng. Dept. City of Mpls.

JOHN R. NEWELL E. M.
Box 1033, Spokane, Wash. Mgr., Spokane Concrete Pipe Co.

PETER M. OSTRAND E. M.
Crosby, Minn. Member Contracting Firm, Ostrand and Hallett.

G. GORDON STEWART E. M.
Roseburg, Ore. Private Eng. Practice and U. S. Mineral Surveyor.

(Miners—Continued)

ARCHIE J. STRANE E. M.
1140 Dayton Ave., St. Paul, Minn. Special Representative, White Eagle Oil and Refining Co.

AXEL H. SWANSON E. M.
Care of Castle-Trethwey Mines, Gowganda, Ont., Can.

1911

THEODORE S. ABBOTT E. M.
535 Grand Ave., St. Paul. Twin City Brick Co.

JOSEPH ANDERSON E. M.
Address unknown.

WALTER C. ANDERSON E. M.
Hibbing, Minn. Eng., Webb Mine. Shenango Furnace Co.

PAUL T. BAILEY E. M.
Yanke Jims, Cal., via Colfax, Cal.

EMORY P. BAKER E. M.
6027 Woodlawn Ave., Chicago, Ill. Chief draftsman, Bridge Dept., Ill. Central R. R. Co.

CHARLES S. BECK E. M.
Box 504, Morenci, Ariz. Supt., Morenci Water Co.

ANSHELM C. BORGESON E. M.
Care of Shenango Mine, Chisholm, Minn.

ROBERT J. BURGESS E. M.
Virginia City, Nev. Supt., Surcease Mine, Yankee Hill, Cal.

CHARLES S. CROUSE E. M.
U. of Ken., Dept. of Mines and Metal. Prof. of Met.

GEORGE M. DRAKE E. M.
834 First Nat.-Soo Line Bldg. Mpls. Pres., Firm of Johnson, Drake & Piper.

VICTOR E. EKLOFF E. M.
Eureka, U. Min. Engr., Chief Consolidated Mining Co.

JAY R. ELLIOTT E. M.
3312 3rd Ave. S., Mpls., Minn. Pres., B. B. Specialty Co.

VICTOR L. FIXEN E. M.
506 Builders Exch. Bldg., Duluth, Minn. Engr. in Charge of Work, MacLeod & Smith, Contractors.

WILLIAM F. JAHN E. M.
Minas Pedrazzini Gold & Silver Mining Co., Arizpe, Sonora, Mex. General Supt.

NEIL S. KINGSLEY E. M.
3009 Portland Ave., Mpls. With Standard Oil Co.

MILTON S. LINDHOLM E. M.
Warren, Ariz. Calumet & Arizona Mining Co.

ERVIN W. McCULLOUGH E. M., Met. E.
214 Liberty Bldg., Indianapolis, Ind. Private Practice.

HAROLD J. RAHILLY E. M.
Care of Anaconda Copper Mining Co., Butte, Mont. Mine Supt., Tramway Mine.

JOHN R. TETLIE E. M.
Box 431, Tonopah, Nev. Chemist, United Comstock Mines Co., Gold Hill, Nev.

E. HAROLD WALKER E. M.
Elizabethville, Katanga, Congo-Belge, Africa. Mine Mgr., Union Miniera Du Haut-Katanga.

CHARLES W. WALTERS E. M.
Room 3533, 120 Broadway, New York City.

ARTHUR J. WEHR E. M.
Fort Riley, Kan. Capt., U. S. A.

LLOYD R. WHITSON E. M.
1009 Southwestern Life Bldg., Dallas, Tex.

1912

GUY N. BJORGE E. M.
788 Mills Bldg., San Francisco, Cal. Mining Geologist.

EDWARD D. COVENTRY E. M.
Willmar, Minn. Willmar Motor Co.

ROBERT H. DICKSON E. M.
Valedon, N. M. Supt., "85" Branch, Calumet & Arizona Mining Co.

LEONARD J. HAGSTROM E. M.
4520 Xerxes Ave. S., Mpls. Field Engr., Northern Appraisal Co.

GEORGE L. HARRINGTON E. M.
560 Avenida de Mayo, Buenos Aires, Argentina. Geologist, Standard Oil Co. in Bolivia and Argentina.

EZRA A. HEWITT E. M.
Ray, Ariz. Supt., Ray Hercules Mines, Inc.

LA FAYETTE KNOX E. M.
Hurley, N. M. Chief Engr., Chino Copper Co., Hurley Plant.

EDWARD G. KREMER E. M.
5024 Harriet Ave., Mpls. Kremer & Hog, Excavating and Gen. Eng.

JOHN LEA E. M.
Univ. Club of Los Angeles, Cal. Supt., White Star Plaster Co., Moapa, Nev.

JOHN W. LEWIS E. M.
623 Mid-Continent Bldg., Tulsa, Okla. Consulting Geologist and Oil Producer.

HOWARD R. McADAMS E. M.
Eveleth, Minn. Oliver Iron Mining Co.

LYNN MARTIN E. M.
Glenwood, Minn. Firm, Martin & Johnsen.

J. CHARLES O'BRIEN E. M.
A. C. M. Co., Conda, Ida. Foreman A. C. M. Phosphate Mine.

WALTER S. OLSON E. M.
Cmsn. of Drainage and Waters, Old Capitol Bldg., St. Paul. Office Eng.

JOE B. PERRY E. M.
Porterville, Cal. Supt. of Mines, Sierra Magnesite Co.

ROSWELL W. PROUTY E. M.
Riverside Portland Cement Co., Riverside, Cal. Examining Geologist.

MAX F. QUINN E. M.
Melrose, Minn.

HOWARD E. STEVENS E. M.
Northwest Amalgam. Fuel Co., Duluth, Minn. Vice-Pres.

WILLIAM L. TAYLOR E. M.
Plymouth Mining Co., Verona, Mich. Supt.

ARTHUR WALLINDER E. M.
Iron Mask Mine, Kamloops, B. C. Supt. and Gen. Mgr., Kamloops Copper Co.

ROLLIE B. WALTER E. M.
Salt Creek, Wyo.

CLARK N. WOODIS E. M.
Deer Trail, Col. Ranching.

1913

LEO J. COADY E. M.
Care of North Butte Mining Co., Butte, Mont. Efficiency Engr.

ROBERT H. ELY E. M.
Eveleth, Minn. Min. Eng. for Robinson-Flinn-Murphy-Dorr Interests.

ARTHUR W. FOSNESS E. M.
515 Union Bank Bldg., Winnipeg, Can. Eng. for the Carter-Halls-Aldinger Co.

ARTHUR H. HAMMOND E. M.
Arizpe, Sonora, Mex. Min. Eng.

J. BERNARD HANSON E. M.
520 N. Dunlap, Memphis, Tenn. Supt. for Gauger-Korsmo Construction Co.

OLAF HONDRUM E. M.
Jerome, Ariz. Shift Boss, United Verde Copper Co.

GREELEY LADD E. M.
2404 Russell Ave. S., Mpls. Asst. Sec.-Treas., Lavoris Chemical Co.

ROY G. MICHIE E. M.
Montevideo, Minn. Co. Eng., Chippewa Co.

ARVID NISSEN E. M., M. S.
Bldg. 86, Edgewood Arsenal, Md. Associate *Physicist*, Chem. Warfare Service.

NORMAN OFSTHEN E. M.
923 W. 34th St., Los Angeles, Cal.

CHARLES A. WALKER E. M.
Address unknown.

1914

ARTHUR P. ANDERSON E. M.
Address unknown.

ALFRED C. BIERMAN E. M.
311 Southland Life Ins. Bldg., Dallas, Tex. Eng. and Geologist.

HOWARD N. EIGEMILLER E. M.
Ramsay, Mich. Chief Eng. and Geologist, Castile Mining Co.

ERNEST L. LARSON E. M.
Linnton, Ore.

ORRIN W. POTTER E. M.
1803 Princeton Ave., St. Paul, Minn. Instr. in Drawing and Descriptive Geometry, U. of Minn.

HOWARD QUINLAN E. M.
542 Ashland Ave., St. Paul, Minn. Vice-Pres., Allen Quinlan Co.

LOUIS G. RAVICZ E. M.
Hayden, Stone & Co., 25 Broad St., New York City. Petroleum Geol. and Engr.

JOHN H. ROBERTSON E. M.
Box 1405, Miami, Ariz.

HAROLD J. WASSON E. M.
6115 Kimbark Ave., Chicago, Ill. Geol. and Eng., New England Oil Corp., Ltd.

1915

WILLIAM V. BUTLER E. M.
Forminiere, 66, Rue des Colonies Brussels, Belgium. Min. Eng. with Societe Internationale Forestiere et Miniere du Congo, Belgian Congo.

ALFRED CHRISTENSON E. M.
Crystal Falls, Mich. District Chief Engr., Menominee Range Mines, McKinney Steel Co.

WALTER A. COLLER E. M.
2270 Riverwood Place, St. Paul, Minn. Broker, Steel and Iron Products.

(Miners—Continued)

LEON T. COLLINS E. M.
3925 So. Wilton Place, Los Angeles, Cal.

ALBERT C. HAUGEN E. M.
Hanska, Minn. Min. Engr.

LOUIS S. HEGLIG E. M.
5050 Nicollet Ave., Mpls., Minn. With Minnesota Tax Cmsn.

CHARLES D. KERR E. M.
101 Leonidas Location, Eveleth, Minn. Oliver Iron Mining Co.

HERMAN NEERLAND E. M.
1246 University Ave., St. Paul, Minn. Right-of-way Engr., Minn. Highway Dept.

FRED C. RAMSING E. M.
125½ Elm St., Anaconda, Mont. Chem., Research Lab., A. C. M. Co.

RICHARD M. SANCHEZ E. M.
Casapalca, Peru, S. A. Chief Eng., Sociedad Minera Backus y Johnston del Peru.

GEORGE K. URQUHART E. M.
Elcor, Minn. Eng., Elva and Corsica Mines, Pickands, Mather & Co.

HENRY H. WADE E. M.
Hopkins, Minn. Metallurgist, Sch. of Mines Exp. Sta., U. of Minn.

PAUL S. WILLIAMS E. M.
810-13 Mid-Continent Bldg., Tulsa, Okla. Oil Operator.

1916

SAM ARONSON E. M.
Atlantic Oil Producing Co., Dallas, Tex. Subsurface Geologist.

JOHN J. CRAIG E. M.
3817 1st Ave. S., Mpls. Asst. Met., Mines Exp. Sta., U. of Minn.

FRED A. DAVIES E. M.
Box 1304, Billings, Mont. Geologist, California Co.

ADOLPH DOVRE E. M.
Cisco, Tex. Independent Oprt.

ALVIN T. KROGH Met. E.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. Research Engr.

OSCAR LEE E. M.
U. S. Bureau of Mines, U. of Ala., University, Ala. Charge of Iron Ore Concentration.

ARCHIE J. MCDERMID E. M.
Box 100, Miami, Ariz. Efficiency Engr. for Miami Copper Co.

ROY H. MCHARDY E. M.
4037 18th Ave. S., Mpls.

HARRY H. NORD E. M.
Billings Mine, Chisholm, Minn. Mine Capt., Stambaugh Iron Co.

1917

EDWIN H. ANDERSON E. M.
Crystal Falls, Mich. Engr., McKinney Steel Co.

CHARLES E. BURESCH E. M.
Lakefield, Minn.

LEWIS S. CORYELL E. M. (Geol.)
Bristow, Okla. Cons. Geologist.

RICHARD C. DENNIS E. M.
Maracaibo, Venezuela, S. A. Engr., New England Oil Corp.

J. LAWRENCE DOPP E. M.
Chiquacamata, Chile, S. A. Eng., Chile Exploration Co.

WILLIAM H. ELSON E. M.
902 Petroleum Bldg., Tulsa, Okla. Indep. Oil Opr. and Cons. Geologist.

OMER F. ERNSTER E. M., M. S.
Care of Sinclair Exploration Co., 45 Nassau St., New York City. In Charge of Geol. Work in Angola, Portuguese West Africa.

EDWARD J. FEARING E. M.
Crosy, Minn. Eng., John A. Savage & Co.

SYDNEY HARMON E M.
Henry L. Doherty & Co., 345 Hamm Bldg., St. Paul, Minn.

W. EARLE HUBBARD E. M. (Geol.)
Drawer 58, Ardmore, Okla. Div. Geol., Humble Oil and Refining Co.

YIH KUN KWONG E. M. (Geol.)
Care of K. W. Kwong, Kiangnan Dock & Eng. Works, Shanghai, China.

A. IRVING LEVORSEN E. M.
Box 127, Okmulgee, Okla. Dist. Geol., Gypsy Oil Co.

PAUL A. PETERSON Met. E.
Address unknown.

EDWIN A. SWEETMAN E. M. (Geol.)
Virginia, Minn. Min. Eng., Interstate Iron Co.

CARLETON S. WALLACE E. M. (Geol.)
Hollywood, Cal. Tile and Marble Contractor.

JOHN J. WOODRUFF E. M.
National Carbon Co., Niagara Falls, N. Y.

RAYMOND W. ALLARD Met. E.
Sch. of Mines, U. of Minn., Mpls. Instr. in Ore Dressing.

HAROLD K. ARMSTRONG E. M.
3034 Lyndale Ave. S., Mpls. Geol., Cerro de Pasco Copper Corp., Cerro de Pasco, Peru.

PERCY G. COWIN E. M.
3826 Summit Ave., Birmingham, Ala. Member of Salmon & Cowin, Inc., Min. Eng. and Contr.

RALPH L. DOWDELL Met. E., M. S.
1466 Como Ave. W., St. Paul, Minn. Instr. in Metallography, U. of Minn.

LYNDON L. FOLEY E. M. (Geol.)
11 W. 48th St., Mpls. Independent Geologist.

ROGER W. GANNETT E. M. (Geol.)
Box 107, Cameron, Wis. Instr. in Geology, Mich. State Coll. of Agri. and Applied Sciences, East Lansing, Mich.

CHUNG HSIEH E. M.
Care of Kirin Y. M. C. A., Kirin City, China. Compradore of Andersen, Mayer & Co., Ltd., Mukden, Manchuria.

GUY E. INGERSOLL E. M. (Geol.)
Box 241, Ray, Ariz. Shift Boss, Ray Mine No. 2, Ray Consolidated Copper Co.

WALTHER L. JERRARD E. M.
Shell Co. of Cal., Room 415, Higgins Bldg., Los Angeles, Cal. Geol.

JOHN A. MOGA E. M.
271 Charles St., St. Paul, Minn. Student, Medical School, U. of M.

HOWARD E. QUINN E. M. (Geol.)
Tex. Sch. of Mines, El Paso, Tex.

1919

SIDNEY A. FRELLSEN E. M.
1523 E. Lake St., Suite 10, Mpls. Consulting Engineer.

BERT GOLDBERG E. M.
138 N. Dale St., St. Paul, Minn.

SAMUEL B. GOLDBERG E. M.
Quirivilca, Peru, via Trujillo, Peru. Mine Foreman and Eng. for Quirivilca Mines of Northern Peru Mining & Smelting Co.

JOSEPH O. HOSTED E. M. (Geol.)
Cerro de Pasco, Peru. Geologist.

WALTER R. MELLEM E. M.
Crosby, Minn. Instr., Crosby-Ironton High School.

WEN PING PAN Met. E.
Hibbing, Minn. Min. Eng., Oliver Iron Mining Co.

1920

ROBERT E. AINSWORTH E. M.
Care of H. A. Van Norman, Room 315, 254 So. Broadway, Los Angeles Right-of-Way Div., Office of H. A. Van Norman, Cons. Eng. for City of Los Angeles.

LEWIS E. ARNOLD E. M.
City Eng. Dept., Los Angeles, Cal.

A. K. BAILEY, JR. E. M.
Llallagua, Bolivia, S. A. Chief Eng. with Compania Estanifera de lallagua.

FRED E. CLARK E. M.
932 S. Main St., Los Angeles, Cal. City Engineer's Office, Los Angeles.

WM. A. COPELAND E. M. (Geol.)
Carnegie Inst. of Tech., Pittsburgh, Pa. Instr. in Geology and Mineralogy.

ABNER J. DONAGHUE E. M.
Box 65, Inspiration, Ariz. Mine Transitman, Inspiration Consolidated Copper Co.

JOHN EDWIN E. M.
Surinaamsche Bauxite Mahtschappig, Paramaribo, Dutch Guiana, S. A. Mining Eng.

HARRY O. FRANK E. M.
2002 Lake of the Isles Blvd., Mpls.

AXEL L. JOHNSON E. M.
Box 412, Nashwauk, Minn. Engr., Butler Bros. Mines, Cooley, Minn.

ERWIN H. KERSTEN E. M.
624 Erie St. S. E., Mpls. Instr. in Metallurgy, Minn. Sch. of Mines.

ISRAEL MARK E. M.
828 16th Ave. N., Mpls., Minn.

CLIFFORD R. NICHOLS E. M.
Plymouth, Cal. Eng., E. J. Longyear Dvlpt. Co.

CLARENCE D. PETERSON E. M.
1927 Washington Ave. S., Mpls. Field Engr., Bureau of Bldgs., Board of Education, Mpls.

