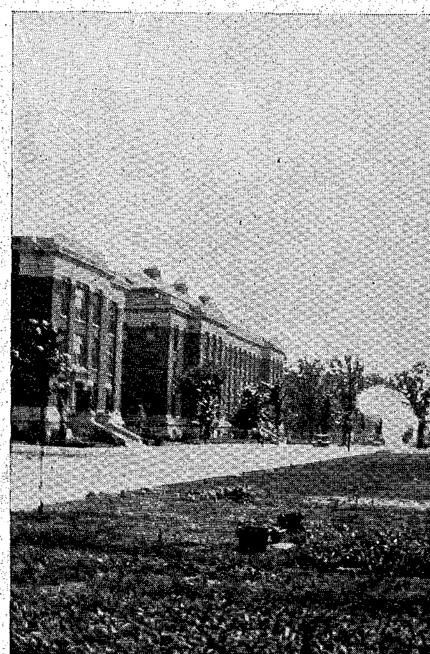
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



Vol. IX OCTOBER, 1928 No. 1

POWER PLANTS

ONE MILLION K.W. is the ultimate capacity of the Central Station shown at the top of the page. The Laundry, illustrated below, operates a 70 h.p. boiler.

Both plants are equipped with fuel burning apparatus, designed, manufactured and installed by Combustion Engineering Corporation.

There is no sharp dividing line between the responsibilities of the stoker or burner manufacturer, the furnace builder and the boiler maker. Steam Generation is a combined process of heat liberation and heat absorption. The performance of individual elements is secondary to the performance of the combination —*as a unit.* The ultimate goal sought is to produce a dependable supply of steam at minimum cost.

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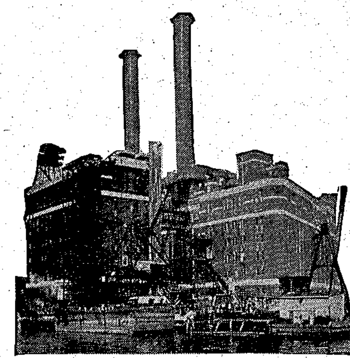

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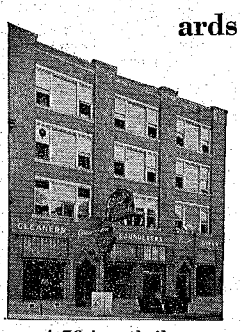

A 70 h. p. boiler serves this laundry

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COMBUSTION ENGINEERING

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

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

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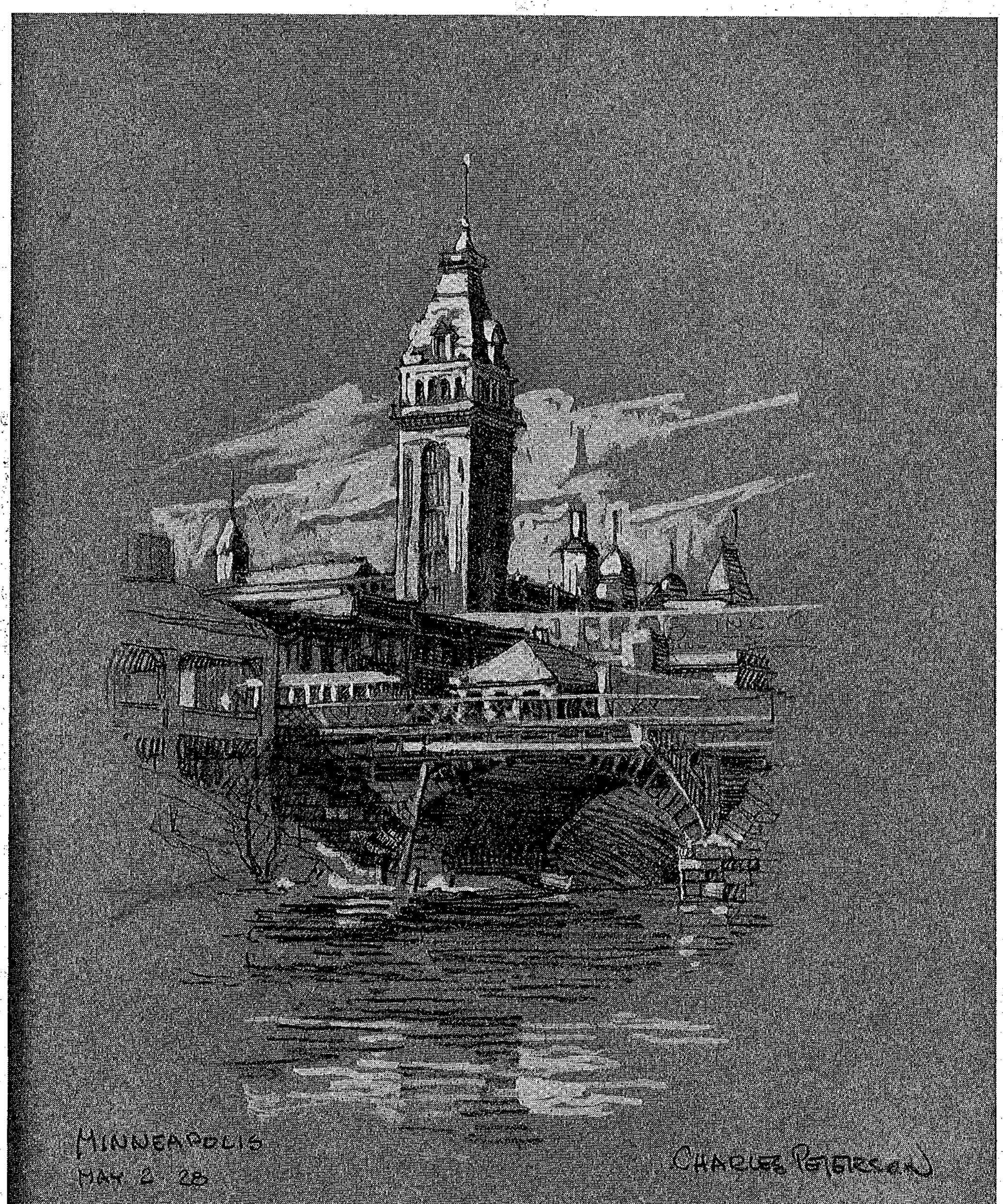


*"Towering Over All Stands
the Old Exposition Building"*

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume IX OCTOBER 1928 Number 1

Seven Years Later

A backward look at school, lessons, the gang, and the problem of the first job

By RALPH W. LIDDLE, B.S. '21
Editor, Edison Round Table,
Commonwealth Edison Company, Chicago.

ADVICE is always cheap, often poor, and it can seldom be accommodated easily to the problem at hand. We choose usually to go our own way, to make our own mistakes, to learn our own lessons. We want to find the answer ourselves. We want to train, to test, to vindicate our own judgment. We want to conduct our own campaign, to be the captain of our own soul.

These are good signs. So long as there is the conviction that one cannot dodge the responsibility for his actions, individualism seems a promising characteristic, at least among intelligent people. But never mind now about such matters of philosophy. I had in mind only to indicate, first, that in these random observations there was certain to be an element of suggestion, criticism or advice. By any of these names it would be the same thing. Second, that these comments, perhaps of interest, perhaps only amusing, may be of some use for two reasons: Because their authority is so dubious they will be analyzed and picked at to discover flaws; and because this process will stimulate thought and probably develop theories more nearly correct. I mean that if all these are proved wrong, our time has still not been wasted.

We will begin with the idea of engineering as a very popular and genteel method of educating young men. It is that. Engineering training is "proper"; it is approved in all quarters, in society, in the business world. One speaks proudly of "taking engineering." We live, it appears, in an era of industry and invention and commerce. What is more natural than that a young man should wish to become some type of engineer.

Engineering training has a broad value, irrespective of what work one eventually does, because it teaches one to think, it develops an analytical mind. Time and again we have been told this, and we are sure it is true. It has not been shown that other educational endeavor does not do the same thing, along other lines, given the same mind to work with. It may be that once developed, the ability and inclination to think and analyze might be applied to any line of work. It is possible that technical training sometimes overdevelops the physical concept, and thus has a narrowing influence. But let us not start a quarrel.

Two of the attractions of engineering training then are its timeliness with respect to the age we live in, and its undoubted potential value in general mental development. Another is the inborn liking boys and men have for material things, for making, seeing, and determining why the wheels go 'round. Another is the factor of succession—the boy whose father ran a railroad locomotive, the flour mill at home, or was in fact a noted engineer. These boys must, of course, be engineers. If the boys are themselves in doubt their parents or relatives sometimes insist that they become engineers.

SO we find in technical schools a considerable number of bright sensible young men who are not really engineers at all. I am not the first to make this discovery, by the way. The condition is not the fault of the students, or of the schools, or of the times, but of all three of these, plus other things. It will be corrected very likely by more careful observation of students, and a broad realization of the simple fact that engineering is by no means the single grand enterprise. My own notion is that the final loss here is not relatively serious, but still unfortunate. In examples I know of it is always clear that the error in choice might easily have been greater, and that the non-engineer seldom is dissatisfied with his training. One sees that, after all, four years are only four years.

Making suggestions in regard to the engineering curriculum is a popular pastime. With all the expert advice university professors get from alumni and other meddlers it is indeed a sad commentary that educational programs have not long ago been perfected. But such is the case, and we must have our say. No matter if we know very little of changes that have been made in the past few years. So much the better, in fact. Our viewpoint is fresh, perhaps too much so.

We will grind our own axe first. This article, as the product of an alumnus, will do its bit to prove that engineers are in need of better training in writing. Curiously enough, the matter of training in expression was mentioned first by two old graduates questioned on the needs of the young engineer. It must be obvious that a man's ability to think clearly is greatly diminished in value if he cannot express these thoughts and conclusions in writing and speaking. Proficiency in expression will aid him in any line of work, and in nearly every job he has to do. The serious importance of this faculty of expression becomes more apparent the more one considers it.

Enlargement of this branch of the curriculum perhaps will not be welcomed by the student. I remember with what glee I ducked English IV in high school. I remember the impatience with which we engineering students studied rhetoric, wrote themes, and on rare occasions, took public speaking. This stuff, we scornfully alleged, was not engineering. We wanted more of a monkey wrench and slide rule flavor in our educational diet. Let the academics toy with literature and writing and talking if they wished. We were made of sterner stuff. I can laugh at this now because it was so foolish, but I cannot conjure up the valuable training I might have had, nor will you be able to.

THE medicine that will help eliminate our infirmities is not always that with the pleasantest taste. A limited power of expression is a too common infirmity of the engineer—one of which he sometimes even boasts. I would prescribe a strong dose of preventive medicine during the training period, and never mind if the patient complains of the taste.

On every hand one hears that there should be more of commercial subjects in engineering courses. The problem of

(Continued to page 18)

Origin of the Techno-Log

A brief description of the growth and development of student publications on the engineering campus

By Francis J. Fox, Ch.E. '30
Associate Editor of the Techno-Log

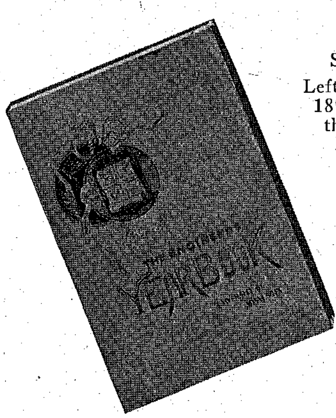
JUST thirty-five years ago the foundations of the present Techno-Log were laid in the first edition of the "Yearbook of the Society of Engineers." The Society of Engineers had long been an active organization in what was then the College of Engineering, Metallurgy, and the Mechanic Arts, when in 1893 it decided to publish a year book. This year book, which was the first publication of its kind in connection with the engineering college, was in charge of an editorial committee representing the departments of civil, mechanical and electrical engineering, mining and architecture. The volume was essentially technical in scope and consisted entirely of articles contributed by students, graduates and faculty members in the various scientific departments of the university. Henry B. Avery, M. E. '93, as managing editor, headed the editorial committee in charge of the 1893 edition, and John W. Erf, C. E. '93, was the business manager.

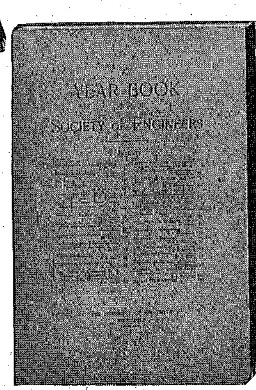
During the fifteen years that followed, the society underwent a gradual expansion until the one hundred twenty-two page yearly publication became inadequate for its needs. In November, 1908, the name was changed to the "Minnesota Engineer" and the magazine appeared on the campus as a quarterly. For the year 1908-09 George M. Shepard, C. E. '09, was chosen editor-in-chief, and Rollo J. Cobarr, E. E. '09, was made business manager.

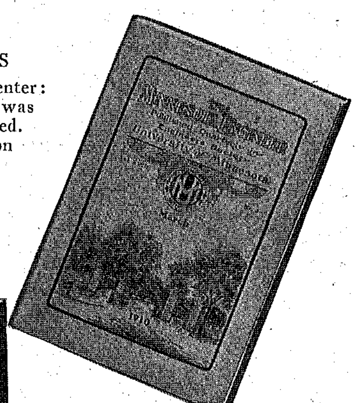
An editorial by Mr. Shepard in the first issue after the reorganization set forth the aims and policies as follows: "The object of this publication is threefold: first, to be the official organ of the Engineer's Society; second, to be a means of presenting to the public technical articles by alumni, students and others; and third, to contain current and alumni news."

An editorial staff consisting of E. W. Leach, C. E. '10, F. W. Buck, M. E. '09, F. T. Paul, C. E. '09, and O. B. Poor, E. E. '09, was appointed, and the magazine set out to accomplish its new purpose.

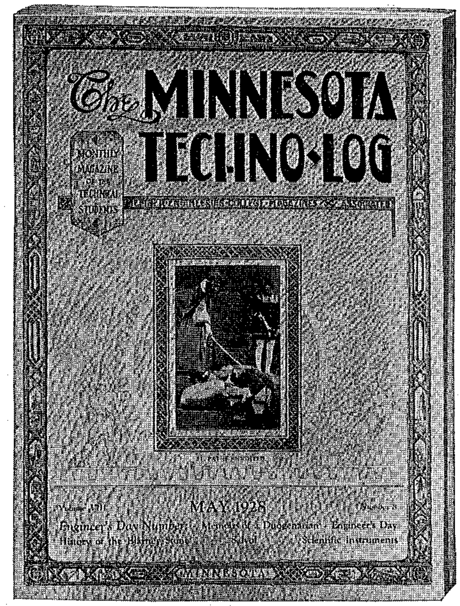
AN advisory board composed of Professors Constant, Flather and Shepardson was formed. Frederick S. Jones, who was at that time dean of the College of Engineering, was named to head the committee. This board, under the leadership of Dean Jones and later of Dean Shenehon, functioned until publication of the "Engineer" was suspended in December, 1915.







SOME EARLY EDITIONS
Left: Yearbook of 1897. Center: 1892-93 Yearbook. This was the first edition to be published. Right: March 1910 edition of the Minnesota Engineer



THE 1928 TECHNO-LOG
This is a reproduction of the 1928 Engineer's Day edition. The cover was designed by Walter J. Huchthausen.

During the following six years there was no publication and not a great deal of activity on the technical campus, but in November, 1920, the Association of Engineering Students, a reorganization of the old Society of Engineers, decided to re-establish a magazine in the technical colleges.

As the result of this decision, Martin F. Wichman and O. F. Beeman were chosen managing editor and business manager of the new monthly, which was to be called the Techno-Log.

A small room on the fourth floor of the Main Engineering building, scarcely more than a "cubby hole," was transformed by virtue of two desks, a plain table, some chairs, a typewriter, and several energetic engineers to the publication office of the "Minnesota Techno-Log."

After much hard work on the part of the staff, the first issue came off the press with news, alumni notes, editorials and several technical articles.

Constant changes in the membership of the staff became the rule for the first few issues, and in January, 1921, Carlos W. del Plaine, C. E. '21, succeeded Mr. Wichman as managing editor. As the staff became more thoroughly organized, more articles were printed, illustrations became more frequent, and a humor column was added.

THE following paragraph taken from an editorial that appeared in the November issue of 1921, of which A. E. Horstkotte, C. E. '21, was managing editor, gives somewhat of an idea of the success with which Mr. del Plaine's efforts of the preceding year met: "When the pressure of other duties made it impossible for Wichman to continue actively as managing editor, that position was filled by Carlos W. del Plaine. Though already a busy man, del Plaine took time to adopt the Techno-Log for his 'hobby,' as he calls it, and under his direction its existence was justified. Each succeeding issue brought favorable comment from the publications of other schools, particularly engineering institutions. Under del Plaine's management, the business and advertising departments were put on a substantial basis."

One of the important episodes in the history of the Techno-Log took place in April, 1922, when L. M. Bergford was managing editor, and Otto Person was business manager and the Techno-Log became a member of the Engineering College Magazines Associated.

The E. C. M. A. is an association of technical magazines published in the various engineering colleges of the United States. It was formed in 1920 as a means of gaining adequate representation for the widely scattered college publications in soliciting national advertising and to improve the quality of the member magazines.

Prior to actual membership in the Engineering College Magazines Associated, the Techno-Log adopted several of the association's standards of practice including the seven by ten inch page size which has since become the standard size for nearly all college periodicals.

Clarence W. Teal, E. E. '24, managing editor, and Philip W. Richardson, E. E. '25, business manager, made an innovation in Techno-Log procedure when they published the edition of June, 1924, in which the regular alumni column was extended to form a directory of all the alumni of the College of Engineering and Architecture, the School of Chemistry and the School of Mines. This alumni edition established a precedent which has been followed with increasing favor.

The third of October, 1924, was a memorable day in the life of the Techno-Log, for on this day, as the result of the unceasing efforts of Albert W. Morse, who succeeded Mr. Teal as managing editor, the office was moved from the small, dark room on the top floor of the Main Engineering building to its present quarters—a large, well lighted room on the ground floor of the Electrical Engineering building.

Resigning the managing editorship in January 1925 in order to take a position with the Minneapolis Civic and Commerce Association, Mr. Morse was succeeded by Kenefick Robertson and Herman F. Beseler as managing editors. Although he was away from the university, Mr. Morse kept in close contact with the affairs of the Techno-Log and did much to direct its policy. In May, 1925, he drew up a constitution providing for the maintenance of the Techno-Log as a separate organization from the Association of Engineering Students. The constitution provided for the formation of an organization to be known as the Techno-Log association and to be composed of all students in engineering, architecture, chemistry, and mines.

At the annual all-university elections, seven students are elected from this association, who with the deans of the College of Engineering and Architecture, the School of Chemistry, and the School of Mines, serve as the Techno-Log board. This board elects the managing editor and confirms the appointment of the business manager, who is selected by the editor.

This constitution was adopted by the engineering students at the all-university elections in May, 1925, with but three dissenting votes. A few minor changes were made in the constitution at the spring elections in 1928.

Under the editorial guidance of Paul B. Nelson, E. E. '26, a complete June issue was published in 1926, and in addition to this a forty-four page alumni directory was put out.

While Carl F. Luethi, C. E. '27, was managing editor and Sheldon F. Johnson, E. E. '28, was business manager, the 1927 national convention of the Engineering College Magazines Associated was held at Minnesota, with the Techno-Log in the role of host.

Immediately after coming into office in October, 1927, Lawrence A. Clousing, E. E. '28, and Carl E. Swanson, E. E. '28, set out on a campaign to put the magazine on a blanket subscription basis. After a year of work, during which the signatures of over ninety per cent of the engineering students were obtained as being in favor of the blanket tax, the Board of Regents granted the request, and the publication is now under the blanket subscription plan.

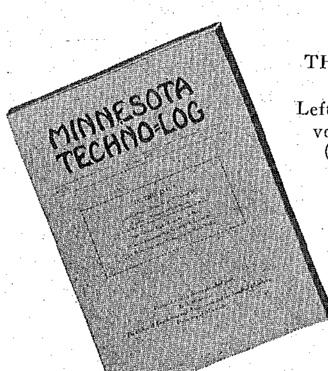
The blanket subscription plan is a method which is used by several other engineering magazines at other colleges and universities and on this campus by the Minnesota Daily. Under this plan, the Techno-Log subscription price is added to the incidental fee of each student in the College of Engineering and Architecture, the School of Chemistry, and the School of Mines.

This gives all engineering students the publication, assures the publication of a definite income, and obviates the necessity of overworked staff members carrying on a subscription campaign and collecting money.

Of all the issues published during the year, the June issue is by far the most important. The entire staff spends many weeks of careful compilation of the addresses of the alumni.

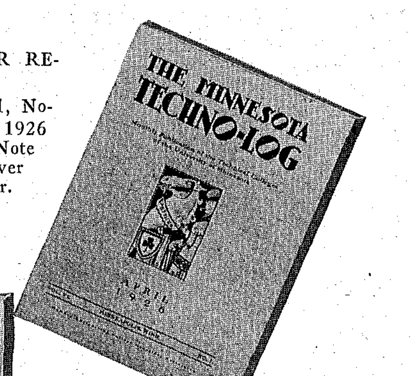
No doubt this work is appreciated, and is found valuable by the alumni, for men who have been long away from the university and who are sometimes in the far corners of the world, write for the June issue as early as January. The various staffs have always felt that if this issue is of value in keeping the graduate in touch with "the old gang," the work put in it is well worth while.

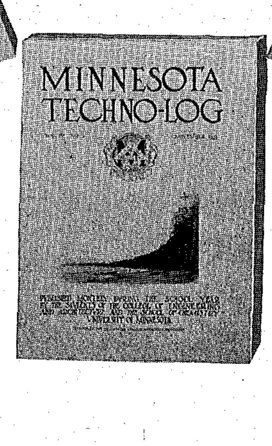
From this brief history of the Techno-Log it might seem that none others than managing editors and business managers had a hand in its growth and development. Of course this is not the case, but as the long list of those whose time and energy went into the making of past Techno-Logs is far too great, to reproduce here, let it be said that their work has been greatly appreciated in the past and will be more appreciated in the future.



THE MAGAZINE AFTER RE-ORGANIZATION

Left to right: December 1921, November 1923, and April 1926 (Engineer's Day edition). Note the variation in the cover design from year to year.





Rayon

A triumph of modern chemical and mechanical engineering now the third most important textile

By RALPH E. MONTONNA
Assistant Professor of Chemical Engineering.

WHEN a business, even a textile business, passes the hundred million dollar mark, it is worthy of consideration by engineers because it is a potential source of employment. When it ranks as the third most important textile, and this country is the world's leading producer, its economic importance commands the attention of technical men. And, finally, when that business is the creation of chemists, chemical and mechanical engineers, there is romance in its story which holds interest for an audience of engineers. That is the position of rayon in the business world today.

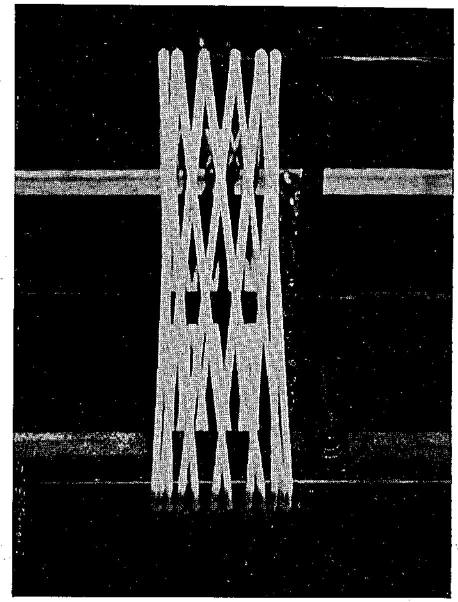
In 1913 this country produced only about one and a half million pounds of rayon valued at a little over three million dollars, while, in 1926, sixty-three million pounds valued at over one hundred million dollars was our output. This forty-fold increase has taken place while the world output was increasing seven-fold.

It was in 1922 when the world production reached eighty million pounds that rayon assumed the third position in the textile world, passing silk which had an annual production of about seventy million pounds. Up to this time the fibre had been known as "artificial silk." This designation is clearly a misnomer, since it is a distinctly new textile fibre which is neither an artificial silk, nor in any sense a substitute for silk, but occupies a unique position of its own. Recognizing these facts, the American Association of Textile Manufacturers sought a name which would be distinctive and finally agreed upon "rayon." The new name has met with wide acceptance in this country, but not as completely in Europe where the old term "artificial silk"—German Kunstseide—is still largely used.

HISTORICAL

Of all fibres, silk is the simplest, the most perfect and the most highly prized. It is natural therefore, that there should be attempts to duplicate Nature's handiwork or prepare a substitute. The first recorded suggestion of this kind is accredited to Reaumur, a French entomologist, who, in 1734, published the results of his studies of the silkworm and its method of producing silk, and suggested the imitation of this much desired natural fibre. Because of the technical difficulties, nothing came of this suggestion for one hundred fifty years. In 1875, Andemars, a Swiss chemist, purified a paste of young mulberry branches and treated it with nitric acid. He dissolved his product (nitrocellulose) in ether-alcohol, added an etherial solution of india rubber and spun the mixture by drawing out a thread by means of a steel point into water. The process was not a commercial success, nor were the efforts of Crookes, Weston, Swan, Powell, and others, who, in 1882 and the following years, tried to make carbon filaments for electric lights from nitrocellulose impregnated with rare earth oxides. But these efforts served to iron out many technical difficulties and undoubtedly contributed to the success of Count Hilaire de Chardonnet, who has been called the "father of rayon." His process was disclosed in a sealed document deposited with the French academy in 1884 and the year 1891 witnessed the commercial production of nitro-cellulose rayon at Besancon.

OTHER methods for producing rayon were rapidly developed. In 1890, Despaisses patented the cuprammonium process, but he died before working his patents and this method was first used commercially in 1897 by Pauly, who improved the original method slightly. In 1892, Cross, Bevan and Beadle discovered viscose or cellulose xanthate, and this was soon utilized by Stern as the basis for another method of producing rayon, the method which today is used for about eighty per cent of the rayon manufactured. At about the same time, cellulose acetate was produced by Cross and Bevan and successfully developed in Germany by the firm of Donnersmarck into a fourth process for producing rayon. Other processes have been proposed from time to time, but have not been commercially successful. One which was patented in Holland last year, however, based on cellulose formate, shows some promise of giving competition to the four successful methods.



Here is a close up of a skein of rayon on the reel. Lacings are put through these skeins to keep the crossings so that the skein may later be unwound without any tendency to tangle.

MANUFACTURING PROCEDURE

The process of manufacture of rayon naturally divides itself into three steps, the chemical procedure, the mechanical or spinning process and the textile operations. Rayon is a continuous fibre like silk, but its fundamental raw material is cellulose, which is the basis of cotton and paper, and occurs naturally in the form of short staple fibres. It is necessary, therefore, to subject it to chemical treatment which will get it into a condition such that it may be spun into a continuous fibre. Subsequently it must go through some purely textile operations like any fibre to prepare it for weaving or knitting.

The chemical treatment aims to get the cellulose into solution from which it can be spun. This is done in two ways, either by colloidal solution of the cellulose itself, or by changing the cellulose into a derivative which is soluble. Cellulose is insoluble in all ordinary solvents, but certain reagents have the power of "dispersing" it in colloidal solution, and this process is the basis of one of the four successful manufacturing procedures. Cellulose falls into that class of natural substances occuring most abundantly in nature as the structural material of plants, namely the carbohydrates, which brings it into the organic classification of alcohols. This alcoholic nature renders it capable of forming esters with acids and these esters are soluble in various organic or inorganic solvents. The other three processes are based on these facts. After spinning, in two of these processes, the ester is hydrolyzed removing the acid group and regenerating the cellulose in a

These photos are furnished through the courtesy of the Du Pont Rayon company.

slightly modified form known as hydrocellulose, which is the same as that obtained when the colloidal solution is spun. Thus three processes give a rayon made up of hydrocellulose which is, chemically, practically the same as cotton or paper. The fourth process retains the cellulose as the ester derivative of acetic acid. The four different chemical procedures will now be considered, following which the spinning and textile steps will be described.

Cuprammonium Process

THIS process depends on the fact that cellulose is colloidally dissolved or "dispersed" by a solution of cuprammonium hydroxide known as Schweitzer's reagent. The reagent may be prepared by dissolving copper hydroxide in twenty-two per cent aqueous ammonia which was Schweitzer's method or by the process of Wright, who dissolved copper chips in concentrated aqueous ammonia by blowing air through the mixture.

The source of the cellulose is cotton linters, the short hairs sticking to the cotton seeds after ginning which are too short to be used by the cotton textile industry. Purified sulfite wood pulp may be used, but offers no advantages at the present time. Two general procedures are used, one by which the cuprammonium solution and hydrocellulose are prepared separately and then dissolved which is known as the two-step process, and the other in which the solution and formation of hydrocellulose take place simultaneously. The first method is the one used in Germany known as the Glanzstoff method. The cotton linters are boiled for three hours with a dilute solution of sodium hydroxide and sodium carbonate under pressure to partially hydrate the cellulose, washed, put through a "teasing" machine to loosen up the fibres, bleached, washed again, and centrifuged. The Schweitzer solution is made by Wright's method at 4° C. and stored in graduated reservoirs so the concentration can be regulated. Solution of the cellulose is affected in horizontal iron cylinders rotating at 60 r.p.m. and it is filtered through three filters of metal cloth of successively increasing fineness.

In the one-step process, the linters are first teased, bleached, etc., and finally stirred for two hours with a solution of

The length of this article does not permit us to publish it complete in this issue, but because of its timeliness and obvious value we are breaking from our policy of "no continued articles" and are holding over the remainder for the November number

sodium hydroxide to produce the hydrocellulose. Blue vitriol is then added which produces a precipitate of copper hydroxide. Ammonium hydroxide is next added to produce the cuprammonium base, the whole mixture is cooled and the cellulose dissolves upon the addition of more ammonia. The sodium sulfate settles out, the solution is decanted and filtered. By either process it is important to keep the temperature low and carefully regulate the concentration of copper and ammonia to obtain the maximum concentration of cellulose. The solutions must be protected from air which oxidizes the cellulose, producing a weak fibre, and from carbon dioxide, which precipitates the cellulose.

This cut illustrates the throwing operation which consists in putting the twist in the yarn by winding it from one spool to another. One of the spools is driven at a high rate of speed while the other turns very slowly.

Two kinds of "setting baths" are used into which the cuprammonium solution is spun. Acids precipitate a copper-free cellulose hydrate in the form of opaque, milky, weak threads. Alkali solutions of over five per cent strength precipitate a cupro-alkali-cellulose from which the alkali is removed by washing with water and the copper by washing with dilute acids, leaving a clear, strong, elastic, coppery-colored thread of hydro-cellulose. The latest trend is toward the use of the alkaline coagulation method followed by the acid wash because the thread has better water-resisting properties although the coppery color is noticeable.

Nitrocellulose Process

This process depends upon the fact that certain nitric acid esters of cellulose —often incorrectly called nitro-cellulose —are soluble in various volatile organic solvents and can be spun from such solutions by evaporation or by coagulation. Cotton linters here also are used as the source of cellulose and are put through the same processes of teasing, scouring, bleaching and washing as in the cuprammonium process. Finally, the cotton is dried to a very small percentage of moisture and stored in airtight cans. The nitrating acid consists of a mixture of concentrated nitric and sulfuric acids of various proportions depending on the temperature and degree of nitration desired. The nitrators are either iron or stoneware pots set in water baths for cooling purposes.

TWO methods of nitration are in general use, the Thompson displacement process and the Dupont or rapid process. In the former the nitrating acid is placed in the pots and the dry cotton stirred in with aluminum forks. A perforated segmented cover is placed over the charge so that the charge just wets its bottom and water is run over the top to a depth of two inches. This prevents fumes and very little mixing takes place. At 30°C. nitration takes from one to two hours depending on the strength of acid used. The strong spent acid is then drawn off through a cock at the bottom, while water to displace it is run in at the top. This washing is continued until the water coming off is only slightly acid when the nitro-cellulose is removed and is ready for stabilizing. This process has the advantages of safety, low cost of labor, power and maintenance, and better yield. The disadvantage is that it is slow.

The Dupont method is much better suited to large scale production. The pots are of iron and equipped with agitators which are run at 70 r.p.m. while the cotton is being charged, then at 35 r.p.m. Nitration is complete in 18-24 minutes. The paddles are then speeded

(Continued on page 26)

Indian Homecoming

JOSEPH E. OSBORNE, *Gen. Chm.*

MINNESOTA has long been criticized by her students and alumni as well as by rival universities for her failure to propagate and keep alive suitable traditions. There is at least one tradition, however, which was founded long ago, in the cradle days of our university, which has been kept alive and has burned higher and higher each year. I am speaking of the tradition of Homecoming. At no university in the Big Ten, and probably at no other college or university in the country has Homecoming been the big day in college life that it has been here at Minnesota.

In 1927, the Crusade Homecoming under the capable direction of Doren Eitsert was the most satisfactory celebration that we have had at Minnesota. Each year the group in charge of the plans has gone to more expense and effort to make the Homecoming attractive to alumni and students alike. This year is no exception and the committees have been working for weeks making preparations for what we hope will be the biggest and best Homecoming Minnesota has ever had. An Indian theme has been selected as the Homecoming motif and will predominate through the decorations of the campus buildings, fraternity and sorority houses as well as the down town stores. Chief Two Guns White Calf of the Glacier Park reservation of Blackfeet Indians, accompanied by a dozen braves and squaws are coming to give a touch of originality to the program. Chief Two Guns White Calf is the Indian whose picture appears on the Buffalo nickel.

ENGINEERING HOMECOMING

JOHN NEWHOUSE, *Chairman*

THE committee will be headed by John C. Newhouse, senior electrical; Adolph Ringer, mechanical engineering; George Meffert, civil engineering; Melvin Elmquist, electrical engineering; Janet Leib, architecture; and Ray Higgins, chemistry, are on the committee.

The plans for the day will follow closely those carried out in preceding years, taking special care for the comfort and convenience of the homecoming engineers.

With this idea in mind, room 135 in the Main Engineering building has been secured. This room will be furnished with comfortable lounges and chairs, and will serve as a headquarters for the alumnus, where he can meet his old classmates and talk things over. Refreshments will be served throughout the morning.

Adequate parking space will be provided for the graduates in the rear of the Electrical Engineering building, and will be for the exclusive use of the former engineering students.

The program for the day will wind up with the Chicago-Minnesota football game in the afternoon.

1928 ROOTER SECTION

By HOMER D. THOMAS, M. E. "31"

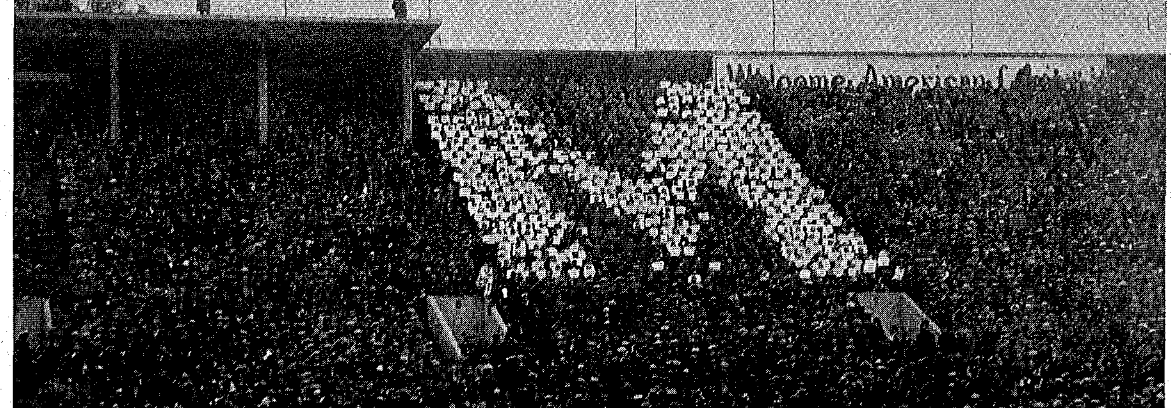
IN the spring of 1927, after the historic engineers-foresters class scrap, a reconciliation was effected which resulted in the organization of the rooter section. With Pi Thompson and Leon Mears as the motivating influences plans were made for these two groups of husky male students to get together and expend their surplus energy cheering for Minnesota in a section of their own.

This idea was enthusiastically received by the senate athletic committee, the deans of the various colleges and the Minnesota alumni association, but in view of past attempts both at Minnesota and other big ten colleges, they were very skeptical of its success. However, they promised their assistance, and generously co-operated with the committee.

The system used so successfully by the larger schools on the west coast was adopted for use in our section. Each member was provided with vari-colored cards and a special rooter club cap which was worn at each game. The cap which was adopted and which is being worn in the section again this year, is of a reversible type, maroon on one side and gold on the other. These caps by reason of their two-color construction made possible the formation of a maroon and gold "M" which was used as the background for the patterns formed with the colored cards.

Two cards were distributed at each game, one maroon and gold and the other bearing the colors of the visiting team. Owing to the impossibility of getting a group of approximately seven hundred to appear for practices, instruction cards were prepared and placed on the individual seats. These contained complete directions for the presentation of each design. This made it possible for the rooter king to merely call for a certain design instead of giving specific directions for each formation.

The section appeared in action at all conference games during the season, and was declared a complete success by the alumni and all others interested in the development of school spirit at Minnesota.



Engineer's rooter section in action at the Minnesota - Wisconsin game in 1927. The "M" is formed by reversible maroon and gold caps worn by the rooters.

News from the Technical Campus

Stuaent and faculty activities—departmental notes—notable alumni work

Minnesota to Be Hosts to Eta Kappa Nu

THE Minnesota Omicron chapter of Eta Kappa Nu will be hosts to the national convention of the fraternity on Friday and Saturday, November 2 and 3. Representatives from each of the twenty-six active chapters are expected to attend, and preparations are being made to handle about fifty delegates. Arrangements have been completed to run a special car from Chicago, arriving in Minneapolis on Friday morning, to accommodate the delegates coming from the eastern schools.

Raymond C. Freeman, president of Omicron chapter and general chairman of arrangements for the convention, has announced a program for the two days that is expected to keep the delegates busy, insure their having a good time, and leave them with a good opinion of the Minnesota engineering campus. The majority of the visitors will arrive Friday morning, and will proceed immediately with registration. The first business session will occur late Friday morning, and will be followed by an informal luncheon. The afternoon will be occupied with business sessions, and the evening program calls for a smoker, to which all alumni members of Eta Kappa Nu residing in the Twin Cities are invited. Business meetings are again scheduled for Saturday morning, with a luncheon at noon. Delegates in all probability will be taken on a tour and inspection trip Saturday afternoon, but details of this part of the program have not yet been completed. The climax the convention will come Saturday evening with the annual banquet, which will be held at the Nicollet hotel.

Visiting engineers who are members of fraternities with chapters on the campus will be housed at their respective chapter houses, while the rest of the delegates will make their headquarters at the Nicollet hotel. Campus headquarters will be established in the Electrical Engineering building, where the convention meetings will be held.

Committees appointed by Ray Freeman to plan for the convention include Lester Borchardt, program; Erling Saxhaug, housing; William H. Painter, publicity; James E. Specht, finance; W. Glenn Williams, banquet; John Millunchick, smoker; Irwin Vigness, luncheon; Clinton J. Johnston, tour; William DeVoy, transportation; and Lloyd Oman, alumni.

New Appointments to English Faculty

The English Department announces the appointment of the following instructors: Hoffman R. Hays, John E. Davis, and Clifford Haga. Mr. Hays was graduated from Cornell, and received his M. A. from Columbia. Mr. Davis completed his undergraduate work at Minnesota and obtained his master's degree from Michigan. Mr. Haga, after being graduated from Minnesota, studied for his master's degree at Illinois.

Lewis Takes Research Post

After two years spent at Minnesota in intensive research in the field of photo chemistry, Dr. Bernard Lewis, who was working under a National Research fellowship which he obtained at Cambridge University, has left the School of Chemistry, and is now at the University of Berlin.

Dr. Lewis expects to remain in Berlin for a year, during which time he will spend his time working on problems in gas kinetics under Dr. Max Bodenstein is known as a world authority on gas kinetics and is the author of many books and papers on this subject.

Aeronautical Engineering

Let's have it in terms of bolts and gears! As an aeronautical engineer, or as an engineer, one is interested in knowing the aims of that particular branch of engineering.

It is the primary object of the course to train men for flying. To further this aim one receives a general ground school training. However, as one advances in the course he specializes in designing motors, or aerodynamics. He may prefer lighter-than-air craft to heavier-than-air-craft or vice versa.

In charge of this branch of engineering we have: B. J. Robertson, whose particular subject is engines, G. Hoglund, in charge of airplane design, and C. Boehnlein, in charge of aero-dynamics.

Mr. Boehnlein spent last spring developing the aviation curriculum. The course is still in a premature state and much is to be done toward stimulating active interest in the course.

Mr. Robertson spent the summer experimenting with internally cooled motors. In connection with his work he corresponded with men at Wright Field upon the subject.

Mr. Hoglund spent two months at the naval air station at Lakehurst, New Jersey, studying lighter-than-air craft.

New Equipment in the Experimental Engineering Laboratories

DUE to the increase in the number of students and the growth in the work in the Experimental Engineering Laboratories, it has been essential to find new floor space. This has been partially met in an inexpensive manner by the addition of a balcony on the east side of the laboratory. This balcony is of steel construction with wood floor and provides an area of 20x100 ft., and will be used for general laboratory work. In the construction of this balcony, several changes were required in the high pressure steam line. It was found cheaper to put in a new four inch line with welded joints than to make these changes using the old type connections.

During the early summer a new testing machine was purchased by the Minnesota Highway Department and installed for joint use by the Highway Department and the University. It is a 400,000 pound Universal machine and provides capacity twice as large as any previous machine. This will be of exceptional value to the work in the Structural and Concrete Departments. The Structural Department also has acquired a Beggs deformeter for determining stresses, flexible structures. By this equipment it will be possible to solve many problems which are impossible of mathematical analysis.

Of interest to Aeronautical Engineers is the fact that the Navy has furnished a considerable amount of laboratory equipment to be used for structural purposes in the new course in Aeronautical Engineering. The equipment consists of a complete airplane, a twelve cylinder Packard motor, a twelve cylinder Liberty motor, with many spare fuselage and motor parts and a rather complete line of airplane instruments. The instruments include altimeters, tachometers, flight speed indicators, etc.

A new exhaust line and fan have been installed to take care of the exhaust gases from the engines as well as safety devices on several machines.

As well as the above mentioned equipment many small pieces of apparatus have been acquired, a new Ford motor, steam and gas engine indicators, calorimeters, balances, gauges, etc. Thus the laboratories are gaining in modern equipment but one should not lose sight of the fact that much of the old equipment is becoming obsolete.

Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

THE TECHNO-LOG is now in its ninth year of publication and it is with pleasure and pride that we look back seeing the improvement and advancement that has been made in the past years. This improvement has taken many days and nights of work by the men that have preceded the present staff and we are awed by the mass of work that is ahead of us. We only realize the vastness of the toil and initiative displayed in the former volumes.

It is due to last year's managing editor and business manager, Lawrence A. Clousing and Carl E. Swanson, that the TECHNO-LOG has taken another step along the path of progress. It is with a great deal of pleasure that the present managing editor recalls the days spent working with these men, gaining in experience which he hopes will help make this year's TECHNO-LOG more interesting to its readers.

Lending a Helping Hand

EVERY year sees the start of a Freshman class, a class that will in the years to come be the Senior class. It is these men that will carry on the traditions and the activities of the college. The upper class men who now have the important positions are looked upon by these Frosh as having attained heights which are reached only through "pull." This, in the most cases, is not true—for there are few men holding any office which they can not successfully handle. All of these men who are holding offices have started at the bottom and worked to the top by their own efforts. Yet, it is true that a helping hand is a big lift.

When any upper class man sees a freshman who is willing to work and who is interested in the advancement of the Engineering college why not give him a lift? He may need just the help that you are the best fitted to give him. Whether it is help with his studies or with some other activity, help him. Remember that you were a freshman just a few years ago.

Another School Year

ON every side we hear friends greeting each other and telling of their plans for the coming year. Other groups of men are talking about their work and good times of the past summer. Among the activities planned are sports—football, baseball, basketball and the like—and politics. Many men are going to study and improve their grades—other men are going to loaf the year away—and still others do not know just what they want to do. These are the men that we would like to interest.

The TECHNO-LOG is the engineering publication on this campus and belongs to all engineers. All engineers should be interested in it and its welfare. Among the men that are interested in the TECHNO-LOG are men who aspire to positions on the staff but who do not feel that they are adapted to editorial work, others of these men feel that they could not successfully sell advertising. But regardless of ability to write or sell there is always something for you to do on the staff. The TECHNO-LOG office is the center of activities on the engineering campus and no matter what line of endeavor a student plans to follow when he gets his degree he will be able to get valuable experience here in the office. The TECHNO-LOG can always use the men and the men can always use the experience that they gain. Come down to room 37 Electrical Engineering building and meet the staff and help your magazine along.