CLIFFORD R. RAITER E. M.
1303 Sherburne Ave., St. Paul, Minn. Asst. Supt., Constr. and Repair, City of St. Paul.

JAMES D. WHEELER E. M. (Geol.)
Standard Oil Co. of Calif., Colombia, S. A.

1921

ROY G. BUTLER E. M.
233 Park Ave., Beaver Dam, Wis. Minn. State Highway Cmsn.

(Miners—Continued)

EDWIN N. CARLSON E. M. (Geol.)
Box 1116, Wichita, Kan. Geologist, White Eagle Oil and Refining Co.

CHARLES H. CHADBOURN E. M.
5129 Penn Ave. S., Mpls., Minn. Chadbourn Bros. & Co., Realtors, 705 Palace Bldg., Mpls.

HERMAN F. DAVIES E. M. (Geol.)
Box 1304, Billings, Mont. Geologist, Cal. Oil Co.

LOREN W. DAWSON Met. E.
Home address, 2532 Stevens Ave., Mpls. Maintenance and Constr. Dept., Northern Pacific Ry. Co., Jamestown, N. D.

ELDEN FRANK E. M.
319 No. 60 Ave. W., Duluth, Minn. Insp. Dept., Minn. Steel Co

BENNIE W. GANDRUD E. M.
U S. Bureau of Mines, Tuscaloosa, Ala.

FRANK J. HAMERNIK Met. E.
Houghton, Mich. Student, Mich. College of Mines.

KENNETH A. JOHNSTON E. M.
Buhl, Minn. Eng., Wanless Mine, Oliver Iron Min. Co.

WILLIAM J. NICHOLS Met. E.
International, Utah. Assayer, International Smelter.

CARL H. SEBENIUS E. M.
Annapolis, Mo. Annapolis Lead Co.

EDWIN C. SPONBERG E. M.
Berkshire Mine, Mellen, Wis. Asst. Chem. Eng., Berkshire Mining & Development Co.

C. M. WALZ E. M. (Geol.)
1470 W. 35th, Mpls.

FRANK B. WENGER Met. E.
Deerwood, Minn. Eng., Potts Exploration Co.

HERBERT S. WEST Met. E.
Dept. of Public Works, City of St. Paul. Civil Engineer.

EUGENE ZANGER E. M.
New York & Honduras Rosario Mining Co., San Juancito, Honduras, C. A.

1922

E. MAURICE ADAMS E. M.
1816 Tenth St., Wichita Falls, Tex. Min. Eng., W. H. Godfrey, Wichita Falls.

OSCAR B. ANDERSON E. M.
209 Washington St., No. Hibbing, Minn. Eng. Dept., Oliver Iron Mining Co.

CLIFTON T. BARKER E. M.
Care of U. S. Eng. Corps, Chattanooga, Tenn. Junior Hydraulic Eng.

J. CARROLL BARR E. M.
309 North Mercer St., Newcastle, Pa. With Shenango Valley Improvement Co.

CHEN PING CHANG E. M.
Address unknown.

LUIS DE U. ECHEBARRIA E. M.
Care of New England Oil Corp., Ltd., Apartado 60, Maracaibo, Venezuela, S. A. Engineer.

ARNOLD A. GUSTAFSON E. M.
Crosby, Minn. Eng., Whitmarsh Mining Co. and Fee Agent, Geo. H. Crosby Interests.

MAYER G. HANSEN E. M.
Box 210, Jerome, Ariz. Geologist, United Verde Copper Co.

LOUIS HOFFMAN E. M.
1002 Girard Ave. N., Mpls.

LAWRENCE I. HOPE E. M.
City Engineer's Office, Mpls. Junior Engineer.

TRYGVE JOHNSEN Met. E.
Eng. Dept., N. P. Ry., St. Paul, Minn. Inspector of Construction.

RALPH C. JOHNSON E. M.
Elk River, Minn. Independent Oil Co.

RAYMOND G. KILP E. M.
3420 19th Ave. S., Mpls. Minn. State Highway Cmsn.

SZE CHEN LIN E. M.
36 San Sieh Chie, West City, Peking, China. Eng., Union Trading Corp.

THOMAS S. LOVERING
E. M. (Geol.), M. S., Ph. D.
U. of Ariz., Tucson, Ariz. Instr., Dept. of Geology.

FREDERICK R. MCKENZIE E. M.
Care of Johnson, Drake & Piper Co., Library, Pa.

GREGORY M. MOGA E. M.
1115 E. 1st St., Duluth, Minn. Foreman, Western Tool and Forge Co.

RICHARD C. PATTON E. M. (Geol.)
337 S. Reno St., Los Angeles, Cal.

FRANK J. PLUT E. M.
P. O. Box 484, Ironton, Minn. Eng., Whitmarsh Mining Co.

VICTOR T. THOENI E. M.
519 McKinley Ave., Kellogg, Ida. Assayer, Assay Office, Bunker Hill and Sullivan Smelter.

J. BYRON WILSON E. M.
5053 Penn Ave. S., Mpls.

1923

ALFRED T. ANDERSON E. M.
Elcor, Minn. Pickands, Mather & Co.

JOHN N. BRAWLEY E. M.
829 Goodrich Ave., St. Paul, Minn South Park Foundry & Mach. Co.

WALTER W. BRENNER E. M.
511 Yegen Block, Butte, Mont. Anaconda Copper Co.

ROBERT A. CALHOUN E. M.
Jerome, Ariz.

CHI CHANG E. M.
Arcana Hotel, Coleraine, Minn. Eng., Oliver Iron Min. Co.

J. WITHERS CLAY E. M. (Geol.)
419 1st Nat. Bank Bldg., Shreveport, La. Draftsman, Eng. and Geological Dept., La. Oil Refining Corp.

HOWARD J. CONHAIM E. M. (Geol.)
902 Petroleum Bldg., Tulsa Okla.

FRED D. DEVANEY E. M.
U. S. Bureau of Mines, Tuscaloosa, Ala.

HARRY C. DINMORE E. M.
178 Fourth Ave., East Orange, N. J. Ins., Underwriters' Lab., Inc., Boston and New York.

CHAS. E. ERDMANN E. M. (Geol.)
612 9th Ave. S. E., Mpls. Junior Geologist U. S. Geological Survey.

ARTHUR C. ERICKSON E. M.
306 N. 5th Ave. W., Virginia, Minn. Eng., Oliver Iron Min. Co., Virginia District.

ADOLPH L. FOSS E. M. (Geol.)
Box 476, Ramsay, Mich. Asst. Min. Eng. and Geologist, Castile Min. Co.

ARTHUR J. FRIEDL E. M. (Geol.)
1163 Laurel Ave., St. Paul, Minn.

LUKE J. GALLAGHER E. M.
Faribault, Minn.

ALEXANDER M. GOW E. M.
Apt. 317, 512 Delaware St. S. E., Minneapolis.

WILLIS R. GRISWOLD E. M (Geol.)
509 N. Mercer St., Newcastle, Pa.

HARTLEY H. HAWLICK E. M.
800 Flour Exch., Crete, Neb Mill Mutual Insurance Co.

HOWARD HENKEL E. M. (Geol.)
Box 1961, Jerome, Ariz. Miner and Timberman.

GEORGE HEZZELWOOD E. M.
Eureka, Utah. Asst. Eng., Tintic Standard Min. Co.

GORDON B. JEFFERS E. M., M. S.
Insp. Dept., Minn. Steel Co., Morgan Park, Duluth.

VERN L. KEGLER E. M. (Geol.)
2909 Knox Ave. S., Mpls. Resident Eng., Ducktown Sulphur, Copper & Iron Co., Ltd., Isabella, Tenn.

SHOU KUN KWONG E. M.
Address unknown.

H. E. LATENDRESSE E. M. (Geol.)
Rhodesian-Congo Border Concessions, Ltd., Nhanga, North Rhodesia.

JULIAN H. LEVY E. M.
Illinois State Highway Commission, Springfield, Ill.

RICHARD J. LILLY E. M. (Geol.)
Inst. in Geology, Williams College, Williamstown, Mass.

O. WILLIAM LUNDQUIST E. M.
Box 149, Little Falls, Minn. Lake Co. Eng.

JOHN L. MIDDLETON E. M. (Geol.)
66 Rue des Colonies, Brussels, Belgium. Societe Internationale Foresiere et Minerie du Congo, Belgian Congo.

FRANK E. MOONEY Met. E
405 Monroe St., Gary, Ind. Ill. Steel Co., Gary Plant.

HENRY A. PABST E. M.
Hibbing, Minn. Pit Eng., Mahoning Mine, Pickands, Mather & Co.

ROBERT W. PERSONS Met. E.
Ingersoll-Rand Co., 11 Broadway, New York City. Sales Eng., Rock Drill Sales Dept.

ROLAND B. QUENEAU Met. E.
The Pitometer Co., 50 Church St., New York City.

ROBERT H. RIDGWAY E. M.
U. S. Engineers' Office, Municipal Bldg., Chattanooga, Tenn. Surveyor.

CHARLES B. RUSSELL E. M.
Min. Eng., Bethlehem Mines Corp.

ADOLPH J. SCHNEID Met. E.
Columbia Tool Steel Co., Chicago Heights, Ill.

JOHN N. SEARLES E. M.
State Highway Dept., Wabasha, Minn.

ANTHONY SJOLINDER E. M.
1917 Feronia Ave., St. Paul, Minn. Const. Div., Eng. Dept., N. P. Ry., St Paul.

(*Miners—Continued*)

CARL JAMES SMITH E. M.
Box 298, Coronado, Cal.
Cons. Eng. and Geologist.

CLIFFORD H. SWENSEN E. M.
Constr. Eng., Bethlehem Mines Corp.

HERBERT E. THELLIN E. M.
Box 333, Crosby, Minn.

EVERETT H. TOLLEFSON E. M.
312 S. E. Harvard, Mpls. Instr., Dept. of Drawing and Desc. Geom., U. of Minn.

EDGAR W. VIVIAN E. M.
Eng. Utica Mine, Hibbing, Minn.

FRED H. WILCOX E. M. (Geol.)
Cisco, Tex. Geologist for Firm, Lind-Wilcox.

WILLIAM M. WINTER E. M.
Olivia, Minn. Jr. Eng. for Kircher Bros., Contractors.

DONALD H. WOLFER E. M. (Geol.)
111 Cambridge Ave., St. Paul, Minn. Geologist and Eng., Campbell Oil Co.

HARRY M. WRBITZKY E. M.
Ill. Highway Dept., Peoria, Ill. Jr. Highway Eng.

1924

JOHN A. BALLORO E. M.
2202 Bryant Ave. So., Mpls.
Graduate Work, Harvard Univ.

DONALD G. BRUNNER E. M.
Quartzburg, Idaho. With Idaho Gold Mining Co.

LESLIE M. CASK E. M.
1004 26th Ave. N. E., Mpls. Eng. Dept., Monroe Location, Oliver Iron Min. Co.

FRANCIS J. CURRAN Met. E.
Apt. 21, 315 W. 15th St., Mpls.
Arrow Head Steel Products Co.

ARTHUR C. FORSYTH Met. E.
77 W. Market St., Bethlehem, Pa.
Steel Foundry, Bethlehem Steel Co.

TA HENG HUANG E. M.
73 Warwick Road, Earl's Court, S. W. 5, London, England

BERNARD C. HUTCHINSON E. M.
Inland Steel Co., Chicago, Ill.

CLYDE P. GRAEBER E. M. (Geol.)
5021 Bryant Ave. S., Mpls.

WILLARD C. JENSEN E. M.
Anaconda Copper Mining Co., Anaconda, Mont.

CLARENCE J. KNUTSON E. M. (Geol.)
Glendive, Mont. Instrumentman, N. P. Ry. Co.

RAYMOND M. LARSEN E. M.
Box 4, Midwest, Wyo.
Midwest Refining Co.

CLARENCE O. LEE E. M.
616 Fourth St., Albert Lea, Minn.

CECIL J. MOE E. M.
1602 28th St., Superior, Wis.

JOHN H. NELIMARK E. M. (Geol.)
Virginia, Minn.
Oliver Iron Mining Co.

STANLEY G. OLSON E. M.
U. S. Steel Co., Kennecott, Alaska.

PHILIP E. OSCARSON E. M.
Bisbee, Ariz. Eng. Force, Calumet and Arizona Min. Co.

JAMES L. STEWART E. M. (Geol.)
4028 Lyndale Ave. S., Mpls.
Instrumentman, N. P. Ry. Co.

KUO HSIANG SUNG E. M.
Care of 57 S. 9th St., Mpls.

1925

A. J. HALEY E. M.
Mucker, Anaconda Copper Co., Butte, Mont.

E. H. HENNEN E. M.
Smackover, Ark. Roxana Oil Corp.

GEORGE A. JOHNSON Met. E.
Home address, 215 Prospect Street, Marquette, Mich. Bethlehem Steel Co.

HUGO R. KAMB
4130 Girard Ave. N., Mpls.

BERNARD J. LARPENTEUR Met. E.
3321 Clinton Ave., Mpls. Tech. Asst., Sch. of Mines Exp. Sta., U. of Minn

Minnesota Technical Student

The Techno-log wishes you an enjoyable and profitable summer vacation.

We are grateful for your support this year and are counting on your interest for 1925-26.

Subscribe when you enroll in September for Volume VI—the Best Techno-Log Yet!

THE 1925 GEOGRAPHICAL DIRECTORY

A., Architecture; Ae., Architectural Engineering; C., Civil; E., Electrical; G., General; M., Mechanical; Ch., Chemist; Ch. E., Chemical Engineer; A. C., Analytical Chemist; E. M., Engineer of Mines; E. M. (Geol.), Engineer of Mines, Geology; Met. E., Metallurgical Engineer.

ALABAMA

ANNISTON
Jesperson, Clarence M. 10 E
BESSEMER
Charles S. Morgan 03, E. M.
BIRMINGHAM
Soshnik, Edward J. 22 C
Percy G. Cowin 18, E. M.
GADSDEN
Downing, Frank E. 04 C
MOBILE
Batson, Charles Dewey 07 C
TUSCALOOSA
F. D. DeVaney 23, E. M.
B. W. Gandrud 21, E. M.
Oscar Lee 16, E. M.

ARIZONA

AJO
John S. Olmstead 08, E. M.
BISBEE
Kauffman, Roy 08 E
F. E. Oscarson 24, E. M.
Resok, Ingwald 03 E
Franklin W. Smith 03, E. M.
Harry A. Ziesemer 07, E. M.
Ralph A. Ziesemer 05, E. M.
CASA GRANDE
Eugene D. Chandler 00, E. M.
CLARKDALE
Kerns, Ralph W. 07 E
HAYDEN
Johnson, Nels 05 C
INSPIRATION
Abner J. Donaghue 20, E. M.
JEROME
R. A. Calhoun 23, E. M.
M. G. Hansen 22, E. M.
Howard Henkel 23, E. M. (Geol.)
Olaf Hundrum 13, E. M.
Kruse, Helmer V. 13 C
MIAMI
Archie J. McDermid 16, E. M.
J. H. Robertson 14, E. M.
MORENCI
Chas. S. Beck 11, E. M.
George Becker 97, E. M.
PRESCOTT
W. W. Lytzen 05, E. M.
RAY
E. A. Hewitt 12, E. M.
Guy E. Ingersoll 18, E. M. (Geol.)
W. H. Truesdale 03, E. M.
TUCSON
L. S. Lovering 22, E. M. (Geol.)
WARREN
M. S. Lindholm 11, E. M.
D. M. Rait 03, E. M.
H. A. Smith 01, E. M.
E. E. Whitley 03, E. M.

ARKANSAS

SMACKOVER
E. H. Hennen 25, E. M.