Homecoming

ONE of the newest of the traditions in the Engineering college is that of the special engineering homecoming which is a branch of the general homecoming. In the past two years the men who had charge of this work have secured a room in the Main Engineering building and furnished it for the comfort of the returning graduates. Rugs, over-stuffed chairs, curtains on the windows and every other means of making room 137 as much like home as possible have been gathered in the past and used. Room 137 is a place where the alumni and their friends can meet their old classmates instead of the masses of university alumni.

October twentieth is the day set aside for home coming this year, and again the engineers are far ahead. The room has been furnished and the building decorated. All signs of school work have vanished and the alumni will have the same old place to lounge and talk over old times.

Parking

THE problem of automobile parking on the campus has reached such proportions that the university administration is seriously debating the question of barring student operated cars from the campus. The situation at Minnesota is much more serious than at most other colleges and universities because of the wide territory from which the students come. If student automobiles are banned from the campus, many students face the prospect of a street car trip of an hour or more to and from the university. This, aside from the inconvenience, would prove disastrous to many engineers who, after a full day spent in class and laboratory, must plan carefully and conserve their time in order to prepare the next day's work.

The university authorities are doing all they can to establish parking spaces about the campus, but the building program of the university is gradually decreasing the available ground, and the narrowness of the streets makes it impossible to use them for parking purposes. The only way that we can hope to decrease traffic congestion on the campus is to park cars in the more outlying places and drive during the day only when necessary. The extra block or two traversed by the more primitive method of walking will scarcely be noticed, and if it will save us the privilege of having cars, it should be well worth while.

Think or Follow—Which?

IF we were to tie a mill stone around our neck and jump off the Washington Avenue bridge—would you do the same thing? You immediately say, "No!"

But—when the country suddenly plunges itself into the worship of some man, all of us follow and sing his praises to the skies. If an engineer, of whom we have heard but little, becomes internationally known and decides to run for public office,—should we blindly follow him because he is an engineer?

Of the two men, the best should win, and if all the educated people in this country would use the brains that it is reported God gave them they would not all fall in line and blindly follow the beaten path. They would think and consider the good that each of these men would do the country as a whole, and then make their decision. Let us, the supposedly educated portion of the present generation, make our own decisions and then cast our lot with the man who will do our country the most good.

Reports

IN each of the various departments of the College of Engineering the faculty members require different types of reports to be written. In the physics department the type of report is again different. These various types of reports mean that the student is obtaining no training which will do him any good, except the calculation of the problem considered. This dissimilarity of reports leads to confusion on the part of the student in that when each department requires a different type the student does not know just how to write the kind of a report that the instructor in any particular department wants. He perhaps writes a report and finds when he has submitted it to his instructor that it is entirely wrong and then has to rewrite it.

Is there not some style of report that could be made standard for all of the laboratory courses that the engineering students have to take from the time that they enter the University until they leave—some type of a report that will give him experience and practice which he can use when he has finished his college education and has started to work?

Read This

WE feel that each and every engineering graduate should be well founded in his particular branch of engineering, but that this is not enough. In addition he should have a general speaking acquaintance with the rest of the branches of engineering and science. In the coming year the TECHNO-LOG will present articles and stories written by men who are well known to the engineers on the campus. These will be written in a style that is readable and understandable by engineers. These stories, it is hoped, will help broaden the students' field of vision.

It is also planned to run stories written by alumni who are working and who, in these stories, give their view point. It is hoped that these stories will make the selection of positions easier for the seniors in the coming spring.

There will be some stories by student writers on the experiences of these students while they were in the summer camps. The civils, the R. O. T. C. units, and the miners all go to camp and these stories will be printed. The news of the engineering campus will not be neglected and will be illustrated as far as possible.

If any engineer has a "hot" idea we would like to have him write it up or at least come in and talk it over with us.

We aim to please.

Faculty Sketches

PROFESSOR J. M. BRYANT, former head of the department of electrical engineering at the University of Texas, was appointed professor of electrical engineering and head of the department at the University of Minnesota last spring.

He was born in East Templeton, Massachusetts, on July 10, 1877. His early education was obtained in the schools and high school of Templeton and in Cushing Academy, at Ashburnham, Mass.

Professor Bryant is a graduate of Worcester Polytechnic Institute, where he received the degree of bachelor of science in electrical engineering in 1901, and the electrical engineer degree in 1909. He obtained his master's degree at the University of Illinois in 1911. He was a member of the staff of the department of electrical engineering at the University of Illinois from 1903 to 1914.

Immediately after graduation he entered the service of the General Electric company. For several years past he has been a member of the staff of that company as a consulting engineer. He has had a varied experience as a consultant in other branches of the field of electrical engineering.

During the World War, Professor Bryant was president of the academic board of the U. S. Army School of Military Aeronautics and chairman of the board of control of the war schools, at the University of Texas. These duties involved a large organization of faculty and students and the expenditure of large sums of money. The total enrolment of students in the various army schools under his direction amounted to about 25,000.

Professor Bryant is the author of various papers and articles relating to electrical engineering, and joint author with J. A. Correll of a book entitled "Alternating Current Circuits."

Among the societies in which Professor Bryant holds membership are: The American Institute of Electrical Engineers (director), Illuminating Engineering Society, Society for the Promotion of Engineering Education (member of the council), American Association of University Professors, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

"What About Our Faculty and Alumni"

FACULTY

Civil Engineering

C. A. Hughes travelled to his old home in Toronto this summer. He says he likes it as well as ever.

Prof. F. C. Lang worked with the Minnesota State Highway department this season.

E. S. Sutherland, teaching fellow in municipal and sanitary engineering, is a 1927 graduate of Clemson college.

Prof. J. I. Parcel is on a year's leave of absence. He is engaged in the contracting business with Leif J. Sverdrup, C. E. '21, at St. Louis, Missouri.

Prof. F. H. Bass returned recently from a trip through New England. He spent the early part of the summer in designing a sewage disposal plant for Alexandria, Minnesota.

J. A. Wise taught structural engineering during summer session. He is acting chief engineer for the Mohawk Aircraft company. He traveled to Washington, D. C., by plane recently to consult with Department of Commerce officials on aircraft design.

E. S. Sheiry, assistant professor of structural engineering, takes Prof. J. I. Parcel's place. Mr. Sheiry is a specialist on foundations. He was in charge of the construction of the St. Paul plant of the Ford Motor company for Stone and Webster of Boston, Mass. He is a graduate of Massachusetts Institute of Technology.

John Swanberg, C.E. '25, teaching fellow in highways, spent his summer with the Minnesota Highway department, laying different types of asphalt pavements. He also found time to do some research on paving machines.

L. F. Boon spent the early part of the summer making traverse computations, land and topographic surveys for the proposed government dam at Hastings, Minnesota, which is being built by the U. S. Engineers.

A. S. Cutler made a trip to Michigan, where he visited his old home.

O. S. Zellner traveled through fifteen states, 6,000 miles in all.

Cutler, Zellner and Boon spent the last six weeks with the junior civils at the Cass Lake camp.

Chemistry

Prof. R. E. Kirk spent two weeks at the officers training camp at Piccatinny Arsenal, Dover, New Jersey, where he received some intensive training in explosives.

Two other members of the faculty with a military turn of mind are K. A. Kobe and L. J. Maynard, who did chemical warfare work at Fort Logan, Colo.

As a holder of a National Research Fellowship, Dr. H. N. Alyea is doing research work under Dr. S. C. Lind. Dr. Alyea comes from the Noble Institute at Stockholm, Sweden, where he studied with the renowned Swedish chemist Arrhenius.

With the exception of a few weeks spent luring the wily fish, Mr. Kameda vigorously pursued his work toward a Ph.D. degree.

Mr. G. B. Heisig taught during the first summer session and later visited relatives in Texas.

Mr. W. Cornell worked with the Geologic Survey analyzing samples of limestone. Three weeks of his time were taken up by a visit in the East.

Miss Lillian Cohen attended the Chemical Institute at Evanston during the early part of August. She also spent a week visiting in Duluth.

Mr. James Holst is no longer at the University as he is now working as holder of a Rochester Foundation Fellowship.

Dr. R. S. Livingston taught during the first summer session and later in the summer motored to California.

Dr. I. M. Koltoff spent the summer abroad, where he attended the International Chemical Meeting at the Hague. He later lectured at the University of Utrecht on hydrogen ion concentration on which he is considered a world authority. Upon his return to this country he addressed the Eastern New York Section of the American Chemical Society at Schenectady, N. Y.

Prof. M. C. Sneed made an extensive auto tour during his vacation, traveling about seven thousand miles in all. He visited the national parks and the gold mines of Lead, S. D. The last part of the summer he spent hunting and fishing in the western part of the state.

Dr. S. C. Lind acted as consulting chemist for the Dow Chemical Co. of Midland, Michigan.

Dr. L. I. Smith of the School of Chemistry with Professor Butters of the Botany Department made an extended auto trip east. Dr. Smith at that time attended the meeting of the American Chemical Society which was held at Swampscott, Mass.

P. J. Riley, who is instrument curator, took a three weeks vacation to Duluth and Round Lake, Minnesota, to visit friends and relatives.

Prof. A. E. Stoppel spent July, August, and part of September on the west coast.

E. A. Pearson who received his M. S. degree in the School of Chemistry in 1921 is back at Minnesota after teaching at the Junior College. He is working for a doctor's degree under Prof. I. M. Kolthoff.

Prof. N. W. Taylor worked in the physics division of the Mayo clinic at Rochester.

Miss Ruth Elmquist has returned to the University of Minnesota and is working for a Ph.D.

Dr. George Glockler spent the early part of the summer working for the American Petroleum Institute on "Separation and Identification of the Constituents of Petroleum." He is now in Washington, D. C., at the Bureau of Standards on business matters relating to his work.

Thirteen assistants have been given appointments in the School of Chemistry for the coming year. They are: Albert L. Chaney, Edward M. Van Duzee, Maurice G. Larian, Ernest B. Sandell and Frank H. Stodolla, all of whom are Minnesota alumni. Those from other universities are: Richard Black of Carleton college, Angus E. Cameron of Oberlin college, Walter N. Day of the University of Chicago, William E. Filbert of Dakota Wesleyan university, Karen E. Gilmore of Smith college, Grant W. Smith of Grinell university, and Florence N. Schott of the Women's College of Constantinople.

Drawing and Descriptive Geometry

William H. Kirchner spent most of the summer visiting in the state of Massachusetts and other places in the east.

Robert W. French spent the summer months at the civil engineers camp at Cass Lake, Minn.

Leon Archibald was employed by Sherburne county during the summer months but found some time to spend at his summer home on Big Birch lake.

Henry Eggers remained in Minneapolis all summer.

Alex Levens did practical work the first part of the summer and taught during the second session of summer school.

Howard Meyers taught during the first session of summer school and spent the rest of the summer looking after the duties of his recent appointment as chairman on advance standings.

Orrin W. Potter has returned after a year's leave of absence. During his leave, Mr. Waterman of the mechanical engineering department took his place.

Robert F. Schuck spent part of the summer working for the Republic Creosoting company and the remainder of the summer he could be found at his summer home on Big Birch lake.

William S. Williams taught summer school and also did some work for the geology department.

Fred T. Cruzen also taught summer school and did map work for the geology department.

Emmett O. Shultz spent the summer in Chicopee Falls, Massachusetts, doing time study work for the Fisk Rubber company.

Lloyd J. Quaid spent part of the summer working for the Electric Machine company and the remaining part of the summer he spent at his home in central Illinois.

The department has two new men this year; Joseph M. Sherdian is taking the place of Mr. Doseff who is now with the architecture department and R. H. Rankin is taking the place of Mr. Andrews who is now in California.

Electrical Engineering

F. W. Springer spent the summer developing and negotiating for the sale of a patent of a device known as the Springer

(Continued on page 16)

(Continued from page 14)

true tone mounting for loud speakers. Professor Springer now has his invention being tested in a number of large radio research laboratories, including such firms as: Stromberg-Carlson, Philco, Magnavox, Victor Talking Machine company, and the Lee De Forest laboratories.

E. W. Johnson was engaged in the generation department of the Northern States Power company of Minneapolis, during the summer months.

J. H. Kuhlman was associated with the Electric Machinery company of Minneapolis as consulting engineer for three weeks during the summer.

M. E. Todd, assistant professor of electric power engineering, for the first part of the summer vacation period, was in charge of the office of the John A. Clark Electric company, electrical jobbers of Minneapolis. During the week of September 17-23, he assisted with the instruction at the metermen's short course at Iowa State college, Ames, Iowa. On the following week end, Professor Todd made a trip to Kansas City and Lawrence, Kansas, on business. While at the latter place, he enjoyed a "look in" on the Haskell Institute, and also the University of Kansas.

H. E. Hartig, a new addition to the faculty of the electrical department, was transferred from the mathematics department late this summer. For the first part of the vacation period, he was engaged in teaching the first summer session. During the remainder of the vacation, he spent most of his time in the laboratory perfecting a device for an absolute method for measuring the velocity of fluids.

W. T. Ryan spent the summer attending conventions. He was present at the A. I. E. E. convention in Denver and at the A. S. M. E. convention in St. Paul. He also took a trip to Winnipeg, on business.

Robert F. Edgar of the class of 1927, is spending his second year on the faculty, as a teaching fellow. During his vacation he spent most of his time in the Experimental department of the Electric Machinery company of Minneapolis, and worked on his thesis on Magnetic Noises of Synchronous Machines.

G. Clinton Hawkins, E '28, is now chief operator and engineer of the University radio station, WLB.

Edwin C. Fredrickson, E '28, is now on the faculty as a teaching fellow. "Ed" spent the summer with the Northwestern Bell Telephone company in Minneapolis.

Anthony Schavonne, E '28, is now a teaching fellow in the Electrical department. He worked in the motor vehicle light testing laboratory during the summer. He was married in September.

Mathematics and Mechanics

Messrs. Siler, Miller, Hartig, Doeringsfeld, and Boehnlein were teaching during the first summer session.

Among the new faculty members in the department are Messrs. Barker, Peebles, and Sherberg.

Mr. Barker was heretofore connected with the University of Iowa. He has done considerable work in hydraulic testing for the Bureau of Public Roads.

Professor Hartig and Dalaker were busy most of the summer writing a new text book on calculus. The book will probably be used beginning with the spring quarter.

Immediately after the end of the spring quarter, Mr. Branovan left for Chicago where he was working with a consulting engineer. He spent a short vacation in northern Wisconsin where he reports good fishing.

Mr. Saibel has returned for his second year at Minnesota. He spent his vacation traveling through Europe. While there he visited France, Holland, and several other countries. While in Holland he attended most of the Olympic games at Brussels.

Mr. Neubauer left the department this fall to teach in the geography department. His office is located in the Old Library and as far as we know, the setting agrees very well with him.

Mechanical

Prof. J. R. Du Priest motored to the University of North Carolina at Chapel Hill soon after the spring quarter ended to attend the meeting of the Society for the Promotion of Engineering Education. He and his family found time to visit many famous places in the East, Washington and Lee University, the Endless Caverns in Virginia, Natural Bridge, and Staunton Military Academy. He returned from the east over what was the original Cumberland trail. After returning to Minnesota he found time for a few fishing trips with his former classmate, M. W. Davidson, professor of Mechanical Engineering at the University of South Dakota. He and Professor Du Priest graduated from Virginia State College in 1901.

An A. S. M. E. regional meeting was held in the Twin Cities August 27-30, at which Mr. Du Priest presented a paper on "Friction in Dredge Pipes."

Prof. W. H. Richards taught a class of thirty teachers in an industrial teachers' course during the first summer session. The last part of the vacation period was spent on Madeline Island, Lake Superior.

T. P. Hughes worked in the heat treatment department of the Minneapolis Honeywell Heat Regulator company.

J. H. Moffett forgot his foundry practice for the summer months and "played" at being a carpenter in Cincinnati, Ohio, where he built himself a house.

Prof. J. V. Martenis stayed in Minneapolis practically all summer. He presented a paper on engineering education before the state convention of Power Engineers. He is director of education for this society.

Professor J. O. Jones has also left the department. He is at present teaching at his Alma Mater—the University of Kansas. We assume that he is again teaching hydraulics, his favorite subject.

Professors Wilcox and "Billie" Brooke spent most of the summer rewriting the new mechanics text-book. Together with Professor Boehnlein they attended the convention of the Society for the Promotion of Engineering Education at Chapel Hill, N. C.

"Doc" Holman now has his office in the Administration building. He is the new superintendent of buildings and grounds, having succeeded Mr. H. A. Hildebrandt. At last "Doc." has found a problem without a mathematical solution—that of keeping the cars away from the yellow curbs.

After having taught at the first session, Mr. Doeringsfeld spent most of his time at a lake in northern Wisconsin.

Mr. Wells has left the university to accept a position at the University of Pittsburgh.

At the end of the first summer session, Professor Siler left for the northern part of the state but whether on business or pleasure or both, we do not know.

Mr. Miller spent most of the latter part of the summer in Canada.

Professor Boehnlein went to Langley Field, West Virginia, where he inspected the equipment of this airport. He also attended the convention of the S.P.E.E. at Chapel Hill, N. C., and later taught at the second summer session.

Immediately after the close of the spring quarter, Professor McClintock left for parts unknown. He has since returned and is now engaged in juggling binomials and integrals without fear or favor.

English

Mr. Richardson taught at both summer sessions, spending a large part of his time in charge of the new "Self-Appraisal" course for high school graduates. Toward the close of August, he left for California, where he enjoyed a delightful vacation until the opening of the fall quarter recalled him to his duties.

Mr. Woodall, who was married during the summer, journeyed to his old home in New York State, where the wedding was solemnized.

After teaching at the first session of summer school, Mr. Creamer spent the latter part of the summer at Forest Lake.

The McMillan Book Co. has engaged Mr. Ambler as a "college traveler" to represent the organization at the various universities throughout the West.

Mr. Beers taught at the first summer session.

ALUMNI

'21—Leif J. Sverdrup and Mr. John I. Parcel, former faculty members, are now consulting bridge engineers at St. Louis.

'25—Kenefick Robertson, who was at one time managing editor of the TECHNO-LOG, was married on Saturday, September 15, to Miss Helen Isabel Re Qua, daughter of B. H. Re Qua of Sioux Falls, S. D.

'27—John Charles Brightfeet, who has been working for the General Electric Company at Erie, Penn., has been transferred from the testing department to the railway engineering division.

(Continued on page 22)

Judge (to class president): You are accused of disturbing the peace by undue noise.

Victim: It was necessary, your honor; I was trying to call a meeting of mechanical engineers to order.

Judge: Oh! That's different. Case dismissed.

Seven Years Later

(Continued from page 5)

adding these outside courses seems no more difficult than putting two more quarts of water in a gallon pail that is already full. I imagine men who plan the course lists would agree it is just as simple. Few deny the value of these outside courses to the engineer; it is a question of what can be done about them in school, and which ones can or should be left for such attention as the engineer may give them after graduation. The outside courses we have in mind include economics, business law, accounting, psychology, public speaking, sociology, civics, business organization and management, technical writing, corporation finance, history, biology. I defy anyone to prove that a single one of these courses would not be useful to an engineer as an engineer, as a man, and as a citizen. The list could be enlarged.

IT is plainly impossible to include all of these courses, or even half of them. One compromise would be to give short courses, perhaps little more than a survey, in many of them. The objection to this plan—and its advantage—is that the student learns a little about a variety of things. Such a procedure would probably not be pleasant for the instructor, who would prefer to see the job done more thoroughly. But the student might gain much from this exposure to new subects. New interests and aptitudes are likely to appear. He acquires sooner perhaps a proper perspective on his major course of training. Familiarity with these outside subjects points the way to their further pursuit after graduation, and encourages it. When he meets these subects in his work, as he is certain to, he will not be in the dark concerning them.

It has been suggested that giving these electives ahead of the junior or senior year is too wasteful because a student forgets what he has learned, or cannot see the importance or application of them. I agree with this opinion, and believe the problem is a greater one even, because some graduates of two to five years experience are just becoming convinced that all of engineering is not engineering. The longer one waits the more difficult it is to start along new lines, or to do outside study. In some way the importance of this broader "exposure" must be driven home to the student.

I have talked with several men who come in contact with a considerable number of engineering graduates, and have asked each of them this question: "What is the most common fault you observe in young engineers?" The answers show no striking uniformity, which is encouraging, and we will go briefly through the list. It is fair to suggest that engineering graduates have no monopoly on these faults, and that their critics are such by request only.

ONE of these men had just finished studying a list of eighteen names. He had a position to fill, doubted if any of these eighteen candidates was the right man, and was displeased about it. I asked him what it was all these men lacked.

"Call it technical ability," he said, "or the engineering mind. I want a man who is critical, analytical; who can interpolate, and project his ideas. This is a mean job, but it could be made a good one. Young engineers have a natural anxiety," he continued, changing the subject, "to land this executive position they have been equipping themselves to occupy, and often they seem to forget that the quickest method is by following the line of work in which

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Seven Years Later

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they are particularly interested. They want short cuts. Their minds are more on the job itself than on the route to it.

"By taking engineering a man indicates his interest in material things, in physical phenomena. Let him get a diploma and he at once wants to be a leader, a boss of men. It is not easy to explain to him that we have here two distinct types of ability, that leadership requires the development of qualities that are not guaranteed by the possession of a degree. All of this takes time, at least it always has."

Another man says, "Our young engineers as a rule do not do enough independent thinking. They listen to gossip about company policy, and politics, and take for granted that this hearsay is the truth, when a little serious thought would explode it. Too often they judge their prospects on certain work by the record of old-timers whose circumstances are and always have been different, instead of investigating the progress of fellow students, or, in the absence of this facility, make a rational estimate for themselves. The graduate usually underestimates the advantage he has over the average employe, and too often insists on starting above him."

With one more observation we will get along to the problem of the first job. A man tells me that young engineers in general do not look the part, and that if they are to get ahead they must. If these remarks are personal, they are also made in all sincerity and with due respect.

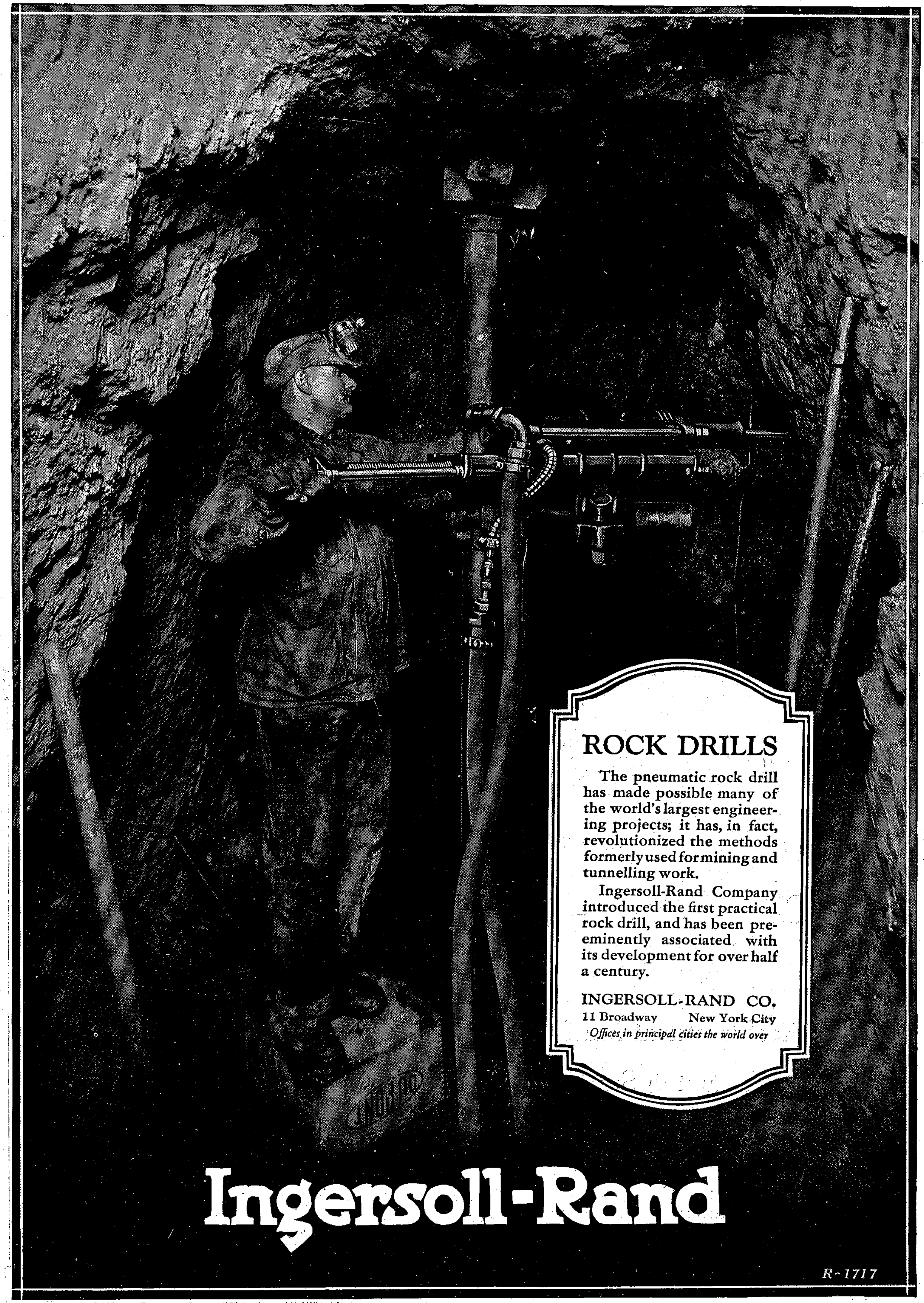
"Show me twenty young men," he says, "all of the same age, half of them just out of school and half of them with two or three years of experience. I will pick out the group who have been out a few years, and not miss more than a man or two."

This accurate selection, he believes, can be made on the basis of appearance, neatness, trimness, reasonable confidence; a question partly of how intimate one's acquaintance is with the barber shop, laundry and tailor. He told me of a graduate training course student who was for the time being an inspector. A letter came in from some customer who was visited frequently by company inspectors, remarking that this fellow knew his business, that he seemed "very smart, for an electrician." A check-up on the man brought in the report that he was "good, in spite of his careless appearance."

Young engineers should look the part. This doesn't mean that they have to dress as well as the office boy. It's a rare boss who can keep up with his office boy on dress. But anyone can be neat and finished in appearance, and it counts. No one, as a matter of fact, has very many intimate friends. We know most people, and most people know us, by impression. It is important, it is imperative, that we try to make these impressions uniformly favorable. It has been shrewdly observed that while a genius may look, talk, and act, as he pleases, a young man can not. It is to be remembered that these favorable impressions may, and must, be made without a sacrifice of individuality or sincerity.

No matter with what degree of authority he may speak, every man has a theory or system which he thinks should be followed in selecting the first job, and, it may be, in choosing between later opportunities. In order that the impression of plans mentioned later may

(*Continued on page 24*)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Faculty and Alumni

(Continued from page 16)

Chemistry

'22—Sam Aronowsky is a graduate student in bio-chemistry at the farm campus. He is studying under a fellowship given by the Cloquet Wood Product company.

'26—Harold Bunger is doing graduate work under a Shevlin fellowship at the School of Chemistry.

'26—Marvin C. Rogers, formerly circulation manager of the TECHNO-LOG, is in the chemical engineering department of the University of Michigan and expects to get his Ph. D. next June.

'26—John Beal is doing research work at the experimental engineering laboratory.

'26—P. S. Haugsrud is another chemical engineering graduate student at Minnesota.

'27—J. H. Arnold is a graduate student at the Massachusetts Institute of Technology.

'27—L. W. Cornell is an assistant and fellow at the School of Chemistry.

'27—J. E. Holst is a chemical engineer doing research and development work for the Rochester Foundation.

'27—Kenneth Kobe is an assistant and a Du Pont fellow in the School of Chemistry.

'27—John Tronson is a chemical engineer employed by the Goodrich Rubber company at Akron, Ohio.

'28—M. E. Buzzell is employed at the research department of the International Lead Refining company, Chicago.

'28—R. P. Jallings is a chemical engineer in development for the Midwest Oil company, Coults, Alberta, Canada.

'28—R. Gerlicher, like Mr. Tronson is also employed by the Goodrich Rubber company.

'28—G. B. Gehrenbeck is employed as chemical enginer for the Dow Chemical company, Midland, Michigan.

'28—A. Seestron is employed by Proctor and Gamble at Ivorydale, Ohio, doing chemical engineering work.

'28—Fred Rohrman, who received his M. S. degree here last spring, has won a fellowship in chemical engineering at Columbia University.

Civils

Where to find members of C. E. '28.

Roger Amidon, Roy Engstrom, George Ferguson, Charles R. Knox, C. H. Prior, and James Rydeen, are with the U. S. Geological Survey, working on stream measurement and river development, in Kentucky, Tennessee, and Ohio.

Frank Bailey and J. B. Ringwood are with the engineering department of the Elgin, Joliet and Eastern railway, at Joliet.

Ralph Johnson is with the Minnesota Highway Commission, at Willmar.

Lee McNally is with the Soo Line, working on the grade separation in Chicago.

O. K. Normann is at Anoka with the U. S. Bureau of Public Roads.

George Schoepfer is with the Metropolitan Drainage Commission, St. Paul.

Carl Frank is with the U. S. Coast and Geodetic Survey, Washington, D. C.

John Bergford is with the Soo Line, at Duluth.

W. W. Dreveskracht is with the Minneapolis Street Railway.

Paul Silliman is with the Greyhound Motor Transportation company, Chicago.

Frank Tebo is with the Hennepin Bridge company at Anoka.

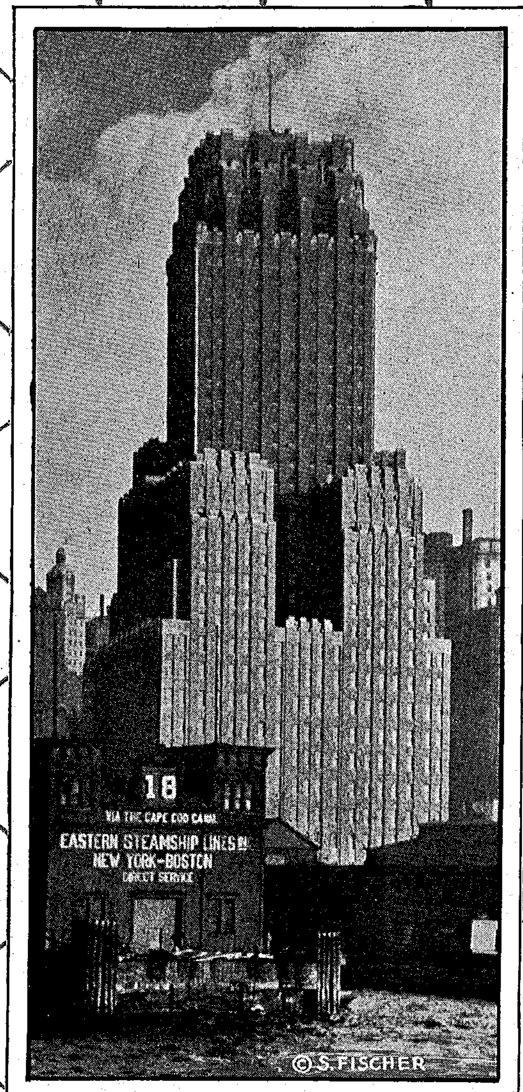
Ben Mayeron is with the Chicago Sanitary district commission.

L. Stuart Kreger is with the Illinois State Highway commission.

'25—M. E. Nordstrom who was associated with Cowen and company, designers, is now with the Kalman Steel company of St. Paul.

'26—Arne A. Jakkula has left the C. E. Department for the University of Michigan, where he has accepted a position as instructor of civil engineering.

'26—James R. Johnson and Hibbert Hill, '23, have resigned their positions on the faculty and are now with the U. S. Army Engineers in St. Paul.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VIA THE CAPE COD CANAL
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Seven Years Later

(*Continued from page 20*)

remain in your mind, I present my own simple theory first. It is that a man will achieve the greatest success, and be happiest, in chasing the ideas and things in which he is most interested, and that he should try always to broaden himself and his outlook. That ends it. Matters of money, service to society, promotion, personal eminence and the like need not be considered, because they will be taken care of automatically, or rather, they can not be greatly increased by any method now known. In stating this theory I realize that the young man may not be certain, at a given time, where his greatest interests lie; and I know that they may change. Suppose he doesn't know, and suppose they do change. The theory stands.

A somewhat more definite plan for finding one's best place in the world is suggested by a mature man who has had much to do with engineering graduates. It is an elimination process consisting of three steps. First: Pick the line of business one likes best, meaning sales, research, manufacturing, public utility, or whatever. Second: Pick a place to live. Different climates, territories, people, cities, appeal to different people. Third: Get a job, and work like hell.

These plans, and most others, assume that the student knows his own mind, and his interest, which is often not the case. His only means of finding out, except by experience, is to turn his alleged power of analysis to himself, and add whatever disinterested advice he can obtain from professors, fellow students, or friends.

One hears, from the employer's side of the house, some criticism of the practice of shopping for experience, changing rapidly from one job to another. Yet if a man is convinced he is in the wrong line of work it is his duty to all concerned to make a change. The answer is then that sometimes you shouldn't change and sometimes you should. Graduate training courses are helping to solve this problem by giving the student engineer a greater variety of work.

IN a previous suggestion in regard to "outside" courses for the engineering student there is the same idea of providing a broader choice, in order that men may "find themselves" sooner. This is perhaps the heart of the whole problem. It leads to the suggestion that the graduate, every graduate, try to land himself where the view is broadest, where he can observe, compare, experiment, and develop in an atmosphere where selection and change is easier, where it is difficult to stay in the wrong groove. I think this is the most important single consideration in the early career of an engineer. Beside it such things as money and pull are unimportant.

"Business," an employment director tells me, "is not over-critical of the young man who comes in and tries to earn and learn his own way. It does not take so well to certain campus fads in clothes, jewelry, slang, and the like. It is no help that business may be narrow-minded about these things. It won't change overnight." Business people are human; they like to work with honest, ambitious young men, but they don't want to be reminded that they haven't had the benefits of a college education.

I wish engineering graduates would talk less, and think less, about what school they came from, and what they learned there. I wish they would work harder on little jobs that every one agrees they shouldn't be doing for long, instead, sometimes, of stalling and acting insulted at not being given more important things to do. Everyone has to do some office boy work. I wish they would remember that initiative and ability can be plainly shown on the most measly little job. I wish that, instead of "waiting for a break," they would take advantage of the opportunities for self-development that are everywhere. I wish they would try to develop a genuinely inquiring mind, and take nothing for granted. I wish that none of them would think I am conceited or cynical for saying things to them that I wish someone had said to me while I was in school.

Techno-Log Editor: I refused this article weeks ago. Why are you sending it in again?

Student: I thought your perception had improved by this time.

Student: Will that engine run?

Inst.: No, you fool; it's bolted to the floor.

1st Tramp (on a rainy night): Let's sleep outdoors.

2nd Tramp: How come?

1st Tramp: Plenty of room and bath.

Visitor: Do careless students make bad engineers?

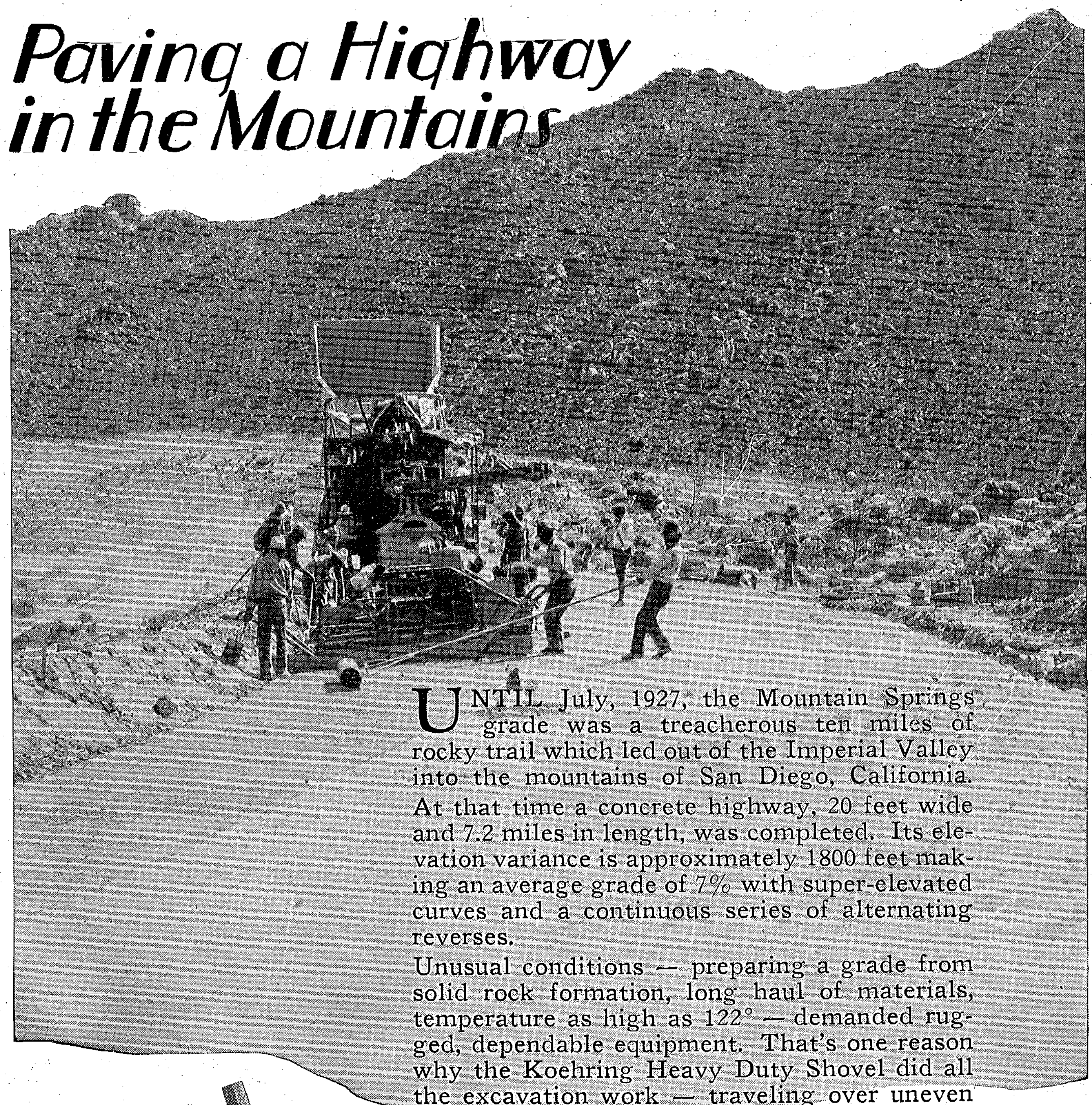
Inst.: Bad! Say, did you ever hear of an engineer being converted?

Rayon

(Continued from page 9)

up and the charge dropped to draining tables on the floor below and from there to centrifuges. The centrifuged product drops to the floor below into larger vats of water where it is submerged and washed by jets of water, after which it is ready for stabilizing. This method has the advantage of speed and adaptability to large scale production for which advantages are sacrificed safety, low maintenance and power costs and somewhat of yield. The charge of a nitrator by either process varies from 20-35 pounds of cotton and from 30-50 times this weight of mixed acid. The nitrogen content of the product varies from 10.5-12.0 per cent depending on the strength of acid, time and temperature. This is the "soluble pyroxylin" range and is a lower nitrogen content than guncotton.

The nitro-cellulose is "stabilized" by boiling with several changes of water for about 40 hours. It is then "pulped" in Jordan engines or Hollanders to aid in removing the acid from the central canal of the fibres and finally "poached" by boiling with dilute sodium carbonate solution. After washing, it is centrifuged and pressed to about 25-35 per cent water. If it is to be shipped, this water is displaced in the press with ethyl or propyl alcohols. The press cake is dissolved in horizontal, slow-revolving, tin-lined drums, with an ether-alcohol solvent (40% alcohol, 60% ether) to form a 25-30 per cent solution. The mixer is agitated for 15-20 hours to insure complete solution and the solution then filtered through specially constructed filters under a pressure of from 500-1000 pounds per square inch. Coagulation of the thread in spinning may be by evaporation of the solvent in heated air or by coagulation in water. The tender thread is still nitrocellulose and must be denitrated by washing with some chemical which will remove the nitrate groups leaving regenerated cellulose or hydrocellulose, which is much less inflammable than the nitrate. The best reagent for this purpose is a solution of ammonium polysulfide. The product is a dirty, pale yellow fibre which must be bleached before use.



Drippings from the Oil Can

Upper-classman (in patronizing manner): By hard work I have nearly completed four years of college.
Freshie: Honestly?
U.: Sh! Not so loud.

There was a young lady named Alys
Who thought the art room a palys;
But an engineer 'tis said,
Our dear Alys mis-led—
Now she curses the place with a malys.

Student: Have you ever recited "To the West Wind?"
Richardson: No, but I've tried to talk to classes.

DUE TO ENVIRONMENT

E. E.—What makes you think that my head is made of cork?
C. E.—It always seems to be at the mouth of a bottle.

Prof.: Can you tell me when the revival of learning took place?
Falsetto: Just before the finals.

Don't worry if your job is small
And your rewards are few;
Remember that the mighty oak
Was once a nut like you.
—*The Engineer's Bulletin.*

Student: I've been working on this problem for fifteen minutes and I haven't gotten it yet. I believe I need assistance.
Inst.: You don't need assistance. You need a rest.

Freshie (after receiving a bolt from the dispensary): Shall I put it on myself?
Soph.: Naw, on the machine.

Freshie: Who is Dean Leland?
Soph: Good Lord! Don't you—
Freshie: Oh!

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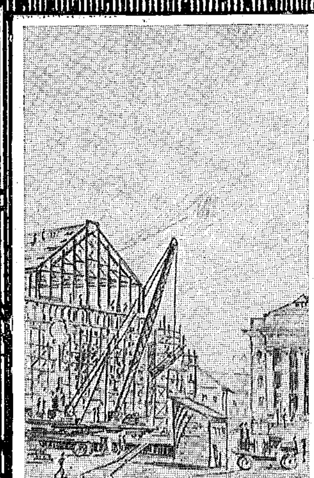

MEMBER - ENGINEERING - COLLEGE - MAGAZINES - ASSOCIATED

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

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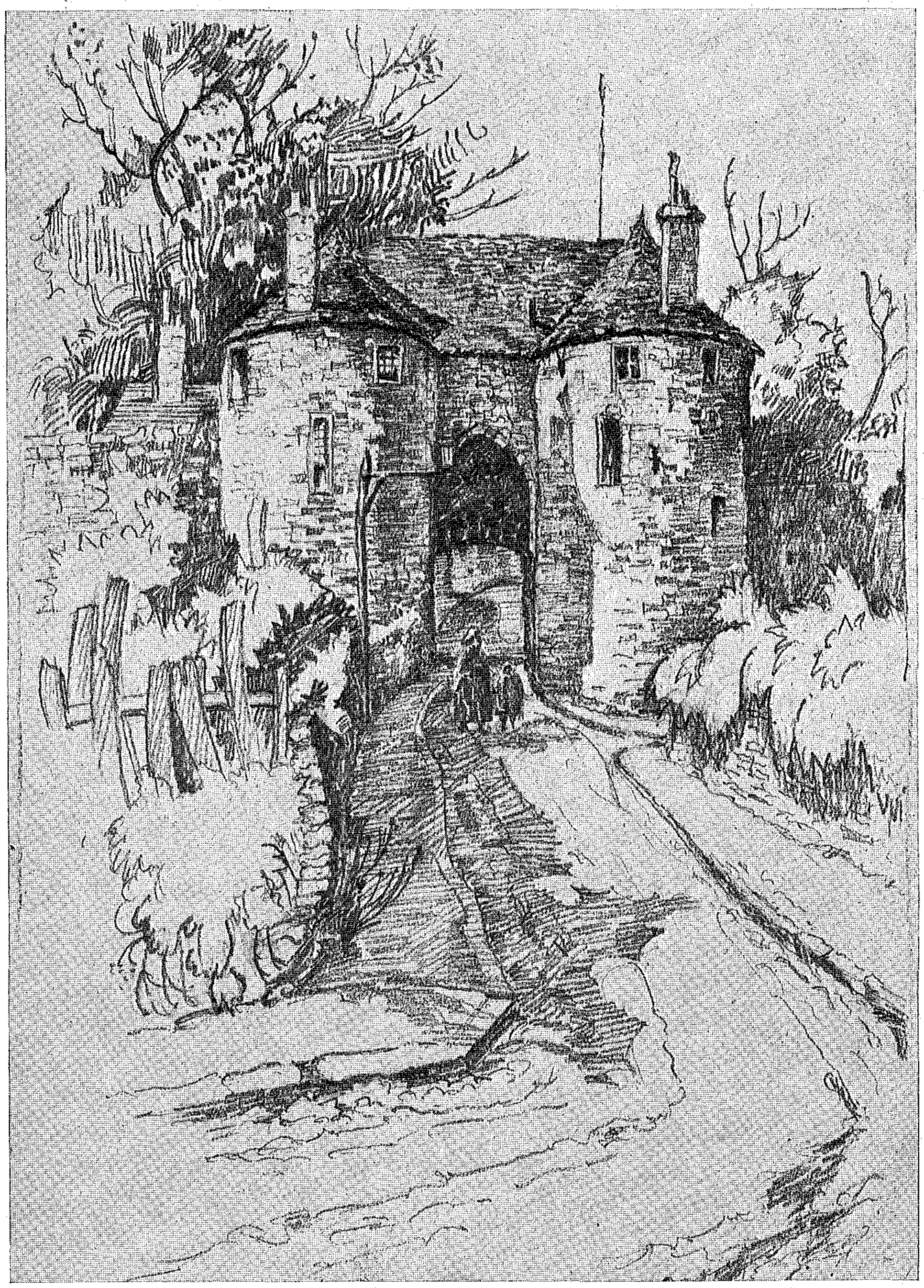


An Old Gateway

The MINNESOTA TECHNO-LOG
University of Minnesota
Volume IX NOVEMBER 1928 Number 2

An Hawaiian Luau

Minnesota engineers might receive an inspiration from the yearly celebration of the agricultural students of the University of Hawaii

By CARL F. LUETHI, C '27
Ensign, U. S. N. R.

MINNESOTA technical students yearly stage their Engineers' Day celebration when St. Pat rewards all his good and faithful servants, foresters set aside a day on which to do honor to their saint Paul Bunyon, and the aggies have their All-Ag day when the campus is treated to an exhibition of things agricultural.

But they all might receive an inspiration if they could attend an Hawaiian luau, a yearly celebration of the agricultural students of the University of Hawaii. A luau can best be described as similar to an American barbecue, and the festivity staged on these occasions was modeled after the native Hawaiian luau of old, with some modifications.

The native food served at these festivals is an education in itself and is worthy of a much more fitting description than I can possibly give it after but a single demonstration. And it must be here noted that I refuse to accept responsibility for the correctness of any or all of the Hawaiian names used herein.

The main attraction is a roasted pig, prepared in the following manner. A hole is dug in the ground in which a huge fire is built under a pile of rocks. When the rocks are sufficiently hot, a freshly killed hog is introduced upon the scene and the hot rocks are placed in and around the carcass. Stalks from green banana trees are then crushed to a somewhat pulpy state and placed over the hog after which the entire pit is covered with the leaves of the ti plant. The imu, as it is called, is left thus until the hog is roasted to a turn in his own juice and the juices of the banana stalks and ti leaves.

A second imu is also built for the preparation of the native pudding, kulolo. This is merely a mixture of cocoanut meat and taro roots, and when roasted results in a brown gelatinous mass of uncertain texture and taste, but is considered high delectable to the initiated.

At this luau a third imu was used for the roasting of fish, which were wrapped in layers of ti leaves and placed in the pit in a manner similar to the above.

There were also other delicacies prepared for the enjoyment of the assembled students and visitors. One of these was the native staple, poi. Now poi is to the Hawaiian race what bread is to the average Minneapolitan. It is made of the roots of the taro, crushed fine and boiled. The resulting mixture is a grey starchy product strongly resembling a good variety of paper hanger's paste and, to my inexperienced palate, tasting about the same. It is graded according to its consistency as two-fingered or three-fingered poi, depending upon whether it requires two or three fingers to ensnare a suitable mouthful.

Another dish considered by connoisseurs to be a great luxury and which is a prime favorite to render poi more palatable is lomilomi salmon. This is simply raw salmon shredded and mixed with tomatoes, the whole being highly season. The proper method of attack is to scoop up a quantity of lomilomi with an experienced forefinger, dash it into a platter of poi, and after properly subduing it with the sticky mass, convey the tasty morsel to its final destination with a single graceful movement.

Still another dish that was good even to my super-civilized taste was chicken boiled in tender taro leaves, which are much like spinach and which impart an original flavor to the chicken.

The final item was a variety of pudding called huapia, which consisted of cocoanut meat boiled with cornstarch. This was also very pleasant tasting.

It would seem by the above that the taro and ti plants form the base of most of the Hawaiian culinary art, and it is true that they seem to be very necessary in the physical and social life of the natives. Taro, for instance, is a plant which grows in water somewhat like rice, and whose bulbous roots grow like potatoes and are practically all starch. It might be interesting to add also that the roots of the ti plant forms the basis of the native alcoholic drink, okolehau, a couple shots of which make the visiting gob prepared to return to his ship and throw pineapples at the admiral.

Truly to appreciate a native Hawaiian luau, the participants must be present during the preparation of the food and the ensuing celebration which lasts four or five days. Everyone squats on the ground and the food is placed on low tables covered with ti leaves. No table implements are used whatever, all food being served on ti leaves and everyone working on the assumption that fingers were made before forks. Eating is frequently interrupted by dancing and singing by anyone who is so minded.

At this luau, however, modifications were indulged in as more befitting the circumstances. The food was prepared on the two days preceding and the civil engineering building was decorated and equipped for the purpose. The walls were covered with leaves of the royal and cocoanut palms and the tables were all covered with ti leaves. Most of the food was served in ti leaves but the more liquid varieties were served in small wooden containers. Small wooden ice cream spoons were also furnished, thus lending a little dignity to the occasion and undoubtedly saving the day for numerous ties, shirts, and dress fronts.

After all visible foodstuffs had vanished, entertainment was furnished by a pretty little Hawaiian girl of about twelve South Sea summers who appeared on the scene arrayed in a Hula skirt of ti leaves and numerous flower leis. She danced the Hawaiian Hula to the accompaniment of native singers and players, and then gave a more modern version which seemed to be a mad medley of the Hula, Charleston, and Black Bottom.

At the conclusion of this feature, a number of fast fencing and boxing matches were fought in an outdoor ring. This concluded the festivities and provided the final demonstration that in the long run, university students are the same the world over.

Rayon

A triumph of modern chemical and mechanical engineering now the third most important textile

By RALPH E. MONTONNA
Assistant Professor of Chemical Engineering.

This material is a continuation of the article by Dr. Montonna, which appeared in the October issue of the Techno-Log.

VISCOSE PROCESS

THIS process, by which 80 per cent of the rayon is made in this country, uses a purified sulfite pulp as raw material and depends on the fact that the cellulose ester of xanthogenic acid is soluble in alkali solutions and can be regenerated from such solution by neutralizing with acid. The sulfite pulp is treated with a 15-20 per cent solution of sodium hydroxide for an hour which forms "soda cellulose." The excess alkali is then pressed or centrifuged out and the soda cellulose aged. It is "crumbled" to a crumb-like mass in mixers and treated with carbon bisulfide for 2-3 hours. The carbon bisulfide vapors are sucked off from the crumbly orange mass of cellulose xanthate and it is dissolved in dilute caustic soda. This crude viscose is then "aged" or "ripened" under carefully controlled temperature. During the ripening, a chemical change goes on, during which the ratio of cellulose to sulfur increases and by which the viscosity of the final solution is increased. The ripened product is sometimes purified by precipitating with sodium bicarbonate, washing with water or sodium sulfate solution and redissolving in caustic soda. The solution is filtered either in plate and frame presses or by super-centrifuging and is then ready for spinning.

The coagulation is accomplished in acid "setting" baths giving a fibre of regenerated hydrocellulose. Many kinds of setting baths are used, varying from dilute H_2SO_4 and $NaHSO_4$ (nitre cake) to dilute acid containing zinc salts and a little glucose. The coagulated filaments of hydrocellulose still contain absorbed sulfur compounds. They are desulfurized by treatment with a dilute solution of sodium sulfide, bleached and dried.

CELLULOSE ACETATE PROCESS

This process is very similar to the nitrocellulose process except that the ester of acetic acid is used as such to form the finished fiber. The raw material is cotton linters which are esterified with acetic anhydride using glacial acetic acid as the solvent. Two general types of procedure are followed. The two-step process most generally used in Europe first subjects the cotton to the hydrolyzing action of a dilute solution of sulfuric in glacial acetic acid, producing a modified or hydrocellulose. This mixture is then treated with acetic anhydride until the cotton dissolves. The other process which is the American practice performs both steps simultaneously. Certain catalysts are generally used in the first process and are necessary in the second. These are for the most part dehydrating agents such as sulfuric, hydrochloric, hydrobromic acids and iodine or salts or organic derivatives which will give these acids by hydrolysis such as zinc chloride, copper, iron or ammonium sulfate, benzene sulfonic acid and chloracetic acid. These catalysts speed up the reaction so much that it is hard to control unless certain diluents or inhibiting reagents are added. Chlorbenzene, phenolethers, nitro-benzene, carbon tetrachloride, ethyl acetate and aromatic hydrocarbons have been used for this purpose. The temperature of the reaction varies from ordinary temperature up to 70°C. and the time necessary is in inverse ratio to the temperature.

In some plants the acetylation mixture is filtered and used directly for spinning by coagulation with water. In others the ester is precipitated by pouring into water, filtered and dissolved in volatile solvents such as chloroform, ethyl acetate-alcohol, or phenols. This solution after filtering may be spun into heated air or into a coagulating bath which will dissolve the solvent.

METHODS OF SPINNING RAYON

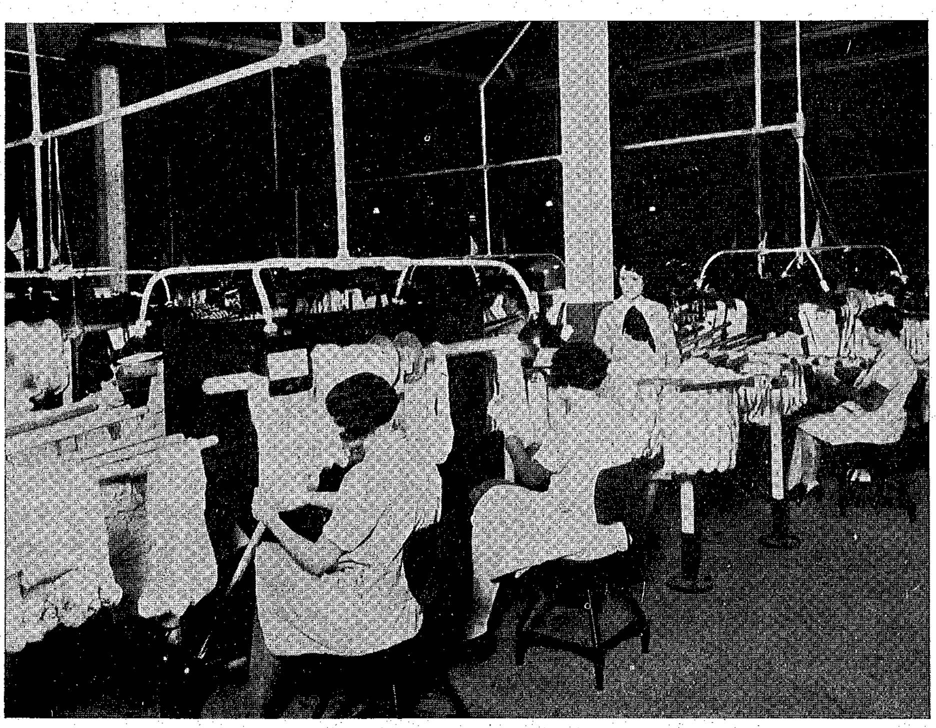
In general, the spinning operation consists of forcing the cellulose solution through a number of fine openings into a coagulating medium. The methods of spinning are divided into two classes according to the type of coagulating medium. These classes are "dry" spinning which depends on the evaporation of the solvents in heated air for the coagulation and "wet" spinning in which the solvents are dissolved by a coagulating solution. Wet spinning only is applicable to cuprammonium and viscose rayons, since their solutions are in water and relatively nonvolatile. Either method may be employed on the nitrocellulose and cellulose acetate rayons. Wet spinning may be further subdivided according to the method by which the wet thread is handled into "bobbin" and "centrifugal" spinning. In centrifugal spinning the individual filaments composing the thread are always twisted together by the spin of the centrifuge. Bobbin spinning may employ a "twister" to introduce the twist or may be done as "straight" spinning in which case the filaments are twisted together in a subsequent operation known as "throwing" by winding from one bobbin onto another whose axis runs at right angles to the first and at a greater speed. Dry spinning is very little used now because of the difficulty of recovering the volatile solvents from the air. Air at about 50°C. was used and circulated through the spinning machine which was enclosed in gas-tight glass cases and then through a recovery system consisting either of absorption towers or refrigerating coils. The setting baths employed in wet spinning are circulated continuously through the spinning machine by pumps. Volatile solvents may be recovered from them by distillation or they may be replaced by fresh solution and the salts recovered in other processes.

After filtering, the various cellulose solutions are subjected to vacuum to remove air bubbles and stored in reservoirs which feed a manifold running the length of the spinning machine. Formerly the solution was forced through the orifices by air pressure of about 100 lbs. per square inch applied to the reservoirs. Now practically all spinning is at much lower pressure which is secured by small geared pumps that must be calibrated with exceeding accuracy in order to deliver the solution at exactly the right rate for the bobbins or centrifuges to take up the coagulated thread with just the desired amount of tension. If the delivery is too slow the thread will snap; if too fast, the tension is lost and the thread will tangle.

Each pump delivers to a "spinnerette" or spinning orifice. These are small thimbles whose ends are pierced by a number of fine orifices, the number and size of the orifices determining the size and number of the individual filaments in the thread. The usual numbers of filaments in a thread are 12, 18, 22, 36, or 72. Only a few rayons are spun with the higher numbers of filaments, although the recent tendency is toward more and finer individual filaments because this adds strength to the thread and gives fabrics made from it better draping qualities. The spinnerettes are made either of platinum or of Pyrex glass and the holes are very carefully sized, uniform and perfectly round. The orifices in modern spinnerettes will be about .002-.005 inches in diameter (.05-.12 mm.) although they were formerly much larger (0.50 mm.).

The green tender threads are picked up from the setting bath and led over a set of tumbrils whose axles have a reciprocating motion, together and apart, thus producing some stretch in the thread. Thence it is led through guides to the bobbin or centrifuge. Sometimes, in bobbin spinning, a "twister" is interposed somewhere between the spinnerette and the bobbin. This is a small rotating tube driven by gears which the thread enters parallel to the axis of rotation and leaves at right angles. Usually about 100 twists per yard are introduced, the number being controlled by the speed at which the twister or the centrifuge rotates. The bobbins are made of glass or Bakelite and are about six inches in diameter and 10-12 inches wide. A traveling guide moving along the axis of the bobbin produces even winding. The centrifuges are of bronze with removable hard rubber linings which are 4-6 inches in diameter. They are geared synchronously to the drive of the spinning machine and run at from 5000-6000 r.p.m. Spinning speeds vary with the type of rayon and kind of spinning used from 50 meters per minute up. The speed of pump, tumbrils and receiver (bobbin or spinnerette) must be carefully synchronized to prevent undue tension which would break the tender thread, and when it is realized that there may be several hundred sets of these on a single drive of a spinning machine, some idea of the tremendous mechanical problems of this industry may be gained.

The glass bobbin of green rayon or the centrifuge "cheese" is automatically stopped and the pump shut off when sufficient thread has been spun, and workers then remove them for subsequent operations and replace with an empty bobbin or hard rubber centrifuge liner and again start the pump and lead the thread around its course. The green fiber, wet with acid, is first washed free of acid. The nitrocellulose is treated with a bath of ammonium polysulfide for denitration or the viscose with a sodium sulfide bath for the removal of sulfur. These fibers must then be washed again. The washed green cake is then bleached with a dilute solution of chloride of lime under carefully controlled conditions. Overbleaching weakens the fiber considerably. After the bleach is washed out, the rayon is usually reeled into skeins of about 3000 yards each. If "straight" spinning has been employed a "throwing" operation to put the twist in the fiber is interposed at some point in the process. Finally the rayon skeins are dried in tunnel driers under an atmosphere carefully controlled both as to temperature and humdity, so that it comes out with the amount of moisture it would naturally take up by "regain." It is then carefully inspected and graded by girls, usually under uniform artificial light. A considerably higher price may be obtained if the skeins are reeled onto small bobbins suitable for knitting machines.



A view of the inspection room. Each skein of rayon must be examined carefully to make sure that it is in perfect condition.

Comparison of the Different Products and Processes

The viscose process is by far the most important in this country. About 80 per cent of the rayon is produced by this method. It is the cheapest process and although the product was at first inferior, it is now equal or superior to the others. It is fairly simple chemically, and the spinning is easy, lending itself readily to centrifugal receivers. The desulfurizing step is neither difficult nor costly and there is no recovery process for either volatile solvents or for metals in this process. The acetate process is the most expensive and is a delicate chemical operation. The spinning offers no unusual difficulties, but the acetic acid must be recovered. If dry spinning is used there are also volatile solvents to be recovered. The only thing that has maintained this process in competition with the others is the superior quality of the product, especially in regard to wet strength. Neither the cuprammonium nor the nitrocellulose process have become very popular in this country. They are intermediate to the other two in cost, the nitro rayon being slightly the more expensive. Both are rather complicated as to chemical processes as well as in spinning. Both necessitate expensive recovery systems, the nitro for volatile solvents, the other for both copper and ammonia. The nitrocellulose or Chardonnet process has had greatest success in France where it originated; the cuprammonium or Pauly process, in Germany; and the cellulose acetate process in England. One company, the Tubize Silk Company, operates a nitrocellulose process in this country; a branch of a large English company, The American Cellulose and Chemicals Company, using the acetate process, built a large plant several years ago; and, at the present, the Bemberg Company, a German concern, is building a large cuprammonium plant in Tennessee. The Viscose company and the Dupont company are the largest producers of viscose rayon although there are many other smaller concerns using this process.

The greatest disadvantage which rayon has compared to natural silk is the fact that it weakens greatly when wet. It possesses about two-thirds the strength of natural silk dry, compares favorably with cotton, and is stronger than wool. Tenacity tests vary greatly according to different investigators, but an idea of the comparative strength may be gained from Table 3. Note especially how acetate rayon retains its strength when wet.

Various methods of improving the strength such as treatment with dilute mineral acids and drying in a moist atmosphere, treatment with formaldehyde

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Signal Corps at Fort Sheridan

An intensive program of work, instruction, and recreation was the lot of the electricals during the summer at camp

By CYRIL T. WALL, E. E. '29

THE signal corps camp, which each member of the advanced signal corps must attend for one summer, was held this year at Fort Sheridan, Illinois.

As no Minnesota unit had ever before been to Fort Sheridan, our destination was of particular interest to us. Upon investigation we learned that it was one of the oldest army posts in the middle west and station of the Fourteenth Cavalry and the Sixth Infantry regiments. The Fourteenth is the cavalry regiment that always takes the major horse show honors and the Sixth Infantry is the second oldest existing organization of the army.

We found the post to be a beautiful place, located among the famous North Shore suburbs, just outside of Chicago. A long row of barracks buildings, topped by a medieval appearing tower, faced the parade grounds at the center of the reservation. The residences of the officers of the post were on shady winding roads along the lake shore at the head of the parade grounds. The R. O. T. C. camp was a small city of tents erected near the southern edge of the reservation.

Upon our arrival at the fort we spent some time in looking about and after orienting ourselves we reported to the camp. We were then assigned temporary tents in which to leave our personal belongings. In these tents, much to our disgust at first and later delight we were to live the following six weeks. When every one in the company was enrolled we were marched in formation to the post hospital where we underwent a thorough physical examination.

This "processing" which lasted more than three hours, included an examination of the eyes, ears, nose, throat, heart, lungs, limbs, posture, and everything else that could be examined. Then in much the same manner as a Ford car in the process of assembly we received the clothes in which we were to work, march, and eat for the next six weeks. We then returned to the camp and received our cots, bedding, and other equipment including mess kits, tin knives, tin forks, and tin spoons. Throwing all of these into a shelter-half, we struggled also with them down to our tents where we tried to dope out the intricacies of the art of making up an army cot and keeping house in an army tent.

During these first hours at camp we made the acquaintance of the fellows from other universities, with whom we were to eat, sleep, work and play for the rest of the training period. We learned that the entire R. O. T. C. unit was under the command of Major Saratt, from the University of Illinois, with Captain Parsons, also from Illinois, Lieutenant Mack from Ohio State, and Lieutenant Schlosberg from Michigan, in charge of the signal company. Harry E. Strider, the only representative from the Minnesota military department filled the position of master sergeant for our company.

There were twelve cadets from Minnesota: Wesley Gray, Karl Heidman, Melnor Rudser, Rudolph Bierwagon, Fred Suhr, Cyril Braum, M. J. Hauge, C. T. Wall, Irwin Vigness, Donald Raney, John Madden and E. C. Carsberg.

Captain Parsons hoping that the cadets from various colleges might all become well acquainted with each other, and perhaps get a better insight into the methods of other universities, decreed that no two men from the same school could live in the same tent, so, his plan unsuspected by us, he lined us up according to height and reassigned us in order to our tents. Much to his surprise on the last day of camp he discovered that four Minnesota men had occupied the same tent throughout the training period.

We learned that the four hundred men in the camp were divided into five companies. There were three companies of infantry, one of cavalry and our signal corps. The cavalry, quartered on the next street, named us, either affectionately or jealously the "Telephone Girls." The affectionate names we had for the cavalry are not a matter of record. There were about sixty men in our company and were from Michigan, Minnesota, Illinois, Ohio State, and Wisconsin universities.

Camp immediately fell into swing and the next three weeks were far from monotonous. Mornings after drill there were lectures on the procedure followed in the handling of field messages, codes and ciphers, meteorology, and other subjects of military interest. We spent half an hour each morning at radio code practice and had a code speed test each week. Afternoons there were lectures in radio station operation and in the installation of field telephone systems.

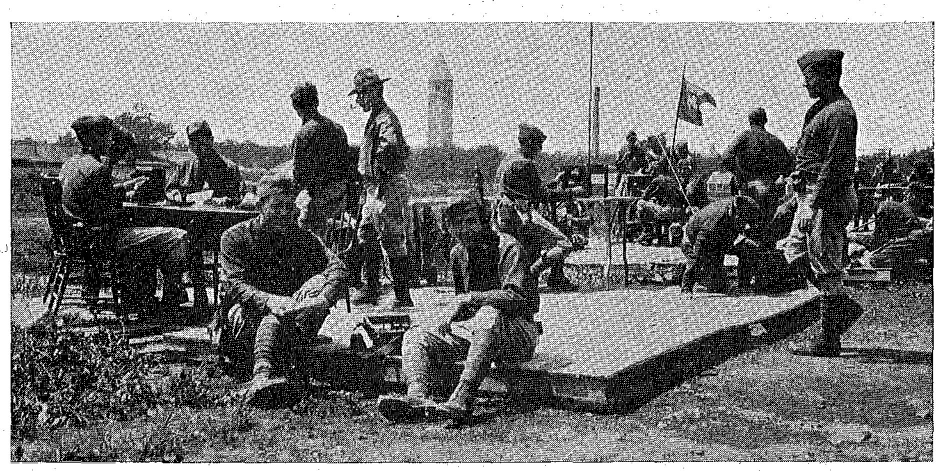
At the end of this period came a welcome break in the program and we spent three days on the beach at pistol practice. The .45 caliber automatic looks like a fairly simple weapon. Lying on a table in a box, it is, but held in the right hand at arm's length pointed at a moving target it loses its simplicity. Howover, the average shooting ability of the company was very high, as more than half of the men qualified as marksmen or better.

IT was about this time that another screen epic was filmed. The Paramount news reel man happened through the post and the Signal Corps was called upon to perform. We ran through our daily program—falling in for formation, morning drill, calisthenics, and grub line. That afternoon we posed as a message center operating full blast in the heat of a battle.

Speculation was rife about camp for some time as to who might become famous stars, but Paramount was blind to our abilities and no contracts were forthcoming. The post theater, however, did a rushing business on news reel nights until our picture was released.

Camp, by this time, was drawing towards a close and the period devoted to

(*Continued on page 62*)



The message center in operation.

C. A. C. in Kentucky

During the last summer Coast artillery men from Minnesota invaded Camp Knox for the first time

By Realto Cherne, M. E. '29

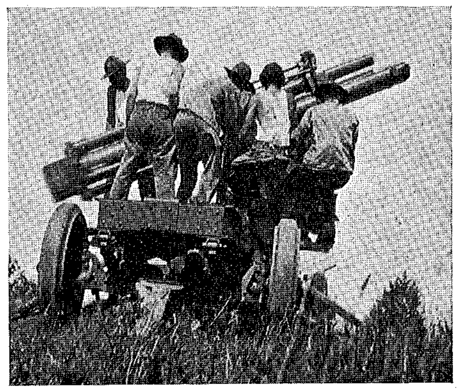
"STOP me if you've heard this one," shouted a Minnesota Artillery man as he clamored for attention from the group loaded in a large Army truck. His outburst was promptly met with a deluge of water, as was the custom in "that man's" army. Water fights (from canteens) never had a definite origin but all credit was finally passed on to "Nick" Bjork of Minnesota. But—I'm getting ahead of the story.

Immediately after Summer vacation started last June, the Minnesota Coast Artillery unit was ordered to report to Camp Knox, Kentucky. Camp Knox is located thirty miles south of Louisville on the Dixie Highway. The distance from Minneapolis varies from 750 to 800 miles, depending largely upon the road selected and ability of driver to stay with the road markers. All but two of the twenty-seven Minnesota Engineers traveled via self-impelled conveyance, thus making money on mileage alloted by the government. The models of cars ranged from a 1913 Ford to a recent Jewett sedan. The writer was fortunate enough to be a passenger in the 1913 vehicle. It was prophesied that same would never reach Chicago, let alone Louisville. Suffice, then, to say that all arrived at camp on time and in good frame of mind.

The usual army procedure was followed in "processing." All of the Minnesota men were successful in passing the physical exam and so proceeded to the store room for Army equipment. Each man hurried through a series of rooms, coming out dressed in O. D. clothes and heavy army shoes, also carrying a duffle bag filled with auxiliary equipment. The suit was assigned to Battery D of Coast Artillery, Major Willis Shippam of Minnesota being Senior Instructor.

The advanced Coast Artillery Corps training course had a very intensive program outlined for us and action started immediately. The feat of cleaning "cosmoline" from the rifles on the first day remains as a never to be forgotten experience. After the previous year's camp, the rifles are inspected and later dipped in a large vat of oil, coming out fully covered with grease. Gasoline was a solvent which was used freely that afternoon. Even a week later, after intensive use brought on by rapid firing, this grease was oozing out of cracks and crevices never before known to be possessed by a Springfield rifle.

The first week was spent on the rifle range, all men attempting to qualify as marksmen, sharpshooter, or expert. Careful use of the Springfield 30-caliber, possessing a kick of an army mule, was necessary for such a test. During this week we carried raincoats all of the time because of unusually rainy weather. Some of the record firing was done during a driving rain, which accounts



A seventy-five millimeter anti-aircraft gun in full recoil.

for the fact that we qualified only four men in rifle marksmanship. Cruel experience was gained when we lay prone on a shelter half which was covered with a few inches of water.

Some sunshine hove into view on Saturday night when a R.O.T.C. dance was held at the Kosair hotel in Louisville. Which city showed rare hospitality when they furnished about 300 girls for dancing partners. No girl arrived in a car of less caliber than a Packard straight eight. The introductions were accomplished without any mishaps, in fact, most of the fellows ended the evening by inviting a girl to a boat ride the next week (provided she bring the lunch). I might mention here that a valuable accessory, on warm nights such as that one, is a clothes wringer.

The second week was taken care of by instructions on the three inch antiaircraft gun, search light, and machine guns. This was all preliminary work; no actual firing being done. Minnesota passed the "blindfold test" on the machine gun 100 per cent. This required the dissembling and reassembling of a Browning machine gun in three minutes. It was during this week, also, that we were instructed in the proper way of doing squads "east and west." Which means that one hour of infantry drill was held each morning.

The week passed rapidly and on Saturday a boat trip on the Ohio river served as entertainment.

On the fourth of July most of the fellows took trips around to see some of the notable sights of Kentucky. Some went up to Latonia to see the southern horses of track fame.

Camp life grew more interesting because the three-inch was being fired at a target towed by airplane. So successful were we, that the tow line, made of piano wire, was cut on two different occasions. Much quick action was experienced when a battery of eight machine guns were concentrated on balloons filled with hydrogen. Battery "D" was known as the battery that did not let a balloon get away.

The following Saturday a trip was planned that would take in the Mammouth Cave, which is one of the seven natural wonders of the world. Most of the Minnesota unit decided to make the trip privately instead of with the corps. In this way we gained by seeing two additional caves, including the Great Onyx Cave where the body of Floyd Collins lies in state. In the Mammouth Cave, we walked for five miles underground. The time consumed was about three and one-half hours—a "real" walk.

THE next couple weeks were spent trying to get the A. A. gun trained on the flying target. A record was taken from which the firing score of the battery was calculated. The machine gun fire proved very effective during this period.

About this time another "social fling" was taken. The occasion being another dance in Louisville.

Pistol firing now became the absorbing interest. Minnesota came to the fore here and qualified 19 men as marksmen or better. This record led some of the camp to believe that Minneapolis was quite close to Chicago.

During the sixth week of camp a series of track meets were held in which Minnesota men came through with points in many events. Much success was met with by the wrestlers and boxers of our division. The week ended with a large group demonstration for the secretary of war. All units demonstrated the use of weapons and effectiveness of fire control.

The last two days were taken up with the routine of handing in of equip-

(Continued on page 62)

Three Themes

Herewith are published three of the better themes written by students taking engineering English during the fall quarter. These have been selected by the editors of the MINNESOTA TECHNO-LOG *from a group of themes compiled by the faculty of the English department.*

It is hoped that this page will bring between the English department and the MINNESOTA TECHNO-LOG *a closer cooperation—something that will grow in years to come. All students who are interested in writing are invited to see Mr. Richardson and to come to the office of the* TECHNO-LOG, *room 37 of the Electrical building.*

The Four Commemorative Towers

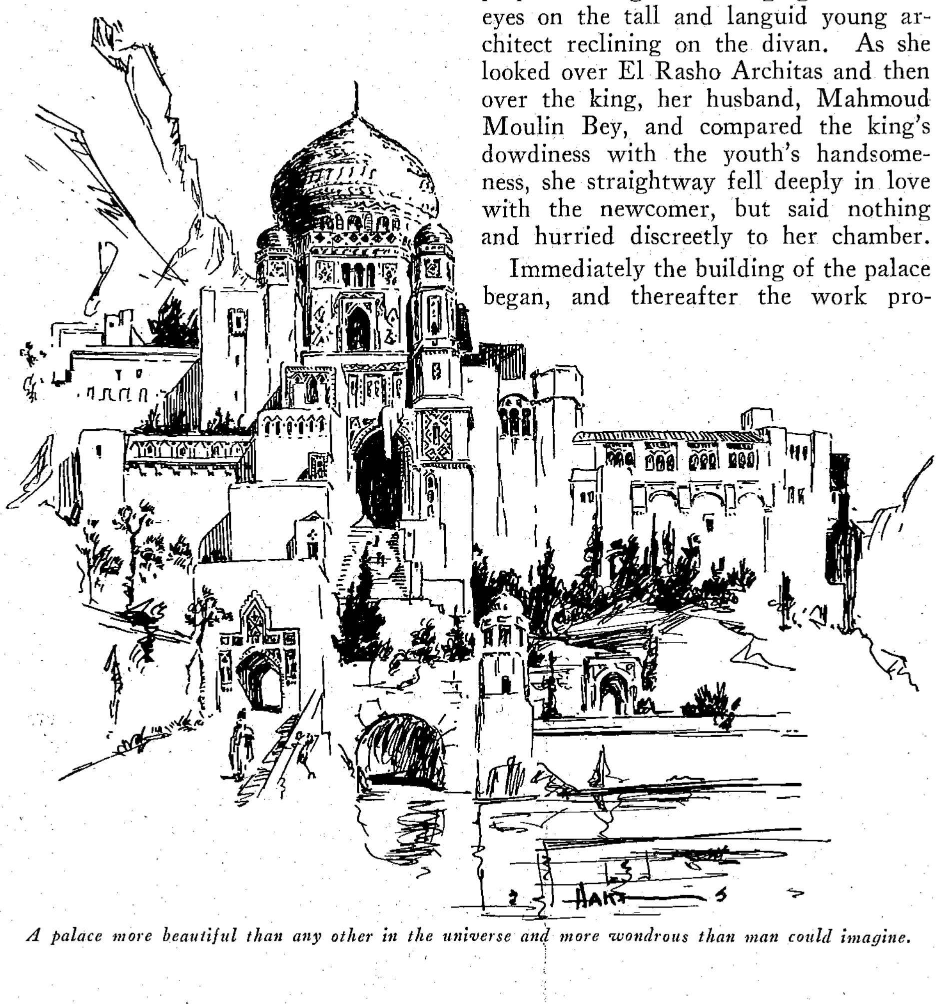
(A New Tale of the Arabian Nights)

By FRANCIS V. GORMAN

THERE once lived in Persia a king named Mahmoud Moulin Bey and his beautiful queen, La Sebana. In all the land, there was no woman so beautiful to behold as La Sebana, the consort of the king. And in all the world, there were no people more happy than the subjects of the king, no city more prosperous than his capital, and no court more brilliant and gay.

One day, there came to the city a stranger from India, old and much travelled, who beheld with scorn the buildings of the king and derided his palace. For had not he, the stranger, beheld in India a palace more beautiful than any other in the universe and more wonderous than man could imagine?

Mahmoud Moulin Bey was sore at heart and much perplexed. The rumor of the magnificent palace in India grew and the king was shamed that he had not such magnificence. The people also were downcast and wished to relieve their king of his sorrow.



A palace more beautiful than any other in the universe and more wondrous than man could imagine.

Now, late one night there sought for admission at the city gates a youth, tall and handsome beyond measure, well clothed and mounted, and the guards accosted him saying, "Whence art thou, and why?"

And he answered, "Lo, I have come out of India."

Forthwith, they took him to the king because he came out of India. Mahmoud Moulin Bey questioned the youth and found that his name was El Rasho Architas, and that he had seen the palace of great magnificence. The youth waxed loquacious under the questioning of the king, and little by little imparted his knowledge of the building of the palace in India. It transpired that he had been a student under the master architect.

When the king heard this, he gave a glad cry and at once offered the youth the contents of the royal treasury to build such a palace that would eclipse any and all palaces scattered about the world, including the one in India. The youth accepted.

It happened that the queen, La Sebana, was passing through a corridor adjacent to the court room and heard the king's cry of gladness. At once she peeped through the hangings and cast eyes on the tall and languid young architect reclining on the divan. As she looked over El Rasho Architas and then over the king, her husband, Mahmoud Moulin Bey, and compared the king's dowdiness with the youth's handsomeness, she straightway fell deeply in love with the newcomer, but said nothing and hurried discreetly to her chamber.

Immediately the building of the palace began, and thereafter the work progressed with much speed. The king and all his court, including the queen, came daily to see how things were coming along. The queen cleverly managed to dodge the court and return to El Rasho. Both of them then went up into one of the towers of the new building on the concrete hoist, where they were wont to stay all afternoon undisturbed.

And so the palace progressed rapidly. Eventually the building was finished, and the queen deeply in love with El Rasho, and he in love with her. And the king knew it not.

The day of the final acceptance and inspection of the finished palace was at hand, and all who saw it marvelled at the gorgeousness of the pile, the gleaming of its alabaster walls, and its jeweled towers. The jeweled towers were four in number, and dedicated to the queen by the lovesick young architect. The north tower was covered with diamonds of great size. It shone like ice in the sun and sparkled in a million shafts of quavering light. This, the first tower built, commemorated the heart of the queen, when she pretended to be cold and frosty the more to make him win her.

The second tower was to the south, and made of jet to honor the queen's hair. In the moonlight, it glowed with soft light like shadows and sun in his love's raven hair.

The east tower welcomed the dawn of the love of the queen and the architect, and was of emeralds and sapphires to remind the designer of the deep lights in the soulful eyes of his love. When the sun rose, then did the tower seem to quiver and palpitate like the soul-fire in her eyes.

The tower to the west was of all the most magnificent and stately, and built when La Sebana declared her love for El Rasho, the architect. All of rubies

In all the land, there was no woman so beautiful to behold as La Sebana, the consort of the king.

it was, and came to the magnificence of its ruby glory in the rose hue of the setting sun, for then it sparkled like living fire, the burning, unquenchable fire of their love.

Now, the king comanded a great feast to take place in the new palace, and commanded further that all his subjects should also be feasted therein, for the palace was very huge. At the feast, Mahmoud Moulin Bey reclined at the head of the table, El Rasho Architas to his right, and La Sebana at his left hand. And ever behind the king's back did the two lovers exchange sweet and covert glances. When the moon tipped the cypresses, the king rose and turned to El Rasho saying, "Name for us thy reward, that it may be given thee."

El Rasho saw his sojourn at the palace terminated with a reward, so he said, "Sire, let us wait." He could see more of the queen.

After a time, Mahmoud became sodden with wine and rich food and fear came to him. Turning again to El Rasho Architas, he asked, "Could you ever conceive and execute a palace to equal, perhaps to surpass this one of mine?"

El Rasho, also giddy with wine, boasted that he could build another palace of such pluperfect grandeur that it would outshine even Mahmoud Moulin Bey's.

Thereupon the king was very wroth that there should be a possibility that any other palace in the world should eclipse his. At once he commanded that the eyes of the youth be burned out, and his hands cut off at the wrist, that he might never again see to execute nor have hands to design anything which might cloud the glory of this marvelous palace. Straightway, all was done as he commanded.

Chivalry

By Scott Tisdale

DURING the Middle Ages there grew up an institution known as chivalry which had at the time being a profound influence upon the society of the period and which has left its impress upon our own modern civilization. The term chivalry indicates the organization of knighthood and in a more general sense the aims and ideals of knights.

Of the ideals of chivalry the most outstanding and perhaps most far-reaching in its effects was the attitude of honor and respect for and devotion to women. Up to the time of the Middle Ages woman had occupied a social position much inferior to that of man. Greece did not recognize the freedom of womanhood but held the members of the female sex to be much inferior to man. Rome had developed an attitude of respect for women, but it was a respect engendered more or less for political reasons. Mothers and wives were treated with great regard by the Romans, but this esteem was rendered to them not as females but as the faithful companions and patriotic mothers of citizens. The inferiority of womanhood was attacked during the Middle Ages as a gross materialism. Chivalry was the standing protest of knighthood, of mankind, of womanhood, against the degradation of woman. Our modern attitude toward women has unquestionably been an outgrowth of the higher standard adopted and idealized by chivalry and knighthood.

The moral aspect of chivalry played a vital part in the lives of those who lived during medieval times. It exercised a salutary influence at a time when governments were unsettled and laws but little regarded, when feudalism and serfdom were in full sway. It had a strong disciplinary effect at a time when feudalism was inclining toward violence. The code of ethics of chivalry upheld courage and enterprise in obedience to rule, consecrated military prowess to the service of the church, glorified the virtues of liberality, good faith, unselfishness and courtesy. Though it often carried the feelings of love and honor to a fanatical excess, yet the reverence paid to them contributed to prevent mankind from relapsing into barbarism. The part that chivalry played in the Crusades was alone of considerable consequence. In fact without chivalry the Crusades would in all probability have never taken the form or proportions which they did. On the other hand the Crusades tended to make chivalry more Christian than it had been. It was held to be the knight's duty to regard with veneration the Virgin Mary, to defend Christianity, to protect the Church, and to do battle against the infidel.

Like all institutions that have arisen to a position of influence, chivalry had its faults and even some of the high ideals for which it stands are open to question. Essentially it was a class spirit and class spirit at whatever time or place it may arise is not in keeping with ideals of liberty, freedom, liberality and unselfishness. The knight was bound to endless fantastic courtesies toward men and still more toward women of a certain rank; he might, and frequently did treat all below that rank with scorn and cruelty. And then we find that chivalry rested practically, like the highest civilization of ancient Greece and Rome, on slave labor, which lays it open to further adverse criticism.

During certain periods of the age of chivalry knights engaged in war for the love of battle without regard to the cause for which war was waged, and delighted in a fantastic display of personal daring which could not in any way advance the objects of the siege or campaign which was going on. In short it would appear that chivalry substituted purely personal obligations devised in the interest of an exclusive class, for the more homely duties of an honest man and a good citizen.

If the influence which the age of chivalry has exercised upon literature is any measure of its importance as an institution then we should hold it in high regard. The achievements of the knights were sung by troubadours and minstrels throughout Europe, and many of these old tales have come down to us. It was the spirit of knighthood which led the

(Continued on page 64)

The youth little by little imparted his knowledge of the building of the palace.

Why Miners Leave Home

Being a review of the junior field trip to Arizona and points southwest

By EDWARD D. COLLINS, M. '29

ANOTHER annual pilgrimage of the juniors from the School of Mines to the great Southwest is on the records as a huge success. Ten students, five miners and five metallurgists, and three professors took the trip. Thirteen may be an unlucky number to some, but the miners conclusively proved that there is nothing to this ancient and timeworn superstition.

The party included E. H. Comstock, W. H. Parker and P. C. Christianson, professors; "Ing" Serigstad, "Mac" McLean, "Mac" McMillen, "Annie" Amundson, and "Ned" Collins, miners; and "Gadget" Anderson, "Moritz" Fetzer, "Gully" Gulleson, "Dick" Merritt and "Jack" Neemes, metallurgists.

We bade adieu to the campus on the dreary morning of May 15th with "Ing" catching the train on a gallop in preference to staying behind. Traveling promised to be rather monotonous in spite of the time dispelling properties of bridge and "bull-sessions." "Gully" insisted that we would see no scenery until we arrived in the mountains, and persistently refused to go near the windows.

The first stop was at the large and prosperous city of Albert Lea where McMillen joined the party. He informed us that he had secured special rates for us on a dinner so we dashed for the lunch counter. The rates were very special—a forty cent dinner for seventy-five cents. Mac excused himself as he had already eaten at home.

The afternoon was uneventful, and evening found us at Des Moines. Here we lunched and stretched our legs, thankful for the half-hour between trains.

During the night we passed through Omaha where Mr. Parker joined the party. Morning found us in the flat wheat country of Kansas where they raise a thousand jackrabbits to the single dairy cow. We spent the morning on the observation car, viewing the never-changing treeless plains with increasing distaste.

We arrived in Colorado Springs at the foot of Pike's Peak at noon. We cautiously avoided the clutches of managers of sightseeing tours of all kinds, parked our baggage at the Alamo hotel, and went out in search of a square meal.

Upon returning we found that the afternoon was ours. Some went here, some went there, and the rest of us piled into a Pierce-Arrow (adv.) sightseeing bus bound for the Garden of the Gods. We managed to run through a souvenir store without spending anything except our time. This is considered quite an accomplishment.

Early the next morning we piled into the two Pierce-Arrows (miners ride in style or not at all) that had been hired to take us up to Cripple Creek—at one time the largest gold mining camp in the world. The scenery was wonderful to say the least, and the air was *invigorating*. We had come prepared, but, nevertheless, we were cold. Snow started to fall at an elevation of 8,000 feet and continued to do so for the rest of the ride up.

JUNIOR MINERS AND METALLURGISTS
Back row: McMillen, Anderson, Neemes, Merritt.
Second row: Amundsen, Serigstad, Fetzer, Gulleson, McLean, Christianson.
Seated in front: Collins.

At Cripple Creek we stopped for a cup of hot coffee and a view of the town. This once flourishing city of 50,000 has dwindled to a mere 5,000 souls. Fine brick buildings stand in ruins, having been destroyed to cut off payment of taxes which worked out mines could not afford.

Reinforced by hot coffee we continued upon our journey to the Cresson mine where we were to make our first inspection. We spent an hour or so looking over the ore sorting plant and then partook of the lunch which we had packed along via paper sack. After lunch the metallurgists hied themselves off to the Portland mill at Victor, and the miners went underground.

A two thousand foot drop brought us down to the bottom of the mine. We picked our way through drifts, crosscuts, stopes, raises, winzes, dogholes and other places of interest to miners. We peered interestedly into a hole 100 feet long, 40 feet wide and 800 feet high, nearly large enough to hold the Foshay tower. We stared at a small opening in the wall from which $2,000,000 worth of gold ore was taken. We stemmed an underground river that came rushing down one of the drifts. Then, after viewing more bulkheads, timber sets, ore pockets, and whatnot, we took the cage to the surface.

In the meantime the metallurgists viewed the process of concentrating gold and silver ore that originally contained values of only $3.50 to $7.50 per ton. They burned their fingers badly when one of the workmen spilled a quantity of molten gold bullion. They saw a few of the genuine gold bricks in existence, but didn't bring any of them home.

The miners, after a hot bath and change to dry clothes, drove to Victor, where the two parties united. We returned to Colorado Springs by way of the famous Corley Mountain Highway, crossing the divide at 10,300 feet. The mountain scenery far surpassed anything we had seen before, and the air was still invigorating, to say the least. The city was a welcome sight.

The following day the metallurgists departed for the Golden Cycle mill, where they again saw the concentration of gold and silver ores, but on a much larger scale than before. They inspected crushers, roasters, cyanidation operations and precipitation works. The superintendent offered them a small block of gold worth the trifling sum of $30,000 upon the condition that one of them carry it out of the plant in one hand. However, they decided it would be too much of an inconvenience to be burdened with, and left the brick with the superintendent.