CALIFORNIA

ALHAMBRA
Cram, Clyde M. 07 C
BAKERSFIELD
Thompson, Jesse L. 16 E
BELLFLOWER
Frank A. Bowman 04, E. M.
BERKELEY
Bostwick, Ross D. 23 Che.
Hagness, Thorfin Kusten 18 Che., 19 Che. E.
BEVERLY HILLS
Robert R. Boyd 05, E. M.
BIG CREEK
Barber, Harold Alvah 21 C
Nelson, Martin E. 24 C
BURBANK
Oostad, Olaf L. 15 C
CARTAGO
Marshall, Olive W. 17 Ch.
CORONADO
C. J. Smith 23, E. M.
CLAREMONT
Taylor, Edward W. 98 C
COVINA
Douglass, Fred Luke 91 C
FRESNO
Councilman, H. Powell 08 M
GLENDALE
Burrows, Robert P. 11 E
S. L. Gillan 97, E. M.
Everington, James W. 01 C
W. E. Hunt 00, E. M.
Poore, Charles Delos 05 AC.
GRAFTON
Jay Crowley 09, E. M.
HOLLYWOOD
Stone, Harris G. 06 E
C. S. Wallace 17, E. M.
KENNETT
O. J. Egleston 00, E. M.
LELAND STANFORD
Rask, Olaf S. 17 Ch.
LODI
J. A. Cullyford 08, E. M.
LONG BEACH
Carpenter, Hugh Westcott 21 C
Hervey Gulick 05, E. M.
Kreinkamp, Linton H. 17 A
R. H. Toll 00, E. M.
LOS ANGELES
Anderson, Milton L. 21 A
Bachrach, Alfred 05 E
Beneke, Walter E 20 C
Bushnell, Elbert Ellsworth 85 M
Dahl, George 21 A
Dorr, William R. 14 M
Dunn, Andrew P. 06 E
Durham, Samuel W. 17 Ch.
Gibbs, Clayton T. 18 E
Greenwood, Williston Wirt 90 C
Hanauer, Monroe H. 06 C
Hansen, Edwin Lewis 21 C
Hartzberg, Edward Maxwell 19 M
Hendrickson, Arnold Bernard 22 E
Jevne, George W. 10 C
Kessel, Herbert, 18 Che., 19 Ch.E.
Kreinkamp, Herbert A. 22 A
Layden, Arthur L. 15 E
Lyford, Dortt H. 11 E
McKenzie, Leonard F. 20 E
Morin, Wm. Truesdell, 22 Che., 23 Ch.E.
Morrish, Frederic E. 09 E
Nelson, Glenn 23 C
Oram, Robert C. (Geold.) 11 M
Pengilly, Joseph H. 11 E
Schmid, Robert J. 08 C
Swenningsen, Oliver 08 E
Talbot, Thomas F. 18 E
Tannehill, Louis Wm. 16 A
Udell, Carl D. 09 M
Vita, Theodore 09 E

Miners

R. E. Ainsworth 20, E. M.
L. E. Arnold 20, E. M.
W. C. Bass 99, E. M.
F. E. Clark 20, E. M.
L. T. Collins 15, E. M.
J. B. McIntosh 98, E. M.
N. H. Oisthun 13, E. M.
H. E. Olund 07, E. M.
R. C. Patten 22, E. M.
W. L. Jerrard 18, E. M.
MORE ISLAND
Page, Mark L. 03 E
MOUNTAIN VIEW
Wilson, Glenn Wm. 11 E
OAKLAND
C. L. Walker 98, E. M.
G. W. Wallace 06, E. M.
OCEAN PARK
D. E. Curry 05, E. M.
OLEUM
Bovell, Morris L. 21 Che.
PASADENA
W. H. Clapp 01, E. M.
PETALUMA
Comstock, John Walter 08 C
PLYMOUTH
C. R. Nichols 20, E. M.
PORTERVILLE
J. B. Perry 12, E. M.
REDLANDS
Dibble, Barry 03 E
RIO OSO
John Taresh 01, E. M.
RIVERSIDE
R. W. Prouty 17, E. M.
SACRAMENTO
MacKusick, Elwood M. 99 E
E. C. Mills 97, E. M.
SAN BERNARDINO
Aldrich, Louis W. 23 C
Barnes, Dean M. 21 E
Spencer, Raymond D. 23 C
SAN DIEGO
Blossom, George Wm. 11 E
H. H. Holden 03, Met. E.
Petrich, Alfred C. 19 E
Thompson, Roy E. 1900 E
SAN FRANCISCO
Alves, Eva (Dresser) 09 Ch.
Anderson, Arthur R. 12 E
Benham, Claude F. 13 E
Bisbee, Elmer 05 C
Bjonerud, Earl S. 22 E
G. N. Bjorge 12, E. M.
Brown, Wm. Penn 12 M
Chowen, Walter A. 91 C
Duncon, George R. 19 E
Elfstrum, Axel Evold 11 C
Green, Fred H. 07 C
Hoyt, Hiram Patrick 93 C
Jones, Raymond L. 05 E
Ringstrom, Hugo, 15 Ch., 17 M.S.
Taylor, Duane L. 17 M
Torgerson, I. E. 12 C
Tubby, Oliver M. 07 M
Tuck, George Albert 05 M
STOCKTON
Bicknell, Henry R. 10 Ch.
WESTEND
Gauger, A. W. 14 Ch.
YANKE JIMS
P. T. Bailey 11, E. M.

COLORADO

BOULDER
Rank, Samuel A. 75 C
DEER TRAIL
C. N. Woodis 12, E. M.
DENVER
Anderson, Martin E. 01 E
Dahlberg, Henry W. 10 Che.
Johnson, Carl Albert 21 M
Johnson, Carl Arthur 11 C
Lee, Engbert A. 97 C
Nekola, John W. 07 M
H. S. Sanderson 01, Met. E.
Stenger, Laurence A. 06 E
Wolfe, George Edward 24 E
FOWLER
Knowlton, Herbert H. 08 C
PUEBLO
Dallimore, Arthur N. 08 C
SMUGGLER
J. S. Petersen 08, E. M.

CONNECTICUT

NEW HAVEN
Bean, William L. 02 M
Hiers, Charles Russell 24 M
McLean, Milton D. 21 G

DISTRICT OF COLUMBIA

WASHINGTON
Aslakson, Carl I. 23 C
Becker, Ward E. 17 E
Cohen, Nathan 06 E
Cox, Richard Ferguson 08 M
Fleming, Laurence T. 10 M
Gerlach, Arthur C. 17 M
J. A. Grimes 08, E. M.
Hill, Hibbert M. 23 C
O. G. Haass 08, E. M.
Ingberg, Simon 09 C
Jones, Lewis Allen 07 C
Lundquist, Reuben A. 05 E
F. M. Leonard 10, E. M.
McCrady, Archie R. 24 C
Mattison, George C. 11 C
Nortner, Sylvester E. 16 C
Peterson, Barney J. 12 C
Peterson, Clarence A. 08 E
Robbins, Orison 03 C
Roepke, Otto B. 06 E
Schottler, George J. 23 E
Willis, Benjamin S. 17 E
Zimmerman, Arthur C. 23 C

Chemists

Doran, James M. 07 Ch.
Engstrom, Leslie G. 19 Ch.
Kracek, Frank C. 20 Che.
Kneutzel, Ward Edw. 17 Che.
McBride, Russell S. 08 Ch.
Morey, George W. 09 Che.

FLORIDA

JACKSONVILLE
Coe, Clarence Stanley 89 C
Long, Fred W. 96 C
TAMPA
Hamilton, Jefferson Merritt 19 A
Grochau, Earl Henry 21 C

GEORGIA

ATLANTA
Chase, Arthur W. 93 E
BRUNSWICK
Reu, Albrecht H., 19 Che., 20 Ch.E.
SAVANNAH
Riegel, Louis F. 11 E

IDAHO

ARLING
Alsop, Ernest Benbow 06 C
AVERY
Janzen, William H. 20 E
BOISE
Markhus, Olaf G. F. 97 E
Morse, Guilford A., 15 Che., 15 Ch.E.
Smith, Hugh A. 15 E
CONDA
J. C. O'Brien 13, E. M.
GRANITE
Peterson, Harold K. 18 E
KELLOGG
V. T. Theoni 22, E. M.
LEWISTON
Kjosness, Ingraham G. 03 M
RIGBY
Tronson, Carl A. 10 Ch.
QUARTZBURG
D. G. Brunner 24, E. M.
WALLACE
R. S. Merriam 05, E. M.
S. L. Shonts 04, E. M.

ILLINOIS

ALTON
Cosh, Richard Alexander 19 M
AURORA
Brown, Homer L. 17 M
Zeleny, Frank 98 M

CHICAGO
Appleman, Frank C. 24 E
Ashbaugh, Lewis E. 1900 M
Aslakson, Baxter Martin 91 M
Aultfather, David 22 E
Bayless, Harry Cornelius 99 M
Bergquist, John Emil 13 C
Braden, Rene A. 23 E
Clausen, Elmer W. 23 E
Colson, Lauren G. 21 E
Copeland, Floyd E. 23 M
Curtis, Benjamin J. 13 C
Dahlquist, Philip L. 10 C
Eckenbeck, Everett E. 17 E
Fitts, Joel Archer 09 E
Gilchrist, Charles Chandler 98 E
Grath, Arthur William 20 E
Hanke, Carl C. 20 C
Hartman, Walter K. 19 E
Hektner, Joel 17 M
Helwig, William F. 23 E
Hinman, Charles H. 24 A
Holmstine, Ralph D. 24 M
Hornibrook, James W. 09 E
Houston, Cecil C. 09 C
Houts, Guy J. 01 E
Howatt, John 04 E
Hubbell, Arthur C. 14 M
Hughes, Frank Chas. 03 M
Husehy, Gisle E. 24 E
Johnson, Albert Warren 23 C
Juran, Joseph M. 24 E
Kaufman, Morris B. 24 C
Kelsey, Howard Christian 23 M
King, John E. 22 E
Kivley, Ray Charles 18 M
Konstant, Nicholas 18 C
Kristy, George A. 09 E
Kriz, J. J. 12 C
Kruse, Orlin O. 20 E
Langford, George Jr. 24 M
Liddle, Ralph Wesley 21 G
Lindelien, Eugen 23 M
Lenie, James Henry 97 M
Luedeman, Clarence H. 23 Ac
McMeekin, Glenn D. 21 G
McMillan, Franklin R. 05 C
Maiser, Walter 23 C
Marcroft, Harold C. 24 E
Messer, Harold D. 23 M
Morris, John O. 88 M
Olson, C. Milford 24 C
Oscarson, Gerhard L. 22 E
Pangburn, Carroll 22 E
Pardee, C. A. 13 E
Pardee, Walter S. 77 A
Pavek, William J. 19 M
Peoples, John S. 14 M
Peterson, Albert E. 19 E
Rankin, Renville S. 14 C
Ransom, Glen B. 22 E
Rezab, John J. 07 E
Rickman, Herman W. 17 C
Ruemmele, A. E. 12 M
Russell, Winfred W. 23 E
Sausen, Bert R. 13 M
Schwartz, John S. 19 A
Selander, Karl W. 22 E
Skagerberg, Rutcher 15 E
Smith, Cedric B. 14 C
Sperry, Leonard B. 05 M
Strate, Thomas Henry 01 C
Strom, Arthur 23 A
Swanson, Paul H. 23 C
Teberg, Ernest J. 16 E
Thompson, Everett 23 C
Turner, Leslie E. 09 E
Hawkins, Edward W. 24 A
Velz, Clarence 24 C
Von Schlegell, Frederick 95 E
Walijeski, A. Arnold 24 E
Ward, Alvin C. 23 E
Weber, Hanard P. 24 E
Wicks, John 04 E
Widell, Gustaf Frederick 05 C
Wiggins, John B. 23 E
Wilk, Benjamin 13 C
Williams, Fred M. 09 E
Williams, Myrl J. 20 M
Williams, Wilbur S. 09 M
Wills, David C. 23 E
Wilson, Frank W. 23 E

Chemists

Borrowman, Geo. L. 95 A.C.
Kern, Herbert A., 13 Che., 14 Ch.E.
Martin, Edmund W. H., 12 Ch.E.
Owens, Jay Clyde 17 Ch.
Schwartz, Marcel 22 Che.
Washburn, Frederick M. 17 Ch.

Miners

E. F. Baker 11, E. M.
R. G. Harmon 10, E. M.
B. C. Hutchinson 24, E. M.
O. E. Keller 05, E. M.
J. R. McKenzie 10, E. M.
H. J. Wasson 14, E. M.

CHICAGO HEIGHTS
Heggen, Reuben 24 E
A. J. Scheid 23, Met. E.

CICERO
Carlson, Richard E. 22 E
Wiggins, John B. 23 E

DECATUR
Elwood, Daniel H. 23 E

DIXON
Silverman, Emil 22 C

EVANSTON
Kester, Ernest B., 23 M.S. (Ch.)

GENEVA
Kapphahn, Ernest Harvey 19 G

HINSDALE
Daniels, Elmer Anson, 12 Ch., 12 M.S., 17 Ph.D.

JOLIET
Cook, Walter K. 22 C
Emerson, Lynn A. 11 E
McCoy, Ira C. 11 E
Somero, Waino M. 24 C
Stoner, Clifford M. 24 C
Umbehocker, Frank 21 M
Villaume, Walter F. 23 C

LAGRANGE
Gutsche, Frank Carl 10 Che.

LASALLE
Peck, Lloyd 23 C
F. W. Holler 10, E. M.
B. R. Neustadt 06, E. M.

OAK PARK
Cottingham, George Jr. 15 C
Dowd, Archie Joseph 19 M
Olson, Arnim G. 22 E
Pierson, Joe W. 19 E
Waby, Delton T. 23 M

PEORIA
Barnum, Charles B. 24 A
Chapin, S. Caryl 24 C
H. M. Wrbitzky 23, E. M.

PONTIAC
Weis, Wallace D. 21 C

RIVER FOREST
Lambie, Horace 23 E

ROCK ISLAND
Chapman, Burton L. 10 C

SPRINGFIELD
Abrahamson, Harry W. 23 C
J. H. Levy 23, E. M.

URBANA
Dietrichson, Gerhard 10 Ch.
Larson, Louis J. 14 C

WAUKEGAN
Acomb, Wm. Edward 02 M

INDIANA

BELFORD
Saltwick, Andrew 24 M
Reck, Robt. Carlyle, 21 Che., 21 Ch.E.

FORT WAYNE
Cass, Hoyt R. 24 E
Rath, Harvey C. 23 E

GARY
Cottingham, Wm. P. 11 C
F. E. Mooney 23, Met E.

INDIANAPOLIS
Higburg, William 17 Che.
Markoe, James Cox P. 12 M
May, Darwin R., 14 Che., 15 Ch.E.
E. W. McCullough, 11, E. M.
Prentice, Robert S. 08 E
Thorne, Donald 23 E
Wagner, Adolph 98 E

SOUTH BEND
Muessel, Robert W. 21 C

IOWA

AMES
L. L. Clement 06, E. M.

ASKALOOSE
Weatherill, Cedric 14 C

CEDAR RAPIDS
Blomquist, Hjalmar F. 07 C

CHARLES CITY
Finke, Walter J. 10 E

DAVENPORT
Moyer, Malcolm B. 09 M
Norelius, Emil Francis 08 M

DES MOINES
Ash, J. Wesley 08 C
Reeve, Howard E. 23 E

DUBUQUE
Madden, Francis 03 C

HOWARD CITY
Merten, Howard V. 14 Ch.

INDEPENDENCE
Dunlap, George Martin 24 E

JANESVILLE
Wild, Carl D. 15 C

LOGAN
Bradley, Byron H. 13 C

MARSHALLTOWN
Eige, Elmer H. 23 M

MASON CITY
Judd, Maurice D. 23 C
Ost, Roland E. 22 C

NEWTON
Stanius, Godfrey 21 E
Thayer, Paul W. 14 M

OAKLAND
Haines, Howard N. 23 A

OTTUMWA
Smith, Leighton 03 C
Triem, Ralph H. 20 E

REDFIELD
Olsen, Arthur O. 10 C

SIOUX CITY
Arzt, Emmanuel A. 99 E
Donauer, Max 18 Che.
H. J. Hoard 03, E. M.
Mitchell, Lloyd S. 23 C

WATERLOO
A. M. Locke 08, E. M.

WAUKON
Howard, Monroe Sherman 92 E

KANSAS

ARKANSAS CITY
Werdenhoff, James H. 21 C

ATCHISSON
Hastings, Clive 96 M

EL DORADO
Fuhrman, Alvin O. 24 Che.

FORT LEAVENWORTH
McQuillan, Raymond 11 E

FORT RILEY
Grow, Robert Walker 16 C
A. J. Wehr 11, E. M.

KANSAS CITY
Langman, Harley R. 24 M

LAWRENCE
Graham, Eugene Clayton 02 G

MANHATTAN
Kleinschmidt, Florian A. 22 M

OIL HILL
Thordarson, Wm., 23 Che., 24 M.S.

PITTSBERG
Woodman, Howard Howe 97 C

WICHITA
E. N. Carlson 21, E. M. (Geol.)

KENTUCKY

ASHLAND
Porter, Ralph Elmer, 13 Che., 14 Ch.E.

LEXINGTON
C. S. Crouse 11, E. M.

LOUISVILLE
King, Harvey 18 A

MIDLAND
Peterson, Neander Eberhard 22 C

PADACAH
Knapp, Lester 12 E

LOUISIANA

MARRERO
Fleming, Douglas R. 08 C

SHREVEPORT
J. W. Clay 23, E. M. (Geol.)

UNIVERSITY
Fieger, Ernest A., 20 Che., 21 Ch.E.

MAINE

BELFAST
Mathes, Richard E. 24 E

MARYLAND

BALTIMORE
Bellau, Lewis S. 05 E
Tuve, Merle A. 22 E

COLLEGE PARK
Linden, Henning 17 E

EDGEWOOD
Hartnett, John G. 11 Ch.
A. E. Nissen 13, E. M.

MASSACHUSETTS

BOSTON
Andrus, Raymond J. 07 E
Emery, George Chase 19 A
Fallon, Eugene L. 14 E
Lang, James Sherburne 96 M
McVean, Norman S. 21 E
Miller, Andrew L. 21 E
Morrow, LeLon Walker 16 Ch.
Nebel, Walter Harry 11 E
Olstad, Oscar A. 11 M
Payne, Harold G. 06 E
Reuter, Peter Theodore 21 M
Walker, Frank B. 97 C
Woodward, Herbert M. 90 M

BROOKLINE
Andrus, Harry J. 22 C
A. E. May 98, E. M.

CAMBRIDGE
Bonsall, Wallace C. 24 A
Darling, Stephen F., 22 Ch., 24 M.S.
Graf, Donald T. 22 A
Korslund, Harry J. 20 A
Ludwig, Llewellyn G. 24 Ch.
Plowman, Geo. Taylor 92 A
Yagve, Victor 13 Ch.

FRANKLIN
Tomlinson, L. C. 04 E

LYNN
Webster, Harry M. 15 E

PITTSFIELD
Burrill, Charles M. 23 E
Currie, Neill Jr. 08 E
Goodwin, Victor E. 04 E

SPRINGFIELD
Jones, Ivor Vaughan 15 C
Walker, William A. 11 E

WEST MEDFORD
Czock, Jacob Henry 20 M

WILLIAMSTOWN
R. J. Lilly 23, E. M. (Geol.)

MICHIGAN

ANN ARBOR
Badger, Walter Lucius, 08 Ch., 09 M.S.
Gilbert, Roy 20 C
Hoorn, Frederick W. 12 E
Mehandru, Behari L. 24 M
Orbeck, Martin J. 11 C

BESSEMER
Holmberg, Abner Waldo 15 M

CRYSTAL FALLS
E. H. Anderson 17, E. M.
Alfred Christenson 15, E. M.

DETROIT
Babcock, Vernon M. 23 E
Brooke, Harold L. 18 E
Dale, Dallas W. 24 M
Dedic, Richard J. 24 C
Elliot, Harry Cass 19 M
Gutsche, Edward J. 04 Ch.
Hamilton, Herbert C. 97 Ch.E.
Huntoon, Milton B. 99 E
Hvoslef, Fred. W. 17 M
Loye, Benjamin W. 06 M
Malmstrom, Axel L. 17 E
Morris, Thomas Carlyle 08 M
Prudden, Geo. H. Jr. 17 A
Rand, Lars 12 M
Riddington, Frederick W., 21 Che., 22 Ch.E.
Shepard, Donald D. 11 E
Swenson, Clarence Q. 17 M
Walker, Geo. Warren 09 Ch.
White, Arden Dean 22 C

EAST LANSING
R. W. Gannett 18, E. M. (Geol.)

ESCANABA
Simmonds, Richard R. 21 C

FLINT
Anderson, Joseph A. 23 M
Murray, John Hays 17 M
Rhame, Paul W. 20 M
Wagner, John W. 24 M

GRAND RAPIDS
Langland, Harold S. 19 E
Lyon, Glenn H. 20 A
Mahoney, Wm. L. 13 E
Tallmadge, Hiram 16 E
HOUGHTON
F. J. Hammerrik 21, Met. E.
HIGHLAND PARK
Hoppin, Glenn H. 08 E
IRONWOOD
Sears, Daw L. 14 C
JACKSON
Briggs, William G. 21 E
MARQUETTE
G. A. Johnson 25, Met. E.
RAMSAY
H. N. Eidemiller 14, E. M.
SAULT STE. MARIE
Sawyer, Emerson D. 10 C
VERONA
W. L. Taylor 17, E. M.

MINNESOTA

ALBERTA
Schlattman, Edward C. 08 C
ALBERT LEA
Pless, Arnold 20 C
C. O. Lee 24, E. M.
ALEXANDRIA
Lewis, John G. 24 E
ANOKA
Childs, Harvey Butler 06 C
Reed, Arthur L. 06 C
ATWATER
Swenson, Charles 07 C
AURORA
Pearson, Elmer A., 20 Che., 21 Ch.E.
AUSTIN
Bisbee, Bertin A. 22 E
BARNESVILLE
Thompson, Claudius 22 C
BELLINGHAM
Strege, Henry W. 24 E
BEMIDJI
Sherman, Gabe 21 E
BIWABIK
William Trulander 25, E. M.
BLOOMINGHAM
Scott, Elmer C. 15 C
BRAINERD
Croswell, Daniel Robbins 16 E
Daviam, Joseph Henry 03 C
BUHL
K. A. Johnston 21, E. M.
Walker, George W. 08 C
BRECKENRIDGE
Bastaas, Mark 17 C
CALLAWAY
Chilton, Edward G. 13 C
CALUMET
Ort, Leonard E. 14 C
CANBY
Thompson, Theodore S. 24 C
CANNON FALLS
Slade, Loring 22 C
CARLTON
Nickerson, Neal C. 18 C
CHISHOLM
Anderson, George T. 15 C
H. H. Angst 05, E. M.
A. C. Bergeson 11, E. M.
Case, Gerald F. 23 E
H. H. Nord 16, E. M.
Olson, Elmer J. 23 C
CLOQUET
Aronovsky, Samuel Isaac, 21 Che., 22 Ch.E.
Glenn, Harry W. 24 Che.
COLERAINE
Battles, Leon E. 18 C
Chi Chang 23, E. M.
Elstad, Rudolph T. 19 C
A. Y. Peterson 99, E. M.
COLOGNE
McCubrey, Everett James 21 C
CROOKSTON
Nicholson, Harry G., 21 Che., 22 Ch.E.
Riedesel, George M. 17 A
CROSBY
E. J. Fearing 17, E. M.
A. A. Gustafson 22, E. M.
W. R. Mellem 19, E. M.
F. M. Ostrand 10, E. M.
H. E. Thellin 23, E. M.
DEERWOOD
F. B. Wenger 21, Met. E.

DELANO
Brackow, Herbert E. C., 12 Ch.E.
DETROIT
Gunstad, Paul Iver 01 C
H. W. Teague 08, E. M.
DULUTH
Anderson, Milton J. 20 A
Berry, George F. 24 M
Bishop, Ira L. 11 M
Bleifuss, Donald 20 C
Buck, Frederick W. 09 M
Burke, Roy L. 05 C
DeFreece, Paul K. 23 C
Dinsmore, Arthur T. 12 M
Dorsey, John G. 15 C
Fahland, Frank Jr. 22 M
Fee, E. Franklin 07 M
Fieldman, David Pinkus 11 C
Fitzgerald, Wm. J. 20 C
Grettum, Walter A. 24 E
Hammerstrom, Aleck A. 21 E
Hankins, Nathaniel Reeve 24 C
Hargraves, Robert A. 23 E
Hibbard, Sheldon S. 23 M
Hoff, John Edgar 20 Ch.
Holbeck, John I. 24 E
Hoyt, William H. 90 C
Hustad, Byron P. 10 E
Jaques, Robert 09 C
Kapphahn, R. J. 12 C
Kelly, Earl W. 07 C
Knutson, Harry 17 M
Larson, Victor F. 17 M
Luft, Hans Lawrence 24 Che.
McEachin, John L. 22 E
Magnuson, John E. 22 E
Melander, Albin Reinhold 21 A
Mitchell, L. Morris 14 C
Nelson, Edward K. 24 M
Nelson, Einer 24 M
Olin, Henry A. 23 E
Person, Otto C. 24 Ae
Pulver, Richard F. 23 E
Quinn, John 08 C
Ringsred, Arthur C. 06 M
Ross, Russell H. 18 E
Roy, Mills Chapin 21 M
Schwedes, Walter F. 06 E
Sneve, Jack Stickney 11 M
Spring, Willis W. 07 M
Stewart, Clarence H. 03 C
Tennstrom, Carl 23 C
Tondell, Mandell 07 C

Miners

H. E. Farnam 10, E. M.
T. F. Field 05, E. M.
Elden Frank 21 E. M.
V. L. Fixen 11, E. M.
Elden Frank 21, E. M.
L. T. Gavin 09, E. M.
G. B. Jeffers 23, E. M.
A. K. Knickerbocker 08, E. M.
G. M. Moga 22, E. M.
A. C. Oberg 07, E. M.
W. A. Rose 06, E. M.
J. L. Strong 08, E. M.
H. E. Stevens 12, E. M.
EAGLE BEND
Blomberg, Evar H. 16 E
EASTON
W. E. Herring 10, E. M.
ELCOR
A. T. Anderson 23, E. M.
V. I. Mann 25, E. M.
G. K. Urquhart 15, E. M.
ELK RIVER
L. K. Houlton 04, E. M.
R. C. Johnson 22, E. M.
Longfellow, Dwight W. 08 C
Normann, Rolf A. 24 C
ELY
K. J. Duncan 10, E. M.
J. M. Santo 09, E. M.
EVELETH
Damberg, Paul S. 22 A
EYOTA
Patrick J. Boyle 08, E. M.
R. H. Ely 13, E. M.
C. D. Kerr 15, E. M.
M. S. Kingston 04, E. M.
H. R. McAdams 12, E. M.
Cassidy, Walter J. 24 E
FAIRMONT
Croft, Lyman H. 25 Che.
Curtis, Thomas Henry 12 C
Eustis, Irving N. 17 M
Kasper, Walter F. 11 M
Starrett, Howard M. 09 M

FARIBAULT
Crawford, Wallace T. 06 M
L. J. Gallagher 23, E. M.
Hanrahan, Edmond C. 20 G
Hosfield, Raleigh Wm. 12 C
Klemer, Frank H. 01 C
McKellip, Frank W. 98 E
FARMINGTON
Newberry, Lester W. 22 C
Wood, Victor Russell 22 C
FEDERAL DAM, CASS CO.
Foote, Orson B. 09 E
FERGUS FALLS
Flygore, August L. 12 C
Frankovitz, John Joseph 03 E
Pagel, H. Armin 23 M.S. (Ch.)
FOLEY
Markson, Christian O. 22 C
FRONTENAC
Meskal, George 23 C
FULDA
Price, John R. 14 C
GAYLORD
Hecht, Henry W. 24 C
Johnson, Raymond Y. 24 C
GLENCOE
Hankenson, John J. 92 C
GLENWOOD
Lynn Martin 12, E. M.
GROVE CITY
Nelson, Richard L. 21 E
HANSKA
A. C. Haugen 15, E. M.
HASTINGS
Harris, Nathan 20 G
HAWLEY
Anderson, Ole Andreas 93 M
HIBBING
O. B. Anderson 22, E. M.
W. C. Anderson 11, E. M.
R. H. Bassett 07, E. M.
John Brandt 06, E. M.
Friedman, Edwin A. 23 E
P. S. Kurtzman 06, E. M.
H. E. Loye 05, E. M.
Markus, Benjamin 17 Ch.
H. A. Pabst 23, E. M.
W. P. Pan 19, Met. E.
Pan Wen Ping 16 C
Pan, Wen Ping 18 Ch.
Reeve, Charles H. 19 E
Swanson, Philip G. 23 M
Turnquist, Axel A. 16 E
E. W. Vivian 23, E. M.
HOPKINS
Anderson, Harvey B. 13 C
HUTCHINSON
Higgins, Elvin L. 92 C
Sherwood, Edward B. 20 C
INTERNATIONAL FALLS
Anderson, Edward S. 21 E
Cantwell, Wm. F. 11 Ch.
IRONTON
W. A. Deichen 08, E. M.
F. J. Plut 22, E. M.
JANESVILLE
Peters, Walter C. 22 M
KEEWATIN
Leach, Edward W. 10 C
LAKE CITY
Tews, Arthur W. 24 C
LAKEFIELD
C. E. Buresch 17, E. M.
LEROY
Brown, Harry E. 22 G
LESUEUR
Little, LeRoy C. 24 E
LITCHFIELD
McCullough, Bruce M. 16 C
LITTLE FALLS
Donahoe, Robert Emmet 21 E
O. W. Lundquist 23, E. M.
Ryan, Loiel S. 12 C
LONG LAKE
Kelley, William 22 C
LUVERNE
Cummings, Elmer F. 12 C
MANKATO
Esser, Frank F. 09 C
Gerlach, Henry C. 22 A
Kleinschmidt, Armin R. 22 M
Neilsen, Chris 18 Che.
Nelson, Edgar M. 24 E
MAYNARD
Johnson, Alexander B. 15 C
MELROSE
M. F. Quinn 18, E. M. (Geol.)

MENDOTA
Braddock, Edward 24 C
MINNEAPOLIS
Aaslund, Arne 23 C
Adams, Edward H. 22 G
Adams, John W. 12 C
Adler, Eugene H. 14 E
Alexander, George D. 20 C
Alrick, Banona G. 06 C
Anderson, Emil G. 24 E
Anderson, Fayette C. 24 E
Anderson, Hilder Alvin 18 M
Anderson, John G. 99 C
Anderson, Joseph W. 15 E
Anderson, Neis S. 22 C
Andrews, George Cutler 87 M
Arenson, Timothy George 16 E
Arstad, Leonard O. 24 E
Aske, Irving 20 E
Asleson, Hans 10 C
Austin, Paul 21 E
Avery, Henry R. 93 M
Bachelder, William H. 24 C
Backstrom, Emil F. 24 A
Backstrom, Wilburg A. 23 A
Bailey, George R. 22 C
Bakken, Lawrence H. 22 A
Barger, Harold L. 21 E
Barnum, Marvin Culver 11 M
Bates, Albert Henry 05 M
Beck, Vernon S. 10 E
Beery, Charles B. 09 M
Bell, Maurice Dwight 07 M
Berg, Swan P. 23 C
Bergford, Rolf F. 23 C
Bergstrom, Marlow B. 22 E
Bestor, George C. 24 C
Bevan, R. Louis 24 C
Biskup, William Frank 16 C
Bleecher, George W. 16 E
Boehnlein, Charles 17 M
Boerner, Francis C. 11 C
Borst, Wellington Lyle 24 M
Bouquet, Otto T. 23 E
Boynm, Irvin 17 E
Brenchley, Harry E. 08 C
Briggs, Hiram Kenneth 19 G
Brockway, Roydon R. 05 C
Brody, Mace J. 24 C
Bros, Bernard M. 23 M
Bros, Chester W. 22 M
Bros, Ernest Theodore 17 M
Bros, Raymond Joseph 19 M
Brown, Floyd W. 17 A
Brownell, Otto E. 10 C
Bruce, Hjalmar N. 16 C
Burch, Albert Morgan 96 C
Burch, Edward P. 92 E
Burnett, H. V. 14 C
Capstick, Donald Walker 22 G
Carlson, Anders J. 16 C
Carlson, Warren E. 24 E
Carr, Harvey C. 03 C
Carter, Robert J. S. 08 E
Chalmers, Charles H. 94 E
Chernus, Maurice C. 23 C
Childs, James A. 09 C
Clark, John S. D. 22 M
Clark, William G. 12 M
Collins, Stewart G. 04 G
Colvin, James A. 14 M
Comb, Fred Rundle 10 M
Cooper, Leo H. 06 E
Corser, John 16 M
Critchett, Edw. Fowler 13 M
Croft, Edna K. (Miss) 22 A
Croft, Ernest B. 11 C
Cross, Roland E. 23 M
Crounse, Avery Fitch 03 G
Curtis, Verne F. 22 M
Cutler, Alvin S. 05 C
Dahl, Harold W. 24 E
Dahlstrom, Raymond E. 10 E
Darmody, William J. 24 M
Davies, Ralph M. 09 E
Dawson, John W. 22 A
Deane, George Brooks 19 A
Deutsche, Richard E. 18 C
Dill, Lyle Alger 21 G
Dimont, J. Morton 24 E
Dindorf, Edward C. 24 C
Doell, Charles E. 16 C
Dorrance, Albert P. 12 E
Douglass, Addison H. 17 C
Dow, William G. 16 E
Dresser, Harry Samuel 16 M
Drinkell, Leon R. 19 E
DuToit, George A. 19 M
Earl, Donald E. 24 M
Eddy, Clarence J. 22 M

(Minneapolis—Continued)