We miners betook ourselves to the Pikeview coal mine where we spent the morning and part of the afternoon. After a thrilling three mile ride underground in a tiny coal car just large enough to hold the five of us, we inquired casually of the motorman as to the maximum speed of his motor.

"Oh," was his laconic reply, "It will hit about twelve miles per hour."

We went up and down entries, drifts and crosscuts, through overcasts and into rooms to the working faces. A special demonstration of a coal mining machine was put on for our benefit.

We returned to the shaft riding on a loaded coal train. This ride proved more thrilling than the trip out, principally to the three of us lying flat on our stomachs on the motor. The ride was slow and we endured all manner of cramps and aches without moving a hair for fear of being picked off by any one of dozens of projecting timbers.

We ate our paper sack lunch on the surface and then made a tour of inspection of the shops and surface plant.

We discovered, upon our return, that

(Continued on page 58)

The Battle of the Engineers

Icy water from high pressure fire mains, mud, and not a little blood fail to dampen the engineers' class spirit

By J. P. SHIRLEY, E. '32

"Sound, sound the clarion, fill the fife!
To all the sensual world proclaim,
One crowded hour of glorious life
Is worth an age without a name."

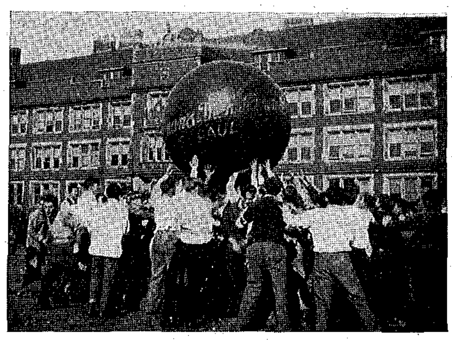
THE engineers have had their hour—yea, and crowded and glorious it was. The lowliest freshman, the mightiest sophomore, has thrilled to the war cry of battle. An avalanche of green crushing the life blood, tearing and hacking, biting and clawing, repulsed the onslaught of the sophomore horde, and established their victory in the annual class scrap, in no uncertain terms.

Hostilities began some time before the starting gun was sounded. The coolly calculating, diabolically shrewd sophs had resorted to subterfuge in a desperate attempt to deplete the ranks of their opponents. With honeyed words, and cautious cajolery, they lured many of the most titanic, but gullible freshmen, from the cloistered quiet of the class room to parts unknown. Mystery shrowded their actions; defeat crowned their efforts. They failed to account for the psychological effect, and their oversight was to be the cause of their downfall. For the yearling aggregation appeared upon the field of battle with a grim determination, an unfaltering insistence, which carried them to heights of moral frenzy, and caused their gonfalon to be unfurled from the highest pinnacle.

The opening event of the melee was a pushball contest. Although outnumbered almost two to one, the sophs strove valiantly to thwart the advance of the green tide. Time and time again they halted, but never could they stem the volcanic fury of the belligerent freshmen. So with blood curdling cheers that shattered the morale of their antagonists, the frosh crashed through to win the initial sortie.

In that gentlest of all pastimes—cowboy jousting—the frosh supremacy was again proved incontrovertible. Mounted on steeds which were sure footed, stalwart and swift—the ambidexterous green horsemen succeeded in overthrowing three of their opponents. The sophomores, however, could unhorse but two of the better conditioned frosh cowboys—although willing to stoop to any level to encompass their plans—leather was pulled, rowels sunk deep, necks choked, —but all to no avail. The equine and equestrian ability of the frosh was proved beyond dispute.

The sophomores receive an involuntary bath at the hands of the freshmen.



A tense moment in the pushball contest.

Then came the sack rush—known more properly as the sack pull. Here was a case where the ingenuity of the contestants would be of immense value in determining the winner. For after five or ten scrambled bodies have affixed themselves about a dainty gunny sack, more or less inventive genius is required to dissect the labyrinthine complexity, to determine where was what, which cranium belonged to what contestant. Was it a freshman fibula which caught that alien proboscis and caused the blood to flow? Shirts were ripped, trousers torn, heads battered, arms and legs wrenched from their sockets,—and when the smoke of conflict cleared—the palm of victory was again awarded to the somewhat bedraggled frosh.

On the greased pole, however, the sophomores were unconquerable. Using their previous training to good advantage, they were enabled to score three wins in rapid succession. Could it be that the superhuman endurance of the lordly soph might yet defeat the attempts of the victory-crazed freshmen? For a clean sweep on the pole, and a win in the tug-of-war would spell defeat for the green warriors. The peril was imminent,—but the erstwhile leader of the frosh was not to be gainsaid. He called upon one "Sandy" Spinek, who belabored his opponent with such ferocity that the issue was not long held in suspense. Then came Freshman Cooperman who acquitted his mission in a style which would have flattered the most vicious gangster of all Chicago's underworld.

Only the tug of war remained, and although assured of victory, the frosh blood was up—it seethed and broiled as molten magmas that pour from realms plutonic. And like the Thracians of ancient day, the green champions neither gave nor asked for quarter. Thirty stalwart sons and true were chosen by each aggregation, anchor men acclaimed by vox populi, and the contest was on. Muscles strained to the breaking point, eyes bulged from their sockets, jugglers protruded. Then from the freshmen a "Yo! Yo! Yo!"—steady and rhythmical with ever increasing cadence it beat upon the ears of the spectators and crystallized the hearts of the astounded sophomores. The green tyros could not be refused. Proving themselves possessed of true philosophical natures, the sophomore huskies entered the delightfully refreshing stream of water en masse—their motto "Pas de remords."

The day was won, the soph derobed of his pristine glory, the freshman permitted to roam the shaded hills of old Valhalla.

Louis M. Schaller, a senior civil engineer, was in charge of the hostilities, and deserves especial praise for the manner in which he handled the affair. Professor Otto S. Zelner, faculty adviser, acted in a variety of capacities, serving as umpire, and official timekeeper, both of which duties he completed with remarkable facility.

A freshman is unbalanced by his opponent and "slips to defeat" on the greased pole.

Northern Lights

A senior engineer reviews the incidents of 1928 civil camp at Cass Lake

By KARL M. EGGEN, C.E. '29

THE sun, sinking low in the west, disclosed a group of boot-shod men assembling at a spot among the pines that skirt the shore of beautiful Cass lake. They found a busy crew ahead of them whose efforts had already given this place a camp like appearance. The last rays of the sun were reflected by white canvas of tents that sheltered the material and instruments. Of course, you have guessed by now that it was the sixteenth of August, and aspiring civil engineers were gathering again at their senior summer camp. All night long and most of Friday the followers of St. Patrick straggled in, and by dark the camp was quite complete. Every tent was up, and every one had a home.

Sleep was welcomed after such a busy day, and music from a circular saw beaten with a hammer was not a pleasant sound at 5:45 A. M. Golden brown wheat cakes, crisp strips of bacon and hot coffee were the reward of those who answered the call, however; so we had no difficulty in forgiving the cook for such unearthly proceedings. The suggestion of food will always conjure visions of pumpkin pie such as only Albert, the cook, can concoct; and the number of pieces devoured by famished surveyors reached into the realm of infinity.

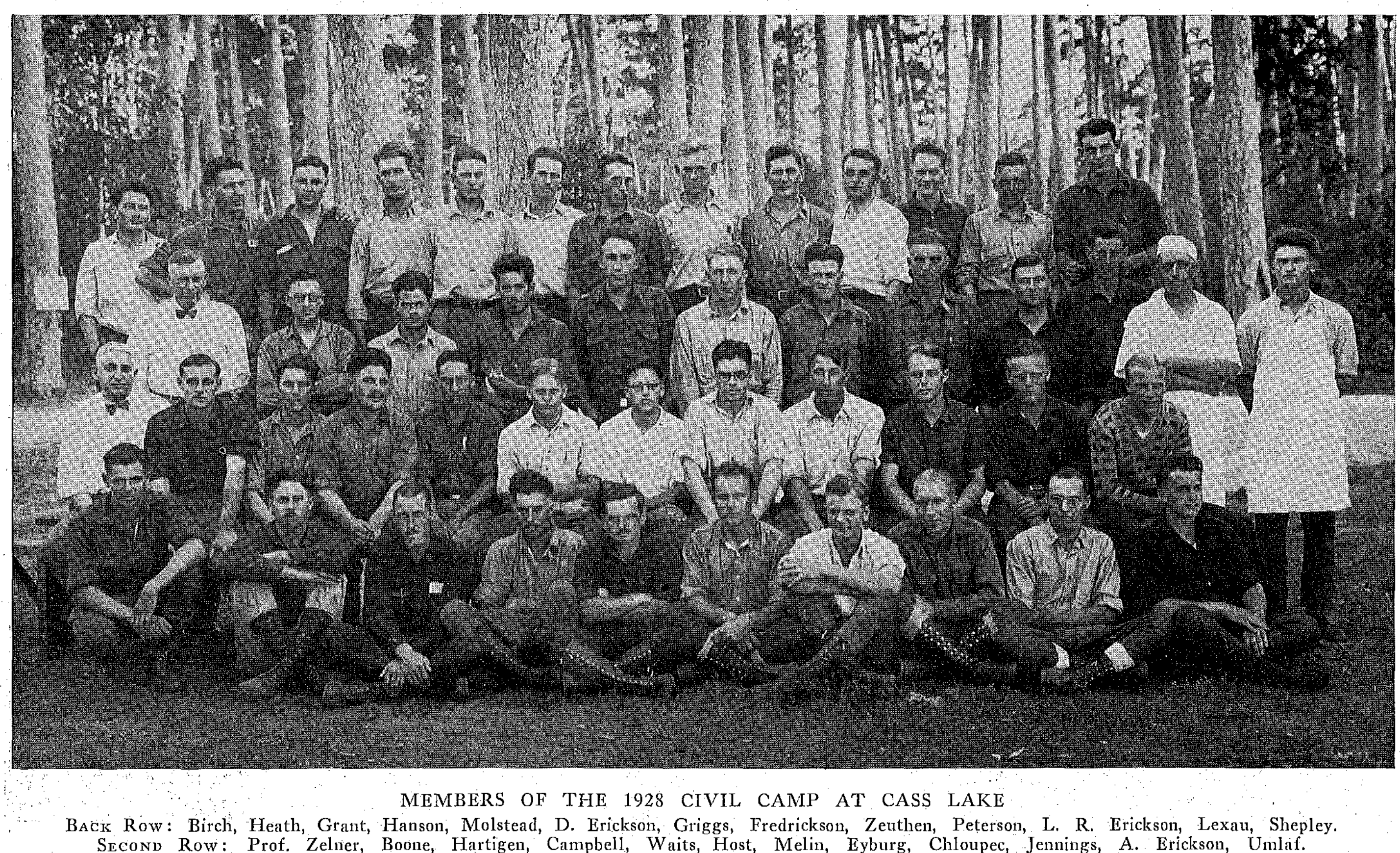
Saturday, work started in earnest, and we found ourselves assigned to bench levels, triangulation, base line measurement, stadia topography, stream measurement, railroad work, or plane table topography. On this, our first day out, we made the acquaintance of some of the denizens of the forest and learned that food hidden in the woods is not a guarantee against an empty stomach at noon.

Mr. Cutler had charge of railroad work while Mr. Zelner supervised topography and hyrographic work. Office computations were directed by Mr. Boon.

Every man was given an opportunity to work on each of the important tasks and was shifted from chief of one party to lowly rear chain of another with amazing rapidity. Stadia topography parties were sent out on innumerable roads and fire trails cut through the forests as well as along the lake shore with instructions to work out topography as far as practicable into the woods. Much work ensued for the axmen; possibly Lexau's reputation as a slave driver was not entirely deserved even though eighteen shots represented his day's work. Wallin and Shepley deserve credit for originating the idea that a transit is not necessary in running a topography traverse. They discovered their error, however, and raced five miles back to camp for one of the instruments.

A crossover to be run between the Great Northern and Soo provided plenty of entertainment, and arguments waxed thick and furious before it was finally computed and staked. Plane table parties mapped much of the sparsely wooded areas for miles around, and the discharge of the Mississippi river at the Cass lake outlet was measured by everyone. Triangulation presented its difficulties when visibility was poor; and, to make matters worse, some fellows seemed to take fiendish glee in picking up stations being read. What could be worse than trying to read triangulation "Tower" with a stiff wind sweeping across Pike bay and necessitating hanging onto the railing with one hand in order to avoid being blown off while attempting to manipulate the instrument with the other? Almost any cold clear September

(Continued on page 60)



MEMBERS OF THE 1928 CIVIL CAMP AT CASS LAKE

BACK ROW: Birch, Heath, Grant, Hanson, Molstead, D. Erickson, Griggs, Fredrickson, Zeuthen, Peterson, L. R. Erickson, Lexau, Shepley.
SECOND ROW: Prof. Zelner, Boone, Hartigen, Campbell, Waits, Host, Melin, Eyburg, Chloupec, Jennings, A. Erickson, Umlaf.
THIRD ROW: Prof. Cutler, Maturi, Heiberg, Gunnerson, Rykken, Lohn, Jensen, Wallin, Hindermann, Eck, Schaller, I. E. Anderson.
FRONT ROW: A. A. Anderson, Bjork, Helseth, Dunshee, Kingston, Alderson, Solberg, Eggen, W. W. Anderson, McCauley.

Around the World With Our Alumni

Architects

'24—I. W. Silverman, who is at present in the School of Architecture of Harvard University, recently returned from an extensive tour of Europe.

'26—Robert Kranzfelder was in town for homecoming. Robert is a field engineer at Memphis, Tenn.

'27—H. A. Davidson, who was recently with the St. Paul Foundry company, is now with Schuett Meier company of Minneapolis.

Chemists

'05—George Borrowman was a visitor on the campus during Homecoming. Mr. Borrowman is now doing analytical work in Chicago.

'12—Dr. Elmer A. Daniels, who obtained his Ph. D. at Minnesota in 1917, is now with the Kritchevsky and Bogert company of Chicago. His position is that of consulting chemist. Dr. Daniels was formerly in the employ of the Western Electric company, where he did work of a similar nature. One of the senior partners of the firm, Dr. Kritchevsky, was at one time an instructor at the university.

'14—Ralph E. Porter has moved from Ashland, Wisconsin, and is now situated in St. Paul, where he's working with Swift and company. His particular line of work has to deal with various aspects of the manufacture of leather.

'18—Dr. Woldemar Sternberg is now occupying the position of technologist with the Campfire Marshmallow company of Chicago.

'26—Marvin C. Rogers, former staff member of the TECHNO-LOG, is working toward his Ph.D. degree at the University of Michigan. He is still in the Chemical Engineering Department.

Civils

'06—B. G. Aldrick, who was formerly with C. A. P. Turner company, is now with Schuett-Meier Co., structural engineers in Minneapolis.

'10—It is rumored that A. C. Godward, the city planning engineer, may be elected as president of the Civic and Commerce association of Minneapolis. He has been active in civic affairs for twenty-two years, working first on the park board and later as the city planning engineer and consulting engineer. A few weeks ago he was elected as a director of the Minneapolis Civic and Commerce association.

'12—E. F. Cummings is now associated with the Madsen Construction company. He was recently with the James Leck company.

'14—L. M. Mitchell, chief engineer of Whitney Bros. Construction company of Duluth, is in charge of the construction of the Detroit-Windsor vehicular tunnel, under the Detroit river.

'23—R. H. Flindt is now with Schuett Meier company, structural engineers of Minneapolis. He was formerly with C. A. P. Turner Co. of St. Paul.

'25—Norman R. Moore has changed his residence. He is now at 229 Highland Ave., Elmhurst, Illinois.

'27—Carl Luethi, a former managing editor of the TECHNO-LOG, was married to Miss Hilda Gross on July 11 this year. He is now with the Air Service Incorporated in Minneapolis. After 6 P. M. he will generally be found at 3644 Cedar Ave.

'27—Kenneth M. Clark is now with the U. S. Engineers in St. Paul. Kenneth was with the Sanitary District of Chicago until August fifteenth.

'27—H. T. and E. O. Pearson are both with the Klein Iron and Foundry company, Oklahoma City. Einar, who was with the U. S. Engineers at Peoria, Illinois, joined his brother in August. Harold has been at Oklahoma City since November, 1927.

'27—John C. Marcroft, who is a civilian engineer with the U. S. Navy, was married in New York, August 27. He is "at home" at Guantanamo Bay, Cuba.

Electricals

'97—W. L. Miller, of Winona, Minnesota, was on hand for homecoming, and spent the week-end as the guest of Prof. F. W. Springer. "Will" is now manager of the Union Fibre company of Winona.

'03—Frank Hughes, now residing in Chicago, was in town with a party of friends to attend the homecoming game, October 20. Frank is now in the insurance business. Previous to this he operated isolated central stations and was also interested in several electrical investments.

'03—F. C. Hughes visited the technical campus recently. He is now in the insurance business in Chicago. He wishes he could have Saturday afternoons off like the members of the university.

'23—J. M. Newman, 541 Downer avenue, Milwaukee, Wisconsin, is now employed at the Cutler Hammer Mfg. Co., Milwaukee, Wisconsin. Says he, "It certaintl is worth some of my vacation time to get back to Minneapolis to visit a few friends and see a football game at the same time."

'23—Roy N. Williams was married to Miss Clara Rose of Duluth on August fourth, this year.

'23—A. A. Kearney is still with the Northern States Power Company, St. Paul. Adrian is married and has a four-months-old electrical engineer in the family.

'24—Joseph Juran, who has been an inspection engineer with the Western Electric company at Chicago, was recently appointed chief of inspection of the statistical department.

'26—Larry Hafsted, 36th and Broad Branch Ave., Washington, D. C., is a physicist in the Carnegie Institute of Washington, D. C.

'27—Carl E. Swanson, former business manager of the TECHNO-LOG, dropped us a line from East Pittsburg, Pa. He is now in the advertising department of the Westinghouse company.

Mechanicals

'23—Shelden S. Hibbard is now a mechanical and structural engineer with the Clyde Iron Works of Duluth. Shelden is married and has a baby daughter.

'25—What was his hobby while in school has proved useful to Herman F. Beseler. He now has a position as landscape architect with the Hoyt Landscape Nurseries of Saint Paul, Minnesota.

'25—Russell E. Backstrom was married to Miss Helen Parker of Minneapolis on September fifteenth.

'27—Wilfred W. Lowther was married to Miss Ruth Maxwell of Excelsior. The wedding took place October sixth.

'27—Lyle M. Cook is located at Aurora, Illinois, where he holds a position as combustion engineer.

Mines

'03—Samuel W. Cohen is president and general manager of the General Asbestos company of Montreal.

'10—Charles K. Conkey, general manager of the Fegles Construction Co., which has the contract for the Hastings dam, was a visitor at the School of Mines on October 26.

'18—Guy E. Ingersoll has been appointed assistant professor of mining and metallurgy at the School of Mines and Geology of the State College of Washington at Pullman.

'24—John H. Nelimark, geologist for the Independent Oil and Gas company of Tulsa, Oklahoma, visited the School of Mines with his wife during homecoming.

Homecoming visitors at the School of Mines include A. W. Fosness, '13, whose office is in the Royal Bank Building in Winnipeg, W. M. Winter, '23, of Olivia, Minnesota, Trygve Johnson, '22, of Duluth, and Israel Mark, '20, of Minneapolis.

'25—Dr. J. S. De Lury, of Saskatoon, Canada, was recently appointed commissioner of mines and professor of geology and mineralogy at the University of Manitoba.

A graduate of the University of Toronto and of the University of Minnesota, Dr. De Lury, was in charge of the department of geology in the University of Idaho before coming to Manitoba in 1913. He has done field work for the Ontario Bureau of Mines, the Geological Survey of Canada and the Canadian Government.

Dr. De Lury is well known in Winnepeg and Manitoba and has been connected with the department of geology and mineralogy at the University of Manitoba for some time.

He is a Fellow of the Royal Society of Canada, has served as chairman of the Manitoba branch of the Canadian Institute of Mining and Metallurgy and has also held the position of vice-president of the institute.

'26—George Huck informs us that he has been appointed assistant superintendent of the Structural Shape Mills at the Saucon Plant, near Bethlehem, Pa.

Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

When Homer Nods

MR. ARTHUR BRISBANE, celebrated columnist, in a recent editorial states without qualification that "Cannibalism has been abolished; that took thousands of centuries. Slavery has been abolished; that took thousands of years. Poverty will be abolished and that will be the *BEGINNING* of civilization."

From a man of such broad education, such statements show surprising ignorance. It is suggested that Mr. Brisbane consult Mr. Albert Galloway Keller, or other prominent anthropologists, in order that he may be duly informed of his error. Mr. Brisbane would have been closer to the truth had he remarked that "Cannibalism has not been abolished in thousands of centuries; slavery has not been abolished in thousands of years,—when, then, may we hope that poverty will be abolished and that the *BEGINNING* of civilization will become a reality." And, Mr. Brisbane, a great number of educated men hold to the belief that the discovery of the way to cause such a common phenomenon as fire WAS the *BEGINNING* of civilization!

Not satisfied with these inaccuracies, Mr. Brisbane continues to prophesy, "Fortunately the human race has many millions of years ahead of it." This seems to be a most unorthodox optimism. If God created, can He then not destroy with equal facility? If chaos was merely replaced by the harmonious order which prevails at present, and there is no Supreme Intellect, may not the reverse process be followed as readily?

Expert Testimony

MR. ADOLPH F. MEYER reports to the park board of the city of Minneapolis that the construction of a drainage ditch west of Cedar Lake would not affect park lake levels. His conclusions were reached after a complete examination of all available maps and other data, and after lengthy consultations with Mr. Norling, construction engineer, and Mr. Elliott, county drainage engineer.

The fact that the recommendations submitted by Mr. Meyer differ from those previously received by the park board is of some significance. But that a warning was sounded in the public interest, which called forth a more critical study of the problem is of paramount importance.

Such action on the part of southern California officials would have been the direct means of preventing the collapse of the St. Francis dam. Such procedure would have saved the residents of California many millions of dollars and an unknown number of human lives.

Great physicians are reluctant to diagnose until their views have been examined by others. Great engineers will find the same procedure much to their benefit.

Football

TO carry on after repeated failure, that is worth while. To have looked forward to championship honors and have them suddenly snatched away, that is Fate. To fight on, one more battle, the best,—not the last,—that is football.

It is this type of courage which football engenders. The game is not of importance primarily because of the physical development afforded participants, nor has it gained such prominence because of the hedonic desires of the present age. But the game is of singular importance because it trains men to aim high, to attain success through failure.

Robert Browning was a great poet; he was also a sound philosopher. Toward the closing years of his life he wrote:

"What I aspired to be,
And was not, comforts me."

It is better to aim high and to fail, than to seek for nothing and obtain it.

Can and Will

CAN and will are two small words that would not mean very much to any one when they see either of them standing alone, but when these words are spoken or written together they mean much more.

When a man graduates from school his success all depends upon himself. His school can make contacts for him so that he can meet the men from various firms, but the school can not get the graduating man a job. That is up to the man himself, his ability to meet other men and his capability to hold the job after he has gotten it.

All of this resolves itself into those two little words, can and will.

Aircraft and the Engineer

FLYING, in its present reborn status, is so novel and so entrancing that one is prone to still look upon the airplane as having at least some of the characteristics of the supernatural.

Yet there is no more of wonder about it than there is to the bridge, the steamboat, the locomotive, the automobile or the bicycle. Each is built to fit certain conditions and each varies in design. The airplane is no more of a problem to the aeronautical engineer than is the steamboat to the marine engineer. Each particular model is designed especially to meet a certain demand, civil or military.

As in other engineering the product is a compromise. If speed is wanted, then range or load-carrying ability must be sacrificed. If the craft is to be a great passenger carrier, then we must expect less speed and less maneuverability and so on. But while this balancing of requirements goes on the engineer, and the scientific agencies assisting him, are always at work trying to exact from the governing laws modifications which will permit just a little increase in speed here, a little more load there, more weight per horsepower and more load per square foot of surface.

Everything that goes into the airplane has been subjected to relatively more examination and study in the history of the airplane's existence as a practical vehicle than have the materials entering into the better known vehicles of transportation.

Every bolt, wire, fitting and structural member of an airplane is subjected to an examination before it is selected.

Countless experiments and tests have been made on airplanes in flight and on models in wind tunnels in order to get an idea of the stresses to which the members of the structure will be subjected in various maneuvers. The loads imposed on an airplane in flight while executing different "stunts"—such as looping, rolling and diving—are measured by an instrument known as an accelerometer. Several of the instruments are fastened to the airplane. As a result of these readings engineers can determine accurately the stresses to be expected in the various parts of an airplane structure.

In making tests on model airplanes, two methods are employed. In one, the model is suspended on the arm of an accurate balance in a wind tunnel and the forces imposed upon it by a strong wind current, usually 40 miles per hour, are measured. In a second method, a number of holes are drilled in various parts of the model and small tubes leading to a gauge, inserted so that they will give a measurement of the force imposed by the wind in the wind tunnel.

The engineers study the reports written as a result of these experiments and design the structural members of the airplane accordingly. The layman is surprised to see a stack of papers two inches thick, all covered with calculation, representing the stress analysis of a single airplane.

A test of a small model in a wind tunnel furnishes the data on which accurate prophecy may be made of exactly what performance the full-sized replica will have. If dangerous characteristics are shown in the tunnel test, the model is altered accordingly and the completed plane is marketed with the objectionable features removed.

It is no longer necessary to build and fly a new airplane in order to determine its flying characteristics, its performance, or its inherent safety. This is all done by the engineer on the drafting board and in the wind tunnel.

The airplane of today, approved, inspected and licensed by the Federal Government is a thing of known ability. In this respect the public has such protection as is applied to no other privately owned vehicle of transportation. — *Domestic Air News.*

Faculty Sketches

JOHN HARRISON MOFFETT

ONE crisp February morning of the year 1887, John Harrison Moffett made his initial appearance upon this world of ours. Rushville, the town was called,—a small village in central Indiana, but there were factories there, and foundries. These were to play an important role in his career.

During his high school days Mr. Moffett found it necessary to seek employment in these same foundries in order to support his mother. But that did not hinder him from obtaining the maximum benefit from his education, or from engaging in athletics. Football was his especial forte, and his senior year found him captain of Rushville High.

As a boy, Mr. Moffett had cherished the desire to enter the University of Cincinnati, but he found it necessary to continue his work in the foundry for two years after graduation in order to acquire a sufficiency of funds. In 1911, his long nurtured dreams were fulfilled when he entered the metallurgical engineering school at the University. This was a five year co-operative course terminating in the degree of metallurgical engineer. On account of his previous experience in the foundry, and the co-operative nature of the institution, Mr. Moffett was enabled to finance himself completely.

Then came rumblings of a distant war, threating to engulf the world. The United States government needing men in Central America, demanded expert metallurgists. The services of Mr. Moffett were procured by the mechanical division of the department of operation and maintenance, and he left the University in 1915 to take up his duties along the banks of the Panama Canal.

At about this time, a slide in the Canal cut off the supply of munitions to Russia, Germany threatened to overrun Europe, and the United States found it necessary to enter the gigantic struggle. The furnaces of which Mr. Moffett was in charge, were pushed to their capacity, were forced to run night and day, in an effort to meet the requirements of the government. Thousands of tons of metal were poured into various castings for battleships and destroyers.

After the armistice, the German ships, which had found shelter on the west coast of South America, were towed to Panama, where Mr. Moffett was associated in the arduous task of reconditioning a fleet which had been virtually destroyed by the Germans in a last desperate effort to save it from the hands of the Allies.

In the year 1920, he returned to Cincinnati where he entered the University again and successfully obtained his long coveted degree of Metallurgical Engineer. In the fall of 1921, after negotiations during the summer, Mr. Moffett was appointed instructor in foundry practice at the University of Minnesota. Since then, he has endeared himself to faculty and students alike—it is a rare pleasure to meet a gentleman of such broad education and contagious affability as that possessed by "Moffett."

Engineers—Executives

MORE and more, business men in charge of large manufacturing concerns are turning to the engineer to fill responsible executive positions. They are beginning to realize that the technically trained man, whose mind has been taught to meet emergencies without flinching, who has acquired the knack of handling and leading men, and who can think quickly and accurately, is the very man to fill an executive position.

It would be very helpful if engineering curriculums were so arranged that economics, business administration and other allied subjects could be worked in as electives during the four year college course. Of course the idea of filling an executive position might be very remote in the mind of the average student, but to be able to meet and grasp the opportunity when it comes is no small asset.

News from the Technical Campus

Student and faculty activities—departmental notes—notable alumni work

Dean Leland Addresses First Engineering Convocation

The first all-engineering convocation of the year, held on the eighteenth of October, saw the auditorium packed to capacity. Dean Leland first welcomed the entering freshmen, and stressed the importance of carefully apportioning one's time between studies and extra-curricular activities in order that the maximum benefit might be derived during the school year. He then talked on the fraternal spirit existing between the different classes in the engineering schools, which manifests itself in an altruistic attitude on the part of upperclassmen toward freshmen and sophomores.

Mr. McCreery, ex-football star, and at present assistant to Dean Nicholson, spoke upon "Successful Citizenship in College." He said that the worth of a man is not measured by the money expended upon him, the chattels he holds, the money he can earn, or the sum total of all these, but rather by his contribution to human happiness. To be successful in college, then, the individual must obtain scholastic proficiency—for that is the primary purpose of education. However, that is not all that is needed in order that a college career may be considered a success. The individual must also engage in extra-curricular activities, if he will contribute to human happiness. And by a judicious combination of these, successful citizenship in college is measured.

The assembly was brought to a close with a series of rousing cheers.

Pi Tau Pi Sigma Announces Election Results

Pi Tau Pi Sigma, national honorary signal corps fraternity, announces the election of the following: Roy Comstock, Earl Ewald, Ray Englund, Gordon Farel, Karl Heidman, Carl Jacobson, and Leonard Kloski.

The members of the fraternity are chosen from the students enrolled in the signal corps of advanced R. O. T. C. By installing Epsilon chapter at Minnesota last spring, it was hoped to build up a better *esprit de corps* in the unit, as the success of the organization at other schools has been very gratifying. The officers for the present season are: Thomas C. Finnell, president; Remus R. Owens, vice-president; J. Robert Ginnaty, secretary; and Maynard R. Briggs, treasurer.

Aeronautical Engineers May Receive Commissions in U.S.N.R.

Of great interest to aeronautical engineers is the fact that they may now learn the technique of piloting an airplane. A series of lectures is being given on Thursday evenings by officers of the Naval Reserve located at Lake Calhoun. Those who attend these meetings and successfully pass an examination at the end of the year, will be sent to the Great Lakes traning camp. There they will spend about forty-five days doing ground school work and learning the fundamentals of flying. After obtaining between thirty and forty hours in thr air, the stustudents will leave for Pensacola, Florida, where they will be enlisted as second class seamen, and receive a salary of thirty-six dollars each month.

It may also be of interest that the work will not conflict with the program of the school year, and may be taken in one or two summers, as circumstances demand.

Eta Kappa Nu, honorary electrical engineering fraternity, announces the initiation of Maoling Liu and Fred W. Suhr, of the senior class, and Homer Brown, John Roe, George Shortley and Karl Sommermeyer, of the junior class.

A. I. E. E. Holds Smoker

The A.I.E.E. gave its first smoker of the fall quarter at the Union on October twenty-fourth. The program was opened with an interesting General Electric film entitled "Queen of the Waves." The picture dealt with the history of ships, tracing their evolution from the fragile pioneer canoe to the mammoth electrically propelled battleship of today. In these vessels it was seen how the newest type induction motors are connected directly with the drive shaft of the ship, and receive their power from two 2300 volt A. C. generators, propelled by steam turbines.

Professor Johnson and Professor Bryant, the head of the E. E. department, were introduced to the new members. Professor Bryant, who has been a member of the A.I.E.E. section board for the last four years, commented on the activities and aims of the organization. Professor J. H. Kuhlman delivered the chief talk of the evening.

Coincident with the event of the smoker, the campaign guns of the annual membership drive were sounded. Electricals join now!

Minnesota Engineers In Football

The name of Fred Hovde is familiar to the football world,—but the fact that he is an engineering student is not such common knowledge. Rated as one of the best quarterbacks in the Big Ten, and a candidate for All-American honors, engineers in general, and chemists in particular have just cause for being proud of this clever field general.

There is "Duke" Johnson, a sophomore in the architectural school. "Duke" has played a mighty fine game at tackle, especially on the defensive, where his work has stopped many an enemy drive.

After the injury "Duke" received in the Iowa game, an engineer, Emlein, was chosen to fill his place against Northwestern. And it appears that Apman, another sophomore, will see service during the remainder of the season because of Captain Gibson's dislocated shoulder.

Among the varsity reserves are: Lorenz Berg, Bill Johnson, George Langenberg, Rider Oas, Kermit Udd and Lloyd Westin.

Engineers on the "B" team are: Henry Brunet, L. H. Erviss, Clarence Haupt, V. E. Hinderman, "Bill" Koester, John Kruse, Earl Lenander, Redmond and Robertson.

A large number of engineers are members of the freshman squad. The men are as follows: Harold Anderson, Eddie Finch, E. H. Fulton, Joseph Gates, J. Hauge, C. W. Jones, Martin Jordhal, John Kipp, Donnell Meeks, C. E. Milner, W. L. Molander, Marko Rudman and A. H. Torgenson.

Architectural Society Holds First Meeting

Professor F. M. Mann addressed a recent meeting of the Architectural Society during which plans for the coming year were discussed. In the past, the society has gained prominence largely through its activities in the social field. Professor Mann proposed to alter this somewhat by inviting prominent architects from Minneapolis and St. Paul to attend the gatherings of the organization and deliver short, informal talks upon various phases of the profession. It is hoped that in this manner the members will not only become acquainted with the actual conditions existing in the field, but will also receive a great deal of information which will prove invaluable after graduation.

(Continued on page 54)

How to be a "letter-man" in 1949

THE game is like the games of undergraduate days.

Line-up mental stature and intellectual courage with physical stature and personal courage. And you have the ingredients of the man to whom industry turns for its big decisions.

It may be reassuring to the man in college to know that the limitations on the number who can take part in industry's game are few.

The field is open — wide open.

The needs are vast.

There's plenty of room for those who can answer the call for candidates with the mental equipment and the viewpoint to tackle the world's problems hard and sure.

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

Rayon

(Continued from page 39)

and lactic acid, treatment with mineral salts, mixing with cotton or natural silk or increasing the number of single filaments, have been proposed. Most of these, however, sacrifice some other desirable property which offsets the value of the gain in strength except the last one toward which there is an increasing trend.

All rayons possess a higher lustre than silk, probably because the filaments instead of being cylindrical like silk are somewhat flattened and so expose a greater light reflecting surface. Cuprammonium rayon has a glossy lustre and nitrocellulose a shiny lustre. Viscose and acetate rayons possess a silvery lustre which is more like that of silk. The nitrocellulose rayon is the only one which, of itself, possesses a scroop or rustle like silk. Acetate and copper rayons possess none and viscose only acquires scroop after special treatment with acids like tartaric or lactic. The average density of rayon (1.5) is somewhat greater than natural silk (1.4), but the acetate rayon has the very low density of 1.25. The real basis on which fibres are classified is the International Denier which is the weight in grams of 10,000 meters. Rayon is mostly around

TABLE 3

Comparative Strength of Rayons and Silk

Kind	Size Denier	TEXTILE STRENGTH (GRAMS) Dry	Wet	Loss %	Elongation %
Silk	138.8	515.1	416.3	19.1	21.0
Cuprammonium	150	173.9	40.7	76.5	12.5
Nitrocellulose	150	218.0	86.6	60.2	15.5
Viscose	150	190.0	74.6	60.7	20.0
Acetate	150	157.1	88.0	43.9	18.0

150-160 denier although some have been spun as low as 40-45 denier and the present tendency is toward lower and lower deniers especially in the individual filaments. The Bureau of Standards has tested the inflammability of the various rayons as compared to cotton and finds that viscose is about the same, copper slightly more, and nitrocellulose rayon slightly less inflammable than cotton. Cellulose acetate is non-inflammable. Recently certain advertising claims led people to believe that some of the rayons were specially permeable to the health-giving ultra-violet rays of sunlight. The Bureau of Standards has conducted experiments which show that all the rayons have about the same permeability to this radiation as cotton cloth, which is very slightly so.

Rayon may be distinguished from silk by two simple tests, burning and solubility in alkalies. Natural silk and wool dissolve in 40 per cent sodium hydroxide, while the rayons swell slightly, but do not dissolve. Silk burns with a bad odor like burnt feathers, giving off alkaline vapors and leaving a charred residue. The rayons, except the acetate, burn with no odor, give off acid gases and leave very little ash. Cellulose acetate rayon fuses or burns slowly to a hard brittle globule. A simple test to differentiate the different kinds of rayon is to treat a sample with concentrated sulfuric acid and iodine. Nitro-rayon dissolves with a purple color, copper rayon with a light blue color, acetate with a yellow color and viscose with a dark blue color. Other and more reliable tests which need not be given here, have been worked out by the American Society of Testing Materials and by the Bureau of Standards. A Minnesota graduate, Homer Hamm (Ch. '25) carried out much of the work at the latter place.

USES

Rayon alone probably finds its greatest use in hosiery, underwear and shirts. Its beauty combined with low cost has caused its tremendous rise to favor, for

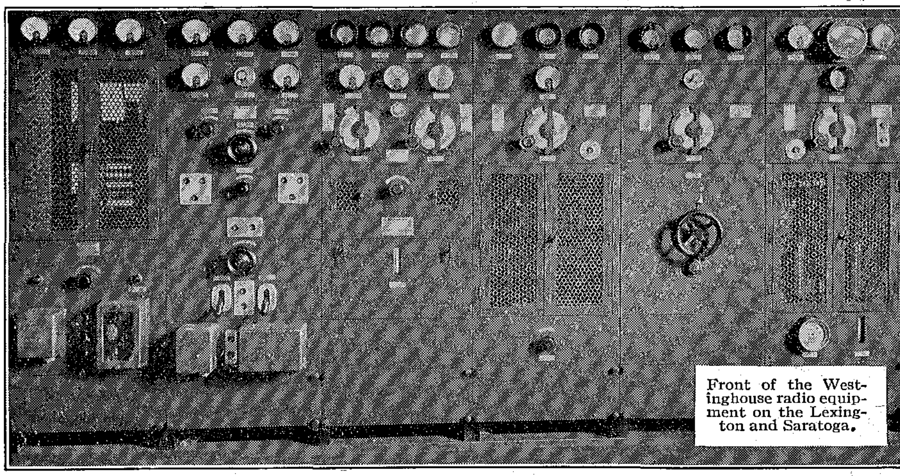
(Continued on page 56)

V. D. LANDON
Radio Design
Detroit Junior College, '22

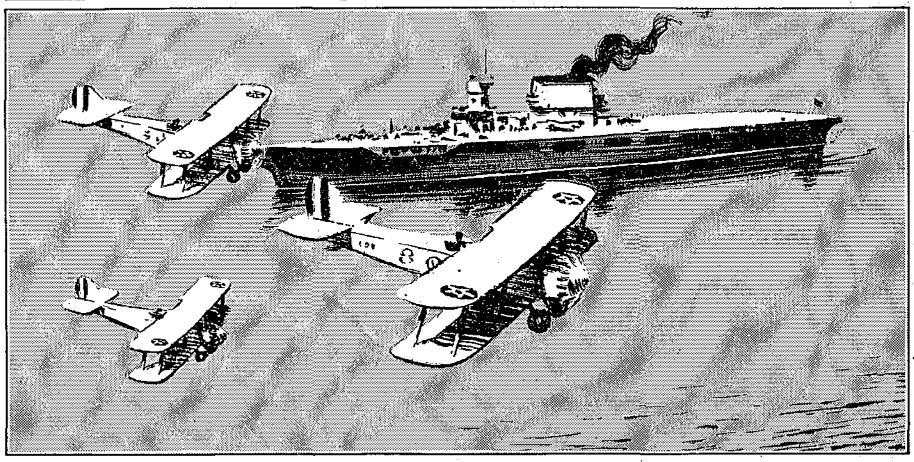
A. N. CURTISS
Design of Transmitters
University of Pittsburgh, '27

O. B. GUNBY
Engineer, Photo Phone Division
Dickinson, '27

JOHN COLEMAN
Radio Engineer
Carnegie Institute of Technology, '23



Front of the Westinghouse radio equipment on the Lexington and Saratoga.



YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

C. J. BURNSIDES
Design of Transmitters
South Dakota School of Mines, '24

C. J. MADSEN,
Radio Installation Engineer
University of Nebraska, '26

S. V. PERRY,
Engineer, Loud Speaker Group
Queens University, '23

H. I. METZ
Development Engineer
University of Pittsburgh, '26

Radio Directs the Navy's Flyers

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

AIRPLANE carriers are a recent development in naval history — and they have a communication problem that calls for the engineering resources of an organization which has shown it can make radio history.

Complex maneuvers are directed, scouting expeditions controlled, and far-flying planes recalled — by radio.

On the U. S. Navy Airplane Carriers "Lexington" and "Saratoga" the situation is met with crystal control transmitters designed to send on different wave lengths. Each plane's receiving set has its own wave length. A turn of the dial on the transmitter selects the wave length corresponding to that of the plane to be reached with a message.

Radio equipment on the "Lexington" and "Saratoga" was designed, built, and installed by Westinghouse — the organization which in 1920 established KDKA, the pioneer radio broadcasting station of the world.

Opportunities to do the history-making things in engineering fall naturally to an organization with a record for making history in its field. And Westinghouse, quite as naturally, offers powerful attractions to young college men whose initiative and enterprise fit them for history-making tasks.

Westinghouse

News from the Technical Campus

(Continued from page 50)

A.S.M.E. to Study Properties of Wire-Rope

The study of the properties governing the life of wire-rope is to be undertaken by a research committee of the A.S.M.E. under the sponsorship of the Engineering Foundation. A large number of manufacturers and users throughout the country have signified their willingness to cooperate in the investigation, which is planned to be both extensive and intensive. It is at present proposed to construct a large size testing machine by which all the actual conditions under which wire-rope is used may be reproduced and their effects measured.

The uncertain life of wire-rope has been one of the major problems confronting those interested in construction work. Here the requirements are especially rigorous, and in the past, it has been found that no accurate estimate of the length of service can be made. Even in elevator installations where the service demands are fairly constant, wide variation in the life of wire-rope has always been observed, and the causes remain indefinable. In several instances, one cable has given three times the service of another, although produced by the same manufacturer, of the same material, and operating under practically identical conditions.

This uncertainty as to length of life has necessitated the discarding of innumerable cables before their maximum usage could be obtained in order to minimize disasters incident upon unforeseen breakage.

Although some research has been done both in this country and abroad, increased knowledge of the effects of service conditions upon wire-rope should lead the way to the production of a better, more stable, and more reliable product.

Arabs Elect Officers

At a meeting of the Arabs, the dramatic organization of the Engineering College, the following officers were elected for the current season: George L. Burch, president; Donald Felthous, vice-president; Rex Severson, business manager; Frederick M. Hakenjos, secretary; Harold R. Shannon, treasurer.

The Arabs society will hold its annual fall dance on the seventeenth of November at Tamarack Lodge.

As yet no definite choice of production for the season has been announced, although several compositions have been submitted. The organization has always selected plays written by members which result in a production entirely original,—written, directed, and acted by Arabs.

Chemists Receive Charter for A.I.C.E. Local Chapter

As a result of the earnest and untiring efforts of Professor C. A. Mann and others of the chemical engineering department, the School of Chemistry has been honored with a charter for a student section of the American Institute of Chemical Engineers. In order to acquaint the chemical engineering students with one and with the principles of the section, a smoker was held in the School of Chemistry, Friday, October 26.

A rather novel method of getting the students acquainted with each other was word composition contest. A tag, with a letter of the alphabet on it, was issued to each student, and the object of the contest was to form the longest and shortest chemical engineering terms from the letters represented by the various groups of students. After much excitement the prize words chosen were "recrystallization," "vat" and "dye."

A pie was the prize awarded to those having the longest word. We still can't figure out what ingenious mathematician must have been present to divide one pie amongst so many deserving winners.

Dr. Mann gave a short talk on the requirements and aims of chemical engineering as a profession, emphasizing the need of social and physical attainments as well as mental ones.

Chemical Society Meets

A meeting of the Minnesota section of the American Chemical Society was held at the School of Chemistry on October thirtieth. The principal speakers were Messrs. L. H. Ryerson and J. J. Willaman.

Dr. Ryerson, who has recently returned from an extensive European trip, discoursed at some length on the meetings of the International Union of Pure and Applied Chemistry at Warsaw in 1927 and at the Hague during the past summer. He referred to the historic paper on Rhenium presented by Dr. Noddack at the Hoffman House. In this connection, Dr. Ryerson gave a panorama of the chemists of Germany, contrasting the hardships that beset them immediately after the close of the World War with the remarkable strides they have made during the last decade. He concluded his talk with an account of an inspection trip through the I. G. Nitrogen plant at Leuna.