Eggers, Henry C. T. 15 E
Ek, Gustaf Albin 17 M
Ekberg, Carl E. 14 C
Ekman, Claes T. 10 C
Ellestad, Irwin M. 22 E
Ellingson, Elmer 16 C
Elliott, A. Douglas 14 E
Elsberg, Nels William 09 C
Enger, Arne 22 E
Enger, Edward Henry 11 C
Erickson, Carl E. 24 C
Erickson, Edwin C. O. 22 C
Erikson, Henry A. 96 E
Estabrooks, Clyde F. 24 M
Everett, William R. 14 E
Fager, Simon Rudolph 04 M
Farmer, John Wesley 21 M
Farnam, Julian Perkins 11 M
Felton, Ralph Potter 92 M
Finley, Joseph Edward 05 C
Fischer, Harold W. 23 E
Flindt, Richard H. 23 C
Ford, Robert E. 95 E
Forfar, Donald M. 09 M
Forsberg, Enock E. 18 A
Fossen, George 17 C
Frias, Floyd M. 20 C
Frost, Herbert Johannes 22 C
Fruen, Arthur Bernard 08 G
Furber, J. Roscoe 24 E
Gage, Hugh Newton 08 C
Gammell, John H. 14 M
Garber, Gabriel E. 06 M
Garthus, Ira B. 24 E
Gee, Harry James 19 G
Gerow, Theron Gardner 20 M
Gerrish, Harry Eldon 05 M
Gerry, Martin H., Jr. 90 M
Giertsen, Marcus O. 12 C
Gillard, Herbert W. 24 C
Gillete, George Lewis 95 C
Gilman, Howard B. 17 A
Gilman, James R. 94 C
Gjesdahl, Maurice Sven 21 M
Godward, Alfred C. 10 C
Goebel, Rudolph C. 13 E
Gould, Edward S. 20 C
Gray, William Irving 92 E
Green, Alfred B. 24 E
Green, Chauncey L. 24 E
Greenberg, Jack 22 C
Greiner, Harry S. 24 E
Grow, Harry Allen 03 C
Guesmer, George O. 23 C
Guggisberg, Charles F. 17 M
Hagelin, Lawrence W. 22 E
Hallady, Leslie L. 21 C
Hammond, Laurence D. 14 M
Hansen, Christian, Jr. 10 E
Harrington, Russell A. 24 E
Harris, Harold R. 14 E
Harris, Sigmund 05 M
Hartig, Henry E. 18 E
Hartney, James L. 14 M
Harwood, Stanley Gordon 08 M
Hawkins, Harvey C. 23 E
Heath, Donald Campbell 16 A
Heidelberger, Otto F. 23 E
Helmick, Dan S. 15 C
Hendrickson, Norman E. 16 C
Herberg, Sanford 24 C
Herrick, Carl Albert 02 M
Herrmann, Raymond R. 12 E
Hibbard, Truman 97 E
Hickok, Harvey (Mrs.) 96 G
(Miss Jesse E. Stevens)
Higgins, John T. 90 C
Hildebrandt, H. A. 99 E
Hirleman, Clark W. 12 M
Hoag, Wm. Ricketson 84 C
Hobart, Walter B. 07 C
Holmstine, Arthur G. 17 M
Hopkins, Mark L. 09 E
Hotchkiss, Fred W. 18 E
Houlton, Amos D. 01 E
Houston, George S. 02 C
Hubbard, Henry A. 09 C
Huhn, George P. 91 E
Hustad, Andrew P. 09 C
Hustad, John C. 14 C
Huston, David B. 07 C
Jackson, Otto E. 14 E
Jacobson, Frank H. 24 E
Jacobson, Howard Carey 21 G
Jensen, Cyril D. 21 C
Jensen, John Arthur 05 C
Johnson, Alphonse Nels 21 C
Johnson, Edgar W. 14 C
Johnson, Elmer W. 14 E
Johnson, Gustav A. 23 E
Johnson, Ira Leroy 16 M
Johnson, Nels 23 C
Johnston, Charles K. 21 E
Jones, George R. 14 E
Kamnenberg, Walter F. 23 E
Kaplan, Seeman 18 A
Kapple, Frederick R. 24 E
Katter, Reuben L. 22 M
Keeler, Jasper F. 22 C
King, F. V. 12 C
Kinsell, William L. 00 E
Klass, Frederick 19 E
Kline, Frank William 24 E
Kuhlman, Rudolph H. 23 M
Kumm, Arthur W. 22 M
Kvitrud, Ingwald 11 C
Lagaard, Alex S. 13 E
Lagaard, Maurice B. 14 C
Lambert, Edwin M. 09 M
Lang, Charles A. 06 E
Lang, Fred C. 08 C
Larson, Amandus C. 20 C
Larson, Carl 16 C
Larson, Glen M. 23 M
Laurence, Philip J. 15 C
Lauritzen, Carl W. 24 E
Lazarus, Morris W. 23 C
Lee, Oscar C. 19 E
Lende, Henry M. 20 C
Levens, Alexander S. 22 C
Levin, Jake M. 18 E
Lewis, Edward B. 05 M
Lewis, George R. 21 M
Liebenberg, Jacob J. 16 A
Lobeck, Tarasin E. 24 E
Loe, Eric Haldorson 88 M
Loye, Percival E. 21 E
Lund, Roy V. 24 C
Lutz, Richard E. 15 E
Lebeck, Carl E. 20 C
McKay, Earle D. 15 C
McGregor, Frazer A. 24 E
McKibben, Lloyd S. 21 E
McLeland, Lyle K. 24 E
Mabbott, Leonard E. J. 24 E
Maney, George Alfred 11 C
Mangney, Elmer J. 21 E
Mangney, Hilding O. 24 E
Mann, Fred Maynard 93 C
Markuson, Miner J. 23 A
Mattison, Oliver 05 C
Mattson, Dewey F. 22 C
Mayer, Harris J. 14 M
Meili, Rudolph Ernest, Jr. 22 G
Mentzer, Clarence A. 22 E
Merriell, Elmer W. 12 E
Merrill, Lewis E. 20 M
Meyer, Carl F. 10 C
Meyer, Herbert W. 14 E
Mixer, Walter R. 17 A
Molskness, Nels S. 20 E
Monsen, Manley A. B. 24 E
Moore, Clarence F. 20 G
Morris, Frank A. 24 M
Morris, John E. 09 M
Morrison, John E. 22 C
Morse, George 93 A
Morton, Harry G. 04 E
Mowery, Clarence W. 08 C
Mover, A. F. 10 M
Nash, Russell O. 23 E
Nason, George L. 10 C
Nelson, Elmer A. 23 C
Nelson, Gustaf A. 19 E
Nelson, Nels B. 04 C
Nelson, Oscar B. 05 C
Nelson, Otis S. 17 M
Nelson, Thorwald E. 90 M
Nemec, Frank L. 09 M
Newhall, William B. 00 M
Nielson, Eunice V. 23 A
Nielsen, Walter M. 22 E
Noble, John Frithiof 21 G
Nordenson, Arnold 22 M
Nordstrom, Ernest Aldon 22 M
Nordvall, Glenn 23 E
Okes, Sidney R. 09 C
Olaison, Clifford 15 E
Olmstead, Charles F. 22 M
Olsen, Melvin S. 08 C
Olson, Roy H. 23 E
Orr, George M. 15 M
Otto, Robert Walter 04 M
Overholt, Harley G. 10 C
Parker, Robert M. 24 C
Paul, Frederick 09 C
Pelley, Lloyd L. 24 E
Peterson, Arthur S. 24 M
Peterson, Harold W. 21 E
Pratt, B. A. 15 C
Prendergast, Arthur 03 C
Purdy, Irving 20 C
Quiggle, Arthur W. 13 C
Raugland, Arnold I. 20 A
Reidhead, Frank E. 93 E
Ritchie, John Reid 16 M
Robertson, B. J. 14 E
Robertson, Burton 14 E
Rooz, Frank T. W. 24 C
Rosendahl, Harold R. 22 M
Ryand, Robert M. 23 E
Ryan, W. T. 05 E
Salisbury, Willis R. 10 G
Sampson, Clifford L. 23 E
Schaller, George C. 23 C
Schilling, Theodore F. 24 E
Schow, Garfield G. 24 E
Schweiso, Clifford C. 23 E
Scott, Herbert L. 23 E
Sebo, Arthur O. 24 M
Seszeng, Gunnar 24 M
Shinehon, Francis 95 C
Shepley, Charles R. 02 C
Siverson, Sigvel J. 11 C
Siverts, Samuel A. 09 C
Skarolid, Charles T. 24 E
Skurdalsvold, P. 15 C
Snow, Clarence J. 14 M
Sorensen, John E. 22 E
South, W. A. 12 C
Springer, Frank W. 93 E
Stephens, Clifford 23 C
Stephenson, Oliver H. 07 M
Sternberg, Carl 07 E
Stimart, Elwood L. 24 E
Stone, Chas. Wellington 16 M
Sutherland, Samuel J. 23 Ae
Svendsen, George P. 08 E
Swanson, Clifford L. 22 C
Swanson, Edwin W. 19 E
Swanstrom, Frank N. 08 E
Swedberg, M. Roy 11 C
Sweet, Ray Rennington 21 E
Swenson, George W. 17 E
Swenson, Gustav A. 20 G
Swenson, H. Seymour 12 C
Teal, Clarence W. 24 E
Thayer, Charles E. 76 C
Thompson, Harry T. 15 E
Thorshov, Olaf 21 A
Timperley, William D. 10 C
Todd, Milo E. 09 E
Torrance, Ell 69 C
Trask, Birney E. 90 C
Treks, Benjamin C. 24 E
Tryon, Philip D. 17 C
Tupper, Charles E. 15 M
Turner, Roy H. 15 E
Tvedt, Lawrence Ardtan 24 Ae
Ungerman, Carl M. 06 E
Vallacher, Theodore L. 20 G
Vaule, Sven Alfred 21 M
Vincent, Jay C. 03 E
VonRohr, Herbert Hugo 21 M
Wagner, Otto H. 07 M
Wahlquist, Hugo Wm. 21 E
Walby, Arthur Carl 11 C
Walling, Benjamin B. 09 E
Walquist, John A. 23 A
Wangaard, Oscar H. 12 C
Washburn, Delos Cuyler 93 A
Watson, Fred O. 16 C
Weigel, Howard N. 14 C
Wentz, Walter W. 14 E
Whitney, Alfred C. 03 G
Wichman, Martin F. 22 E
Wilcox, Hugh B. 14 E
Williams, Charles A. 16 C
Williams, Percival H. 22 E
Williams, Roy N. 23 E
Wills, Arthur Douglas 21 A
Woehler, William L. 07 E
Wodman, Joseph C. 11 M
Woodrick, Oscar F. 08 C
Zimmerschied, Clarence R. 23 E

Chemists

Anderson, M. M., 20 Che., 21 Ch.E.
Beckel, Arthur C. 19 Ch.
Bell, Alexander Dewey, 16 Che., 17 Ch.E.
Brooks, Leslie C. 19 Ch.
Brinton, Paul H. M., 12 Ch., 13 M.S., 16 Ph.D.
Busch, William A. 22 Che.
Callaway, R. S. 11 Che.
Chadbourne, L. Rodney, 22 Che., 23 Ch.E.
Dahlen, Miles 24 Che.
Davies, Edwin T. 07 Che.
Eck, Lester John, 23 Che., 24 M.S.
Edgar, Donald E. 23 Che.
Ellestad, Reuben R., 22 Ch., 24 M.S.
Ernst, R. C. 23 M.S. (Che.)
Firth, Charles V. 23 Che.
Fischer, Earl B. 19 Che.
Goldstein, Milton M., 12 Ch., 13 Ch.E.
Grout, Frank Fitch, 04 Ch., 08 M.S.
Halvorson, Halvor Orin, 22 Che., 23 Ch.E.
Hammond, Kathryn D. 22 Ch.
Hopkins, Joseph Irwin 04 Ch.
Humphrey, Gertrude J. 24 Ch.
Johnson, Donald Lee, 18 Che., 20 Ch.E.
Jones, Ernest Joseph, 20 Che., 21 Ch.E.
Joselowitz, Goodwin 18 Ch.
Karatz, Lucian 12 Ch.
Krantz, Rudolph W. 24 Che.
Lavine, Irvin 24 Che.
Lee, Melville Richard, 21 Che., 22 Ch.E.
Leerskov, Gerhard W. 21 Che.
McMillen, Elliot L. 23 Che.
Mitchell, Donald Francis, 20 Ch., 21 Ch.E.
Morken, Carl H. 22 Che.
Nygard, Edwin M. 21 Ch.
Olsen, Leslie R. 13 Ch.
Otterstein, Earl Frank 13 Ch.
Pennock, Edward M. 05 Ch.
Riley, Philip J. 21 Ch.
Robinson, Rhea B. 12 Ch.
Scandling, Joseph E. 25 Che.
Schermer, Oscar C., 21 Che., 22 Ch.E.
Sorenson, Ben E. 23 Che., 24 M.S.
Sternberg, Heime A., 20 Che., 21 Ch.E.
Stone, Leslie F., 22 Che., 23 Ch.E.
Stoppel, Arthur E., 20 Che., 21 Ch.E.
Sullivan, Betty 22 Ch.
Sutter, Hedwig (Mrs. Roger Wilson) 13 Ch.
Roger Wilson) 13 Ch.
Thorson, Stuart John 19 Ch.
Tinkham, Willis M. 14 Che.
Wallfred, Carl Luther, 20 Che., 21 Ch.E.
Wauless, Lynn Allison 12 Ch.
Webber, Frederick W. 97 Ch.E.
Weber, Ludwig J., 20 Che., 21 Ch.E.
Webster, Cora Helen 23 Ch.
Westerberg, Carl Geo. 21 Ch.
White, Robert H., 23 Che., 24 M.S.
Whited, Oric Ogilvie 08 Ch.
Winslow, Raymond Martin, 19 Che., 20 Ch.E.
Zima, Albert G. 24 Che.

Miners

R. W. Allard 18, Met. E.
J. A. Ballord 24, E. M.
L. M. Case 24, E. M.
C. H. Chadbourn 21, E. M.
Peter Christianson 98, E. M.
W. A. Cole 09, E. M.
C. R. Conkey 10, E. M.
James Cowin 16, E M.
J. J. Craig 16, E. M.
F. J. Curran 24, Met. E.
L. W. Dawson 21, Met. E.
Lawrence Devereux 10, E. M.
G. M. Drake 11, E. M.
J. R. Elliott 11, E. M.
C. E. Erdmann 23, E. M. (Geol.)
E. M. Field 03, E. M.
L. L. Foley 18, E. M. (Geol.)
H. O. Frank 20, E. M.
A. A. Frellsen 19, E. M.
A. L. Gholz 01, E. M.
W. R. Goodwin 08, E. M.
A. M. Gow 23, E. M.
C. P. Graeber 24, E. M. (Geol.)
L. J. Hagstrom 12, E. M.
W. H. Hale 04, E. M.

(*Minneapolis—Continued*)
L. S. Heilig 13, E. M.
Louis Hoffman 23, E. M.
L. I. Hope 22, E. M.
H. R. Kamb 25, E. M. (Geol.)
F. H. Kersten 20, E. M.
R. G. Kilp 22, E. M.
N. S. Kingsley 11, E. M.
E. G. Kremer 13, E. M.
Greeley Ladd 13, E. M.
B. J. Larpenteur 25, Met. E.
R. H. McHardy 16, E. M.
I. C. Mark 20, E. M.
Lucien Merritt 04, E. M.
J. A. Moga 18, E. M.
R. G. Moody 10, E. M.
W. H. Parker 07, E. M.
C. D. Peterson 20, E. M.
O. W. Potter 14, E. M.
H. C. Rawson 06, E. M.
O. A. Reed 07, E. M.
E. W. Smith 07, E. M.
J. L. Stewart 24, E. M. (Geol.)
K. H. Sung 24, E. M.
H. G. Taylor 09, E. M.
E. H. Tollefson 23, E. M.
H. H. Wade 15, E. M.
C. M. Walz 21, E. M. (Geol.)
F. M. Warren 99, E. M.
W. H. Wheeler 06, E. M.
M. A. Wiest 07, E. M.
J. B. Wilson 22, E. M.
Harry Winter 25, Met. E.

MINNEOTA
G. B. Hognason 09, E. M.

MONTEVIDEO
Kircher, Frank J. 09 M
Lawrence, Scott 15 E

MONTGOMERY
Soulik, Joseph H. 11 E

MONTICELLO
Garzon, Julian R. 24 C
Manger, Henry J. 23 C

MOORHEAD
Bergquist, Edwin T. 24 C
Hopeman, Albert M. 05 C

MORA
Handschu, C. E. 15 C

NASHWACK
A. L. Johnson 20, E. M.

NEWFOLDEN
Dahlberg, Arnold V. 05 Ch.

NEW DULUTH
Bernt, Hans E. 20 C
Rose, Norman W. 06 M

NORTH HIBBING
Lundquist, John V. 23 E

NEW ULM
Haeberle, Elmer H. 06 E
Robertson, Charles N. 08 C
Backus, Gerald H. 22 E

OLIVIA
W. M. Winter 23, E. M.

OWATONNA
Nelson, Mark L. 24 A

PELICAN RAPIDS
Ranger, Donald R. 24 C

PERHAM
Pancratz, Frank J. 03 E

PETERSON
Boyum, Benjamin C. 10 C

PINE ISLAND
Parkin, Orrin G. 23 M

PLAINVIEW
Askew, Thomas A., Jr. 16 C

RED WING
Cook, Harry C. 10 M
Cornell, Reuben Willett, 21 Che., 22 Ch.E.
Josephson, Eliot Bryant 10 E

REDWOOD FALLS
Clipfell, Carroll Dale 05 M

RENVILLE
Henry, Burt Charles 21 C

ROBBINSDALE
Merritt, Alva W. 22 E
Shumway, Ernest J. 00 E

ROCHESTER
Boyce, Ellsworth R. 17 C
Leonard, Aubrey C. 23 C

ROTHSAY
Jevrud, Edwin C. 17 E

RUSHFORD
Engh, Harris S. 24 M

SLAYTON
E. G. Minder 05, E. M.

SILVER LAKE
Joseph Sodoma 25, Met. E.

ST. CLOUD
Bergford, Lester 23 C
Jorgens, C. R. D. 12 C
Kearney, Adrian A. 23 E
Willson, Stuart V. 24 M

ST. LOUIS PARK
Manuel, Douglas R. 22 Che.
Rademacher, Richard L., 23 Che., 24 M.S.