Dr. Willaman, who has also but recently returned from Europe, spoke briefly about the scientists he had met on the Continent and in England, and mentioned some of the experimental work they are conducting at present.

Eta Kappa Nu Holds Convention at Minnesota

Friday and Saturday, November 2 and 3, marked the holding of the 24th annual convention of Eta Kappa Nu, Electrical Engineering honor society. Minnesota Omicron was host, and delegates from twenty-two active and three alumni chapters attended the meetings. From California on the west, Texas and Alabama on the south, and New York on the east, the delegates came to aid in making the convention one of the most successful in the history of the society.

Most of the delegates arrived early Friday morning, the majority of them going to the Curtis hotel while the others went to fraternity houses on the campus. Registration occupied the first part of the morning, and at ten o'clock the first business session was called to order by E. S. Lee, national president. After welcoming addresses were delivered by Raymond C. Freeman, president of the local chapter, and Professor J. M. Bryant, head of the electrical engineering department, the convention proceeded with its routine business.

The convention headquarters was in the new Electrical Engineering building. Room 30 was devoted to registration and the auditorium was used for the general convention sessions.

At seven o'clock Friday evening, a formal initiation was held in the electrical auditorium, at which time six men were inducted into the organization. Following the ceremony, the delegates adjourned to the Tau Kappa Epsilon fraternity house, where an informal smoker was held. Saturday morning was devoted to clearing up the remainder of the business of the convention. Shortly after lunch the delegates were taken to the Pillsbury flour mill and conducted on an inspection trip through the mill. At the conclusion of this trip, they boarded busses and were taken on a tour of Minneapolis.

The closing event of the convention was the annual banquet which was held in the sun room of the Curtis Hotel Saturday evening.

Active members of Omicron chapter who assisted in making arrangements for the convention included Raymond C. Freeman, president; Lester F. Borchardt; William T. DeVoy; Clinton J. Johnston; John W. Millunchick; Lloyd Oman; William H. Painter; Erling B. Saxhaug; James E. Specht; C. Irwin Vigness and W. Glenn Williams. The six pledges, who also were active in the work, included Maoling Liu; Fred W. Suhr; Homer Brown; John Roe; George Shortley, and Karl Sommermeyer.

Rayon

(Continued from page 52)

everyone has a latent love of beauty, but in these three fields it has other especially desirable qualities. It has a great power of moisture absorption, which enables it to absorb perspiration and at the same time its larger filaments permit a rapid evaporation. This is a valuable hygienic property, but it has the additional advantage that it does not, like silk, discolor with perspiration and eventually rot. Silk, too, is weighted with metallic salts, usually tin—sometimes up to 300 per cent of the weight of actual silk present—which makes it brittle and not very conducive to good health. Rayon is free from this disadvantage. For these reasons tremendous amounts of rayon are knitted into hosiery and underwear and woven into shirting material.

It is also much used in other knitted goods such as dresses, sweaters, jumpers, scarfs, shawls and neckties. It is used in rubberized cloth for surgical dressings and for insulating purposes in magnetos and electric wire. Crepes and mousselines are woven from it. It is used for artificial fur, plush and velvet. The waste rayon is used for fringes, tassels, button coverings and felt. Sometimes the waste is redissolved and used to make artificial straw, artificial horsehair or hair or bristles, for gas mantles, toys and millinery purposes.

It is also used a great deal in mixed fabrics. With cotton it is used in underwear, hosiery, ribbons, moire, plush, pile fabrics, shoe coverings, cloth gloves, umbrellas and the like. With cotton or sometimes alone it is used in bedspreads, draperies, trimmings, elastic webbing, laces and embroidery. It makes good hat and coat linings because it is more resistant to friction than silk. It has replaced long staple cotton to a large extent because of the high price and rarity of the latter, and the fact that rayon is a continuous thread. Many fabrics have a cotton warp with rayon woof.

These many uses show how rayon is making its own place in the textile world. The use curve is still going upward and the end is not in sight yet. As long as beauty can be obtained so cheaply it will be in demand, and the development of this unique artificial fibre has done much to increase the pleasure and happiness in the world. It is a real achievement for technical chemistry and engineering.

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BAILEY METERS, already so firmly established in the Central Station Field that they are standard equipment in more than 90% of the up-to-date plants, are now being used more and more by the leaders in every line of industry—where they are reducing the losses, improving combustion conditions and providing accurate, reliable and trustworthy data for accounting systems.

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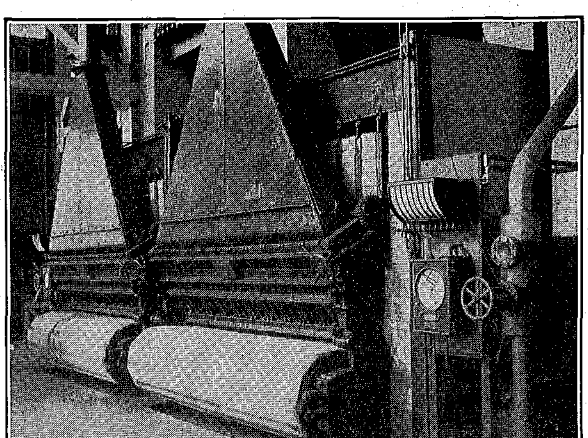
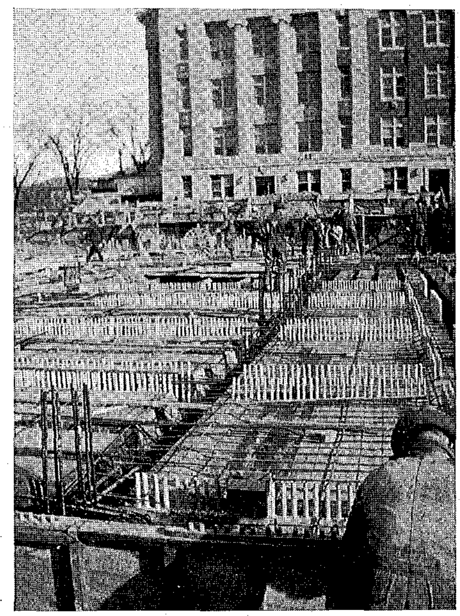
Gas Flow Meters	Temperature Recorders
Gravity Recorders	V-Notch Weir Meters

Write for Bulletin No. 81B

Bailey Meter Co.
Cleveland, Ohio



Bailey Meters at Western Electric Co., Kearney, N. J.



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The experience and knowledge in matters of printing of The Lund Press, Inc., is at your disposal.

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406 Sixth Ave. So. - - Minneapolis

Why Miners Leave Home

(Continued from page 44)

our train did not leave till two A. M.—a most ungodly hour. In fact, we almost gave up in despair as we sat watching the clock tick its unmercifully slow course around those seven hours between seven o'clock and two.

We rode all the next day through desert and more desert with "Gully" looking in vain for some "scenery." We stopped over at Albuquerque for several hours and again took to the Pullmans, bound for Ash Fork, Arizona.

We arrived at noon and transferred from the limited to a local. It was a hot, dusty fifteen miles to Drake, the worst jaunt of the trip. We were all in when we finally arrived. Apparently we were going from bad to worse. We had left the limited at Ash Fork for a local, and here we were at Drake taking a combination freight, fast mail, refrigerator, coal and passenger train for Clarkdale.

We settled down to a drowsy afternoon, but were soon routed out by "Gully" who had at last discovered some scenery. We rushed enmasse to the windows and rear platform where we were treated to our first sight of the canyon country. The train looped back and forth under the steep sides of the canyon; seeming at times to meet itself coming back. This canyon was indeed something to look upon. Barren rock walls of brilliant red and yellow, with once in a while a black band of the Malpais (bad rock) lava.

Near Clarkdale we were treated to a view of what was once the home of the extinct race of cliff dwellers. (We heard of one at Colorado Springs that was built especially for the tourist trade.)

We arrived at the station at Clarkdale at seven o'clock and found Mr. Comstock, who had gone ahead to make arrangements for us. We piled into a school bus that he had chartered to take us up the seven miles to Jerome.

We turned in at the Little Daisy hotel. The town appeared to have several streets which were really one, looping back and forth on the hillside. The town has two dimensions, but neither of them is width. In Jerome one may fall out of the basement window and break his neck; or, falling from the fourth story, receive only a slight jar upon coming to earth. Of course, it all depends on whether one is on the up or down-hill side of the house.

The next day the metallurgists proceeded to Clemenceau and went through the smelter there. We miners journeyed through the United Verde mine. Underground fires at the United Verde mine have been burning since 1893. Our guide took us down a crosscut where the temperature was 140°.

At noon we returned to the surface and went up to the open pit mine which lies directly above the underground workings. Here we again saw evidences of the fires and smelled the sulphur fumes that worked up through the crevasses in the rocks.

The following day the metallurgists went through the smelter at Clarkdale and we miners returned to the mine. The day proved interesting and instructive though much too warm for a normal human being from the north.

That evening at the hotel the professors limbered up, and proved conclusively to several of us that they could still wield a wicked cue. What promised to be a rather large evening for the student proved to be a triumph for the professor.

The next day the miners and metallurgists joined forces and went through the Little Daisy mine which has produced some of the highest grade copper ore in the world.

That afternoon we left by stage for Prescott where we were to catch the train for Phoenix. We found that we had an afternoon to spend, and nobody to spend it on. We made half a dozen trips into an ice-cream parlor and a round of the barber shops. Attempts to photograph a horned toad were productive of much merriment but were rather unsuccessful.

Our train finally arrived and left for Phoenix. We got in at eleven o'clock and went to a hotel for the night.

Next day we again boarded the train for Bisbee, the last stop on our trip. We saw the cactus forest and sat in on a ringside seat at a mirage.

At Bisbee there was a grand rush for the bathroom by miners and metallurgists alike. Imagine our surprise when we found no handles on the bathtub faucets. The obliging bell-hop informed us that baths were fifty cents extra. Mr. Comstock solved the difficulty by suggesting the "Y" where we had a shower, swim and towel for a nickel.

We heard stories of the olden days when water was really scarce. It seems that first bath in a tub of water was about ten dollars, providing the bather didn't drink any of the water. Second bath was seven dollars and so on down to where one might get a bath for a very nominal sum. When the miners planned

(Continued on page 60)

Northern Lights

(Continued from page 46)

evening would find someone "shooting" Polaris, and it was surprising how many decided, after working up their notes, that they "must have read on the wrong star."

The occupants of tent six—Chloupek, Eyberg, Melin and Post made names for themselves when they sold tent five a lamp, which belonged to the university for forty cents. That was the first day of camp before the fellows in number five had become oriented; so possibly the statement that summer camp is a good place for oil stock salesmen is unmerited. Tent number nine was the only one safe from some midnight prank—one of the boys in that tent was so tough he swore in his sleep!

All too soon the time for leaving our home in the national forests arrived, and we gathered again to determine what should be left as a reminder of the class of '29. A flag pole was decided upon and finally placed. All that remained was to take one last look across the lake at the forest covered banks of Cedar island, bid good-bye to Norway beach, then start for home hesitating just a moment at the junction of the forest road and the main trunk highway for a last lingering glance at the spot we had grown so much to love.

Why Miners Leave Home

(Continued from page 58)

a dance in honor of the office force, newly arrived from New York, the management was forced to shut the mill down for two days so that the ladies might have a bath.

The next morning we inspected the Sacremento Hill open pit copper mine and power plant. In the afternoon we went through the Calumet and Arizona power plant. During our visit we were treated to a view of an Arizona cloudburst. Half an hour later the desert was as dry as before.

Friday and Saturday night and all day Sunday were spent by most of the gang at Naco, province of Sonora, Mexico.

The next two days were spent inspecting power plants and shops with trip underground. Jack pulled the prize boner when he decided there was no law against kicking cactus. He decided there didn't have to be a law.

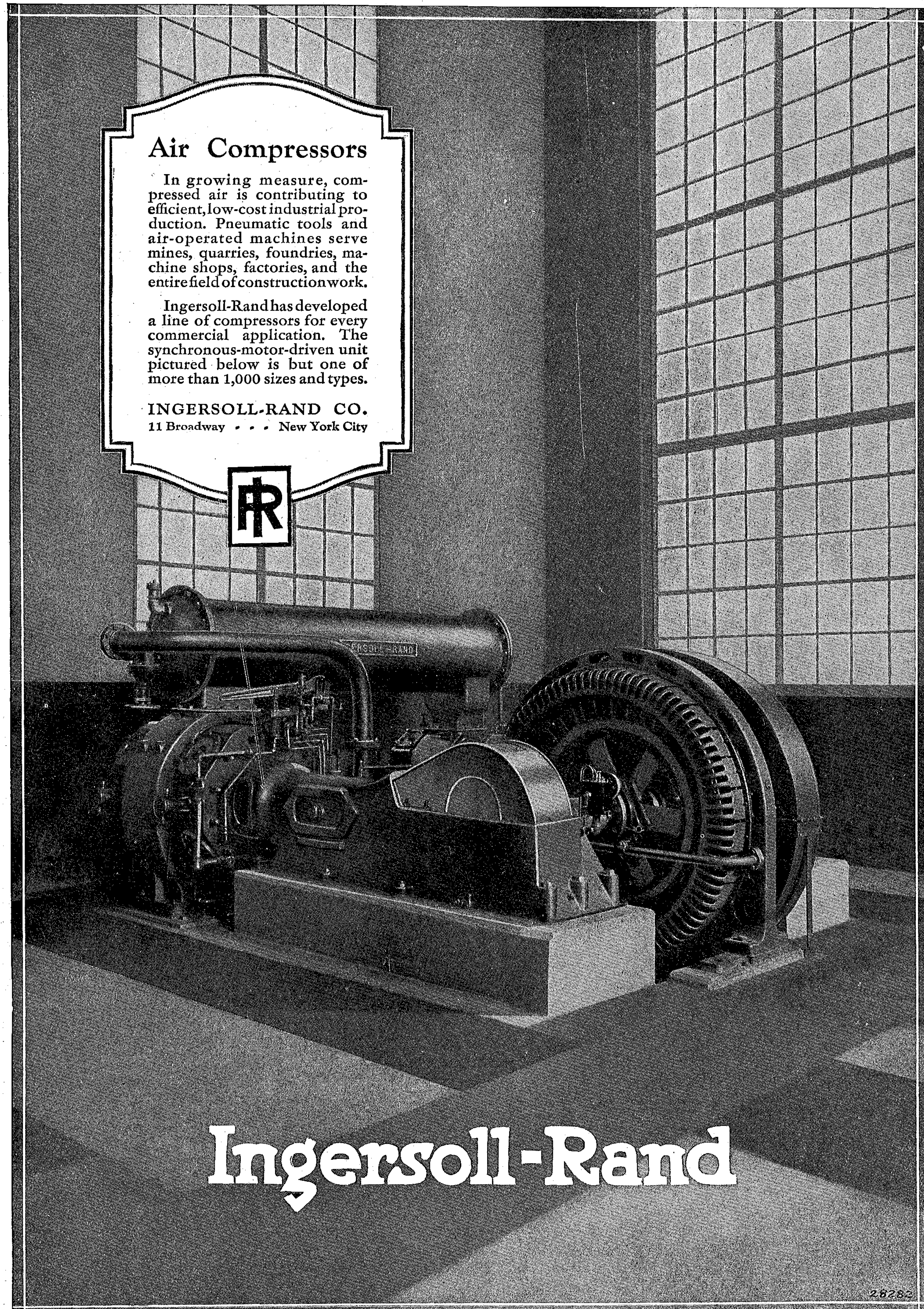
On May 30 the party moved to Douglas and made the rounds of the Copper Queen smelter. The only outstanding features of the plant that everyone remembers were the numerous ice water fountains. Crushers, roasters, reverberatory furnaces, convertors and blast furnaces are forced to take a back seat to a lowly fountain under Arizona's cloudless, rainless skies.

We spent three days rambling around, and then left for San Francisco by boat. The party was now reduced to five, "Jack" and "Dick" having decided to stop over a while longer. Mac and I were the only ones fortunate enough to appreciate the two full meals which were served aboard the ship. The others were afflicted by that strange malady which is characterized by a queer loss of appetite.

In the morning we arrived in San Francisco and Gulleson let a taxidriver persuade us that we wanted to ride two blocks in his cab for 75 cents. We spent the day sightseeing and departed that night for Portland, Oregon.

From Portland we went to Seattle. Here the party again broke up; "Gully, "Mac" and Fetzer going home by the Canadian route, and "Ing" and I starting back over the Milwaukee. "Ing" left me at Spokane, and I returned home alone.

Thus endeth another Junior trip—one of exceedingly instructive value and of much pleasure besides. In closing we wish to remark on the unusual courtesy with which we were met on the part of the officials of all the mines, mills ar smelters which it was our pleasure to visit, and our grateful thanks to them for their trouble.


Air Compressors
In growing measure, compressed air is contributing to efficient, low-cost industrial production. Pneumatic tools and air-operated machines serve mines, quarries, foundries, machine shops, factories, and the entire field of construction work.
Ingersoll-Rand has developed a line of compressors for every commercial application. The synchronous-motor-driven unit pictured below is but one of more than 1,000 sizes and types.
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Signal Corps at Fort Sheridan

(Continued from page 40)

practice work under actual field operating conditions was at hand. For this period we would each day assume a different tactical situation. Daily duties were assigned each by our commanding officer. Each day we would be assigned a different task. We would set up and operate the networks of communication telephone, telegraph, and radio to serve the forces that theoretically manned the situation.

Never did the time become monotonous or dull. The work was of an interesting character, and the program we followed was sufficiently flexible to permit the substitution of alternative subjects. For instance we spent half of one day in communicating by radio telephone with an army airplane which was dispatched especially for our instruction from Chanute Field.

The reader might infer that the camp was a period of all work. Such was not the case as there was ample time for sport and recreation. There were two excellent tennis courts. A diamond ball league was formed among the companies, in which our company finished in second place, losing only to "B" company. Minnesota was represented on this team by four men, John Madden, Rudolph Bierwagon, M. J. Hauge, and Wesley Gray. There was an excellent bathing beach with diving boards and tower to use whenever we desired.

Wednesday and Saturday afternoons, and Sundays were holidays for us. We were also permitted to leave camp evenings to take in a show or carnival at one of the neighboring towns, or perhaps attend a beach party. For those who cared to make a short trip over the week-end there was always something interesting to do in Chicago which was only an hour's ride on the "electric." Visits to Evanston, Waukegan, Cicero, as well as boat trips from Chicago to Milwaukee were always popular.

The social side of camp life was never neglected. The post hostess, Mrs. Goodwin, did her best to provide entertainment. There were the dances in the post gymnasium on Tuesday evenings and on Friday evenings were the bridge parties at the Hostess House. It was largely through her efforts that our stay at camp was so enjoyable.

The training period was soon over and we left camp cherishing the friendships we had made and with the feeling that this was just about the best Signal Corps camp ever held.

C. A. C. in Kentucky

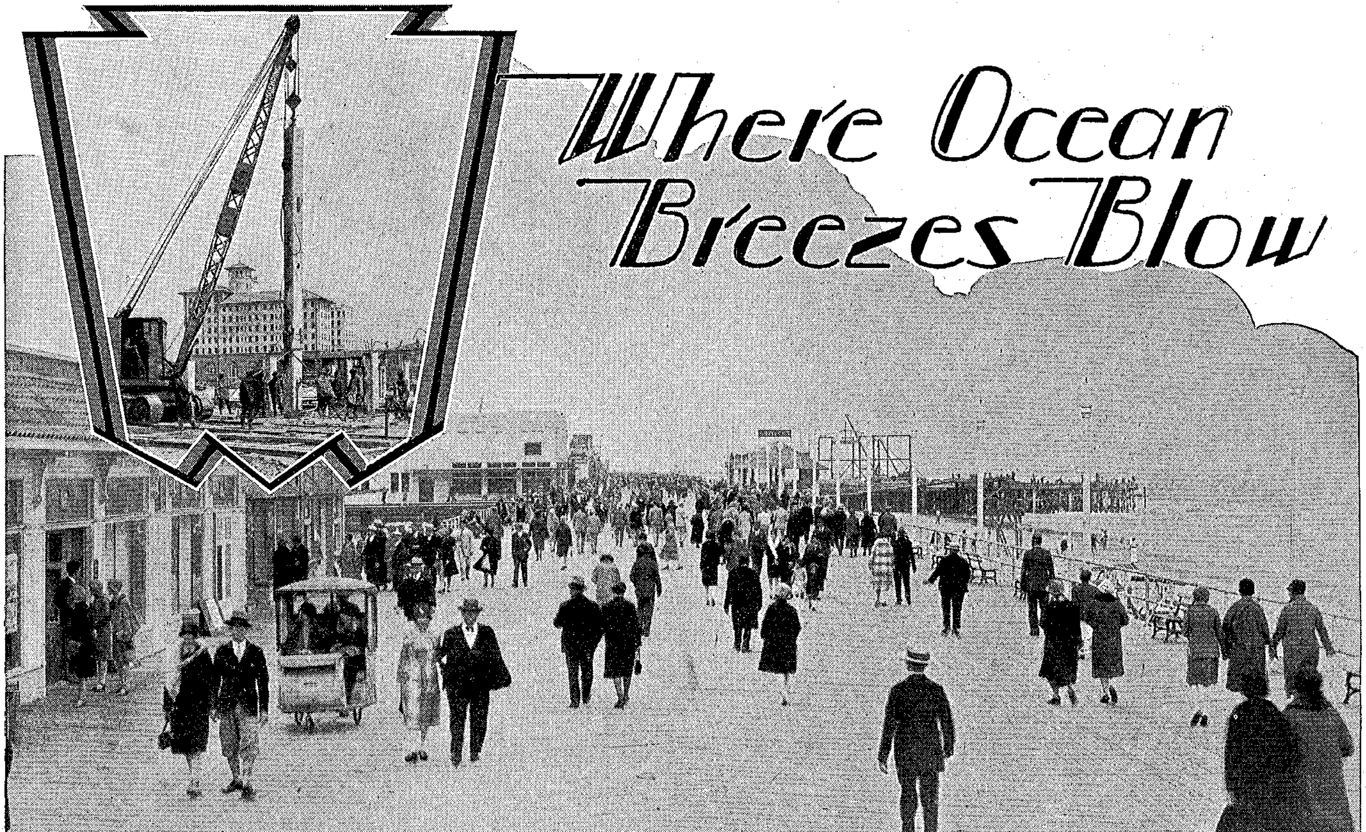
(Continued from page 41)

ment. The units were paid off at five o'clock the morning of July 27. None delayed starting the home trip, the latest start being 5:03 a. m. Some non-stop trips were reported.

Near Camp Knox are many points of historical interest, including: Lincoln's birthplace, Civil war battlefields, Mammouth and numerous other caves, and some of the South's best race tracks. There was ample time during the camp period to visit all points of interest within a radius of 150 miles of Louisville. The roads were in good condition throughout the period of camp.

One could write volumes about such a six weeks experience. However, I will sum up with a few conclusions or words of advice.

1. Don't volunteer for K. P. duty as you'll get it anyway.
2. Don't believe all you hear about Kentucky's liquid refreshments.
3. The acquaintances made at Camp are lasting and are sure to outweigh any minor discomforts which may have stood in the way of getting a commission in the Reserves.
4. Minnesota's engineers proved that they can hold their own in a competitive camp.



Themes

(Continued from page 43)

Crusades, and from the intercourse with the East which grew up during this period the wonders of Oriental enchantment were introduced into the romantic or chivalric poetry, and European literature received a great stimulus. Chivalric poetry, however, existed apart from any influence of this kind and really began with the mythological cycle of King Arthur's Round Table which furnished material that found poetic treatment in various European countries. That the customs and adventures of the knights during the Middle Ages are of lasting interest has been demonstrated by the fact that such recent writers as Tennyson, Matthew Arnold, Swinburne, and William Morris have written tales of knighthood and chivalry.

Cervantes' *Don Quixote* has been pronounced a satirical writing on chivalry and knighthood. Nevertheless, I have found in that book references which I believe show that this famous writer had considerable regard for knighthood, references wich are applicable to the really lasting, worthwhile qualities of chivalry. The character Don Quixote says, "For myself I may say that since I am become a knight errant I find myself valiant, courteous, noble-minded, liberal, gracious, bold, gentle, patient." Cervantes says further, "Thirst for fame that impelled Horatius, Caesar, Cortez is a forceful motive, but there are nobler things. In slaying giants we are to slay pride: generosity must lie low, quietness of mind must appease wrath; faithfulness must destroy lust. Some pass over the broad field of a proud ambition, others of a fraudulent hypocrisy, and some of a true religion. But I, minded of my star, tread the narrow path of errantry, in whose practice I scorn wealth, but not honor."

Sounds

By F. R. Dickey

SEVERAL years ago, along in early September, I was seized with what is best described as "spring fever." Why "spring fever" should catch me in the fall I do not know, but it did and it called me forth to do something different. I made up a bed-roll and slung it on the back of my dog, a large Airedale, used to having his master do strange things to him. I loaded myself with an extra blanket and food and about mid-afternoon we set out, just my dog and I.

We followed up a dry valley with a tortuous coulee as its floor. A half dozen miles from town we stopped and with the aid of debris washed up by the floods in the spring soon cooked a simple supper. After cleaning the dishes and spreading the bed-roll I seated myself on a little knoll and watched the sun sink behind the far horizon. In the dry countries the sunset is always brilliant and frequently very beautiful. After the last ray of sunlight had vanished from the sky I removed my outer garments and pushed them into the foot of the bed-roll and then crawled in after them.

As I lay there in the new fallen darkness, sounds began to impress themselves on me. Dominating all the others was the wind. It moaned through the sage brush and made a sharper whistling noise in the gully. Then the indescribable, but unmistakable howl of a coyote rose over the sound of the wind. It was as though there were a coyote on each hill top, but a lone one probably was making all the noise. My dog came up and lay down close beside me. He had come off second best in an affray with two coyotes a few days before and he remembered it.

The coyote soon stopped, probably to seek a midnight lunch. Quiet reigned for a few minutes. It was broken by a snort that seemed uncomfortably close to my head, then, pawing and stamping, a herd of range horses investigated this strange thing that lay so quietly and was

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Themes

(Continued from page 64)

so startling to their wild senses. After what seemed to be an interminable time the horses went their way and left me to listen to the lesser sounds of the prairie night. A cricket in a nearby clump of sage brush struck up a tune on his hind legs. I wondered what he could be singing about. Was his lady-love within ear shot? Or was it, perhaps, a challenge sent out to any that would listen? Whatever his purpose, it was evidently served for he suddenly ceased his song.

For a long time the silence was unbroken. Then from immeasurably far above came the sounds of a "flight." Early storms in Canada were driving the migratory birds to the south. The whistle of the ducks' wings and the chirping of the smaller birds blended into a solid roof of sound overhead. As sleep overtook me everything died out except the wind—that was still talking to itself in the coulee.

Ginnaty (watching classmate cut his finger nails): Do you file your nails after you cut them?

Newhouse: No, you boob, I just throw them away.

Drippings from the Oil Can

Reasons Why an Engineer Thinks the World a Nice Place After All

Because there are such things as June nights, apple blossoms and the only girl in the world.

Because Andrew Volstead isn't president.

Because there is no indication that the skirts will be longer.

Because no prof can be quite as bad as we imagine.

Because the Dean employs neat dames.

Because God's chosen are all engineers.

Because all coeds don't look as bad as comics depict them.

Because this department is no longer.

It's the Bunk

What is hokum? A freshie wants to know.

Well, hokum is hooey and hooey is tripe, and tripe is apple sauce and apple sauce is blah and blah is baloney and the inquirer can draw his own conclusions.

Any motorman knows how to make a broad jump.

That's Why

The reason engineers are more considerate of other engineers than of miners is because it doesn't make other engineers suspicious.

Try This

Say bud, let me have a cigarette.
Sure, when I come back.
O. K., when are you coming back?
Never.

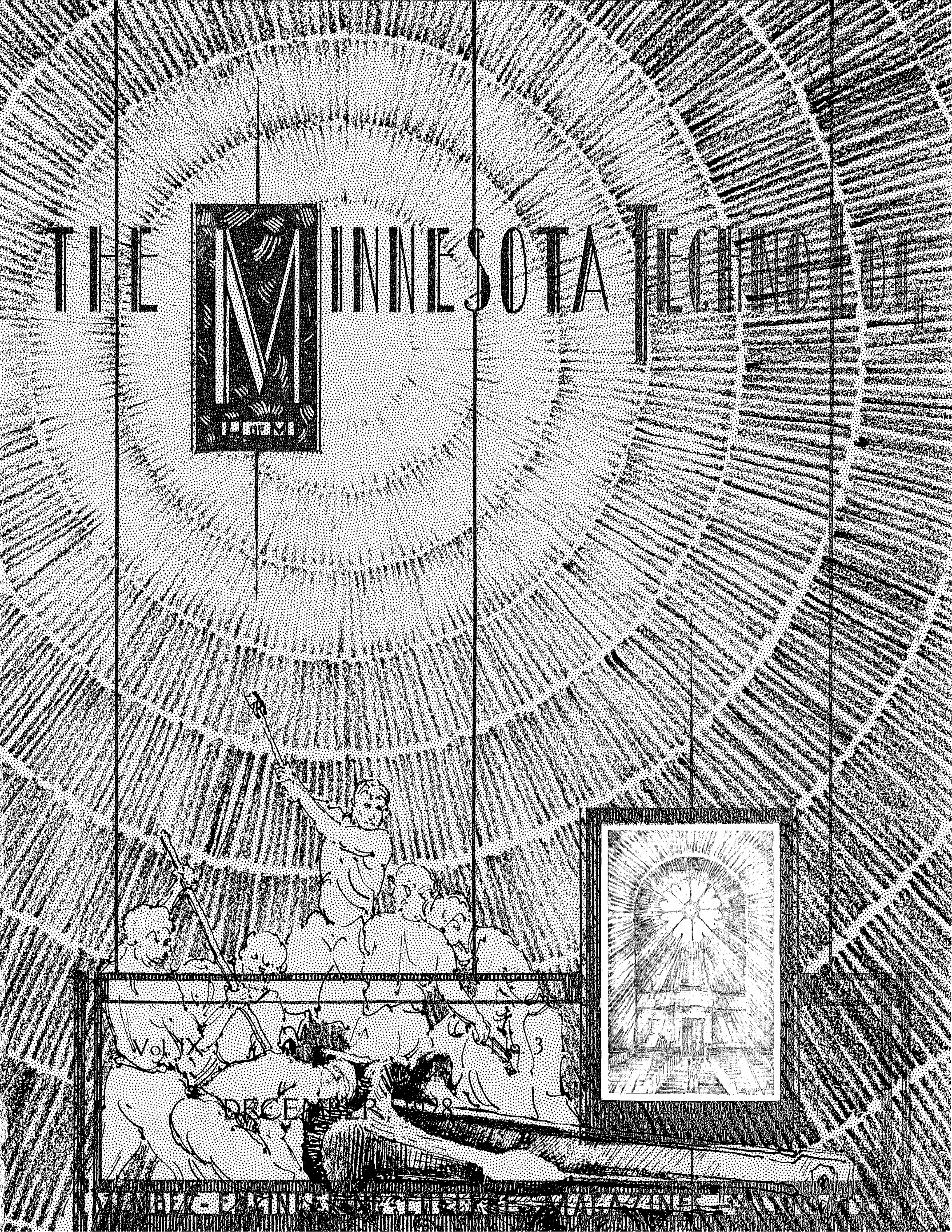
Murmurings from the faculty: We hardly find any persons of good sense save those who agree with us.

Neck: (as he sips the honey from a coed's lips).

Her: "I wonder if anyone has drunk from this mug before."

When ice cream grows on the lettuce trees,
When Saraha's sands are muddy,
When cats and dogs wear overshoes,
That's when I like to study.

—*College Humor.*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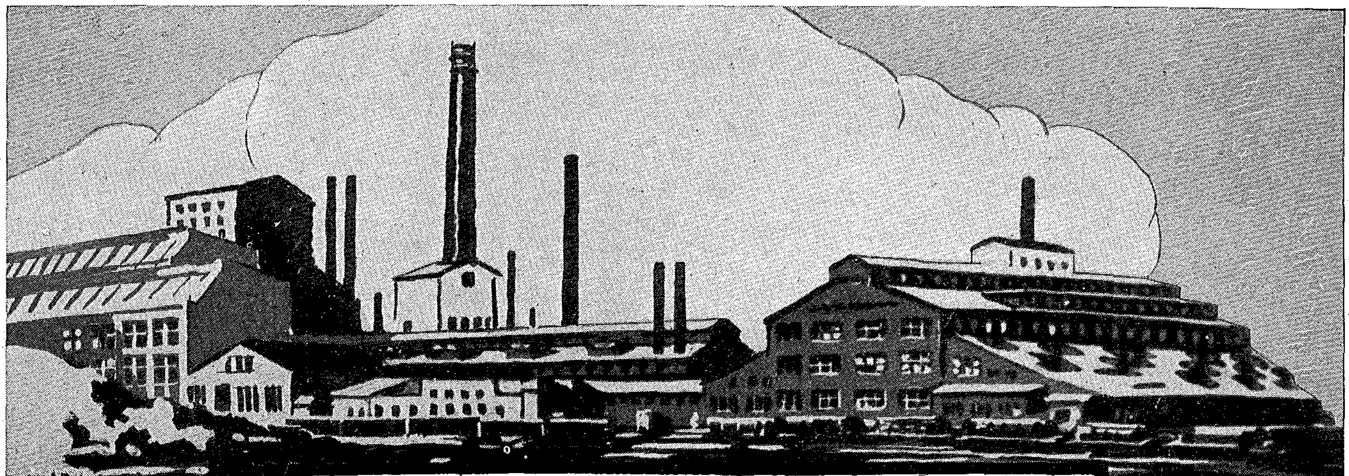

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There is no sharp dividing line between the responsibilities of the stoker or burner manufacturer, the furnace builder and the boiler maker. The performance of individual elements is secondary to the performance of the combination—as a unit.

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This company offers—one contract, one responsibility—for complete fuel burning and steam generating installations.

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

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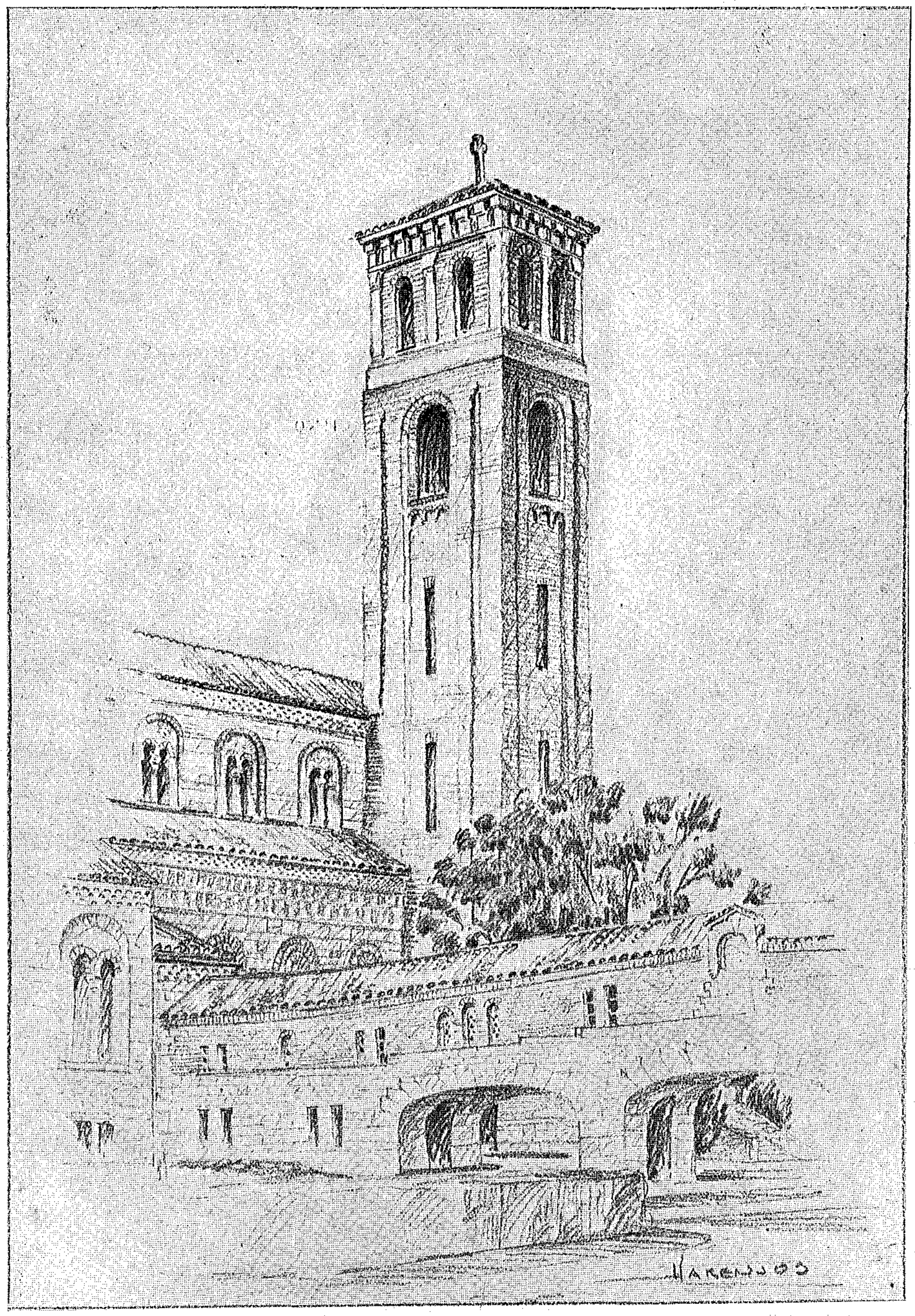

A College Chapel

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume IX DECEMBER 1928 Number 3

Carboloy

A senior miner reports a talk on a new alloy given by Dr. S. L. Hoyt before the School of Mines Society

By NED COLLINS, Mines '29

"CARBOLOY," the latest development in high speed tool alloys, was perfected by Dr. Hoyt in the Research Laboratory of the General Electric Company. According to Dr. Hoyt the men in the laboratories of the General Electric Company work on problems involving physics, physical chemistry, chemistry, electricity, metallurgy, etc. These problems are of a strictly scientific nature and require a fundamental knowledge of the principles involved to arrive at a good answer. This knowledge saves much work in the laboratory if put to proper use.

In 1925 Dr. Hoyt was sent to Europe on a five-month trip. He worked on several projects and made a tour of all the General Electric lamp factories, going through England, France, Belgium, Holland, Germany, Switzerland, Hungary and Austria.

All the European lamp factories are under the direct control of the General Electric Company and work under their patents. This seemingly objectionable monopoly has, however, enabled General Electric to produce a better lamp at a lower cost to the consumer, as a comparison with earlier years will show.

Dr. Hoyt spent several days to a week in each of these lamp factories. At Berlin he became acquainted with an alloy which was being used as a substitute for diamonds in the drawing of tungsten wire.

Tungsten carbide had been treated with cobalt and gave very satisfactory results in the drawing of tungsten wire. Tungsten carbide alone had been found too weak and porous for this purpose.

Dr. Hoyt became very much interested in this alloy, and began investigating its possibilities upon his return to the General Electric Laboratory. "Carboloy," the commercial product, resulted from a year of intensive experimentation. It is made by powdering tungsten carbide, mixing it with cobalt and sintering at 1375°C. It has a hardness very near to that of the diamond and a modulus of rupture of from 200,000 to 250,000 pounds per square inch. The original tungsten carbide has a modulus of only about 50,000 pounds per square inch.

The name "Carboloy" is like Topsy—it "just grew." In making up his samples Dr. Hoyt at first labeled them "tungsten carbide alloy lot No. 1," etc. Then, being a little rushed, he abbreviated—"Tung. Carb. Alloy." This was again shortened to "Carb. Alloy." A friend from the advertising department then suggested changing the spelling, and "Carboloy" came into being. It is now being manufactured by the Carboloy Co., Inc.

Dr. Samuel L. Hoyt is a product of the University of Minnesota, for he received his first degree of E.M. here in 1909. From Minnesota he went to Columbia University, where he received his Ph.D., and then to the Technisches Hochschule at Charlottenberg, Germany.

Dr. Hoyt returned to Minnesota in 1913 as an assistant professor. In 1919 he went with General Electric company at Nela Park. From there he was sent to inspect European lamp factories. On this trip he first came upon Carboloy, and on his return to America he developed it to the present highly perfected alloy of tungsten and cobalt.

In its commercial development as a cutting tool it was first put to use in the low tensile field in the shaping of hard rubber, bakelite, etc. These materials are extremely abrasive, but require only a low tool pressure. "Carboloy" was found to last from 25 to 100 times as long as high speed tool steel.

An interesting example of the saving effected was illustrated in the use of "Carboloy" in the shaping and facing of timing gears made of bakelite filled canvas. With high speed tool steel 150 blanks were machined to a setting of the cutting edges. With "Carboloy" 11,000 blanks were machined to the setting—a ratio of 70 to 1.

The selling price of Carboloy has been $450.00 per pound. This might sound a bit exorbitant until investigation reveals that only a small part of a cutting tool is "Carboloy" which is attached to steel shank by means of copper brazing or a special welding operation.

The General Electric Laboratory pays no attention to cost but only to usefulness, as illustrated by the expenditure of over $100,000 in perfecting "Carboloy." This clearly illustrates the fact that individuals are no longer able to carry out extensive research development work, but must look to the laboratories of large companies for new discoveries.

The use of "Carboloy" in machining steel is limited at the present time, but the outlook is bright. High speed steel and stellite are more adaptable for some work on cast iron, but "Carboloy" will probably replace them to a great extent.

Work is being carried on in the field of rock drilling in an effort to replace the more expensive black diamond.

Oil well drilling is also regarded as an interesting possibility in the search for uses for this remarkable new alloy.

The development of Carboloy brings new interest to the history of the development of high speed steel. The forerunner of the present high speed steel was known as Musatt steel and was developed in England by Robert Musatt about 1870. Analysis of Musatt steel varied greatly. It contained 4 to 12 per cent of tungsten, 2 to 4 per cent manganese and 1½ to 2½ per cent carbon. This steel was the first of the tool steels to possess self hardening properties—that is, it was hard when cooled in air.

This steel was the leading tool steel for about 30 years. The next important development started late in the 19th century and was conducted by F. W. Taylor, generally known as an efficiency en-

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Graduate Training with Large Industrials

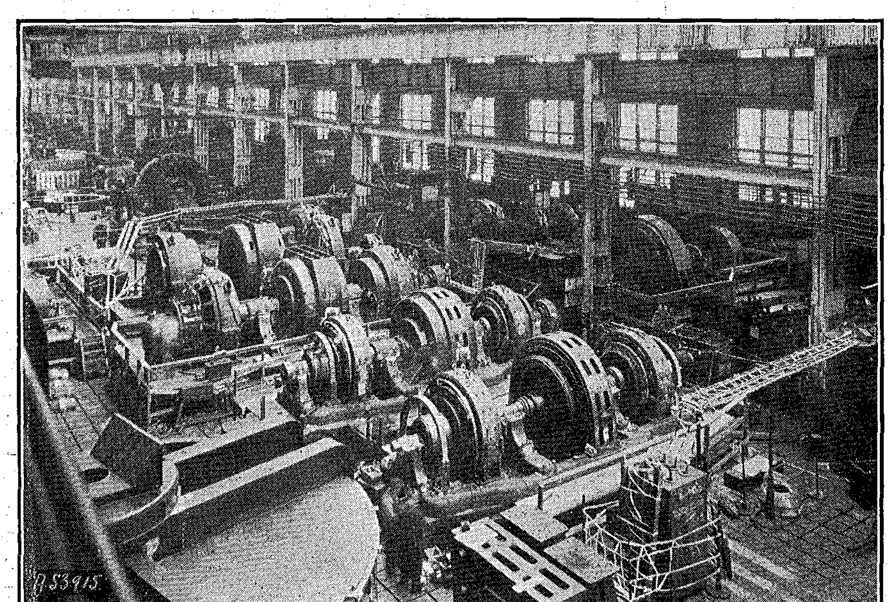
By J. H. DuBois
General Electric Co.

WITH the rapid approach of commencement comes the ever perplexing question, "After college—what?" In the mind of the average senior that "what" is written in large, rather wobbly and uncertain letters. He may ask many questions, but he will get but few satisfactory answers to his queries. His instructors in general, cannot, and his friends will not give advice. This is only right, for no fair minded person feels capable of advising directly that any one particular proposition would provide the best possible starting point. The instructor questioned can at best only review the various opportunities offered by the field in general, or the specific opportunities offered by the particular selection. He cannot advise a graduate as to a particular path to follow to the exclusion of all others, and it would be folly for him to do so. He can only make certain suggestions tempered by his own experience and observations.