ST. JAMES
West, John C. 15 C

ST. PAUL
Abbott, Amos H. 16 E
Abrahamson, Howard B. 18 M
Anderson, Frank L. 16 E
Anderson, Helmer N. 20 M
Arnessen, Herbert P. 11 C
Aure, Roy 22 M
Bachmann, Graydon A. 23 M
Baer, Louis E. 07 E
Barlow, Harry Elmore 03 C
Beeman, Harry John 21 G
Bingham, Stanley Eugene 08 M
Bohland, John A. 95 C
Bosshardt, Willmert C. 22 E
Boyles, Ralph R. 15 M
Brossard, Edward V. 23 M
Buenger, Albert 13 M
Buenger, Edgar Walter 19 A
Bullis, Everard J. 24 C
Bumgardner, Louis T. 23 E
Calmeyer, John Peter 06 E
Carlson, Arvid P. 17 M
Carlson, Chauncy M. 17 E
Carlson, Ernest F. 22 M
Carlton, Richard Paul 21 G
Chapman, Leslie Howard 95 C
Chapman, Wendell P. 14 E
Christilaw, George M. 21 C
Christlieb, Frank B. 23 C
Collis, N. Stuart 24 M
Converse, Clovis M. 09 E
Cooley, Gilbert 22 E
Cotton, Ernest H. 19 E
Crawford, Allen Seymour 12 M
Cribbs, Harry Ernest 23 C
Curry, Byron K. 22 C
Curtiss, Lindsley B. 09 G
Damm, H. Arno 12 E
Davis, Charles Asa 05 E
Davis, Gilbert N. 04 M
Dehn, Elmor Albert 21 C
DelPaine, Carlos Werter 21 C
Dewars, Allen G. 13 E
Dimond, Harvey G. 14 C
Donaldson, Frank Arth. 12 M
Doolittle, William Y. 14 C
Dougan, Harry Knox 08 C
Dunnavan, Ralph B. 23 E
Ebert, Solomon Bernard 17 E
Egilsrud, F. S. 20 M
Ellison, Jay T. 09 C
Engquist, Victor E. 20 E
Erskine, Robert K. 24 M
Feeney, Wayne L. 23 E
Feyder, Wm. Henry 05 C
Fiske, Harold C. 22 E
Fiske, F. William, Jr. 09 C
Fleming, Frank R. 08 M
Forsberg, Elmer John 21 M
Forssell, William O. 22 G
Francis, Paul Edgerton 18 M
Frazer, Carlisle G. 22 C
Garen, George M. 10 C
Gessert, George Richard 07 M
Gilstad, Arthur 23 M
Goldberg, Maurice 23 E
Greenberg, Morris 18 M
Goodkind, Leo 92 A
Guerin, George V., Jr. 24 C
Gustafson, Reuben Wm. 24 C
Haberle, Edward L. 12 C
Hagerman, Oliver S. 18 M
Hayes, Edward J. 20 M
Hayward, George I. 06 C
Hedenstrom, Ernest Axel 12 E
Hewett, Maurice Wm. 13 C
Hiner, Walter G. 23 C
Hodnett, Ralph M. 11 C
Hull, Christopher 06 E
Hoffman, Michael J. 11 C
Holder, Laurance E. 24 C
Holmsten, Victor T. 22 M
Hosmer, Orville H. 23 C
Hovden, Conrad D. 12 E
Hubbard, Fred A. 09 C
Jackson, Earl D. 05 E
Jacobs, Arthur R. 17 E

James, Henry C. 11 E
Jones, Edwin Francis 17 M
Katter, Calvin K. 22 M
King, Lawrence W. 09 C
King, Wesley E. 05 C
Knight, Ralph J. 15 C
Koch, Karl L. 23 E
Kochendorfer, Milton J. 05 E
Kopper, Edward, Jr. 14 M
Kotz, Walter E. 23 C
Krauch, William L. 08 C
Lambert, Fred T. 02 C
Larson, Albin 14 C
Larson, Edwin 21 A
Larson, Martin S. 11 M
LeBlond, Emond J. 05 E
Leonard, Thomas K. 15 C
Lieberman, Henry 23 E
Liese, Herbert W. 24 C
Lilly, Clarence W. 17 E
Lilly, Eugene 19 G
Lockwood, Raymond 20 E
Loeffler, Henry S. 14 E
Logue, John F. 24 M
Lovering, Harry D. 13 C
Lux, Arthur E. 16 E
McCartney, Floyd A. 13 M
McCree, Andrew A. 08 C
McPherson, William B. 02 E
Mackintosh, William S. 21 C
Maiser, Walter S. 23 C
Marshall, Chester R. 23 M
Mayer, Joseph S. 24 E
Meixner, Bernard A. 10 M
Mertz, Karl J. 14 E
Meserve, Ralph H. 23 E
Methven, Clyde 11 C
Mikesh, Edward S. 22 M
Miller, Erwin J. 11 C
Miller, George W. 20 E
Mitchell, John B. 09 C
Moorman, Albert J. 18 A
Moorman, Frank S. 22 A
Morton, Harold S. 12 M
Motl, Charles L. 10 C
Muller, Carl Christ 18 M
Nelson, Clarence L. 20 E
Nelson, Edward S. 09 C
Neville, Earle L. 20 C
Nordstrom, Carl T. 14 C
Norton, Clyde Wood 08 M
Odquist, Carl 23 C
Okes, Day Ira 08 C
Olson, Arthur L. 24 M
Orr, George M. 15 M
Oltman, Charles A. 03 C
Pancrantz, Alexander 05 M
Paulsen, Thorwald 22 C
Pause, Harold A. 23 E
Peckham, Harold E. 23 M
Peterson, A. M. 14 E
Peterson, Richard M. 20 E
Pinska, Lawrence F. 22 C
Poulsen, George F. 17 A
Powles, James W. 01 E
Priedeman, Geo. Walter 08 M
Reardon, John M. 22 C
Richardson, Wilbur P. 99 M
Ringstrom, Ivan G. 12 E
Rockwell, Harvard S. 14 C
Rockwood, Fletcher 14 M
Roe, Harry B. 08 E
Roth, Lewis M. 11 C
Rufsvold, Olav M. 15 C
Sander, Theodore, Jr. 19 E
Sauer, Arthur A. 23 C
Schlenk, Hugo 18 E
Shepard, Geo. M. 09 C
Sickel, Edwin C. 23 E
Skon, Herman Wm. 15 M
Smit, Catherine 22 A
Sommerfeld, Adolph A. 10 C
Souther, M. Edwin 12 C
Sprelm, George H. 24 C
Staehle, Hoswell E. 24 M
Staehle, Gilbert C. 20 C
Stanton, Raymond E. 04 M
Stewart, George A. 22 A
Streich, Harry C. 12 E
Sudheimer, Edward L. 02 M
Swenson, Theodore M. 12 E
Swift, Donald C. 24 E
Tallmadge, Everett S. 14 E
Teberg, Lawrence E. 22 C
Thomas, William A. 17 E
Waterous, Fred A. 20 M
Webster, Donald W. 13 C
Welin, Arthur G. 12 C
Wellisch, Walton 23 E

Whitman, Edward A. 00 C
Willis, Roy 08 C
Wolfangle, Raymond J. 17 C
Wolff, William S. 15 M
Wright, Stewart Vern 19 A
Wunderlick, Milton S. 19 M
Wyly, Lawrence T. 20 G
Yager, Louis 07 C
Young, Joseph E. 21 G

Chemists

Bache, Edmund 24 Che.
Baker, Russel E. 11 Che.
Barnaby, Wm. E. 09 Che.
Barrett, Joseph O., 22 Che., 23 Ch.E.
Corl, Cady S. 21 Ch.
DeWitt, Joseph Henri 10 Ch.
Dunnigan, Merton A. 16 Ch.
Fellom, Arthur J. 13 Ch.
Frederickson, Hubert M. 23 Che.
Halvorson, Henry A. 11 Ch.
Hatch, Lloyd 23 Che.
Heck, Frank J. 19 Ch.
Hennessy, Hugh J. 11 Ch.
Hoffman, Henry Joseph 12 Ch.
Johnson, Elmer, 11 Ch., 12 M.S.
Kampa, Edmund P. 23 Ch.
Kennedy, William W. 07 Ch.
Keuffner, Otto Karl 09 Ch.
Koch, Arthur Louis 19 Che.
Kryger, Edward R. 21 Ch.
Langseth, Axel O. 22 Che.
Livermore, Harvey J. 22 Che.
McMiller, Paul R. 11 Ch.
Olson, Arthur O. 11 Ch.
Parkin, Guy Geo., 12 Ch., 13 M.S.
Peterson, Marshall A., 21 Che., 22 Ch.E.
Rockwood, Ralph H. 10 Ch.
Roehrich, Victor H., 09 Che., 10 M.S.
Smith, Sheldon H. 10 Che.
Swart, Richard H. 21 Che.
Toncheff, Stanil T. 15 Ch.

Miners

T. S. Abbott 11, E. M.
J. N. Brawley 23, E. M.
K. G. Butler 21, E. M.
W. A. Colter 15, E. M.
R. L. Dowdell 18, Met. E.
Arthur Friedl 23, E. M. (Geol.)
Bert Goldberg 19, E. M.
S. E. Harmon 17, E. M.
F. T. Howes 06, E. M.
Trygve Johnsen 22, Met. E.
Herman Neerland 15, E. M.
W. S. Olson 12, E. M.
Howard Quinlan 14, E. M.
C. R. Raiter 20, E. M.
Lynn Rood 09, E. M.
A. O. Sjolander 23, E. M.
A. J. Strane 10, E. M.
H. S. West 21, Met. E.
H. A. Williams 09, E. M.
D. H. Wolfer 23, E. M. (Geol.)

SAUK CENTER
Rosenthal, Paul 22 C

SPRING GROVE
Hansen, Carlos C. 20 C

SPRING VALLEY
Grafing, Verney 99 E

STAPLES
Ainslie, Arthur F. 11 C

STILLWATER
Englin, Charles F. 06 E
Ovestrud, Melvin 13 M
Tierney, Festus P. 22 C

TAFTE
Wilson, Charles A. 22 C

TAYLORS FALLS
W. S. Olson 25, E. M. (Geol.)

TWIN VALLEY
Croswell, Thomas LeRoy 15 C
Nilson, Wilhelm 02 E

TWO HARBORS
Johnson, Austin G. 05 M
Peterson, George T. 08 M

VIRGINIA
Damberg, Rheuben Penn 21 A
A. C. Erickson 23, E. M.
Halden, Herbert O. 23 M
J. H. Nelimark 24, E. M. (Geol.)
Sannicolo, Joseph F. 22 E

INDUSTRIAL LIGHTING CODES.

In order to protect workers from accidents and eye sight damage, no less than five states, New York, New Jersey, Pennsylvania, Wisconsin and Oregon have now in force lighting codes for industrial establishments. Other states are now considering the adoption of an industrial lighting code, and it seems only a question of time when all the states will adopt such a code.

Proper lighting of work places is not only of great importance to the operators working therein, directly affecting their safety and eyesight, but it is a factor of equal importance to the employer, as quality and quantity of output are deciding factors of profit or loss in the operation of the plant.

The introduction to the Wisconsin code reads as follows: "Insufficient and improperly applied illumination is a prolific cause of industrial accidents. In the past few years numerous investigators, studying the cause of accidents, have found that the accident rate in plants with poor lighting is higher than similar plants which are well illuminated. Factories which have installed approved lighting have experienced reductions in their accidents which are very gratifying.

"Of even greater importance, poor lighting impairs vision. Because diminution of eyesight from this cause is gradual, it may take the individual years to become aware of it.

"This makes it all the more important to guard against the insidious effects of dim illumination, of glaring light sources shining in the eyes, of flickering light, of sharp shadows, of glare reflected from polished parts of work. To conserve the eyesight of the working class is a distinct economic gain to the state, but regardless of that, humanitarian considerations demand it.

"Finally, inadequate illumination decreases the production of the industries of the state, and to that extent, the wealth of its people. Factory managers who have installed improved illumination, are unanimous in the conviction that better lighting increases production and decreases spoilage."

The Wisconsin Commission has adopted a rule to the effect that, "diffusive or refractive window glass shall be used for the purpose of improving day light conditions or for the avoidance of eye strain, wherever the location of the work is such that the worker must face large window areas, through which excessively bright light may at times enter the building."

A glass is now available which meets the above requirements. It properly diffuses the light and prevents sun glare passing into the building and is known as Factrolite.

Engineers of to-day are making a thorough study of illumination, so that they may be able to plan and lay out industrial plants, to scientifically increase their efficiency to as near the maximum as possible. This accomplished the engineer is not only doing something worth while for his employer, but is doing quite as much for himself by coming into prominence with modern ideas.

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. 8.

(Virginia—Continued)
H. P. Sherman 25, E. M.
E. A. Sweetman 17, E. M. (Geol.)

WABASHA
John Searles 23, E. M.

WACONIA
Krause, Fred E. 24 E
Martin, Curtis Richard 21 G
Wessale, George 21 E

WADENA
Hayden, Claude E. 24 C
Hayden, John Foot 90 C

WASECA
Johnson, Edgar F. 21 E
Zimmerman, Louis Peter 08 E

WASHTUCNA
Bouge, Nathan H. 04 C

WHEATON
Heidelberger, Roy J. 22 E

WILLMAR
Bergquist, Philip L. 24 C
E. D. Coventry 12, E. M.
Peterson, Peter I. 20 E

WINNEBAGO
Falda, Charles H. 22 C

WINONA
Grettum, Leroy A. 23 E
Miller, William Lott 97 E
D. H. Ruhnke 25, Met. E.

WINTHROP
Eckberg, Curtis R. 24 E
Malmberg, Victor A. 20 C

MISSISSIPPI

JACKSON
Kroeze, Herbert Andrew 19 G

UNIVERSITY P. O.
Woolett, Guy Haines, 10 Ch., 16 M.S., 18 Ph.D.

MISSOURI

ANNAPOLIS
C. H. Sebenius 21, E. M.

JEFFERSON CITY
Espenett, Edward L. 22 C
Grant, Elberth R. 24 C
Putnam, George Wm. 18 G
Sverdrup, Leif J. 21 C

KANSAS CITY
Glass, Clifton A. 98 C
Tibbling, Ernest F. 14 Ch.
Wright, Harris H. 89 M

KNOB LICK
Rydeen, Francis G. A. 05 M

NEW LONDON
Glascock, Henry H. 86 E

ST. LOUIS
Cunningham, Andrew O. 94 C
Dawley, William S. 79 C
Diamond, Grover W. 12 C
Didriksen, Philip Henry 20 G
Ellsworth, Charles D. 20 E
Haines, Allen K. 13 E
Johnson, Noah 94 C
Koehler, Edwin F. 24 M
Lund, Earl H. 22 C
Olson, Richard H. 19 E
Tuttle, Stanley B. 24 M

SEDALIA
Butterworth, Russell I. 16 E

TROY
Ball, Hampton B. 20 M

MONTANA

ANACONDA
W. C. Cadwell 05, E. M.
F. C. Ramsing 15, E. M.
W. C. Jensen 24, E. M.

BILLINGS
Berg, Karl A. E. 20 C
F. A. Davies 16, E. M.
H. F. Davies 21, E. M. (Geol.)
Coleman, Frank D. 05 E

BUTTE
W. W. Bremer 24, E. M.
L. J. Coody 13, E. M.
A. J. Haley 25, E. M.
Jordan, Frank W. 19 E
Pratt, Arthur G. 99 E
H. J. Rahilly 11, E. M.
Stussy, William 00 E
W. N. Tanner 96, E. M.

BOZEMAN
Silverman, Isadore W. 24 A
Thaler, James Auken 00 E
Tove, George L. 20 M

GLENDIVE
C. J. Knutson 24, E. M. (Geol.)

GREAT FALLS
Adams, Elmer E. 06 C
Armstrong, Thomas S. 06 M
Dow, James C. 00 E
Fegan, Elmer Thomas 15 Ch.
Hougan, Sander 21 E
Wiesner, Frederick Edw. 06 C

HAVRE
Haverson, Henry David 07 C

HELENA
C. S. Heidel 10, E. M.
Kivley, Warren O. 16 C

LIVINGSTON
Blake, Robt. Pennell 97 M

MILES CITY
Assland, Christopher 13 C

PHILLIPSBURG
E. A. Fritzberg 10, E. M.

THOMPSON FALLS
Pearce, John Henry 07 E

NEBRASKA

CRETE
H. H. Hawlick 23, E. M.

MITCHELL
Rothi, Paul 04 C

OMAHA
Christensen, Edgar W. 19 E
Eddy, Horace T. 95 E
Johnson, James P. 23 E
Kingsley, Norman W. 20 E
Luce, Alexander Walker 21 M
Podosin, John 21 E
Rome, Robert C. 22 E
Wallfred, John E. 20 M
Weibler, Wm. Mathias 08 E
Wilcox, Halsey H. 15 E
Wilson, Paul Raymond 21 E
Zimmer, Wm. Arthur 06 E

UNIVERSITY PLACE
Japs, Barney G. 09 E

NEVADA

COMSTOCK
A. Winther 03, E. M.

GOLDFIELD
C. D. Wilkinson 95, E. M.

GOLD HILL
N. F. Goodrich 10, E. M.

MOAPA
John Lea 12, E. M.

RENO
E. J. Schrader 05, E. M.

TONOPAH
J. R. Tellie 11, E. M.

VIRGINIA CITY
R. J. Burgess 11, E. M.

NEW HAMPSHIRE

BERLIN
Burningham, F. A., 17 Che., 18 Ch.E.

NEW JERSEY

BAYONNE
Van Cleve, Horatio P. 07 C

BLOOMFIELD
Widell, E. Gideon 17 Che.

CAMDEN
Corson, Benjamin I. 17 Ch.

CARTERET
Kerns, Clinton B. 15 M

EAST ORANGE
H. C. Dinmore 23, E. M.

EDGEWATER
Rose, Anton Richard 04 Ch.

HARRISON
Anderson, Oscar P. 10 E

NEW BRUNSWICK
Von Kuster, Edith I. (Mrs. W. Johnson) 07 Ch.

NEWARK
Frederickson, Harry B. 11 E
Gregg, Tresham Dames 05 G
Williams, Arth. Howard 19 M
Wyman, LeRoy Linwood, 22 Che., 23 Ch.E.
Young, Charles Nelson 12 E

PERTH AMBOY
Paulson, Paul M., 23 Che., 24 M.S.

NEW YORK

ATTICA
Anderson, Edward L. 17 M

BAY SHORE
McCullough, Robert T. 23 E

BROOKLYN
Ely, Irving R. 05 E
Keiser, Karl W. 23 M.
Stoppel, Ernest Albert 11 Ch.
Sushan, Harry M. 19 C

BUFFALO
Frear, J. B. 10 M
Johnson, Carl Sigred 21 C
Kiesner, Frank C. 24 M
Luft, Oscar Wilhelm v.d., 17 Che.
Schildt, William F. H. 08 E
Swenson, Oscar E. 15 C

CANAJOHARIE
Mastin, Marion Gordon 13 Ch.

GLEN FALLS
Miller, Archibald T. 24 E

ITHACA
Barr, John Henry 83 M
Fraser, George 19 A

JERSEY CITY
Grimes, David 19 E

LACKAWANA
Ascher, Raymond C. 23 M

LONG ISLAND
Forbes, Henry C. 22 E

NEW YORK
Abbott, Arthur L. 97 E
Adams, George F. 95 E
Bacon, Charles B. 09 Ch.
Bauer, Ruben Bernard 20 E
Beckjord, Walter C. 09 E
Benner, Raymond C. 02 Che.
Bolme, Ole M. 10 C
Boman, Carl Emanuel 05 E
Bouman, Bernhard 04 E
Buhl, John E. 09 M
Buhl, Paul S. 07 M
Burns, Harvey L. 02 E
Chapman, Arthur G. 11 E
Cheney, Edward J. 04 E
Covell, Russell O. 16 E
Crabbe, George 04 E
Crane, Eugene C. 12 M
Daly, Richard T. 21 C
Demarest, Chas. Sidney 11 E
Dewey, Wm. Harry 93 E
Edelman, Philip 16 E
Elmer, Lloyd Armstrong 21 M
Gannett, Danforth K. 16 E
Gewalt, Carl Henry 21 A
Hahn, Stanley W. 22 A
Hilierty, Chas. Dutton 96 M
Hokanson, Clarence E. 06 E
Hunt, Gates E. 20 E
Ireland, Roy R. 03 E
Johnson, Byron Fillmore 20 C
A. F. Keene 04, E. M.
J. J. Kennedy 08, E. M.
King, Alfred B. 08 E
Koepke, Walter Edwin 13 C
Laird, Lee R. 03 E
Landeen, Arvid G. 10 E
LeTourneau, Edw. H. 05 E
Love, Donald P. 16 E
Love, Edwin M. 20 A
McKeehan, Louis W. 08 G
R. J. McRae 07, E. M.
Magoon, Herbert A. 24 A
Manderfeld, Emanuel 21 E
Markuson, Oscar S. 11 E
Mathes, Robert C. 12 E
Mayer, Albert F. 20 E
Mitchell, Alexander C. 20 E
Mowry, Harry W. 06 E
Myers, Mortimer 97 E
Norcross, Arthur F. 07 E
O'Brien, Raymond J. 11 E
Otto, Frederick A. 04 E
Owens, Leo E. 11 M
R. W. Persons 23, Met. E.
Peterson, Arthur P. 19 E
Porter, Allen Harold 08 Ch.
R. B. Queneau 23, Met. E.
L. G. Ravicz 14, E. M.
Robison, Archer R. 09 E
Siegmann, Chester W. 20 E
Simons, Walter W. 16 E
Smith, Donald C. 18 E
Strathman, Russell A. 20 E
Swensen, Karl P. 07 Em
K. P. Swensen 07, E. M.
Thuras, Albert L. 12 E
Tonell, Robert H. 24 E
C. W. Walters 11, E. M.
Wheeler, Herbert H. 17 E
Wiggins, Gerald Graham 06 E
Wright, Royden Vincent 93 M

NEW ROCHELLE
R. T. Wales 97, E. M.

NIAGARA FALLS
Marr, Horace Sinclair 17 Ch.
French, Edwin Linton 02 E
J. J. Woodruff 17, E. M.

ROCHESTER
Matthews, Glenn Earl, 20 Ch., 21 M.S.
Savage, Edw. Snoad 97 M
Seymour, Merrill W. 21 Ch.

SCHENECTADY
Allee, David A. 02 C
Beardmore, Albert 21 E
Bill, Earl M. 12 E
Downie, John M. 22 E
Dunham, Roy O. 14 E
Engstrom, Elmer W. 23 E
Forsberg, Peter Wm. 11 E
Frazee, Leonard M. 24 E
Grant, Fred R. 09 E
Grobel, Lloyd P. 24 M
Heinemann, John Robt. 19 E
S. L. Hoyt 09, E. M.
Johnson, Ivar W. 24 E
Kater, Jozef J. 24 E
Linhoff, Carl H. 22 E
Marshman, Irving H. 24 E
Mittag, Albert H. 11 E
Morton, Lysle W. 24 E
Rask, Louis G. 03 E
Ross, Kenneth R. 24 M
Satori, Roy H. 21 E
Tullar, Charles E. 01 E
Warren, Laurence C. 24 E

SYRACUSE
Jones, Robert A. 15 E

YONKERS
Rice, Edgar Whitman 02 Ch.

NEW MEXICO

HURLEY
LaFayette Knox 12, E. M.

SANTA FE
C. P. Harrington 06, E. M.

SILVER CITY
A. L. McCarty 04, E. M.

VALEDON
R. H. Dickson 12, E. M.

NORTH CAROLINA

RALEIGH
Anderson, Winslow 23 M.S. (Ch.)
Halverson, John Oliver 07 Ch.
Hemsey, Clayton E. 22 M

NORTH DAKOTA

CROSBY
Rosseau, Clifton C. 24 M

DEVILS LAKE
Wilson, Abner W. 22 E

ENDERLIN
Nelson, George A. 12 E

FARGO
Bunce, Paul F. 06 E
Holien, Edward O. 23 A
Peterson, Albert L. 14 M
Peterson, Lloyd L. H. 24 C
Sheffield, Fred W. 09 C
Tarbell, William P. 22C

GRAND FORKS
Anderson, Edward X., 08 Ch., 09 M.S.

JAMESTOWN
Grime, Edwin N. 00 C
McCall, Harry J. 08 C
Weinke, Ernest 16 C

LAMOURE
Johnson, Carl J. 14 E

MINOT
Peterson, William W. 16 C

PAGE
Miller, William J. 24 E

SHARON
Holmgren, Charles E. 09 M

WILLISTON
Bisek, Peter P. 14 E
Jackson, Myron Bangs 05 Ch.

OHIO

AKRON
Pettijohn, Earl, 10 Ch., 11 M.S., 19 Ph.D.

CINCINNATI
Marshall, Donald Eddy 19 E
Moore, John H. 24 M.
Peterson, Vance C. 20 E
Rosenthal, Oscar L. 19 C
Woolman, Harry D. 24 M

CLEVELAND
Arneson, Lloyd Olaf 21 M
Bierman, Geo. Henry 18 M
Brewster, William E. 12 E
Conley, Wilfred E. 10 E
Drinkall, John F. 19 E
Dunnum, Orney E. 22 E
Eddy, Lynne Walter 07 E
G. M. Gittinan 10, E. M.
Hayward, Laurence W. 21 E
Johnson, Leonard T. 10 E
Larson, Walter J. 20 E
Lee, Walter J. 20 E
Palmer, Roy A. 21 E
Reid, Harry A. 10 E

COLUMBUS
Krag, Walter G. 07 M
Moffat, George Nichol 19 M

DAYTON
Boyd, Paul M. 24 M
Craig, Robert 97 M
Knopp, William R. 09 M

EUCLID
Andrews, George L. 05 M

IVORY DALE
Blodgett, Charles R. 24 M
Cassel, Norman S., 22 Che., 23 Ch.E.
Hamlin, Lehan Hamer 21 M

LIMA
Cutter, Francis Charles 05 M

MANSFIELD
Goss, Harold R. 20 E
Noel, Clay W. 20 E

SANDUSKY
Mikesh, Martin A. 12 M

TOLEDO
Buckhout, Donald H. 17 A
Fortune, Harry G. 20 M

WILLOUGHBY
Taylor, Lyman David 13 E

YOUNGSTOWN
Birnberg, Zingel C. J. 09 M
Ramm, Theodore D. 13 E

OKLAHOMA

ARDMORE
W. E. Hubbard 17, E. M. (Geol.)

BARTLESVILLE
Hoffman, Richard H. 22 M
Stauffacher, Edward L. 24 M

BRISTOW
L. S. Coryell 17, E. M. (Geol.)

FORT SILL
Parkhurst, Harleigh 00 E

MUSKOGEE
C. L. Larson 10, E. M.

OKLAHOMA CITY
F. R. Edwards 08, E. M.
Montgomery, Albertus 13 C

OKMULGEE
A. I. Levorsen 17, E. M.
Paul, Karl F. 24 Che.

TULSA
H. J. Cosheim 23, E. M. (Geol.)
W. H. Elson 17, E. M.
J. W. Lewis 12, E. M.
F. S. Williams 15, E. M.

OREGON

ASHLAND
Dunn, Wilbur Wainright 90 C

CORVALLIS
Martin, W. H. 10 M

HARRISBURG
McAfee, Allan Lindsay 08 E

LINNTON
E. L. Larson 14, E. M.
Smithson, John E. 07 E

MAPLEWOOD
Curtiss, Faith (Sterling) 00 Ch.

MEDFORD
Brockway, Alvah E. 09 E
Waldron, Ralph E. 20 E
Wood, John William 05 E

ONTARIO
Countryman, Peter F. 07 E

PORTLAND
Anderson, Christian 88 C
Anderson, Frank Arthur 08 E
Bjorge, Oscar B. 07 M
Cobban, Rollo J. 09 E
Cook, Robertson 02 M
Cooper, George B. 93 M
Doeltz, Wm. Fred, Jr. 08 C
Hammer, George E. 20 Ch.
Horstkotte, Arthur E. 22 C
Juvrud, Ingvald Oliver 14 Ch.
Meany, James M. 07 M
Nelson, Donald O. 20 C
Rawson, Ralph Harvey 07 M
Shepard, Burchard Post 95 M
C. W. Steele 07, E. M.
Stoddardt, Hugh A. 24 C

ROSEBURG
G. G. Stewart 10, E. M.

PENNSYLVANIA

ALLENTOWN
Reque, Styrke G. 01 E

BEAUMONT
Bernhagen, Lewis Otto 06 AC.

BETHLEHEM
A. C. Forsyth 24, Met. E.
Bakke, Oliver M. 03 Ch.

DONORA
O'Connell, Thomas C. 13 Ch.

EAST PITTSBURGH
Berg, Samuel Arnold 22 E
Brown, Louis Marston 16 E
Burt, Fred R. 16 E
Cornelius, Martin 06 E
Daniel, Thomas Lester 00 M
Gibson, Charles B. 05 E
Kaplan, Eugene V. 10 M
Monseth, Ingwald T. 24 E
Nordlien, Berger W. 22 E
Simmon, Karl A., Jr. 05 E
Steffens, Robert A. 22 E
Towle, Neal C. 12 E
Trask, Alfred S. 23 E

ERIE
Sturtevant, Percy G. 08 E

HARRISBURG
Morse, George Hart 93 E

LESTER
Burwell, Loring Dunham 07 M
Powell, Knox A. 20 M

LIBRARY
F. R. McKenzie 22, E. M.

NEW CASTLE
J. C. Barr 22, E. M.
W. R. Griswold 23, E. M. (Geol.)

NEW KENSINGTON
Bakken, A. C. 23 M. S. (Ch.)
Edwards, Junius David, 12 Ch., 13 Ch.E.
Frary, Francis Cowles, 05 Ac., 06 M.S., 12 Ph.D.
Luger, Karl E. 22 Che.
Pippel, Herbert A. 20 Ch.
Taylor, Cyril Stead 13 Ch.

PHILADELPHIA
Childs, John C. 06 C
Danner, Jake 01 E
Goetzenberger, Ralph L. 13 E
Groat, Benjamin F. 01 G
Lowe, John M. 08 Ch.
Pearson, Charles W. 21 E
Petersen, Harold L. 16 C
Willner, William E. 22 A

PITTSBURG
Bierman, Harry C., 14 Che., 14 Ch.E.
W. A. Copeland 20, E. M. (Geol.)
Dever, Francis A. 20 C
Joles, Harold A. 20 E
A. T. Krogh 16, Met. E.
Lanpher, Murray W. 24 E
Leavenworth, Francis M. 11 Ch.
Parrett, Arthur N., 20 Che., 21 Ch.E.
Skytte, Ernest E. 10 E
Stinson, Will V. 11 E
Willard, Arthur C. 22 E

SCRANTON
Eberhardt, Otto E. 03 E

STATE COLLEGE
Sime, Theodore L. 23 A

STOWE
Williams, Edward Hale 03 M

WILKINSBURG
Dahl, Hjalmer A. 22 E

SOUTH DAKOTA

ANDOVER
Bingen, William J. 12 C

ARMOUR
Burtis, William H. 92 E

BARTON
Tyvand, James A. 24 E

BROOKINGS
Enke, Fred A. 21 C
Mark, Reuben A. 11 C
Mark, Walter J. 09 M

HURON
Ellefson, Selmer 16 E

LIGHT CAP
Blake, Henry R. 01 E

MITCHELL
Smith, Sidney H. 11 C

SIOUX FALLS
Boyce, Leonard F. 12 M
Hult, George A. 16 E
Ransom, Ralph W. 23 M

TENNESSEE

CHATTANOOGA
C. T. Barker 22, E. M.
Hawlik, Henry Irwin 19 C
Irwin, Frank H. 16 E
R. H. Ridgway 23, E. M.
Withee, Warren 15 C

GUILD
Irwin, Vincent H. 13 E

ISABELLA
V. L. Kegler 23, E. M. (Geol.)

MEMPHIS
J. B. Hanson 13, E. M.
Nichols, Browning, Jr. 10 M

TEXAS

CISCO
Adolph Dovre 16, E. M.
F. H. Wilcox 23, E. M. (Geol.)

DALLAS
S. M. Aronson 16, E. M.
A. C. Bierman 14, E. M.
Fernald, Frank O. 04 C
Harris, Clayton 09 E
Rounds, Fred M. 95 E
Smith, Donald Tidd 05 C
L. R. Whitson 11, E. M.

EL PASO
H. E. Quinn 18, E. M. (Geol.)

FORT McINTOSH
Crane, Fremont 86 C

HOUSTON
Chestnut, George L. 97 E

LUBBOCK
Harrington, Marzy Van 24 C

WICHITA FALLS
E. M. Adams 22, E. M.

UTAH

EUREKA
V. E. Ekloff 11, E. M.
G. W. Hezzelwood 23, E. M.

INTERNATIONAL
W. J. Nicholls 21, Met. E.

PRICE
Jones, Watkin W. 11 E

SALT LAKE CITY
Ashworth, Roy H. 11 E
Beyer, Theodore A. 03 C
Brenchley, Walter C. 15 C
E. V. Smith 01, Met. E.
Stoutland, Oliver R. 22 C

VERMONT

ST. JOHNSBURY
Stillman, Marcus H. 09 E

VIRGINIA

DANVILLE
Furber, Pierce P., Jr. 08 C

FORT HUMPHREY
Coe, Edward Harold 19 C
Luplow, Walter D. 17 C

HAMPTON
Joachim, William F. 20 M

NORFOLK
O'Brien, John Erwin 98 M

QUANTICO
Strong, Frank D. 17 Ch.

WASHINGTON

ABERDEEN
Nelson, Carl H. 10 E

DAVENPORT
W. L. Campbell 09, E. M.