After making a thorough study of the field of opportunities open to the college graduate, the prospective candidate for these opportunities finds that in many respects they are interlocking. That is, the advantages that at first appeared to be peculiar to one industry, may upon investigation be found to apply to a number of ventures. A good example of this may be found in salesmanship. By securing employment with a telephone company, for example, the graduate may work his way into the sales organization of this industry and sell its service to the public. Or by entering the service of a manufacturer, the student may train himself to sell a variety of appliances, or if he so desires, specialize in the handling of one thing. Both cases are parallel in substance. The salesman develops and uses his sales ability in both examples; the difference lies in the commodity sold. In like manner, he finds sales working hand in hand with engineering, design with operation, and manufacturing with application.

In the end, the problem usually resolves itself into two considerations, namely, immediate specialization with the small concern dealing with a limited number of products, or the general training courses offered by the large industrials. Each field has its particular advantages, and it is the object of this series of articles to offer a study of these advantages with the hope that the graduates of the near future will be aided in making their choice.

The writer's choice was the "student engineer," or "test" course offered by the General Electric company. Since this article has been written around the conclusions of a number of men on test, the writer's reasons for his particular selection will not be discussed. Realizing as he has the futility of trying to make general statements with no basis except his own observations and opinions as a source of information, the writer has resorted to the conclusions gleaned from the questionnaire that serves as the basis for this article. In gathering this information, representative men from all parts of the world were interviewed, and their answers tabulated. New men, on their first test—obviously still in doubt as to what it is all about; older men with their broader experiences; and others in all stages are represented.



A VIEW OF A GENERAL ELECTRIC COMPANY TEST FLOOR

The questions were submitted to each man individually so that each series of answers represents a distinct personal opinion. The only questions asked were those pertinent to the subject of test, except in two cases, where the questions referred to educational courses offered by the company.

Each man was requested to put in an accurate record of his attitude toward the questions so that the report would be an honest statement of facts.

A study of each question and its significance to the whole will best illustrate the points considered. The first question was included to indicate the length of time spent on the course at the time of writing.

"Number of tests considered real good": The particular significance of this question is to show the diversity of opinion existing regarding the nature of the tests. For example, the radio enthusiast might be bored to tears with a turbine test, while the mechanically inclined would be in the height of his glory. No two men select the same group of tests as the most interesting and instructive; each is influenced by his personal interests to select that which is good and to reject that which, to him at least, is not so good.

The significance of this series of answers to you is obvious. On such a course you will see a vivid picture of many fields: manufacture, research, design, engineering, business. Of these varied fields, some will be more attractive to you than others. In one short six weeks test you may learn that research work offers your best opportunity, or in the same period you may learn that you could not possibly find satisfaction in research work. In either event the time will have been well spent.

In going from the classroom to the job, the most noticeable change is in the introduction of considerable necessary routine. The average student engineer gets about as much satisfaction out of cleaning up the test floor after the job is done as the ex-coed gets out of washing the old man's socks. To get a fifty-fifty break of the novel with the routine is a rare privilege in the present set-up of the industrial world, and one has only to turn to a man whose "experience" consists of tracing drawings, really to appreciate the situation.

During the period spent in the turbine test, the writer helped run a full-load heat run (zero power-factor pump back) between two 50,000-kw. turbines. It took several weeks to connect up the machines and prepare the metering equipment. The test itself required only part of a day after the set up was complete. In spite of the plenteous supply of wisecracks and heavy words about "dragging cables," the real value of the electrical work in the test course comes in the preparation for test. Any attempt to shift the burden of this preparation to the shop men is a rank absurdity although it may produce marked economies in test costs. No portion of the work done by the testing department is as valuable to the men in the course as the work done in preparing the equipment for test.

"How much was your technical training developed?" The test course does not include advance technical training except in the educational courses which are held on the side. It merely presents the concrete evidence of the theoretical applications and leaves the student to supply the theory. Most electrical graduates are educated considerably beyond their understanding and experience, and the work is well laid out to meet their requirements.

Of the ratings placed on the classwork and experience, little need be said. The answers supplied to these questions depend largely upon the man's past experience and education. It is probable that many of the most important features are overlooked when rating experience.

In the educational work offered, there are three possibilities. The first is the regular graduate work at Union college, the second is the advanced engineering course, and the third is the general course. A large concern is always in a better position to give moral and financial support to educational work than the small company. While it is possible to find work with a small company which is located where graduate work may be taken at some nearby university, the opportunities for such combinations are limited. In any event, such opportunities will be much inferior to the highly specialized development and concentration of talent which take place in a school located near some large industrial company.

The advanced engineering course is provided for the few rare men of outstanding brilliance. It is only the larger organizations that can use such men to the limit of their abilities, and this course is planned to meet their requirements and to train them to meet the needs of such an organization.

The general course is provided to promote the habit of study among technical graduates and to supply the technical training and general information which obviously cannot be given on the test floor. This course was planned to meet the average engineer's requirements and includes accounting, economics, business law, marketing and practical engineering. Such a course is of inestimable value to the young engineer because it gives him a general training in a short time which might otherwise require several years if he were to seek out the information by himself. None of the educational courses are compulsory and the student is free to select his own program, ability and interest being the only prerequisite.

It may be well to note in passing that all the men questioned, only three were found who felt they might have done better elsewhere. Many others were interviewed on this question who are not listed in the summary and who were sincerely glad that they had entered the test course. Of these three men, it may be noted that one was the youngest reporting and the other two were the oldest. It is possible that the completed picture may tell a different story to the new man. The other two men had been on the course for two years, which is considerably longer than the average man spends. Most men find some particular line of work which they desire to follow up after they have been on "test" for some time and leave the department to specialize in that division.

It is possible that you, too, may not be able to find the class of work which you desire to follow up and will feel that you might have done better elsewhere. However, such cases are rare, since the wide diversity of opportunities in such an organization provides real opportunities for all classes of men. The testing department does not make any effort to push any man into a permanent job. It merely regulates the panorama and supplies the background. Each man must select his field and then sell himself to that particular department head. This process is much more interesting than it sounds, since all of these men have come up through the testing department and understand the test men and their problems.

No man is expected to remain with the company by mere virtue of the fact that he has entered the testing department. The men are free to leave at any time they find something which appears more advantageous to them. Many men enter the test course expecting to leave after they have completed the tests in some particular field. Some of the large public utilities are now recruiting their men from the test course and other similar graduate training courses.

The last question, listing the valuable points in favor of such a course, speaks for itself. Each answer is a story in itself with one man's experience as the plot. In connection with this question the writer believes that a personal testimony would be in order.

During eight of the ten years spent in high school and college it was the writer's good fortune to have been employed by two outstanding power companies for a portion of the time. With this experience as a background, the writer feels that he has some basis in experience upon which to place his comparisons. The writer feels very much pleased with the test course. The many and varied interests carried on and developed by such an organization were a source of continual wonder and interest. It was surely worth while in the opinion of the writer and he feels confident that the training courses offered by the large industrial companies offer the greatest opportunity to the average graduate at commencement.

Such a course offers you a first-hand opportunity to study the methods of the modern business organization; it allows you to work in the many branches

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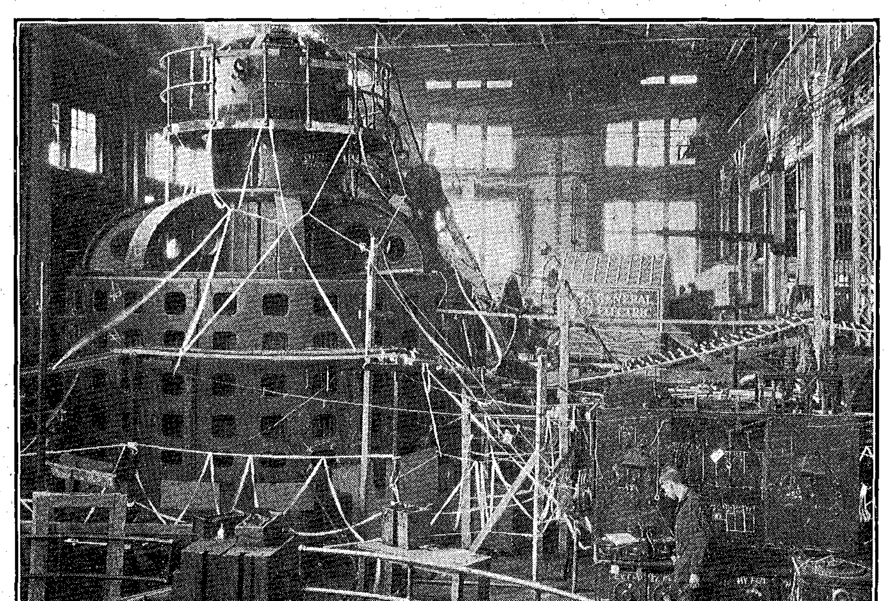

AN 11,000 VOLT GENERATOR BEING TESTED BY STUDENTS

Chromium Plating

Chromium, as a non-tarnishing and wear resisting metal finish, is rapidly surpassing nickel in the plating industry

By G. H. MONTILLON
Associate Professor of Chemical Engineering

METALS old and new are constantly being investigated with the idea that new possibilities may suggest themselves for the ever increasing needs of industry. Chromium, which was first plated by Bunsen in 1854, is being discussed more than any other metal in the plating world at present due to its desirable properties.

Chromium has many characteristics which make it particularly useful in a variety of ways. It is extremely hard, much harder than any known metal, and resists abrasion in a way to delight the user. Chromium is 9 based on the standard scale of hardness, in which talc is 1, and diamond 10, corundum being 9 on that scale. Emery, which is a variety of corundum, is an intimate mixture of corundum with magnetite or hematite, thus showing that chromium is about as hard as emery. Even thin films of chromium, increase the wear of working parts from four to eight times depending on the service rendered. It is resistant to oxidation under ordinary atmospheric or very humid conditions and to the effects of salt spray encountered in marine work. The metal is attacked by hydrochloric acid but less readily by sulfuric. Strong nitric acid does not attack it, as it becomes passive under these conditions. It is not affected by hydrogen sulfide, sulfur dioxide or sulphur compounds generally. Many organic acids, including uric acid, do not affect it. It resists oxidation up to about 1150 C. and does not discolor when heated in air up to 300 C. It has a low coefficient of expansion, in fact it is quite surprising in that particular. The following incident will illustrate this fact. In a certain clockworks a steel gage was plated with 0.0002 of an inch of chromium, making it fit that much snugger. When the gage was returned to the mechanic he insisted that it had been made larger, —the reduced friction of the smooth chromium surface fooled him completely.

With such a host of really useful needs which it could fill, it is peculiar that chromium plating should lie dormant for almost three-quarters of a century before commercial success of the process was made possible. However, the first successful plating served to emphasize these unusual advantages and to stimulate research in this field. As a result, numerous patents have been granted, but relatively few articles have been published which give definite information concerning processes.

The patent situation is well presented by Richard Schneidewind, in Engineering Research Bulletin No. 8 of the University of Michigan, entitled, "A Study of Patents Dealing with the Electrodeposition of Chromium." Schneidewind says in brief that although good fundamental research on chromium plating was done by Carveth and Curry, J. Phys. Chem. 9, 353 (1905), in 1905 it resulted in no immediate commercial interest. Their solution however is a usable one. Commercial chromium plating probably began on a small scale in Germany as a result of patents granted to Salzer, in 1907 and 1909. Due to factors of which he was unaware his solutions did not give uniformly good results. Baum was granted a patent in England in 1913 for a process of making chromium-plated filament holders for electric lights. This filament holder aroused no enthusiasm, and his method of plating was forgotten.

The first good bath that awoke commercial interest was that of Sargent, Trans. Amer. Electrochem. Soc. 37, 275

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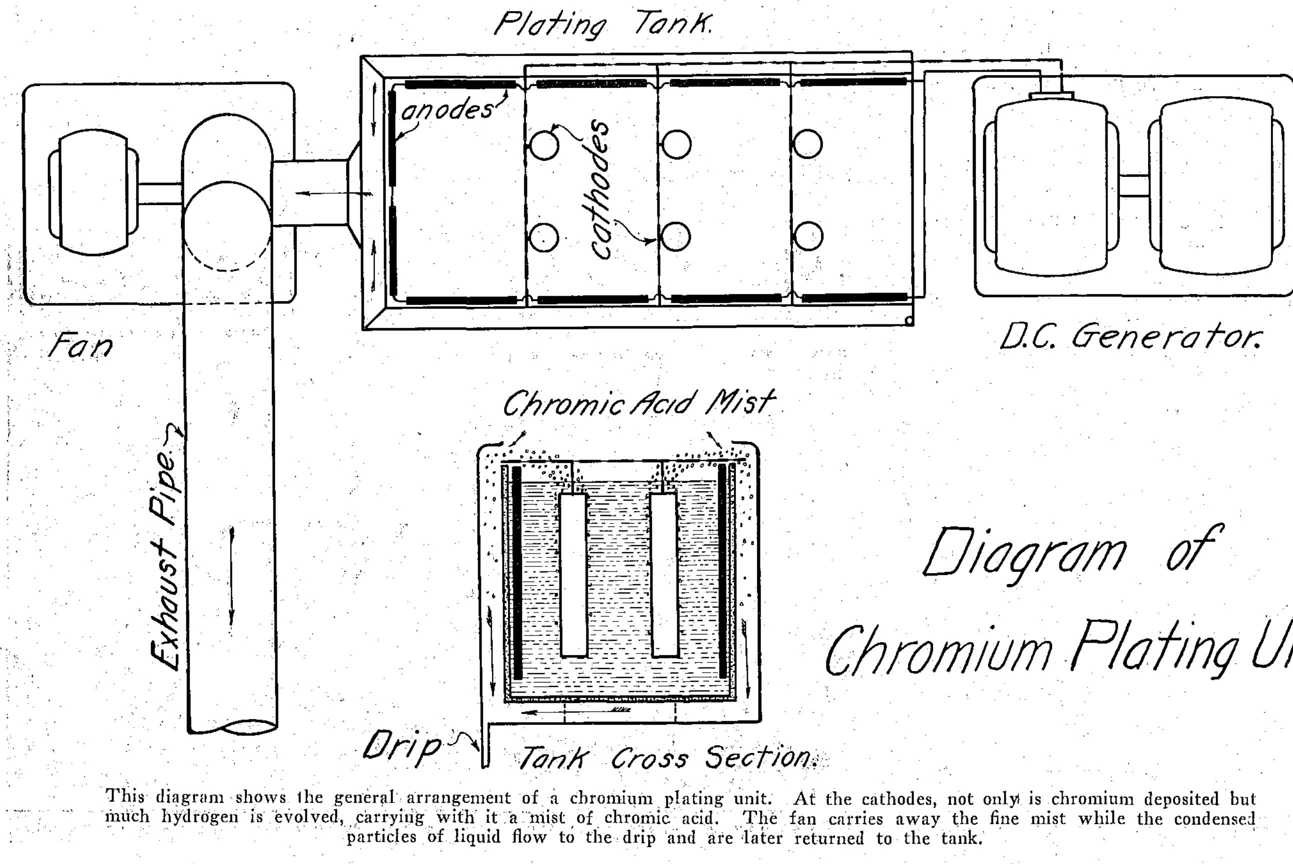

This diagram shows the general arrangement of a chromium plating unit. At the cathodes, not only is chromium deposited but much hydrogen is evolved, carrying with it a mist of chromic acid. The fan carries away the fine mist while the condensed particles of liquid flow to the drip and are later returned to the tank.

Surveying With the Senior Civils

Nordahl Rykken, C.E. '29

SIX weeks is a compartively short time in which to receive practical training in railway surveying, topography, triangulation, levelling, stream gaging, observations for azimuth and position, and plane table instruction. This is the job assigned the senior civils at the summer camp held annually at Cass Lake, Minnesota.

One of the first things which had to be done after making camp was to erect the triangulation stations. A red and white flag was mounted on the top of a pole about twenty or thirty feet above the ground over a fixed point and constructed in such a manner to be easily taken down and reset. One side of the polygon formed by these "stations" called the base line, is accurately measured to thousandths of a foot taking into consideration temperature changes, standard length, tension in the tape, and possible variation in elevation. The positions of all of the other triangulation stations are determined by means of angles. Twelve or more repetitions for accuracy are read on each angle by means of a transit. Under average conditions results have been obtained which are correct within five seconds or about 1/720 of a degree.

All angles were adjusted and balanced in the office and the positions computed trigonometrically. The government triangulation station "Wye" was assumed as the zero point of the system and the positions of all other stations given with reference to this point.

The azimuths of the lines were determined by observations on the North Star, two men in each party, each man completing a set of four readings. Five hubs had been set near the camp and readings on Polaris were taken at eastern elongation and by the hour angle method. The transit was set up before dark to facilitate accuracy in centering over the hub. When the North Star became visible or reached its eastern elongation the angle was read between the star and a light placed about one-half mile down the beach. The light was placed behind a thin strip of wood and shielded from the observer by tracing cloth. A paper reflector and flashlight for illuminating the cross-hairs completed the equipment. The time to the nearest five seconds was recorded with the angle for applying a minor correction made later in the computing tent. Some difficulty was encountered in following the star as it circled in its orbit, since the movement in a few seconds showed appreciably in the telescope. Having determined the azimuth of the line between the hub and the light, the angle from the light to triangulation station "East Cedar" was read in the daytime and the azimuth of one side of the system computed.

For the first time in summer camp the latitude of the place was found by reading the vertical angle to the star at the same time that the observations were taken for azimuth. This was accomplished by setting the intersection of the cross-hairs on the star. Average values agreed within thirty seconds of a nearby government station.

Railroad surveys were made on the Great Northern and Soo Line leading into Cass Lake. A control traverse with zero stationing was started on each railroad beginning in the vicinity of Cuba, Minnesota, and extended about one and a half miles west of Cass Lake. This was done by chaining along the base of the rail and marking each station with red keel. Sufficient distances were chained to locate the fences, right-of-way, telegraph and telephone lines, and any unusual topographical features, supplemented with sketches to reduce the labor of plotting.

The curves could have been measured by prolonging the tangents and finding the point of intersection, but this would require more time than justifiable under the circumstances. Consequently, forward deflection angles and offsets were used. A closed traverse was run around the switch yard and the distance to each frog and switch point measured, locating the cross-overs and turn-outs in the same manner as for curves. It was possible by chaining a control traverse to close all of the side traverses and obtain a constant check on the work. The transit was oriented by backsighting with the plates reading zero on a range pole bisecting the gage distance of the rails. On long shots one was able to dispense with the range pole by bisecting the distance between the rails with the cross-hair.

The distance between the Soo Line and the Great Northern was chained at the beginning of the survey and again

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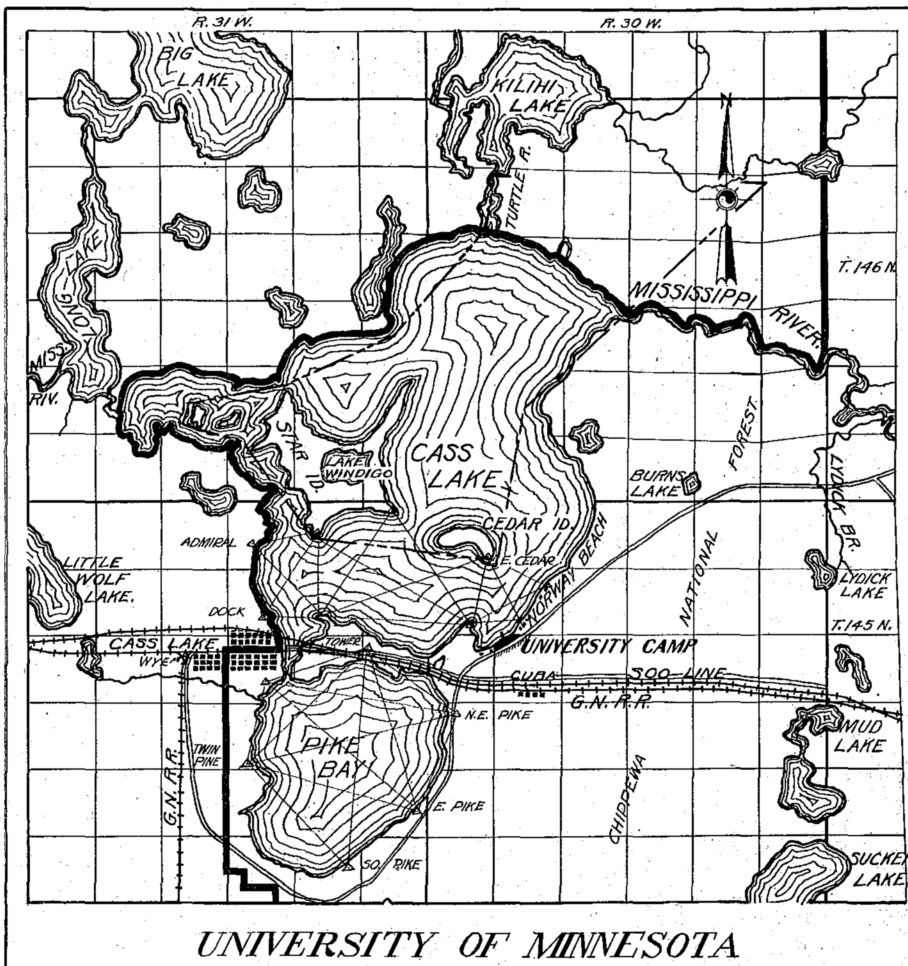


UNIVERSITY OF MINNESOTA
CIVIL ENGINEERING SUMMER CAMP
CASS LAKE, CASS COUNTY MINN.

With the Miners at Crosby

Being a review of the sophomore miner's field trip

By LYLE CHRISTENSEN, Mines '30

AT two o'clock on May 7, 1928, twelve sophomore miners and two professors met at the Spaulding Hotel, Crosby, Minnesota, to start the sophomore field trip.

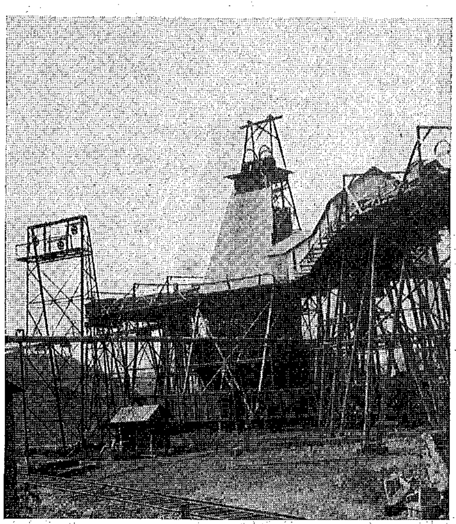
Professors E. M. Lambert and L. S. Heilig headed the party of students which included: Frank J. Belina, Lawerence H. Hansen, Myron Griswold, Ernest C. Kron, Clarence A. Kutz, Charles Landeen, Waldo C. Larson, Joseph L. Lindner, Duane S. Meyers, Edwin H. Strand and Lyle A. Christensen.

The object of this trip was to become adept in the practice of surveying, both on the surface and underground. Surface work included chaining, running levels, turning angles, setting grade stakes, running railroad curves, triangulation, topographic work, stripping estimate of an open pit mine, solar and stellar observations, plane table work and other minor problems, all of which were to be accompanied by a complete set of office and field notes.

The underground work comprised a complete survey of nine traverses in the Armour No. 2 Mine.

On the first afternoon we received all preliminary instructions concerning our duties and then took a short jaunt over to the Armour No. 1 Mine, where our headquarters were located. This was a small room at the end of the "dry" which had previously been equipped with drawing tables. Our instruments and all other equipment were stored in this room. After giving this the once over we hiked back to Crosby, unpacked our belongings and settled down to seven weeks of surveying.

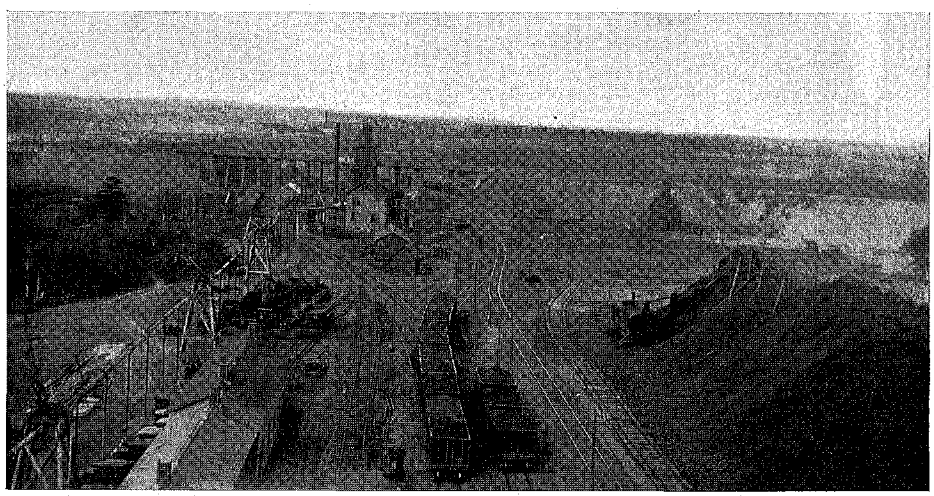
The next morning we reported at seven thirty for our first actual practice (nearly everybody arriving on time). Two chaining problems were assigned in which we discovered, much to our sorrow, that great accuracy was desired. Later we found that this accuracy was negligible compared with the accuracy required in adjusting instruments, which befell us on the next day. It was very discouraging indeed, after working for an hour or so on a peg adjustment, to find upon examination by Mr. Lambert that you were still several thousandths off. After the tedious process of adjustments, the problem of running levels from the head frame of Armour No. 1 to a bench mark in the Pennington pit proved very fascinating, although all of our levels did not check within the required limits of closure on the first trial. When we had used the level enough to understand it, and had attained a fair degree of speed and accuracy, we devoted our attention to the transit, which, of course, had to be adjusted.



HEAD FRAME OF ARMOUR NUMBER 2

When the fundamentals of handling the instruments had been mastered we began our real problems, the first of which was a railroad curve. Every morning, with transits and levels on our backs, and carrying stakes, rods and axes, we would hike a mile to the Feigh Mine which was the location of our work. When the curve was finished, grade stakes were set and a topographic survey of the course was made, all of which were later drawn up in the office at night school which was conducted four or five evenings a week from seven o'clock on.

One clear evening everyone came prepared for the all night session of shooting Polaris. About nine o'clock all instruments were set up and necks were strained for a half an hour until someone spied the small glittering speck in the sky. We continued our observations until two o'clock when the sky clouded over, and we had to go home and finish our work at a later date.



THE ARMOUR NUMBER TWO MINE AT CROSBY, MINNESOTA
This is the mine at which the Minnesota men conducted their survey

Our last days under the blazing Crosby sun were spent at the Portsmouth open pit mine in making a stripping estimate. Every one of us was an Indian brown in color, which had been obtained at the expense of many a sore, burned back and neck.

Then came the night never to be forgotten to a miner who has taken the sophomore field trip. Plumbing the shaft is perhaps the most distinctive feature of the trip, because at this time many miners make the first entrance into a mine. Our party met at the mine at six o'clock in the evening to plumb the shaft. This had to be done in the evening when the mine was not in use. Each party "jiggles in" on two copper wires that are suspended down the shaft, and then climbs down three hundred feet to the bottom level on wet and slimy ladders. At the bottom the instrument must be again set in line with the wires and the first spads are set which are the basis of the survey. The first night underground is usually not a very pleasant one. It is dismal and cold, things all seem to go wrong, plumb-bob cords are burned off, and hands are burned by lamps while climbing up and down ladders.

As the days went on, these annoy-

(*Continued on page 96*)

Reclamation Work Progresses at the Zuiderzee

The Reclamation of the Zuiderzee, now a major engineering project in Europe, will encrease the cultivated area of Holland by ten per cent.

By L. H. REYERSON
Associate Professor of Chemistry

DURING the ninth meeting of the International Union of Pure and Applied Chemistry at The Hague, Holland, in July of this year the delegates of the National Research Council, along with the delegates of other countries were taken on a tour of inspection of the engineering work operating for the reclamation of the Zuiderzee. This is one of the major engineering projects in Europe at the present time. Some idea of the magnitude of the work may be obtained when it is learned that the cultivated area of Holland will be increased by one-tenth upon completion of the project. The work was begun in 1920 and will be finished about 1952 if carried on at the present rate. Only a part of the Zuiderzee will be reclaimed as some of the soil under water has been shown by chemical analyses and other tests to be unsuited for cultivation. A reference to Figure I will show the parts of the present sea which will be reclaimed. A section of reclaimed land surrounded by a dike is called a polder and it will be observed that four such polders are to be recovered from the sea.

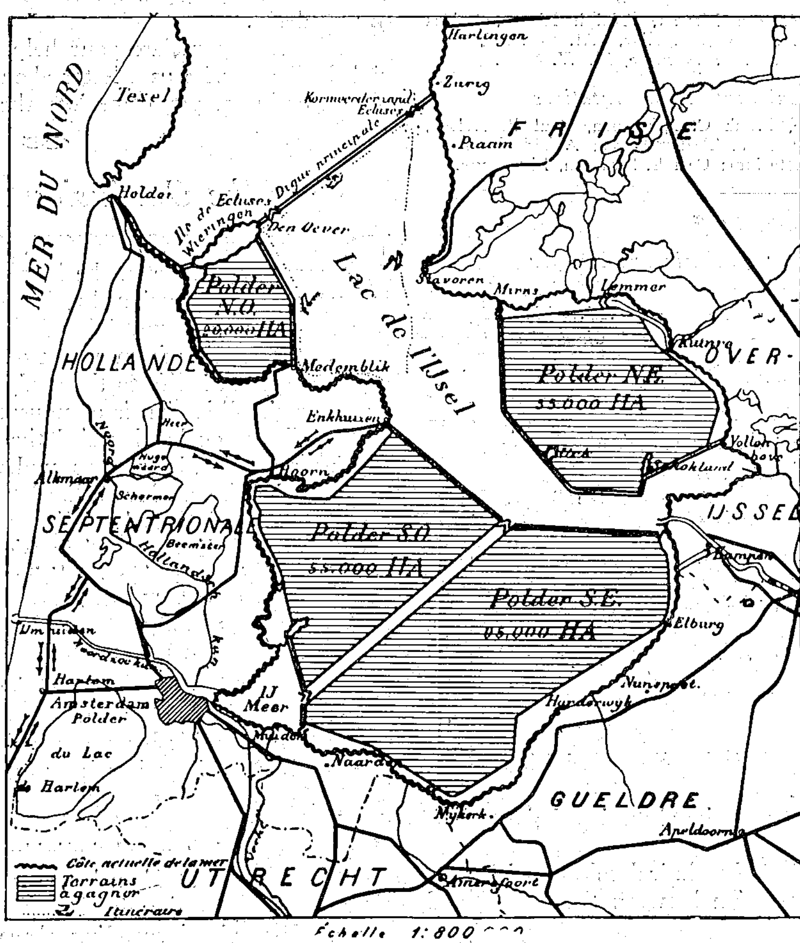


FIG. 1. MAP SHOWING THE PROJECTED RECLAMATION OF THE ZUIDERZEE

The areas and lengths shown in Figures I and II are given in the metric system.

The work may be properly divided into two parts. First comes the enclosing of the Zuiderzee by the principal dike. Then follows the enclosing of the separate polders and the pumping, draining and making ready of the land for the farmers. At the present time construction of the principal dike between Den Oever and the Frisian coast is in progress. This dike will be the chief means of keeping out the water of the North Sea. A dike connecting the Island of Wieringen to the Mainland is also needed and the work on this dike is finished. Construction on the main dike is proceeding at the rate of about three miles per year.

The average height of the top of the main dike will be about twenty-five feet above sea level or about twelve feet above the highest tides known. This will be ample to protect against the waves during a storm. The dike will be about two hundred and seventy feet wide above the water line. It will be noticed that a level shelf more than one hundred feet wide exists on the side of the dike away from the sea. It is proposed to construct a roadway and a double track railway upon this ledge. Because of the large number of bicycles in Holland the roadway must provide for both, automobile and bicycle traffic.

The dike is being constructed of stone, clay and sand. The sand and clay is dredged from the bottom of the present Zuiderzee. Huge dredges are constantly at work and large barges with hopper bottoms transport the material to the dike. Below the water line heavy brushwood mattresses cover the dike. These are sunk into place with stone and the whole is then carefully covered with cut stone. Above the water line a heavy layer of clay is used to cover the sand and gravel mixture which constitutes the inner part of the dike. This clay is surfaced with cut stone to withstand the shock of the waves. The exposed part of the dike which is not called upon to withstand the action of the waves will be clay covered and grass will be grown upon it. The stone which is being used is shipped from the quarries of Belgium and Germany.

Several rivers empty into the Zuiderzee so that upon completion of the main dike the enclosed waters will slowly change from salt water to fresh water. This inland sea called "Yssellake" must take the water from the rivers flowing into it as well as the water from the reclaimed land. In order to prevent the level of this lake from rising too much, sluice gates are being constructed in the main dike. These sluice gates will be opened at low tide or twice in 24 hours and the excess water allowed to run out. This means that the level of the fresh water lake will be maintained above the level of low tide in the North Sea. Fifteen sluice gates are being constructed at de Oever near the Island of Wieringen and ten at Kornwerdergand which is a little more than two miles from the Frisian Coast. At these two points locks are being constructed for navigation purposes.

In times of stormy weather it is evident that the sluice gates cannot be opened. The drainage water must then be stored in the Yssellake. The surface

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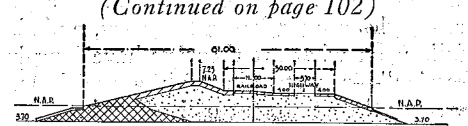


FIG. 2. CROSS SECTION OF THE MAIN DYKE.

The
MINNESOTA TECHNO-LOG
University of Minnesota

Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

Aesthetic Proportions

PSYCHOLOGY has by no means been inactive in the field of aesthetics; it has developed experimental methods for determining the preference of individuals, and social groups. Nor has the TECHNO-LOG been hesitant to utilize the results of these experiments for its own aggrandizement.

The technically minded engineering student would scarcely suppose that a mere rectangle could produce an aesthetic effect, or that it would make any difference what exact proportions the rectangle possessed. Yet it is found that some rectangles are preferred to others, and that the popular choice falls upon what art theorists have long known as the "golden section"—a rectangle with a width approximately sixty to seventy-three per cent of its length.

So the present dimensions of the TECHNO-LOG have been adopted with the hope of sub-consciously gratifying the somewhat latent aesthetic senses of Minnesota engineers.

Tell Us

TO be the monthly magazine of the technical students has been the aim of the TECHNO-LOG ever since its first issue. Now, since the blanket subscription is in effect, this is more true than ever.

To be the organ of all the students, it is necessary that every engineer, architect, chemist and miner take an interest in the magazine and its problems. Not every man on the campus can be a member of the staff, but every one can help out in his own way.

We of the staff feel that we are working on one of the finest technical college magazines in the country, but we know that we cannot achieve perfection, and obviously, many errors must occur. Keeping avoidable errors at an absolute minimum is the aim of the present staff, and the success of this endeavor depends upon the cooperation given by the engineering students.

We will appreciate your help. Tell us about your likes and dislikes; write us a letter about them, call us on the telephone, or better yet, come into the office and get acquainted.

The Confusion of Tongues

DR. OTTO JESPERSON, famed philologist, has but recently completed the invention of a new international language. He has assigned to it the cognomen of Novial from *nov* meaning new and *ial* signifying international auxiliary language. Coming from a man of surpassing learning, a man who has given his life to the study of language, this latest attempt at simplification is of unusual interest.

Dr. Jesperson has handled the problem astutely. He has carefully examined previous undertakings to ascertain their merits and defects. He realized that Volapük was too harsh, that Esperanto included needless complications, that Ido was a pot pouri of disconnected irrationalities, et cetera. Novial combines their desirable qualities and eliminates their evils. It is readily intelligible to every educated person, possesses a grace and euphony that are surprisingly delectable, and is logically constructed.

Many of the advantages to be obtained by the adoption of an international language are at once obvious. The great volumes of scientific literature which leave the press each day in a variety of lingual codes, probably offer the most cogent reason for advocating an auxiliary language. It would make the disclosures of the Fifth Estate common knowledge, available to every instructed individual, whether the author be German or Italian, French or Russian.

To engineers the development is of paramount importance. Instead of spending three years learning the rudiments of one language, the engineer would be enabled to obtain, in a much shorter time, a very complete reading and writing knowledge of every language. This would not only open new vistas of intellectual pursuit but facilitate international communication.

Proving the Airplane's Practicability

DURING the first eight months of this year German air lines covered more than 5,000,000 miles and carried more than 100,000 passengers, not to mention 750 tons of freight, 750 tons of baggage and an equal amount of newspapers and mail matter.

Stunt and demonstration flying continue to take a ghastly toll. That hurts aeronautics more than anything else.

The splendid records established by mail and commercial lines get scant publicity compared to the tragedies which occur in the field of of experiment and adventure, but they are proving the airplane's practicability.—*Washington (D. C.) News.*

Twelve Month School Year

DR. WILLIAM J. MAYO, world famous physician, and member of the board of regents of the University of Minnesota advocates the use of a twelve month school year in high schools and colleges. His suggestion will meet with adverse under-graduate criticism. On casual examination, it appears that Dr. Mayo merely suggests a plan to deprive youth of its modicum of happiness. Doctor Mayo, however, is no dissembler; his ideas are befuddled with no such clap-trap.

The present era of specialization has not been reflected in the school system to the extent that might be expected. Today, it is not sufficient that the neophyte physician be a graduate of an accredited institution, it is expedient that he be a specialist. Similarly in other professions,—where formerly a certificate of graduation was an open sesame to the chosen field, — new requirements make it extremely desirable for the graduate to take several years additional training, in order that he may have an especial knowledge of a particular branch in his profession. In fine, the value of a diploma per se has depreciated. The culmination of this trend has been to increase the length of time which one must spend in school. In other words, the number of years during which an individual is a liability has been greatly augmented. And the future will undoubtedly see the non-specialist placed under a greater handicap.

It is sound judgment, then to advocate a change in existing conditions. This could be accomplished by either of two methods; first, by taking a greater number of courses during each school period, secondly by increasing the length of the scholastic year. The first plan is hardly feasible,—a glance at the number of individuals who are forced to abandon their education each year because of scholastic difficulties suggests emphatically that the undergraduate labors under a sufficient burden. Must the alternative then be adopted?

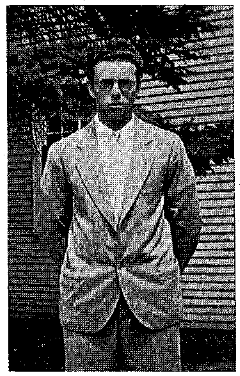
The system of optional attendance at the summer session is probably the most desirable arrangement under the existing conditions. If the number of courses given during the summer could be augmented to approximate the regular sessions, this would be a solution of the problem. Such a course would provide for those who do not now attend the summer sessions because the courses they wish to take are not offered.

On Time—Ye Who Enter Here

IRATE professors have thus paraphrased the inscription above the expansive portals of Satan's domain. It is undeniably true that the disturbance occasioned by late entrance to class is obnoxious and hardly conducive to concentrated thought. The Powers have recognized the fact that it is sometimes impossible to arrive within the situs of learning at the appointed hour. They have thought it was to provide a penalty as a means of stimulating the lagging student to be prompt. The penalty has been proved inadequate. Choleric savants adopt the alternative of barring doors. Outraged students clamor for admittance.

That an evil exists is apparent, that it should be rectified is self-evident, but that the judicative measures adopted by the faculty should be continued is at variance with reason. There are other methods which would effectually solve the difficulty. Any expedient is preferable to exclusion from class, especially when that exclusion frequently necessitates a make-up examination or the copying of a none too legible notes from a fellow student.

Faculty Sketches



EDWARD A. SAIBEL

ON Christmas morning of the year 1903, Edward A. Saibel was born in Boston, Massachusetts. The winters of his early childhood were spent in the environs of Boston, with delightful excursions to the coast of Maine filling the lazy months of summer. The long days were spent in fishing, rowing and an occasional plunge into the icy waters of the Atlantic. Through the grades and high school these trips to the shore of the Pine Tree State were anticipated with youthful enthusiasm.

In 1920, after graduating from high school in Boston, Mr. Saibel successfully completed the college board entrance examinations and entered the Massachusetts Institute of Technology. His original intention was to major in chemistry, but at the close of his Freshman year, he transferred to the physics department and later to mathematics. Four years after his entrance, Mr. Saibel obtained his bachelor's degree in mathematics, which was the first of its kind to be given by the Institute.

During the next two years, he continued his study of mathematics in the graduate school of Cornell University at Ithaca, New York. In 1926 Mr. Saibel returned to M. I. T. where in the following Spring he was awarded the degree of Ph. D. in mathematics. The ensuing fall he was appointed instructor in mathematics at the University of Minnesota.

Mr. Saibel is an ardent hand ball devotee and gymnast. During his last year at M. I. T. he entered the New England Amateur Athletic Union meet and broke the record for the twenty-five foot rope climb. After classes, he may frequently be found on the hand ball courts, either at the stadium or at the Y. M. C. A. His extra-curricular activities, however, were not confined to the field of athletics. For many years he studied the violin, and at one time contemplated taking up music as a profession. At present, he is associated with three string quartets in Minneapolis, which meet at the homes of the various members to play selections from the works of the great composers.

During Christmas vacation of last year, Mr. Saibel and a classmate from Cornell spent the greater portion of the holidays canoeing on the Potomac River. Their trip took them from Washington to the mouth of the river at Chesapeake Bay. At the close of his first year at Minnesota, Mr. Saibel, in company with his mother and younger brother, left for Europe. Their travels carried them through Germany, Czechoslovakia, France and Holland, considerable time being spent in Prague and Amsterdam. His mother and brother remained in Eurfert, Germany, where the latter is studying music.

Mr. Saibel's latest interest has taken him into the subject of art. Although untutored in the fundamentals of line construction, proportions, et cetera—he entered the life class at the University and immediately commenced the sketching of the human figure.

Magazine or Newspaper

IT has been brought to the attention of the editors that technical newspapers have a place on the campus of many engineering schools. The question has been asked "Why do you have a magazine instead of a newspaper?" We shall try to answer this question without giving the impression that we are prejudiced, which, by the way we are not.

In the first place, have you ever considered the inside workings of a magazine or newspaper? If you have you will appreciate more readily the points in favor of the magazine. In the first instance, applying the principle to a concrete example, we already have a campus newspaper at Minnesota. This paper adequately supplies the campus with news, both local and general.

A university campus does not furnish sufficient news material for two newspapers. A newspaper is not a good vehicle for technical articles, while a magazine is well suited for this purpose. Finally, there is the question of finances. No publication, without charging an exorbitant subscription price, can exist without advertising, and as the advertisers catering to university people are insufficient for two newspapers, a monthly magazine is the solution.

News from the Technical Campus

Arabs Initiate Forty as Feature of Fall Party

On Saturday, November 17, the Arabs club, technical men's dramatic organization, held a party at Tamarack Lodge, St. Paul. This party served a two-fold purpose; it brought all the men who worked in the show "High Pressure," which was given last spring, together again, and at the same time gave an opportunity to initiate those men left over as associate members from last year.

The initiation list included the following men: Leland Amundson, Fred Anway, Gordon Bestic, Ed Bjorklund, Melvin Ek, Marshal Erwin, W. B. Erwin, Don Felthous, Addison Fisher, Francis J. Fox, Jack Ginnaty, Francis Gorman, Wesley Gray, T. Guppy, Irvin Grant, Fred Hakenjos, Harry Hall, Vernon Halverson, Leslie Hanson, W. Haverland, Leslie Havens, J. C. Hunner, Arnold Johnson, Milton Melzian, Cliff Miller, Rus Miller, E. W. Nelson, Oslund, Ed Petrick, G. Reid, Wal Swanson, Bruce Wallace, Robert Warren and Eugene Webber.

The club is unique among dramatic organizations on the campus in that the production for the year is written, scored, and staged by active members in the technical colleges. While the plot for this year's play has not been definitely decide on, a production is planned that will surpass anything that the club has attempted before.

Hartig and Wilcox Measure Fluid Velocity

An absolute method of measuring the velocity of fluids is being developed by Professors Hartig and Wilcox of the department of mathematics. The method being tried depends on the fact that the wave length of sound is a function of the velocity of the medium as well as of the physical characteristics of the medium.

While the fluid is at rest, two points are selected on the pipe containing it. These two points are a given whole number of wave lengths apart. As soon as the fluid is set in motion, the distance between the points, measured in wave lengths, changes. The frequency of the sound may then be changed so that the same number of wave lengths are included when the first measurement is taken. The change in frequency necessary to accomplish this is a measure of the velocity of the medium.

Such a method may have far-reaching effects in commercial application, and the experimenters are working on various modifications of this system.

Newhouse Elected Head of 1929 Electrical Party

With the election of John C. Newhouse, senior electrical, to the position of manager, definite arrangements for the 1929 Electrical Party were begun on November 19. The various committees yet to be named will include a representative from each class, with a majority of the positions given to senior men.

The Electrical Party is a bi-annual affair sponsored by the electrical students and faculty. The object of the party is the entertainment of the public by displays of university and professional equipment arranged to demonstrate the various electrical phenomena.

Though the party is not scheduled until the spring quarter, work has been started now to allow time enough to bring a large number of displays from manufacturers of electrical equipment. Mr. J. H. DuBois, E.E. '28, was manager of the last show which was considered very successful with an attendance of approximately five thousand.