EVERETT
Beaulieu, Richard L. 02 C

KELSO
P. E. Jones 10, E. M.
Phelps, Ray R. 10 E

LONGVIEW
Hetherton, Percival 08 M

MALDEN
Baker, Arthur W. 19 M

NO. YAKIMA
Gilman, Nicholas A. 07 M

PASCO
Acker, Sidney H. 23 M

PUGET SOUND
Benedict, George F. 03 E

SEATTLE
Adams, Benjamin W. 10 C
Bennett, Walter James 03 C
Bowen, Fred Fabst 06 C
Bushnell, Chas. Spencer 78 M
Erickson, Carl Gunnard 03 E
Grimshaw, William E. 02 M
Guthrie, J. DeMott 93 E
Linton, James H. 97 Ch.E.
McKenzie, Lauren F. 09 E
Magnusson, Carl E. 96 E
Norelius, Lewis M. 06 C
Quense, John 01 C
Schow, William P. 07 E
Shuck, Gordon R. 06 E
Silliman, Henry D. 97 M
Weber, Erwin L. F. 06 E
Westberg, Russell F. 20 E

SPOKANE
Alton, Herbert D. 07 E
Cowin, Clifford Cecil 12 C
J. R. Newell 10, E. M.
Putz, John H. 14 E

TACOMA
McConnell, Edmund S. 24 E
Peters, William G. 83 C

WEST VIRGINIA

CHARLESTON
Gittinan, David M. 15 M

FAIRMONT
Schoepf, Alfred Walter 08 E

HUNTINGTON
Fairchild, Albert Royal 07 E

MORGANTOWN
Amidon, Lee L. 23 M
Gill, James Herbert 92 M

WHEELING
Root, Frank R. 24 Ae

WISCONSIN

ASHLAND
Larson, Peter L. 24 C

APPLETON
Palmer, Howard B. 22 C

BELOIT
Christianson, Hilmar B. 15 C

BRUCE
Darrell, James E. P. 23 C

CHESTER
Weston, William S. 02 C

CHIPPEWA
Berdan, Hubert J. 22 C
Cray, Seymour R. 22 C

DANBURY
Buhr, Leo 23 C

EAU CLAIRE
Dow, Clarence A. 13 E
Fairbanks, Geo. Wesley 23 E
Frahm, Alfred R. 08 E
Holm, Edwin R. 20 C
McMillan, James S. 22 E

GREEN BAY
Curry, Ezra Benham 20 M
Odegaard, Harold T. 20 M

HUDSON
Kircher, George A. 09 M

HURLEY
Butterworth, Allan C. 11 E

LACROSSE
Bergsland, Grant C. 23 M

MADISON
Daniels, Farrington, 10 Ch., 11 M.S.
Dunlap, Lemuel James 24 E
Korthage, Roy F. 20 Ch.
Hubbard, Robert T. 06 E
Knauss, Archibald C. 16 C
Larson, Ludvig C. 21 E
Luxford, Roland F. 17 C

MAYVILLE
E. S. O'Connor 06, E. M.

MELLEN
F. C. Sponberg 21, E. M.

MENOMONIE
Mitchell, Ralph W. 12 Ch.

MILWAUKEE
Albrecht, George M. 06 E
Bauer, Roscoe W. 24 C
Chapin, Harold S. 12 M
Clarke, Charles P. 08 C
Cross, Charles H. 97 M
Epstein, Hymen 21 Ch.
Hanson, Maurice James 11 E
Johnson, Elving L. 23 E
Johnson, Herman R. 09 E
Mintz, Nathaniel 22 E
Montgomery, Ralph M. 24 M
Newman, John M. 23 E
Odegaard, Harold T. 20 M
Papenthien, Roy Oliver 21 G
Peterson, Clifford E. 23 Che.
Price, Clarence R. 20 E
Reed, Albert I. 85 C
Roberts, Earl H. 15 M
Roberts, Wesley J., 21 Che., 22 Ch.E.
Schlenk, John J. 23 C
Sear, Arthur W. 23 M
Thomas, W. Alan 24 M

OCONOMOWAC
Plank, Howard G. 22 E

OCONTO FALLS
Busch, John S., 20 Che., 20 Ch.E.

OSHKOSH
Simms, Charles G. 24 M

RUBICON
Thurston, Harold H. 13 C

ROTHSCHILD
Nee, Harold E. 24 E

STEVENS POINT
Rathburn, George A. 24 M

SUPERIOR
Deneen, David Joseph 19 A
C. J. Moe 24, E. M.
Scobie, Francis G. 08 E

WAUWATOSA
Foltz, Ross Milton 19 M
Tappan, Ruth W. 22 Ch.

WHITEWATER
Rood, Arnold E. 22 E

WYOMING

CASPER
Rader, Clarence M. 17 C
Uzzell, George Walter 07 E

MIDWEST
R. M. Larsen 24, E. M.

LARAMIE
E. P. McCarty 00, E. M.

SALT CREEK
K. B. Walter 13, E. M.

SUNRISE
W. F. Moenke 06, E. M.

YELLOWSTONE PARK
Lindelef, Charles 09 E

AFRICA

BELGIAN CONGO
W. V. Butler 15, E. M.
J. L. Middleton 23, E. M. (Geol.)
E. H. Walker 11, E. M.

PORTUGESE WEST AFRICA
O. F. Ernster 17, E. M.
R. C. Grant 09, E. M.

RHODESIA
H. E. LaTendresse 23, E. M. (Geol.)

ALASKA

KENNECOTT
S. G. Olson 24, E. M.

VALDEZ
Smith, Byron Elton 07 E

AUSTRALIA

MELBOURNE
Crosby, Milton E. 15 M

CANADA

GOWGANDA, ONTARIO
A. H. Swanson 10, E. M.

HAILEYBURY, ONTARIO
H. R. Bischoff 10, E. M.

KAMLOOPS, B. C.
Arthur Wallinder 12, E. M.

KIRKLAND LAKE, ONTARIO
C. L. Heath 10, E. M.

MONTREAL
Adams, William C. 05 E
S. W. Cohen 03, E. M.
Spence, Wm. James 02 E
Westbrook, Donald 10 M

PORTEAU, B. C.
T. O. Burgess 01, E. M.

PORT ARTHUR
Souba, William Henry 09 M

TORONTO
Anderson, Oscar V. 10 E

WEYBURN
Casberg, James Wm. 08 E
Powell, Louis H. 24 C

WINNIPEG
Borrowman, Leroy F. 08 C
Brown, George J. 08 E
A. W. Fosness 13, E. M.
Schumacher, John H. 03 E

CENTRAL AMERICA

HONDURAS
MINAS DE ORO
H. J. Brosius 04, Met. E.
SAN JUANCITO
E. D. Zauger 21, E. M.

CHINA

KIRIN CITY
Chung Hsieh 18, E. M.

PEKING
Lin, Shu Ming 20 A
Sze Chen Lin 22, E. M.

SHANGHAI
Yih Kun Kwong 17, E. M. (Geol.)

TIENTSIN
Eliassen, Sigurd 18 C

CUBA

HAVANA
Romero, Cerilo L. 17 M

MINAS-DE-MATAHAMBRE, PROVINCE PINAR-DEL-RIO
F. C. Devereux 04, E. M.

CYPRUS

SKOURIOTISSA, NICOSIA
C. F. Jackson 07, E. M.

ENGLAND

LONDON
Estes, Harvey Cole 08 M
T. H. Huang 24, E. M.

ST. MAUR, NEWTON ABBOT, DEVONSHIRE
Cyril Brackenbury 98, E. M.

INDIA

BOMBAY
Cerney, Glen C. 20 M
Shellenberger, Hiram R. 20 M

BURMA
A. B. Calhoun 05, E. M.

MADRAS
Cuddy, Wm. Arthur 15 C

ITALY

ROME
Hammett, Ralph W. 19 A

MEXICO

ARIZPE, SONORA
A. H. Hammond 13, E. M.
W. F. Jahn 11, E. M.

CANANEA, SONORA
H. S. McKay 05, E. M.

EL ORO, ESTADO DE MEXICO
J. G. Flynn 03, E. M.

GUADALAJARA
Burt, John Lucius 90 C

PHILIPPINE ISLANDS

MANILA
Moreno, Gerardo 17 E
Roque, Feliciano T. 24 Che.
Shippam, Willis 09 M
Weeks, William C. 94 C

ARGENTINA

BUENOS AIRES
G. L. Harrington 12, E. M.

BOLIVIA

LLALLAGUA
A. K. Bailey 20, E. M.

CHILE

CHUQUICAMATA
Carlson, C. Philip 21 E
J. L. Dopp 17, E. M.
Knowles, Everett H. 20 E

TOCOPILLA, CHILE
Carlson, Victor H. 20 E

COLOMBIA

AMALFI
E. A. Probst 07, E. M.
J. D. Wheeler 20, E. M. (Geol.)

DUTCH GUIANA

PARAMARIBO
John Edwin 20, E. M.

PERU

CASAPALCA
R. M. Sanchez 15, E. M.

CERRO DE PASCO
H. K. Armstrong 18, E. M.
J. O. Hosted 19, E. M. (Geol.)

QUIRUVILCA
S. B. Goldberg 19, E. M.

VENEZUELA

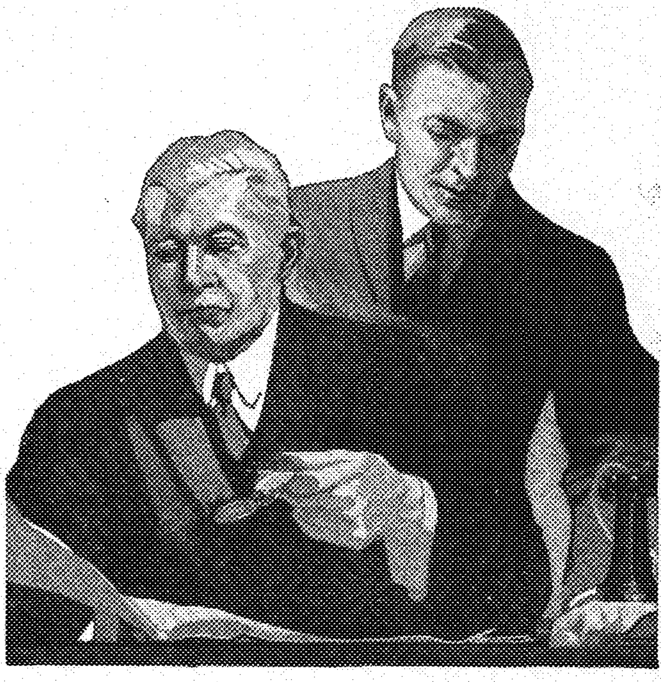
MARACAIBO
B. C. Dennis 17, E. M.
L. de U. Echeberria 22, E. M.

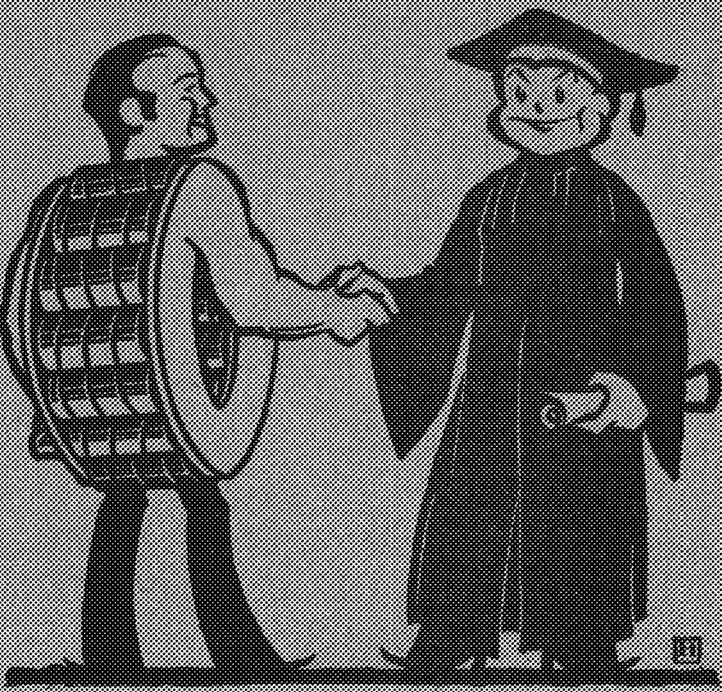
RIO DE JANEIRO
Thompson, Herbert L. 12 M

VIRGIN ISLANDS

Mattison, Geo. Carl 11 C


KEYSTONE
COPPER STEEL





A Friend You May Need

WHEN your fleeting college days are over and you come up against the knotty problems of business life, just bear in mind that the loyal support of true friends is always at your command.

Hyatt bearings are old friends of the engineer. Wherever wheels and shafts turn and destructive friction must be overcome, these modern bearings will serve you and your business associates faithfully and well.

Hyatt bearings give years of continuous smooth operation and carefree service. They banish plain bearing friction and its attendant evils. They reduce power consumption as well as lubrication and maintenance requirements.

On line shafts, in electric motors, mine cars, automobiles, conveyors, industrial trucks, farming implements and many other classes of equipment, Hyatt bearings are big factors for dependability, safety and economy.

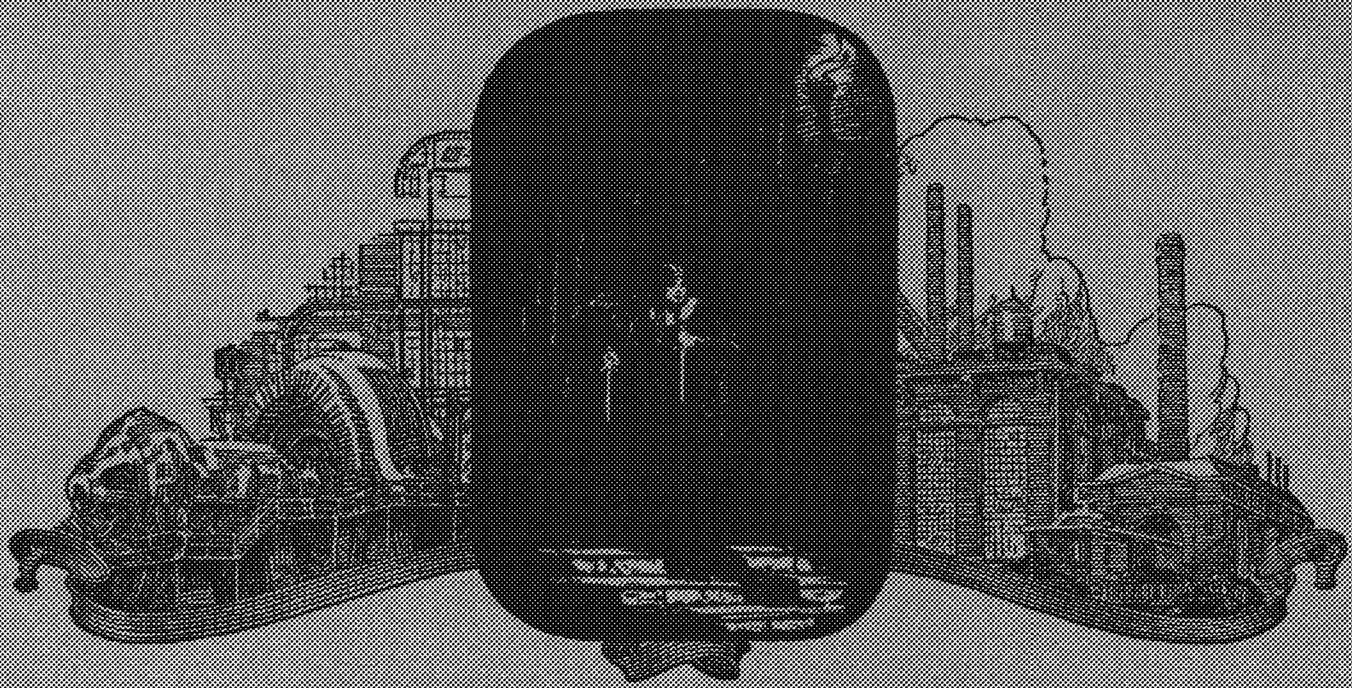
Include Hyatt bearings in your designs and specifications. Hyatt engineers, trained through years of study and practical experience, are ready to give you the benefit of their assistance and suggestions for solving your bearing problems.

Just make a note now that Hyatt roller bearings and the Hyatt organization are always at your command—prepared to serve you and your needs.

HYATT ROLLER BEARING COMPANY
NEWARK, NEW JERSEY

HYATT
Roller Bearings

IF YOU will write to us, mentioning the name of your college, we will send you a small Hyatt bearing which you can use as a paper weight or pocket piece. This will give you a clearer idea of the unique construction which makes the Hyatt roller bearing easy running and durable.



"THE PLAY'S THE THING"

JOHN BARRYMORE himself would "get the hook" if he did not know his cues, or read his lines as called for by the action of the play.

Engineers get cues, too—from the industrial drama of which they are a part. Like actors, their performance must fit the action of an economic play.

Thus the reason that the journals, the societies, the schools, colleges, teachers, and well-known public men, are urging engineers to study economics—to learn the nature and effect of economic laws.

To build the largest generator or the smallest meter, for example, is not always in itself a great engineering feat. The feat consists in having it ready at a time, a price, and with such features as the prevailing economic situation calls for.

In this sense engineers—and particularly Westinghouse engineers—must be "practicing economists". They must follow closely the "action of the play"—analyzing fundamental conditions in every field, and calculating their causes and probable effects.

All this, so that when a cue is spoken in factory or home, on farm or railroad, on the sea or in the air, they may be ready.

This advertisement is eighth in a vocational series, outlining the fields for engineering achievement in the Westinghouse organization. A copy of the entire series will be sent to anyone requesting it.

Westinghouse

W

WESTINGHOUSE ELECTRIC

ACHIEVEMENT & OPPORTUNITY