A.S.C.E. Holds Smoker

On November 22, the A. S. C. E. held its first smoker of the year. Exactly ninety-nine members were present to hear the witticisms of Professor Wilcox and the short talk given by Professor Bass. Grant Waits, president of the Society, introduced the speakers and new members of the faculty to the organization.

The entertainment consisted of piano selections, readings, and several vocal renditions by Stanton Wallin. The committee in charge of arrangements was composed of A. A. Anderson, John Grant, Wm. Malloy, Theodore Jensen, George Meffert, Louis M. Schaller and Grant Waits.

Rowley Becomes Aviator

Aviation, besides having gained entrance to the engineering college curriculum, has become an accepted source of recreation and entertainment by our faculty. The latest addition to the ranks of the rapidly growing aeronautical organization is Frank B. Rowley.

He bought a Waco 10, three passenger biplane and received his instruction during last summer from a friend who is a pilot at the Wold-Chamberlain field. At the present time Professor Rowley is a licensed pilot and will soon receive his commercial flying papers.

Other faculty members who are experienced flyers are Charles Boehnlein and G. O. Hoglund.

Joseph A. Dubray Addresses A.S.M.E.

On November 22 Joseph A. Dubray gave an illustrated talk on the technical phases of the motion picture industry. The talk was given under the auspices of the student branch of the A. S. M. E. and was very well attended and received.

Mr. Dubray is a nationally known expert on motion picture research and is the secretary of the American Society of Cinematographers.

The greater part of his talk was devoted to explaining the methods used for the purpose of obtaining costly effects with a minimum expenditure of money. For example, he told how twenty-seven battleships were constructed in miniature to obtain the effect of a tremendous naval engagement, where the use of the actual ships would have been impossible. Again, foreign scenes may be photographed on the continent, but the actors are superimposed on the original film by "blanking off" the miniature portion of the film with complementary color filters. When these effects are shown on the screen the result is perfectly natural.

At the present time, according to Mr. Dubray, most of the men in the industry are practical men who have got their training through years of experience. The motion picture industry offers great possibilities to men with an engineering training and Mr. Dubray expressed the hope that in the future more college trained men would enter the motion picture field.

Boehnlein and Hoglund Attend Convention

Charles Boehnlein and G. O. Hoglund, professors in the department of aeronautical engineering, attended the Aeronautical Engineering meeting in Chicago on December 5 and 6. This convention was sponsored by the Society of Automotive Engineers and the Aeronautical Chamber of Commerce of Chicago and was held in conjunction with the Aircraft Show.

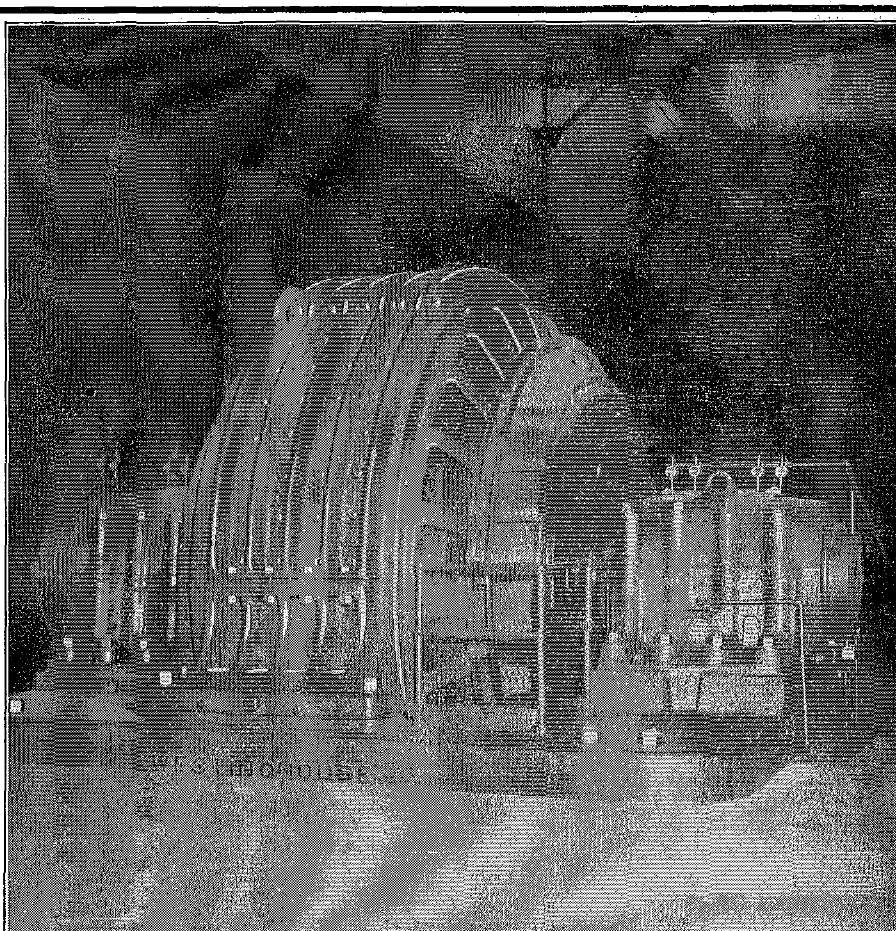
C. L. Elliott at A.I.E.E. Convention in Chicago

Carroll L. Elliott, senior electrical and chairman of the student branch of the American Institute of Electrical Engineers, was appointed delegate to the convention of the Institute at the headquarters of the Western Society of Engineers in Chicago. This convention was held December 3 and is the only student conference during the college year.

J. J. MELLON,
General Engineer,
Rensselaer, '24

J.M.CUNNINGHAM,
Power Engineer,
Colorado School of Mines, '22

J. F. KOVALSKY,
Contract Administration
W. T. N. S., '24



W. G. COOK,
Control Engineer
University of Pennsylvania, '25

A. F. KENYON,
General Engineer
Iowa State College, '22

CLARENCE LYNN,
Designing Engineer,
University of Kansas, '19

YOUNGER COLLEGE MEN ON RECENT WESTINGHOUSE JOBS

The Largest Hot Strip Mill in the World

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

SQUEEZED between giant rolls, heated steel bars flatten to form steel sheets for the bodies of the automobiles that modern America demands.

So rapidly has this demand grown within the past few years that the American Rolling Mill Company, of Middletown, Ohio, recently found it necessary to install a "hot strip" mill larger than any before.

Such record-breaking capacity brought with it a train of new problems. Electric control had to be devised to keep the big 3,000 and 4,000 hp. D. C. motors "in step" and prevent irregularities in thickness or quality of the finished sheets. Huge generators and transformers had to be designed to handle the power requirements of this new mill—the largest of its kind.

To Westinghouse came the assignment of designing, manufacturing, and installing this equipment. Opportunities of this caliber are not rare in an organization with the resources which Westinghouse commands. Westinghouse attracts young men of enterprise and genius because it daily provides opportunities which smaller companies can seldom offer.

Westinghouse

. . . an empire hung on that strap . . . .

THE hitch must be right, the pack must be tight. On details such as that hung the attainment of the day's goal and the final success of the expedition.

Lewis and Clark, first Americans to cross the continent, knew the importance of "trifles" in the concerted plan. They saw to it their equipment was right, they supervised every step from man-power to pack-horse-power, they applied sure knowledge and constant vigilance to their task.

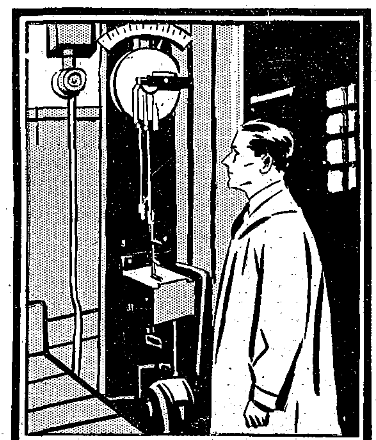
Today's leaders in business have the same point of view.

Men in the Bell System, exploring new country, take infinite pains in preparation. They work toward the smooth coordination of engineering, manufacturing, warehousing, accounting, finance, public service.

. . . and on many threads hangs Western Electric's world of telephone making

It may be a strand of cotton. It may be a fine-spun bit of wire. It may be a decision involving new methods of warehousing.

But tiny or great in size, in the eyes of Western Electric men no problem is ever tiny in importance. Somewhere in the Western Electric organization, somebody is studying his particular thread of the manufacture of telephones as if it were the most important thing in the world to be studied.



Only a thread? Yes; but it may carry a world of responsibility. This cotton-testing machine determines its fitness.

He may be an electrical engineer, equipped with the finest instruments of his art and the will to blaze new pathways of knowledge.

He may be a clear-thinking mechanical engineer whose domain is the factory floor and who seeks to wrest from that domain the last final measure of effective service.

Or he may be a keen student of commercial trends, fired with the zeal to understand; and, understanding, bend the workings of commerce the better to his especial needs.

It is in this spirit that the men of Western Electric make telephones, wire, cable, switchboards—the means by which the Bell System serves the nation.

BELL SYSTEM

A nation-wide system of 18,500,000 *inter-connecting telephones*

"OUR PIONEERING WORK HAS JUST BEGUN"

News from the Technical Campus

(Continued from page 82)

G. E. Representative Talks on Electric Arc Welding

A discussion of the application of electric arc welding to the construction of bridges and buildings was the topic of a most interesting and instructive lecture given November 17, in the main Engineering Auditorium by K. E. McKibben of the General Electric Company.

Welding first came into commercial use about 1887, and since that time has grown very rapidly. For many years it has been used in the construction of various pieces of machinery etc., but until quite recently no adequate apparatus has been designed to permit the use of welding in large structures, such as buildings and bridges. As a result of the research carried out by large engineering concerns, such as the Westinghouse Electric company and the General Electric company, new efficient apparatus has made possible the profitable use of welding in structural work.

As an example of the efficiency of welded joints on eighty recently constructed buildings, not one failure has yet been reported. In the construction of twenty ships and fifteen large bridges by this method, only one joint failure has been recorded, and that was due, not to improper welding, but to faulty design. The designing of structures for using welded joints is quite similar to that used where riveted joints would normally be applied. However the substantial saving in steel in girders using welded joints, as well as the improved efficiency makes the electric arc welding process a prime factor in the planning and construction of future buildings and bridges. It is rapidly replacing the older methods of rivet and reinforced concrete steel construction.

The welding is done with direct current of 175 amperes. Since threefourths of all the heat produced in arc welding is generated at the positive terminal, this terminal is connected to the steel girder to be welded, while the wire to be used as the filler becomes the negative terminal. A temperature of 3200° C. is produced by the arc.

Various tests on joints made by this method prove conclusively that arc welded joints are practically 100% efficient. In not a single tension test conducted by the General Electric company has a failure in a welded joint appeared.

This talk was sponsored on the campus by the American Society of Civil Engineers at their first meeting this fall. Grant Waits, president of the society, introduced the speaker and gave a short talk on Mr. McKibben's work.

Mechanical Department Installs New Equipment

Filling a long felt need at the University, the mechanical engineering department has finally acquired modern and efficient sets of welding equipment. The rapid growth of the industrial application of oxy-acetylene, and thermit welding has necessitated the purchase of this apparatus.

The equipment is complete, containing various types of electric arc and thermit welders as well as oxy-acetylene torches. A set of 18 torches for individual instruction is included. No effort on the part of the engineering staff has been spared to install and maintain this new aparatus, and as a result, students in all branches of engineering will be given the opportunity to acquaint themselves with this vital factor in future engineering work.

During the past three weeks a new steam turbine has been installed in the power laboratory. The machine is the latest of its type, developing 200 K. W. at 3,600 revolutions per minute, and has a direct connection with a 250 K. V. A. three phase generator. It was manufactured by General Electric Company and is one of the few that has been installed in universities. It will serve a dual purpose here, serving both for instruction and for the development of power for the Mechanical Engineering building and Pillsbury Hall.

Mortar and Ball Initiates Sixteen

At the annual Mortar and Ball initiation which was held in the Minnesota Union on Wednesday, November 21, the following men were initiated into the organization: William Coulter, Basil A. Beaver, Earl H. Dominik, Erwin G. Hill, Harold Lieske, George Meffert, Russed Miller, George L. Otterson, Robert Ramsdell, Rolland Stoebe, John Skidmore, George Snodgrass, Wallace Strand, Homer Thomas, Eugene Weber and George E. Main.

Following the initiation ceremonies there was a banquet at the Andrews Hotel, at which Lieutenant Cassidy filled the position of toastmaster. Guests at the banquet were Major Lentz and Major Shippam.

At the election of officers for the local chapter, Frank S. Freeman succeeded Realto Cherne as captain. Abner Bjork was re-elected first lieutenant; Wilbur Sperry succeeded Paul A. Helseth as second lieutenant, and Helseth was elected sergeant to succeed Freeman.

A.S.M.E. Inspects Watab Paper Mills

On November 14, the student branch of A. S. M. E. together with about fifteen members of the Minnesota section made an inspection trip of the Watab Paper Mills at Sartell, Minnesota. The visit was made at the invitation of Mr. Weber, vice-president and manager of the mill.

The visitors were first shown the materials which are used in the production of news print. Then the various instruments for testing paper as to strength, permeability, et cetera, were examined, as well as other pieces of machinery throughout the plant. A demonstration of paper manufacture in its early stages was also presented,—the workmen dressed in the garb of the time presented pictorially the great change initiated by the factory method.

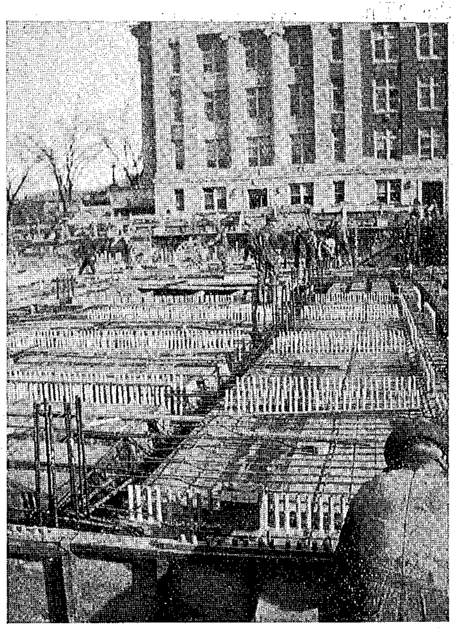
After the visit to the plant, all the members of the party together with officials of the mill adjourned to the town hall where a banquet was served. Interesting pamphlets describing the products of the mill were given as favors. Mr. Herrick, chairman of the Minneapolis section, and professor in the engineering college was toastmaster.

Great Lakes District A.I.E.E. Meets in Chicago

The Great Lakes District of the A. I. E. E. met in Chicago on October 8. This district, which includes Minnesota, Iowa, Wisconsin, Illinois, Indiana, and Michigan, has a committee composed of fifteen men and of these, four are Minnesota Alumni. Professor W. T. Ryan is the president of the district, Allan G. Dewars, ('14 E.E.) is district secretary, Professor M. E. Todd, ('09 E.E.) is chairman of the Minnesota section and V. E. Enquist, ('20 E.E.) is secretary. On the Minnesota section executive committee three of the five members are also Minnesota grads. They are: Gilbert Cooley, ('22 E.E.), C. H. Nelson ('20 E. E.) and Frank Swanstrom, ('08 E.E.).

Minnesota Section A.C.S. Elects Officers

At a recent meeting of the Minnesota Section of the American Chemical Society Dr. S. C. Lind was elected president of the section. The other newly elected officers are: B. J. Oakes, vice-president, R. E. Kirk, secretary, R. E. Montonna, treasurer, R. A. Hoffman, W. M. Sandstrom, and E. E. Schultz, senators for chemical education.



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Other Tux's $27.50 to $65
Tux Vests $6.50 to $12

Tailors—Clothiers—Furnishers

JUSTER BROS

NICOLLET at FOURTH

Around the World With Our Alumni

Civils

'09—S. H. Ingberg, chief of the fire protection section of the U. S. Bureau of Standards, has been performing several unique experiments, testing fireproof safes.

'10—A. C. Godward, who has been employed by the city of Minneapolis as city planning engineer for a number of years, has recently been appointed executive engineer for the Minneapolis committee. He will now devote his time to the commercial and industrial development of the city.

'20—Ernst W. Seemann, formerly of Whitney Bros. of Duluth, is now a Structural Engineer with the Portland Cement association, at Minneapolis.

'20—Carl C. Hanke is an assistant engineer in the Sanitary District of Chicago, and is now working on the construction of a sewage treatment plant. Carl is married and has two children.

'22—O. A. Stoutland is still with the Fargo Foundry company of Fargo, N. D.

'22—T. S. Paulsen is superintendent of building construction at Harvard University. On December 1, Paulsen was married to Miss Phyllis A. Bankart of Boston.

'23—Byron K. Curry recently left the Fegles Construction company of Lewiston, Idaho, and is now with the Hutler Construction company of Fond du Lac, Wis.

'23—John Schlenk, we hear, is engaged to Miss Frances West of St. Paul. Miss West is a graduate of Smith college.

'24—W. E. Wilson of the A. N. Nelson Contracting company of Duluth, was in town for homecoming.

'24—Archie McCrady has a position in the patent attorney's office of the Western Electric company, Chicago. Archie was formerly in the U. S. Patent Office at Washington, D. C.

'24—Martin Nelson recently returned from Sweden after a year of study of the water power development in that country. His residence is now at Grantsburg, Wisconsin.

'25—Rumor hath it that P. E. Richardson is the pompous parent of a rather disgruntled baby girl.

'25—Fred H. Larson recently left the employ of the Middle Rio Grande Conservancy District at Albuquerque, New Mexico, and is now residing in Minneapolis. Fred was married in June, 1927.

'25—John Ward, Jr., is in the contracting business at Aurora, Illinois, constructing sewers, sewage disposal plants and all underground concrete work.

'26—Ray Deegan is working at Waseca, Minnesota, with the highway department.

'26—Edward C. Gould was married to Miss Harriet Steel of Minneapolis. The wedding took place on the eighth of September.

'27—R. I. Riedesel has a position in the bridge department of the Northern Pacific railway, St. Paul.

'27—Douglas M. Campbell is on an aviation barnstorming tour in northern Minnesota. "Doug" just completed a year of active service with the U. S. Navy.

'27—John Borrowman and Lester Gehring are both at Mankato with the Minnesota highway department. John was situated at International Falls, and Les was formerly at Mountain Lake and points southwest.

'27—Floyd O. Borne has transferred from the maintenance department to the construction department of the Northern Pacific railway, and is located at Medora, North Dakota.

Elmer E. McIntire, an electrical engineering graduate of June, 1928, died Tuesday, November 6, at Rocanville, Sask., after an illness of only a week. Funeral services were held in Minneapolis Thursday, Nov. 8, with interment at Sunset Memorial Park.

For the past three months Mr. McIntire has been engaged in construction work for the Northern Light and Power company, Indian Head, Sask., under the supervision of N. W. DuBois, mechanical engineering graduate from Minnesota in the class of 1926.

While a student at the University he earned the respect of faculty members and his fellow students through his industry, sincerity and character.

Surviving are his father and mother, who recently moved to Bremerton, Washington, and two brothers and three sisters, all living in Minnesota.

'27—C. Vernon Youngquist received an addition to the family February, 1928. Vern was formerly with the Illinois highway department, and is now with the U. S. Geological Survey at Ohio State University, Columbus, Ohio.

'27—Ray C. Edlund, who has been with the Minnesota Highway Department since his graduation, is now with the Truscon Steel Company, Minneapolis.

'27—Loran A. McDanield has also joined the ranks of fathers. A son was born on July 7. "Mac" is still with the Minnesota highway department.

'27—Hugh L. Turrittin attended the summer session at Minnesota. Hugh is an instructor of mechanics at the University of Wisconsin.

'27—Ted Haakensen, who is a lieutenant in the U. S. Army and is stationed at Fort Banks, Massachusetts, has received an addition to the family. A daughter was born in January, 1928.

'28—George Ferguson is working for the water research branch of the U. S. Geological Survey. For the next few months he will be engaged in measurements of the Rio Grande River. We feel sorry for Ferguson surrounded by palm groves, and heavily laden fruit trees of every variety,—and Mexico only eleven miles away. He may be reached at Box 1187, McAllen, Texas.

Electricals

'03—Ingwald A. Rosok, the present manager of the light and power branch of the Arizona Edison company's local properties, is to have full charge of the light, power and water units in the new power plant which the company is constructing at Naco, Arizona.

'17—Martin Cornelius, another Minnesota alumnus, is now employed by the Westinghouse Electric company in the Chicago office engineering division.

'17—George W. Swenson, a former faculty member in the electrical department, was one of the distinguished "grads," who returned for homecoming festivities. G. W. is now head of the electrical engineering department at the Michigan College of Mines and Technology, located at Houghton, Michigan.

'24—L. C. Warren, who is in the employ of the International General Electric Company, has been granted a year's vacation. He is at present studying law and finance at the graduate school of the University of Wisconsin. Warren's address is 204 North Murray Street, Madison, Wisconsin.

'26—C. B. Feldman, having received his master's degree this summer, has accepted a position with the Bell Laboratories of New York. Carl has been a teaching fellow at the university here for the past two years.

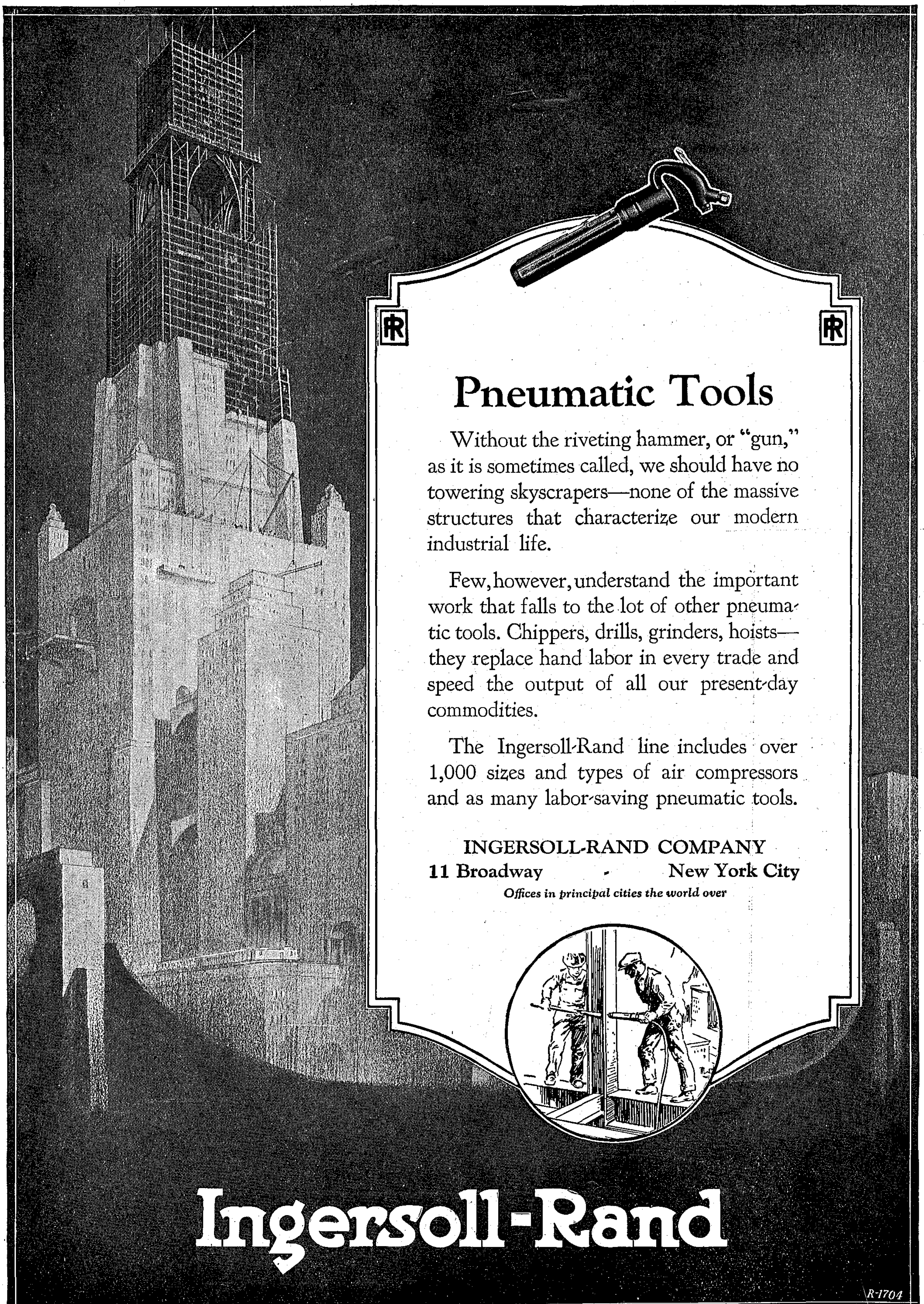
'27—Jerome C. Smith is connected with the radio engineering department of the General Electric Company. Mail may be addressed to him at 814 Union Street, Schenectady, New York.

'27—Lloyd V. Berkner, who is with Commander Byrd on his expedition to the South Pole, has been in communication with 9XI, the experimental radio station at the University.

The *Eleanor Bolling* has already reached New Zealand, where it will pick up the aeroplanes that were brought there by whaling schooners. As soon as the *City of New York,* the boat that Lloyd is on, reaches New Zealand the ships will go to the Ross Sea. It is now summer time in that region, and the water is open so that they can go as far south as is possible by boat. There are many whales in the Ross Sea and Commander Byrd thinks that they will see several of them. When they reach the ice line the supplies will be unloaded and a base established there; there will be several smaller bases between the main base and the pole, the distances between these points to be transversed by aeroplane.

'28—D. O. Johnson, Art Burris and John Elmberg are with the Westinghouse Electric company in Wilkinsburg, Pa.

'28—J. Marvin Cook, former president of the senior class, was married early this summer. The bride was Evelyn Simonson of St. Paul. The ceremony was performed July 30, 1928, in the latter city, whereupon the couple did a fade-out for a honeymoon in the Black Hills. Marvin is now with the Cutler-Hammer company in Milwaukee, Wis.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Graduate Training With Large Industrials

(Continued from page 75)

which are united in such a complex organization; and it gives you valuable practical experience in meeting and working with others as well as real insight into the mechanical work. This kind of a program prevents premature specialization. To quote Harrington, in closing:

"It is not uncommon to find great deviation from the intended course, men educated as civil engineers practicing in mechanical lines, and mechanical engineering graduates doing civil or electrical work. Even if the specialty practiced could be predetermined, the advantage of special preparation for it, within the limits of the four-year course, would be more than offset by the narrowing effect of crowding out other important subjects; and an error in choosing a specialty would probably result in mediocrity or failure, for great opportunities do not occur frequently; and if they cannot be seized promptly they are generally lost. Therefore it is essential that your education be both broad and thorough, if the greatest success is to be attained."

QUESTIONS

Following are the questions given to the men of the student course and their answers:

No. 1. Number of tests which you have had.
No. 2. Number of tests which you consider real good.
No. 3. Per cent of time spent in routine work not considered valuable experience.
No. 4. Amount of technical training required to do assigned work.
No. 5. Amount your technical training was developed.
No. 6. Rate the classwork offered.
No. 7. Rate the experience received in the course.
No. 8. Are you glad you came?
No. 9. What do you consider the most valuable part of the test course?

EACH HORIZONTAL ROW GIVES ONE MAN'S ANSWERS

No. 1	2	3	4	5	6	7	8	9
5	3	30%	50%	20%	B	B	Yes	Opportunity to handle and become familiar with large equipment.
7	4	50%	5%	10%	C	B	Yes	Practical experience.
2	1	50%	25%	10%	C	B	Yes	Practical testing with full authority of test.
1	1	75%	10%	10%	C	C	No	See large factory work.
2	1	40%	10%	20%	B	A	Yes	Experience with large apparatus.
2	2	35%	20%	35%	B	C	Yes	Experimental and manufacturing experience.
5	3	50%	10%	15%	C	B	Yes	Having it for a background.
3	2	75%	20%	10%	B	B	Yes	Association with electrical equipment and practical experience.
3	2	0	10%	10%	B	B	Yes	Contact with other young engineers.
7	4	30%	25%	15%		A	Yes	Association with industry and manufacturing processes.
1	1	30%	20%	20%		B	Yes	Actual responsibility of testing.
1	1	50%	5%	15%		B	Yes	Chance for observation of equipment and manufacturing.
4	2	60%	10%	15%	B	C	Yes	Opportunity to study new features of design and manufacturing methods.
9	2	60%	5%	35%	B	B	No	Practical training and variation of work.
6	5	50%	10%	20%	A	B	Yes	Opportunity of working on large apparatus as well as seeing its manufacture.
8	3	65%	7%	20%	E	C	No	Prestige gained through work with G. E.
7	6	60%	40%	30%		A	Yes	
4	2	40%	20%	50%	B	A	Yes	Opportunity to learn by inspection and operation electrical appts. manufacture.
5	4	40%	3%	10%	A	A	Yes	Development resourcefulness.
5	2	60%	5%	5%	B	A	Yes	Practical exp. General information by mixing with other men.
4	2	50%	10%	10%	B	A	Yes	Practical experience. Meeting other people.
7	4	70%	25%	10%	B	A	Yes	Engineering contacts among younger engineers.

Chromium Plating

(Continued from page 76)

(1920). This bath is essentially the one most generally used at the present time. A year later Grube, a German, applied for a patent on a solution essentially the same as Sargent's. Schneidewind says further that, "In the years immediately following chromium plating developed rapidly on a commercial scale. Although much interest has been aroused and many patents have been taken out, nothing new of a very fundamental nature has been developed. In fact, most modern baths, although they may have been prepared in different ways, will prove, when subjected to a chemical analysis, to have almost identical components in almost identical proportions." Such a condition brought about by a lack of understanding of what actually occurred in the plating solution after use has resulted in an undue amount of confusion in the patent situation and has retarded development of the art in that way.

Schneidewind concludes that very little important information has been disclosed in the patent literature which is not antedated by information published in the scientific literature. He thinks it is doubtful whether there is any patent or group of patents which can control the process of electrodeposition of metallic chromium from chromic acid baths.

Aside from the patent situation, there have been several other factors which have hindered the rapid adaption of this process by the average commercial plater.

1. The high cost of the relatively impure materials.
2. The necessity of unusual and careful chemical control of the constituents of the bath.

The use of much larger currents per unit area of surface plated than for any other common metal, and the necessity of getting that current to each remote corner of the object, to insure a bright plate.

4. The low current efficiency of the process. Only about 15 per cent of the current actually produces metallic chromium. The other 85 per cent produces hydrogen and oxygen which carry with them a spray of the chromic acid solution. This mist of chromic acid irritates the membranes of the nose and throat, so that special ventilation is necessary to carry the mist away.

On the other hand, one must consider the fact that very thin films of chromium serve the purpose as well as thicker films of other metals thereby partially offsetting the low current efficiency, and further than the bright plate resulting from careful control does not require any buffing at all, thus cutting down labor costs.

These factors will now be considered briefly, in the light of recent developments. A couple of years ago chromic acid was selling at about 40c a pound, while the present price published in the November 1928 Journal of Industrial and Engineering Chemistry is only 21 cents a pound. Manufacturers also are producing this material with lower content of sulphate than ever before.

The industry has been greatly aided by the large number of papers on various phases of chromium plating. A good example of this is the work of Haring and Barrows, Technologic Paper No. 346 of the Bureau of Standards, entitled, "Electrodeposition of Chromium from Chromic Acid Baths." In this paper a great deal has been done to indicate the limits of the conditions tending to give that beautiful bright finish so much desired by every plater. Methods of chemical control of the constituents are carefully worked out, and the general relation of temperature of the bath to the current density have been carefully determined. Haring and Barrows have shown that satisfactory deposits can be obtained from baths of the general composition:

Chromic Acid........250 gm. per liter
Sulfuric Acid........ 2.5 gm. per liter

Similar results may be obtained by replacing the 2.5 gm. of sulfuric acid with 3.3 gm. of chromic sulfate. This ratio by weight of chromic acid to sulfuric must be maintained at 100 to 1. As fresh chromic acid is added to a plating bath to replenish that used up during the process, that ratio must always be kept constant. This emphasizes the need of using pure chromic acid relatively free from sulfate.

It has been shown also, to take an average case, that using a temperature of 50° C. with bath, the optimum current density for steel or nickel is about 150 amperes per sq. ft. of work plated, while for copper or brass it is about 230 amperes per sq. ft.

The use of such necessarily high current densities to insure bright plates has caused considerable concern, and the improper spacing of work with insufficient current leads has resulted in a great deal of grief. Technique along this line must be developed by each plant depending on the sizes and shapes of articles being handled. Experience, here, is a dear teacher but nevertheless the most reliable one.

There seems to be little possibility of improving the current efficiency of the

(Continued on page 100)

Surveying With the Senior Civils

(Continued from page 77)

at Cass Lake to tie in the two railroads. In order to determine the direction of the railroads, a transit had to be set up at the U. S. Engineer's triangulation station "Wye" and the point of intersection made by the Great Northern with the line of sight of the transit set on triangulation station "Cass Lake" located. All that remained to be done was to read the angle between the tangent of the railroad and the station "Cass Lake" and to chain the distance to station "Wye." Office work on the railroad survey consisted of computing the azimuths and positions of the two railroads with respect to station "Wye" and plotting on detail paper.

The elevation and vertical alignment of the roads were found by taking "top of rail profile." This consisted in running levels on the top of one rail, finding the elevation at every one hundred feet and checking against bench marks along the railroad. It is possible by the reduction of these notes to find the actual grades in the railroad and to study the irregularities in the road bed.

The value and economy of a railroad location depends on the ingenuity of the surveyor and engineer in preliminary location. Several tentative lines are laid out and the one chosen as the most economical is staked out. Levels are taken on this line for the purpose of constructing a profile. The topography on either side of the line for three or four hundred feet is sketched and the contour lines determined with the use of a hand level. Probable quantities of excavation and embankment may be estimated from the profile and approximate cost of construction computed.

Bench levels were rerun and checked against the results of previous years and new bench marks added where needed. The differences of elevation between points were reduced to give the elevation of the bench marks in sea level datum, initial elevations usually taken from some known government mark. Allowable closures between adjacent bench marks was three hundredths of a foot. A bench mark easily constructed and which served the purpose consisted of a railroad tie spike driven into the base of a tree. Bench marks have been established on the Great Northern railroad, East and West Pike, and on the Black Duck road.

The cross-over problem proved to be one of the hardest to check because of innumerable chances for mistakes in computation. The problem consisted of staking in a cross-over between two non-parallel tangents on the Great Northern and Soo. The cross-over was composed of two turnouts, two circular curves, and a straight tangent of about one hundred feet in length. The angle of convergence had to be measured before computations could be made. Center line stakes were driven at fifty foot intervals and at the ends of the tangent. To check the field work, a transit was set up at the end of the tangent and the plates set to read the deflection angle of that point. When oriented, the telescope should be pointed directly on the stake at the other end of the tangent.

The entire West Pike region offered good opportunities for stadia topography. A short stake about a foot in length with a tack in the top of it was driven flush with the ground and made a suitable hub for stadia surveying. A piece of red cloth marked the location of each station. All distances were measured by reading the stadia rod and elevations carried forward by reading the vertical angles. As each backsight was taken the distances and vertical angles were reread as a check and the average of these two values used in computations. The transitman controlled the number and location of shots by considering the scale of the map and information relative to the breaks in vegetation, position of buildings, and other information regarding the nature of the territory. The position of each hub was computed by latitude and departure and plotted with its elevation after closing out the traverses with the main traverse which had been staked out on the western shore of Pike Bay. In this manner the entire area from triangulation station "Nursery" to the Scout cabins situated beyond station

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Surveying With the Senior Civils

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Twin Pines along West Pike, including the numerous side trails, was surveyed and plotted. This section is comprised of low swamps and Norway pine forest.

The plane table was found most suitable for mapping the golf course directly north of Cass Lake. The drawing was oriented by setting over station "Dock" and sighting on "West Base," and later tied into a stadia traverse which had been established on the north edge of the golf course. The reductions of the vertical angles and distances to give elevations are made in the field and the contour lines plotted as the survey progresses. The completed map is to be used in revising the present nine hole course and enlarging to a regular eighteen hole golf course.

One of the most interesting problems we had at camp was that of stream gaging and current meter rating. The meter attached to an eight foot pole was propelled through the water at a constant speed in the old box factory canal near Cass Lake. Meter rating consists essentially of plotting the number of revolutions of the propellor against various speeds; conversely, stream gaging is made by counting the revolutions of the propellor in a given period and finding the velocity of the stream corresponding to the revolutions as given by the graph. The discharge of the Mississippi River in cubic feet per second near the outlet from Cass Lake was measured by immersing the electric meter to a distance of six-tenths or two and eight-tenths of the depth at ten foot intervals as shown by a tag line stretched across the river. Previous to this, soundings had been taken of the river at these points to determine its depth or cross-section. The area of each panel so divided, multiplied by the average velocity will give the discharge in that panel, and the summation of all panels gives the total discharge of the river.

It was through the excellent supervision of Professor Cutler in railway engineering, Professor Zelner in topographic and hydrographic surveying, and of Professor Boon in office computations, that all assignments were completed.

Miners at Crosby

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ances became trivial for the main end toward which every one was working was the completion of the traverses. Breaking of tapes, however, continued throughout the underground work. A ruling was made at the beginning of this work that each party that broke a tape would have to buy the rest of the gang a treat. This became a process of cancelling breaks, until it finally ran into such difficulties that the system was abolished.

Each night when we had finished underground, the task of cleaning the ore from our transit and tape faced us. This required about thirty minutes of hard work, and our instruments had to pass inspection before we left for home.

The last week proved to be the hardest on the trip. All computations had to be finished and checked in by Saturday night. Duties that should have been completed at an earlier date had to be finished now; consequently the last few nights contained much more work than sleep.

Carboloy

(Continued from page 73)

gineer, and Mansel White, a metallurgist of the Bethlehem Steel Co. They startled the world by exhibiting at Paris in 1900 tool steels which could be used at such speeds and feeds that the cutting tool was heated to a red heat. Their outstanding contribution to high speed steel was the process of heat treatment in which the steels were heated to very high temperatures, 2100° to 2200° F followed by drawing at higher temperatures than had previously been used—1050° to 1250° F. This treatment with slight modifications is in use at the present time.

A modern high speed steel may have quite a variation in composition but the following analyses are typical of two classes:

The first type, known as *low tungsten-high vanadium* steel, has a composition range as shown below:

C	Cr
0.65-0.75%	3.25-4.25%
W	V
13-14.5%	1.50-2.00%

The class known as the *high tungsten-low vanadium* group varies in composition as follows:

C	Cr
0.68-0.75%	3.50-4.50%
W	V
17.5-18.5%	0.90-1.25%

Thus "Carboloy," still new to the field, has already replaced high speed steel and Stellite in many cases, and promises to become a very useful alloy over a wide range of work.

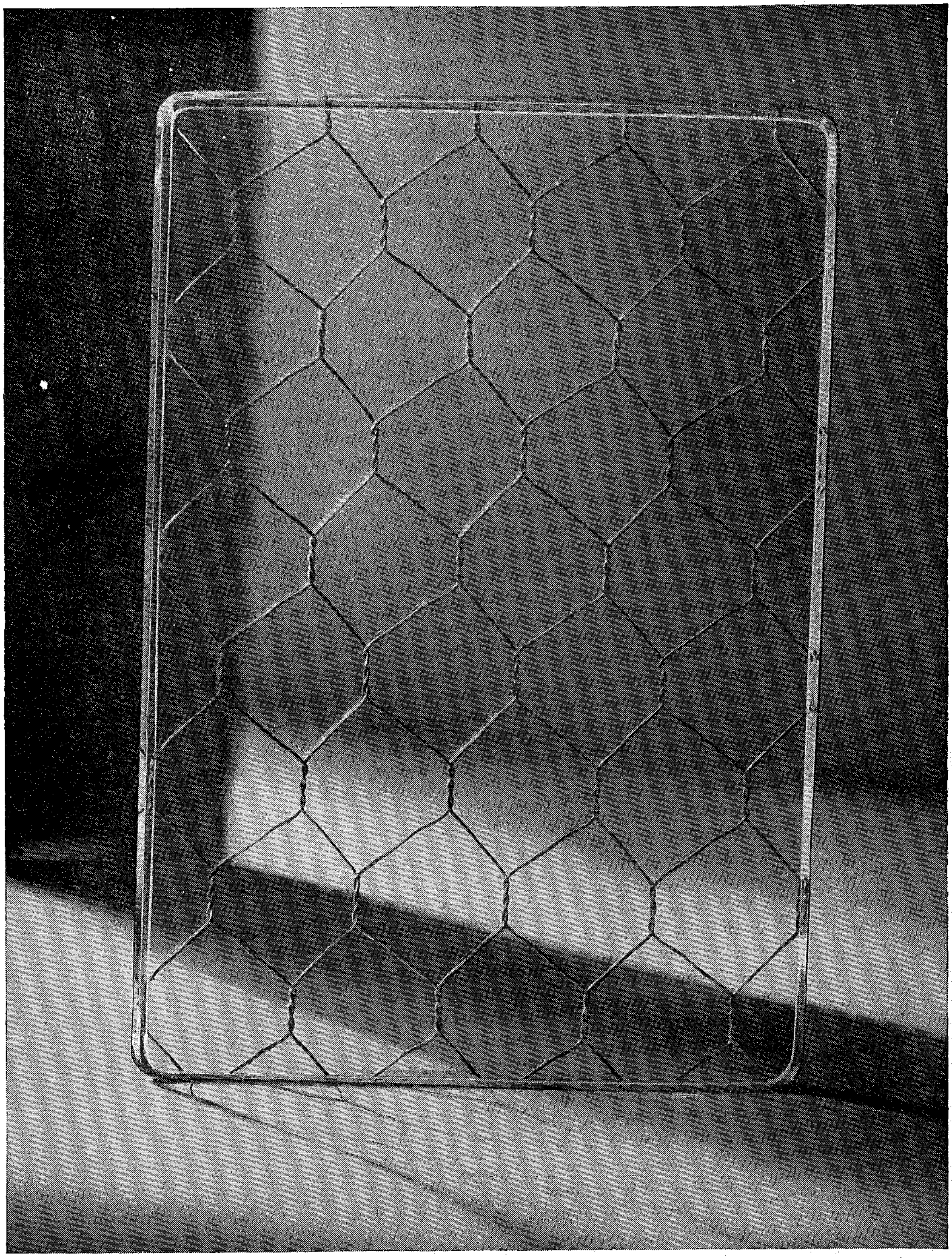
DRIPPINGS

One of the stenographers on the campus gave a sure indication of the trend of her thought when she typed "slenderness rations" for "slenderness ratio" in making up a recent stresses quiz.

Student (in astronomy): "Has anything ever been discovered on Venus?"
Professor (whose mind has wandered): "No, not if the pictures of her are authentic."—*Punch Bowl.*

Have you a cigarette?
Lots of them, thanks.

And the Bituminous said to the Anthracite, "Don't be a damned fuel."—*Froth.*



Chromium Plating

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present type of plating bath but with so much that is being done along this line one wonders if the possibility of getting a part of that wasted 85 per cent will not spur some one on to real success.

As the host of useful properties would indicate, chromium plating has been put to many uses in industry. A great many of these have been described by Wm. Blum of the Bureau of Standards in the Metal Industry (New York) 25, 14-16 (1927). The work at the Bureau showed that the application of about 0.0002″ of chromium deposited upon the nickel surface of an otherwise finished electrolytic plate, gave impressions even better than the originals, and yielded several times as many impressions as the nicked faced or the case-hardened steel plates. This work pointed the way to the advantage in using chromium plating for gages. This method obviates the use of a heat treating method in a great many cases and has the advantage that an old gage can be replated at anytime so as to be as good as new. Other uses followed rapidly. It is now used for rolls for making paper, and due to its heat resisting properties is also used on the rolls for making plate glass. These same properties show why it is used for molds for the synthetic resins like bakelite, and for molds for vulcanizing rubber. It is also used for plating metal screens, for various sifting or grading operations, and increases their useful life many times.

Due to its corrosion resistance chromium plating is used on pipes and metals exposed to nitric acid. Its resistance to sulfur compounds makes it valuable in the paper industry, where either the sulfite or the soda processes are used. In the petroleum refining field, chromium plating is being used for protecting the costly high pressure equipment used in the modern stills. It is resistant both to the flue gases and to the sulfur compounds in the petroleum.

The average man is more familiar with the application of chromium plating to auto parts, bathroom and other plumbing fixtures and to reflectors. Anyone who has spent many a weary hour polishing the nickel on his car will appreciate the ease of wiping the chromium plated parts with a damp cloth, for only the dust or outer dust needs to be removed from the chromium surface. The dull appearance of the nickel however is due to the actual tarnishing of the metal, and the brightness can only be restored by literally grinding away the tarnish to expose fresh nickel, and eventually the base metal beneath.

Chromium plating is now being used on wrist watches, watch chains, cigarette cases and similar articles. Its bright luster makes it look much like platinum, while at the same time its durability and non-tarnishing characteristics enhance its value.

This whole subject of the use of chromium plating for metal ware is well summarized by R. K. Hetherington in the Metal Industry (N. Y.) 26, 256 (1928) who says, "Out of all the mass of articles, technical papers and conversation about chromium plating, one thing stands out, and that is that chromium plating is bringing back the beauty of metal design popular years ago, but impractical then because of the difficulty of keeping it bright and polished. Now with a permanent rich lustre between silver and platinum, a finish that lends itself equally well to massiveness or filigree—chromium plate bids fair to sweep all before it on its rise to popularity. It is bringing with it new designs in plumbing fixtures. It is also influencing the use of color in the bathroom and helping to dress the kitchen."

Reclamation Work Progresses at the Zuiderzee

(Continued from page 79)

of the lake must therefore be large enough to prevent the water level from rising sufficiently to endanger the dikes which surround the polders. The area of the lake is to be about four hundred square miles. It is estimated that this will be ample to prevent large changes in the level of the water. When this lake finally becomes a fresh water lake it will be of great value to the surrounding section of Holland. It will act as a reservoir of water which can be used in dry weather to irrigate the land in the polders and to maintain the water levels in the canals for navigation. In addition to the large lake mentioned above a smaller lake will be formed near Amsterdam.

At first it was intended to complete the main dike before beginning the work on the polder dikes but it was later decided to construct the polder near the Island of Wieringen, at the same time as the other work. The dike for this polder was started in 1927 and will be completed in 1929. The water inside the polder dike must then be pumped out. Pumps of very great capacity are under construction. The pumps which are to be operated at Medemblik will be electrically driven while those near Den Oever will be operated by Diesel motors. With these pumps in operation it is expected that this polder will be drained by the end of 1930. Work will then be started on the canals and roads. This work will take about three years for this small polder and when finished will aid in the removal of the salt from the soil by drainage. The removal of salt from the land by rain water will take several years so that it will be some time after the enclosing of the polder before the land is suitable for farming. The land in the first polder will not be ready for use before the completion of the main dike in 1934. Following this the machinery and equipment used on the main dike will be turned over to the building of the remaining polder dikes. The work will thus proceed in an orderly fashion without too heavy an outlay for equipment. The total cost of the work is estimated to be between three and four hundred million dollars. There will be about five hundred and fifty thousand acres of reclaimed land so that the cost per acre is not exorbitant.

In addition to the cost of the project the Dutch Government is faced with an additional major problem. The majority of people living around the present Zuiderzee are fishermen. The means of livelihood of these fishermen will be removed so that the government is faced with the task of making farmers out of fishermen. The whole operation is indeed a noteworthy achievement for so small a country as Holland and it is a more economic way of increasing territory than is the older method of waging war.

Someday some one is going to give the definition of an engineer but it isn't going to be published.

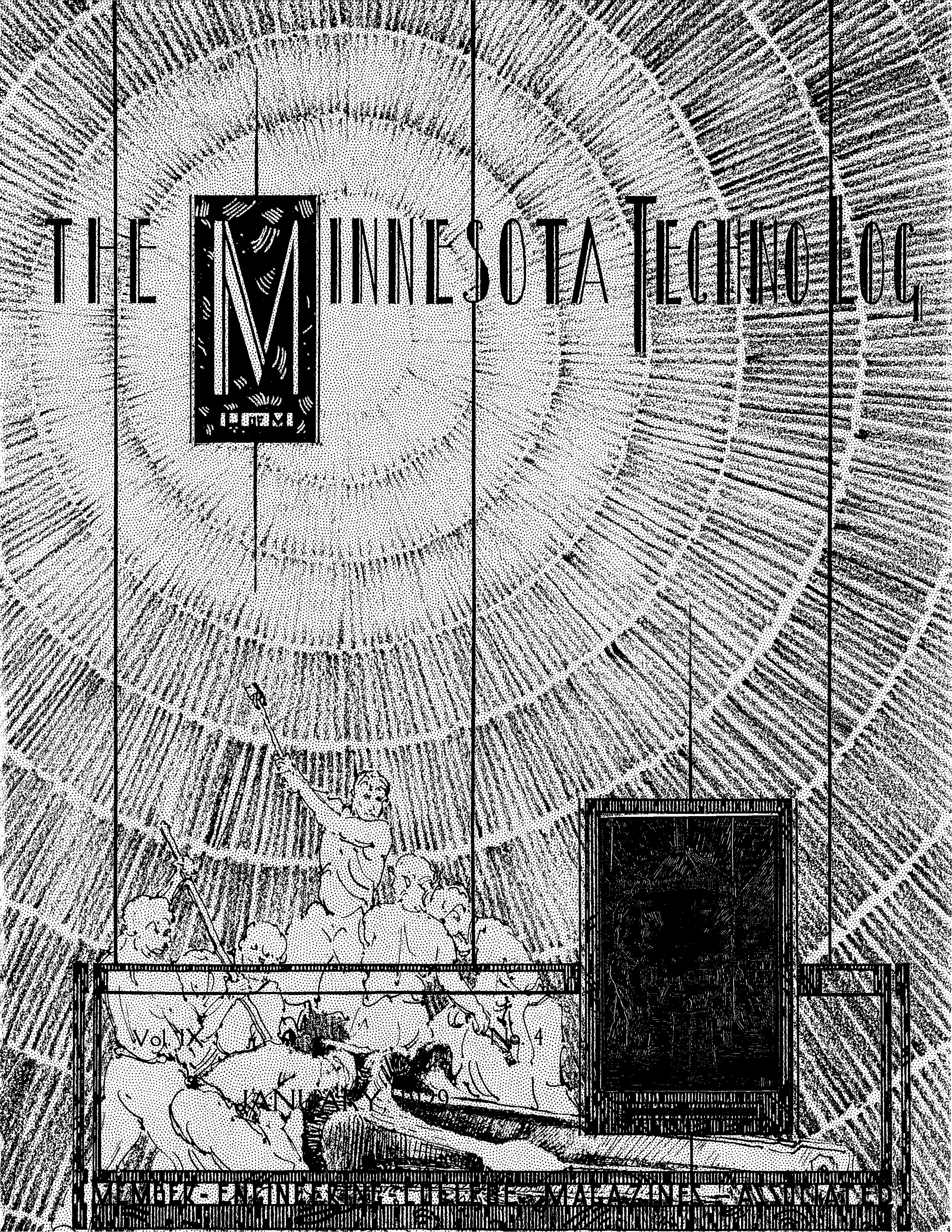
She was only a chemistry prof's daughter but she always had a hot retort.

Prof.: Isn't it true that by entering college one opens the gate to opportunities?

Student: Yes! And by graduation closes them.

Aviator: Want to try a flight, boss?

Aero. Eng.: Nope. I designed that plane.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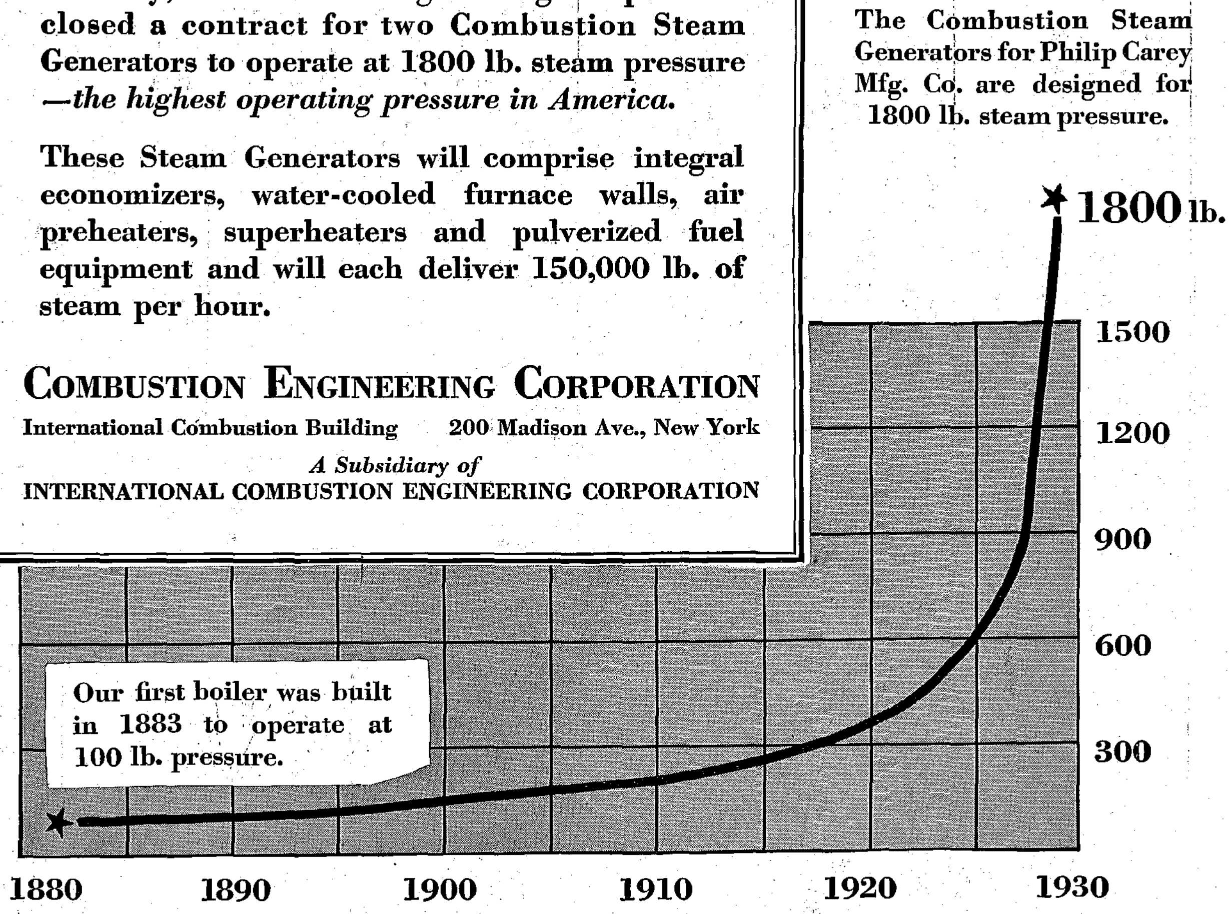

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The MINNESOTA TECHNO-LOG

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Patent Office Possibilities

Minnesota alumnus describes some of the points of patent office work that are of interest to engineers

By ALFRED J. JACOBI, M '25

THE opportunities offered to engineers in the U. S. Patent Office are not generally known. Yet it is a field where the able engineer may find interesting and remunerative employment among agreeable surroundings. This article is written with the hope of informing engineering students of the most important problems to be considered by anyone wishing to enter the U. S. Patent office examining corps.

The entrance examination for Junior Patent Examiners is so designed that an applicant must have the equivalent of a degree in engineering from an accredited college. The examination covers a number of subjects: mathematics, physics, drafting, technics, language, and one of four optional subjects.

The problems in mathematics cover work in the various branches up to and including calculus. Any graduate from the University of Minnesota should have little trouble passing without further preparation. Physics may call for a brief review of the college work and some study of the fundamentals of optics. Drafting requires the reading of a typical patent drawing in which the examinee is required to name the parts by number as given, and describe the operation of the device. Language calls for some knowledge of either French or German.

The examination in technics is calculated to show general knowledge of engineering terms and materials. For this subject, it would be advisable to study some standard work on industrial chemistry. The optional subjects of which one is chosen are mechanical, electrical, civil and chemical engineering, and passing depends upon the knowledge obtained during the course at college.

As for the work itself. Upon entering the office, which is located in Washington, D. C., the individual is assigned to an "art" in which he is especially interested. It may be well here to briefly state that "art" as used in the patent office means, in a general way, some field of industrial endeavor, for example, clocks, measuring devices, bridges, et cetera. It seldom happens that an individual is assigned to a foreign "art," that is, an electrical engineer given a civil or chemical "art." At first the fundamental rules of patent practice are learned as well as the "art," its classification, and what it contains as evidenced by the patents that represent it.

> *After reading the discussion by Mr. Jacobi, I feel that I should reiterate certain of the statements made by him. I do not believe that he has in any way over-estimated the patent office work, either in regard to the general desirability of the work or the financial return which may be expected. I know of no field, relative to engineering which offers a better ultimate financial return than does the field of patent practice. To one interested in this type of work, the field should be worthy of earnest consideration.*
> (Signed) RICHARD R. TREXLER, M '27.

Now consider that you are working in the office. You are given an application for a patent which you read and check for formal errors, at the same time determining what it declares. Then the claims are read which are that part of the disclosure which the applicant believes he has invented. A search is next made of the pertinent "art" with a view of finding matter that is claimed. Then with the application and its claims, and their "art" at hand, a letter is written instructing the applicant about the correction of formal errors and telling him of the claims which you do not believe patentable in view of the "art" cited.

Then you consider the very interesting and disputable question of what is and what is not invention. For example, a man may claim three elements A, B, and C in combination. You find in one patent elements A and B, and in another, elements B and C. The question to determine is whether it constitutes invention to combine element C of the second patent with elements A and B of the first patent, or element A of the first, with elements B and C of the second. Suppose you consider the combination unpatentable and so inform the applicant. He replies that it does constitute invention, because he gets a new result. If neither party can agree, the applicant must appeal to a higher tribunal for his claim. Although this sounds very mechanical, it is extremely interesting.

It is advisable for all examiners to take a course in law, since office promotion will not be made beyond a certain point unless the man is a member of the bar. This is easily arranged by attending night school at one of the many institutions throughout the city. Most examiners plan to leave the office to work as patent attorneys or solicitors,—for the former, membership in the bar is imperative, for the latter it is extremely valuable.

We quibble by saying that a man should follow a profession solely because he loves the work. We are all human, and as humans we strive to raise our standards of living, and this requires greater income. This is not unethical, because raising our standards of living is for the betterment of our chosen profession. Therefore, a discussion of the financial possibilities is not amiss. The initial salary is $1860.00 from which a small percentage is withheld as retirement or resignation pay. This salary is increased by increments of $100.00 to over $2000.00. At present a strenuous effort is being made to bring the salaries up to $2400.00 after three years of service. Living expenses in Washington are moderate, quite comparable to those in the Twin Cities.

Upon leaving the office to begin work for himself or enter the employ of some patent firm, an examiner can expect an increase in salary of between 35 and 50 percent. This is of course largely contingent upon the qualifications possessed by the individual, but independent of the length of time spent with the government.

Aviation Engine Developments

A former Minnesota instructor describes some recent developments in air cooled aeroplane motors

By R. M. Hazen

THE production stage has been reached in the aviation industry due to recent commercial development. Expansion is taking place all along the line from the small sport or two-seater to the large multi-motor transport plane. At the same time funds made available to the army and navy for the purchase of new equipment have been greatly increased. Almost simultaneously with this mounting market for aircraft has come the complete depletion of the stocks of cheap war-built engines. The resulting lack of cheap motive power is proving a temporary handicap to plane manufacturers, especially in the low powered field. Modern engines in the medium and high power range have proved in the past to be sufficiently superior to war-built engines to warrant their higher initial cost. However, in all sizes the need is urgent for still more durable and reliable engines at lower cost.

That steps are being taken to meet this need is evidenced by the great activity in the aviation engine industry. Present developments will result in a complete range of engines of from 25 to 600 horsepower or more in the near future. This expansion can be roughly classified according to developments in the low powered field, approximately 250 horsepower and under, and in the high powered group, over 250 horsepower. Engines in present use in this country fall naturally into this classification as do the majority of engines under development. In the low powered field with the passing of the OX and Hisso from the market, there remains the Wright 'Whirlwind' engine of 200 HP as the only proven modern engine immediately available. In the high powered field the Pratt and Whitney 'Wasp' of 400 HP. has taken the same position with the obsolescence of the Liberty. The newer Wright 'Cyclone' and Pratt and Whitney 'Hornet' of over 500 HP. are well on the way toward displacing water-cooled engines of equal and somewhat greater power except in special applications. This leaves the field under 600 HP. practically monopolized by air cooled engines. Since all of the new engines under this power are of this type no further mention of water cooled engines will be necessary.

The low power group is witnessing the greatest activity due to the greater numerical demand for the cheaper planes and also because this field has scarcely been touched in this country until recently. Demand for cheap engines available at once to replace the war-time engines is being met by importation of foreign engines such as the Siemens-Halske, the Anzani and the Cirrus. That American initiative will not leave this field long monopolized by imported power plants is evidenced by the fact that at the present time between fifteen and twenty new companies have organized and are either just announcing or soon will announce new engines covering the range up to 200 HP. or so very thoroughly. In addition established companies will certainly enter or expand in this field.

Practically all of the new engines are of the stationary radial type. No difficulty is encountered from lack of uniform cooling of radial engines since all cylinders are subjected to the same flow of air without special cowling. Most successful air cooled engines are of this type and new engines naturally follow established practice, especially when there is little time for thorough development work required on new designs. In the lower powers the radial engine streamlines into the fuselage readily without a great amount of obstruction of the pilot's vision, has a short overall length, and has perhaps a slight advantage in weight per horsepower over in-line engines. Another factor in its favor is the ease with which several models may be provided by developing 3, 5, 7 and 9 cylinder engines about a given cylinder design. This simplifies production and reduces costs without great complication since a great many of the parts are adaptable to all models. Cylinders, valves, valve operating mechanism except cams, link rods, pistons, crankshaft, bearings and many other parts may be used in any engine of the series. While the majority of the new engines in the low power group are announcing only the seven cylinder model, most of their manufacturers plan to bring out five, nine and possibly three cylinder models as soon as conditions warrant.

Since initial cost will be a major factor in determining the success of a given engine, great efforts are being put forth to reduce this cost. Probably the majority of innovations in the newer designs are a direct or indirect result of this factor. Several of the new engines have cast iron cylinders in place of the usual steel sleeve with screwed on aluminum head of American practice. This reduces the cost per cylinder very appreciably but results in increasing the weight per horsepower in two ways, namely, by an actual increase in the weight due to the material used and by a reduction in the horsepower available at a given speed. This latter is the most important factor and results from the reduction in brake mean effective pressure of from 120 to 130 pounds per square inch obtained with the composite cylinder to 100 to 110 pounds probable in a well designed cast iron cylinder. Bolting of a cast aluminum head to a finned cast iron sleeve will undoubtedly be resorted to in some cases as a compromise which should give good results if carefully worked out, especially in the smaller cylinder sizes.

Numerous innovations in the valve operating mechanisms are found in the new models. The expansion of the cylinder between cold and hot when overhead valves, rockers and pushrods are used does not permit of conventional cam design unless this expansion is compensated for to some extent. By careful cam design the impact loading on the valve parts may be held within reasonable limits without obtaining too great a variation in valve timing between idling and full throttle conditions. However, the majority of the new engines provide some means of compensation and considerable ingenuity is exercised in obtaining this without material cost. Some engines use the conventional single radial cam; others are employing separate camshafts for each cylinder. Open valves, springs and rockers are found on several models to reduce cost in spite of the fact that under average operating conditions enclosure of these parts has been found desirable to prevent wear.

Double ignition is universally provided even on the smaller engines both as a safety factor and because of the small increase of power obtained. In some cases this is obtained from a single double-spark magneto. Superchargers as built-in in the majority of higher powered radial engines usually do not give much over atmospheric pressure in the manifold at full throttle. In other words, while giving a slight supercharging effect, they act chiefly as rotary distributors aiding vaporization, mixing, and equal distribution of the mixture. With this in mind some of the new engines have provided rotary fans running crankshaft speed (to reduce the cost and complication of gearing) in the induction passage. Considering the velocity of the gases through the intake system it is quite likely that some of these 'paddles' actually reduce the volumetric efficiency of the engine without aiding distribution because of their low peripheral velocity, in some cases apparently much less than the average gas velocity.

Among unconventional engines of the low powered class are available the "cam" engine, a four cylinder radial engine using a two-lobed cam in place of a crankshaft, and two two-cycle radial engines. The latter have interesting possibilities in connection with a supercharger, with which there is a likelihood of obtaining sufficient brake mean effective pressure and reduction in fuel consumption to permit it to compete with the four-cycle engine. Idling difficulties must also be overcome. The unencumbered cylinders lend themselves readily to air cooling as well as simple cowling and should have low air resistance when installed in an airplane. Considerable experimental work will undoubtedly still be necessary to bring this type to the point where it can compete in performance with the usual four-cycle engine.

The high powered engine group is influenced by several factors not applicable to the smaller engines. Of primary importance in this field is the effect of military requirements. For some time to come the army and navy will be the chief market for large engines. Any engine not designed to be readily adaptable to their needs in addition to its commercial utility seems doomed to failure. The larger engines are more expensive to develop as well as requiring the highest engineering skill to perfect. It is therefore to be expected that practically all new engines of over 250 horsepower will be placed on the market by manufacturers of considerable experience in the aviation engine game. Their familiarity with military needs, their engineering and production facilities, and the financial backing of these companies all give them an advantage which could scarcely be met by new companies entering the field. Also in this field are found three engines already in production which meet the needs from 400 to 550 H. P. The gap between 200 and 400 HP. will be filled in the near future by present manufacturers by expansion of and refinement of present cylinder designs and the use of a series of engines of varying number of cylinders.

Inasmuch as the inherent advantages of air cooling should be just as pronounced in very large powers as in the smaller sizes, the developments now going on to displace the water cooled engines of 500 or 600 and more horsepower are interesting. In the Hornet and Cyclone engines of 500-550 HP. the practical limit in power for the pure radial type of engine has probably been almost reached. The limit of capacity of the single crankpin bearing even with the one piece master rod construction has been practically reached so that increased power obtained from either increased speed or cylinder size is not likely. Cylinder size is also limited by cooling difficulties as well as lack of space on the crankcase for larger cylinders when nine cylinders are placed radially about a single crankpin. Both higher compression ratios and supercharging above atmospheric pressure result in higher crankpin loading and are not likely to be successful unless new developments in bearing materials permit of higher loading. Special fuels are also necessary with any increase in compression pressure. Hence with the pure radial engine practical limitations preclude any great increase in power.

With the entrance of the United States into the World War, Mr. Hazen enlisted and served two years in France. Returning to the United States at the close of the war, he completed his studies at the University of Michigan and entered the employ of the General Motors Corporation at Dayton, Ohio.

In the fall of 1923 Mr. Hazen became a member of the faculty at Minnesota where he remained for four years. In 1927 he left the University to take a position as assistant to the chief engineer of the Wright Aero Corporation.

Manufacturers are therefore turning to other cylinder arrangements which permit of a greater number of cylinders. Two bank radials in which a two-throw crankshaft is used with a set of radial cylinders operating on each crankpin has long been used in Europe. From both a service and manufacturing standpoint the fewer the number of cylinders used to obtain a given power, the lower the first cost and the greater the ease of maintenance. Hence it is not likely that engines employing small cylinders and two banks of nine cylinders each will be much employed. As in water cooling practice, powers up to 800 HP. will probably be taken care of by 12 cylinders. Two major solutions in arrangement are offered in the new Curtiss and Allison engines. The former is a 12 cylinder radial engine using two banks of six cylinders per bank with individual overhead camshafts for each pair of cylinders in line. It is rated at 600 HP. at 2200 R.P.M. The higher crankshaft speed permissible with two crankpins taking the loads is utilized to increase the horsepower. The possibilities of the air cooled V-type engine were well demonstrated by the air cooled inverted twelve cylinder Liberty developed by the U. S. Army Air Service, in which a Liberty engine was fitted with smaller air cooled cylinders and developed practically the same power as the water cooled Liberty. The Allison Engineering Company is now marketing this engine with some improvements both in the geared and direct-drive models. That an engine which is simply adapted for air cooling with its major parts taken from a ten year old water cooled design can be successfully marketed gives some indication of the possibilities of this type of engine when designed entirely for air cooling and in the light of modern design throughout. The V engine probably offers the most advantages when powers of 600 to 800 are desired. Suitable engines of this type will have a ready market for fast military planes as well as being adaptable when geared for use on transport, bombing and commercial planes. The speed limitations of the radial will not be felt and crankshaft speeds at least as high as used in modern water cooled V engines can be used. Cowling and exhaust manifolds present less of a problem with V than with radial engines, which are important items in its favor. Less frontal resistance and ease of streamlining should also result. Inverted the V engine gives a marked improvement in range of vision of the pilot over the large radial engines in the single engined ship. More engines of this type will undoubtedly make their appearance soon, at least one being well along in the experimental stage. It would not be surprising if this type of engine would displace some of the larger radial engines as experience in its design is acquired.

The introduction and operation of the new engines of all sizes will be watched with great interest by the aviation industry. The competition resulting from the large number of companies entering the field should result in more rapid progress even than in the past. As in the early days of the automobile industry, it is to be expected that many companies will fall by the wayside, perhaps a greater percentage in the aviation industry because of the greater expense of development and the more rigorous requirements to be met by airplane engines. The net result within two or three years should be a well equipped manufacturing group capable of handling all requirements at an appreciably lower cost than at present.

Postoffice Lighting

A comparison of the various types of lighting systems used in Government buildings at the present time

By C. A. PETERSON, EE '08

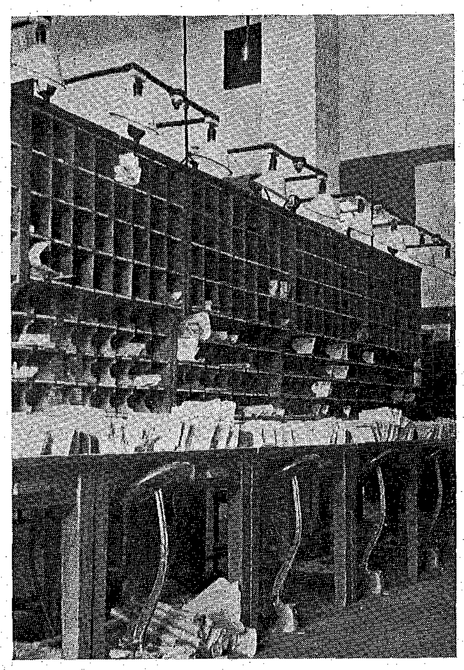
HISTORY tells us that light was the first thing created in this universe. This fact alone is ample evidence that light is one of the great necessities to human welfare; in fact it is the very basis of life.

As civilization advanced, that strong human impulse called the "herding instinct" manifested itself by the development of the postal system. It is an old institution. An early reference to the postal service is found in the book of Esther. The time has been set at 510 B. C. but it is probable that even earlier stages of civilization had some form of postal service. The postal system in this country began with its earliest history. It started in a crude form in Massachusetts in 1639 and a postal service for all the colonies was initiated in 1691, with the inauguration of the American Post.

The duty of the post office is to carry mail from the sender to the desired destination. Each post office may be regarded as a sort of clearing house for the performance of this function. The importance of having the United States government own and control its public buildings was early recognized. The constitution wisely made provision authorizing Congress to exercise control over places required for public buildings. The control of the construction was first entrusted to the President. Later the Secretary of the Treasury was charged from time to time with the construction of certain federal buildings but it was not until 1865 that the office of supervising architect took form.

Although this office functions in practice as a bureau, it is a unit in the office of the Secretary of the Treasury. Its duties are to construct and maintain post offices, customs houses, court houses, marine hospitals, appraisers stores, barge offices and other miscellaneous structures. There are at present over 1400 buildings under the control of the office of the supervising architect. Of these federal buildings, the post office department is the largest tenant, occupying more space than all the other departments combined.

As transportation increased and cities grew larger, it became necessary in order to serve the public satisfactorily to do most of the postal work at night. This called for artificial light. At first each employee was quite happy with a candle or an oil lamp. Even when gas and electricity came into use it was only necessary to spot a lamp here and there where most needed. The carbon filament lamp was used in the earliest lighting. No great evil resulted from the use of these lamps because the light sources were not of sufficient brightness to cause serious discomfort, moreover the postal duties were not very strenuous. The tungsten filament or "Mazda" lamp was a great improvement but only when



LIGHTING FAVORED BY SORTERS
This is the type of lighting favored by the majority of letter sorters.

these lamps were made with concentrated filaments and filled with gas was a light produced of such intensity as to cause serious interference with vision when improperly used. These lamps give a tremendous increase in candlepower and when unprotected by a diffusing medium cause extreme glare.

We have all frequently seen a 100 watt gas-filled lamp used in a fixture with, say, four arms, to replace four twenty-five watt lamps because the big lamp was brighter. Of course the filament of this lamp projected below the twenty-five watt reflector and such conditions brought glare. Later, when the inside frosted lamp made its appearance, glare was not so serious as with the clear bulb but was still too great for comfort without a proper diffusing medium. The modern high intensity lamp of the last decade has stimulated a desire for more light. It has made possible industrial work not only at night but also during the day, in buildings having inadequate daylight. It has enabled industrial operations to be carried on at a higher speed but it has called for closer application and additional eye strain.

White glare is a comparatively new factor in artificial lighting. It has always been an element in natural light so it is important to protect the eyes from bright sunlight or skylight areas or other bright sources of light. Glare has been said to be caused by light out of place or by excessive brightness, excessive quantity, or excessive contrast between the light source and its background. The effects of glare are first physical and optical discomfort, decreased safety to the individual due to reduced visibility, and later injury to the eyes and possibly to the general health.

The present type of lamp has a high brilliance due to its concentrated filament, and if left unshaded, causes eye fatigue and possible injury. Glare due to contrast is best illustrated by the blinding discomfort when facing an automobile headlight at night and the slight discomfort caused by facing the same headlight in the daytime with little contrast in the background. Dazzling glare is produced by light entering the eye which does not aid vision such as one or more bright light sources located more or less directly in front of the individual. This is the most common type of glare and explains the importance of inclosing the present type of lamps in diffusing glassware to reduce the intense brightness to a comfortable stage. Blinding glare is the most severe. It is caused by facing any extremely bright light source such as the sun, unshaded lamp, or an automobile headlight at night. Exposure to such lights generally produces retinal fatigue to such an extent as to cause after images for a short time.

In postal service the work of the eye consists chiefly in reading handwriting or typewriting on the letters and wrappers of the different forms of mail. The color of the envelopes in general use is white with the writing in black or blue ink, although in seaport cities considerable foreign mail is received in colored envelopes bearing addresses in various degrees of legibility from good to poor. Many operations in the postal service require no close eye work. The mail entering at the platform, mostly in bags, is moved in trucks which entail only the reading of the labels in rather large characters. The mail is then dumped on the table where the "facers" stack the letters with the address and the stamps facing the same way. Then the mail goes through the motor driven cancelling machines and from there it is taken by men called "feeders" to the various separation cases where the work of sorting the letters into the right pigeon holes of the case requires close visual concentration. Mail for local delivery is taken from the pigeon holes by the carriers to their respective cases where each carrier sorts this mail in the order of delivery. Mail to be dispatched to distant points is taken by "sweepers" or "strippers" to the state cases for a secondary separation. The work of tying in bundles and placing in pouches according to destination does not require close application but needs adequate light free from glare if errors are to be eliminated.

It is the letter sorting that entails the greatest burden on the visional organs and it is the space for this work that receives the greatest attention in design. The letter sorter stands before a separation case having 48 or more pigeon holes. Each pigeon hole may be numbered to correspond to the number of carrier's route or labled to receive the mail from the various states, large cities and routes taken by the mail trains.

In studying the various processes of the clerk as he sorts a handful of letters and conveys each one to its proper pigeon hole we find that his first act is to fix his attention upon the address. In doing this, the ciliary muscles of the eye not only adjust the crystaline lens to focus the image on the retina, but also control the iris which governs the quantity of light transmitted through the pupil. Now as the address is read the eye follows the letter which the clerk conveys to the proper pigeon hole and again the ciliary muscles must act to adjust for the change of distance, and the difference of illumination. This all happens very quickly for many clerks sort 40 letters per minute and some have been observed to sort 60 per minute for short periods. If the illumination is low the speed of vision is reduced because the pupil is dilated to receive more light and the enlarged pupil tends to introduce refractive errors. The dilation is controlled by one set of muscles of the iris; the other set simultaneously tends to contract the pupil when viewing a nearby object to produce a sharper image. This conflict between the muscles of the iris causes fatigue. A clerk sorting 40 letters per minute must have the images of the 40 addresses register on his retina each minute and possibly as many images of the pigeon holes into which he puts each letter. For speedy work each image should build up quickly and fade just as quickly to allow for succeeding images. It is known that the image builds up quickly under high intensity, but has a tendency to persist if the quantity is excessive.

Now, you will ask, how much light is required? How many watts per square foot or how many foot-candles are required for this work? Let us say that it requires eight foot candles effective upon the eye for this work. Now letters and first class mail generally have a high reflection factor. Most of this mail is white paper reflecting 80 per cent of the light. To produce the above assumed eight foot candles effective upon the eye, then, requires ten foot candles upon the work. An intensity of 160 foot candles may seem excessive but that is just what a tailor would need working on a fabric reflecting five per cent of the light in order to have as much light effective upon the eye as the above sorting clerk.

It has been found that an intensity of ten to fifteen foot candles now generally used upon the work of the letter sorter gives satisfactory service. This intensity has been used since the frosted inside lamps became available.

The lighting equipment for sorting cases in general use consists of bracket arms mounted on the cases. The lights are about two feet apart or two for each clerk. A 30 degree angle porcelain enamel reflector protects the eyes and throws the light on the face of the cases as well. The bottom of the reflectors is about on a line with the top of the cases and one foot in front of them.

This system is the standard design for sorting cases. Flexible cords with plugs are used to connect lights between cases; this arrangement permits the cases to be moved about the workroom and the lights plugged into adjacent cases without the services of an electrician. The growing business of the post office and especially in the holiday rush periods necessitates frequent rearrangement of the furniture. Then, too, local lights in the past have been found necessary to satisfy the clerks and carriers, as a general impression has prevailed that lights mounted some distance above the work are inadequate irrespective of intensity.

Overhead inclosing units have been used in several installations to light sorting cases to determine if better results may be obtained under actual working conditions. Here the fixtures are mounted ten to twelve feet high and 16 inch diameter squat shaped, white opal globes are used with lamps as large as two hundred watts. The intrinsic brightness is not over one and a half candles per square inch which illuminates or reduces glare to a minimum. The mounting height is governed by the difference between the rows of cases in order to prevent shadows. The fixtures are suspended above the center of the aisles between opposite rows of cases facing each other. The direction of the light on the work is then from above, and from the rear of the workers, as it should be. The use of such large sized globes softens the shadows and diffuses the light to such an extent that very little glare is present, even from window envelopes. This type of lighting requires a little more current consumption per worker which is offset by lower installation and maintenance costs and better quality illumination. Postal clerks accustomed to local lights accept this system reluctantly. They believe that a light close to their work is necessary.

Overhead lights are used throughout all the workroom space in addition to the local lights. The lights are spaced about

(*Continued on page 126*)

Overhead luminaires give good illumination and ample intensity of light, but the clerks generally prefer local lights.

Activation of Reactions by Electrical Discharges

Further developments in the production of synthetic petroleum

By GEORGE GLOCKLER
Research Associate, American Petroleum Institute

IN the December issue of last year Mr. L. A. Clousing described the work carried out at the School of Chemistry on the effect of electrical discharge on gaseous hydrocarbons. The product obtained then was a heavy oil of reddish brown color and very high viscosity. It resembled a heavy grade of lubricating oil although some of its properties were quite different and served to distinguish it from hydrocarbons of the straight chain series.

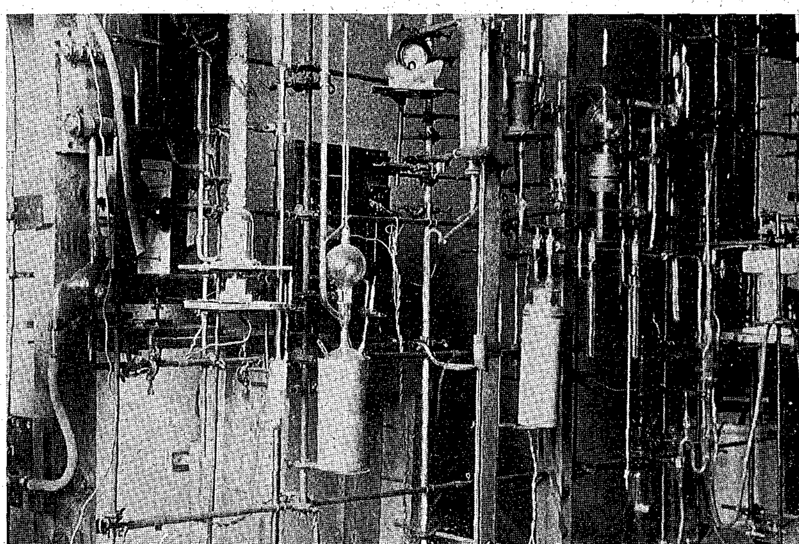
In order to be able to study these liquid hydrocarbons obtained from ethane further, it seemed necessary to produce lighter fractions which could be distilled without a great deal of decomposition. It is customary for the possible identification of these oils that their boiling points be determined and furthermore it is imperative that these oils should be separated by further distillation into their components. From the theory advanced by Professor Lind as to the mechanism of production of these liquids from ethane under the influence of electrical discharge, it is to be expected that these liquids are themselves mixtures of various kinds of molecules. If these various kinds of molecules are to be identified, we must have first of all sufficient material to carry out the processes of fractionation, and identification and we must have a liquid condensate which can be distilled in the ordinary way without decomposition.

Now it is well known that heavy molecules such as make up the first reddish oil obtained from ethane when treated by distillation even under a partial vacuum will decompose under the influence of heat into smaller molecules. This process of decomposition is known as cracking. In order then to study these liquids further it was necessary that we should change our conditions in such a manner that we could produce liquids of smaller molecular weight than 467, which was the average molecular weight of our first product.

There was furthermore involved another point of theoretical interest. As noted above we use as our working hypothesis the theory advanced by Professor Lind as to the possible mechanism involved in these reactions. This theory states that the chemical reactions produced by the electrical discharge is caused by the ionization of the reacting gas. In our case we would have the ethane gas ionized in the discharge as follows:

$$C_2H_6 \quad C_2H_6 \quad +E—$$

The ethane molecule lost an electron and became itself positively charged.



SET UP OF APPARATUS USED IN ELECTRIFYING ETHANE GAS
Ethane gas in passing from right to left is purified, cooled, and then passed through an electrical discharge chamber, where it partly turns into a fluid.

But according to Professor Lind such a positively charged particle will because of the electrical charge it carries attract other neutral molecules and the whole agglomerate will form a "cluster." Now from the studies made by Professor Lind when the ionization produced as typified in the above chemical equation is caused by the alpha particles from radon, it is known that two molecules of ethane react per one ion pair. This means that the cluster is at least two. We can show this clustering process by a chemical equation in a formal way:

$$C_2H_6 + C_2H_6 = (C_2H_6 \,.\, C_2H_6)+$$

When this cluster should become neutralized by the returning electron, we may expect a rearrangement of the component atoms and as a result we may find as a possible reaction product: Butane! As follows

$$(C_2H_6 \,.\, C_2H_6) + E— = C_4H_{10} + H_2$$

Hydrogen is given off and butane gas is formed. Naturally the processes outlined may repeat itself between an ethane and a butane molecule or between two butane molecules and we can form a picture of the gradual increase in the size of the molecules formed until we finally have very big molecules which are liquid or even solids at ordinary temperatures.

On this theory we would expect that we should be able to obtain lighter oils if we could stop the process sooner than we did when we obtained our first reddish oil. And it developed that such was the case. We found that when we helped the oil to run off from the walls of the ozonizer so that it was not under the influence of the electrical discharge for such a long period that then the resulting oils were very much lighter, of a yellow color and of low viscosity. The heating of the ozonizer by external means helped the oil formed to run off, for the viscosity of the oil was greatly lessened at the higher temperature.

Of course it must be kept in mind that the electrical discharge is not a condition of experiment about which we know as yet a great deal. Keeping this in mind we feel that our experiments are reproduceable to a satisfactory degree. But it is of course necessary that we should keep all conditions as constant as possible. For instance, on Professor Lind's theory it is to be expected that the rate of flow of gas would have an influence upon the reaction products. We have slight indication that such is the case.

We may then summarize our remarks as follows: By changing the conditions of the ozonizer we are able to produce lighter oils of a yellow color and density 0.8 and average molecular weight about 150. These lighter oils are better suited for distillation and identification than are the heavier product obtained previously. The behavior of the reaction is such as to be easily understood on the picture proposed by Professor Lind's theory.

We would like to mention one more

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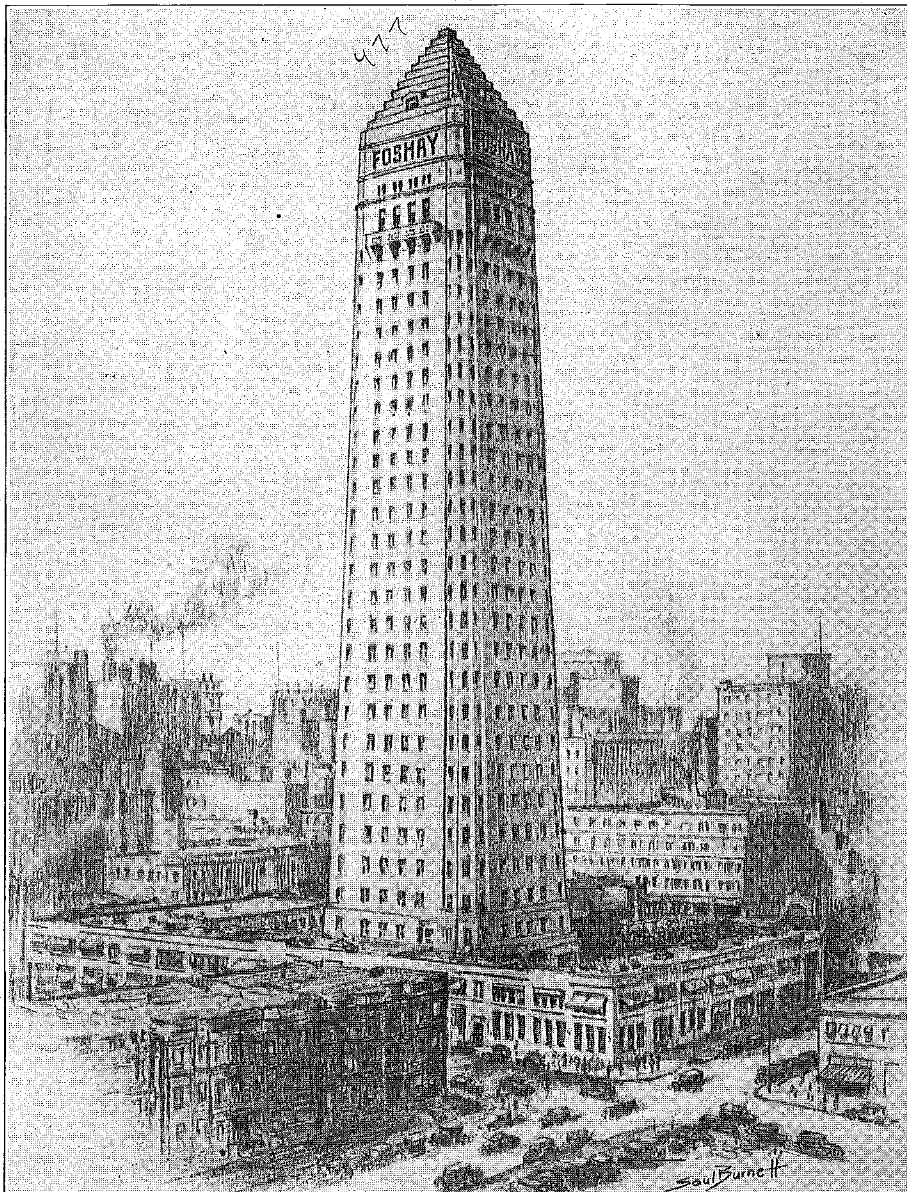

The Foshay Tower

The Foshay Tower is a new type of reinforced concrete construction and is the only building of its type in the world

THE FOSHAY TOWER
This building stands as a monument to the achievements of Magney and Tussler, Minnesota Alumni, who were the engineers in charge of the construction.

THE Foshay building, as first planned, was to be a two story building covering half of a block in the down-town section of Minneapolis. The building was constructed according to this plan and the structure stood for a few years until Mr. Foshay found that the remaining property on the block could be obtained. He obtained the rest of the land and conceived the idea of building a skyscraper that would be the first in the northwest.

A boyhood admiration of the Washington monument reached its apogee when Mr. Foshay suggested to the architects that the proposed building be modeled along the lines exemplified in the famous monument.

The building is a two story structure with a tower rising from its center. The tower is 32 stories high and is so designed that all the mechanical equipment is contained in the center of the building. This includes the chimney, the elevators, all the plumbing and heating pipes, electricity mains, and the rest rooms. The centralization of all this equipment makes it possible for every office in the tower to have direct access to daylight.

The heating of the entire building is controlled by one thermostat located on the outside of the building which causes the heat to be turned on or off as the outside temperature fluctuates. In this manner a uniform temperature is maintained throughout the entire building.

The building is heated by steam obtained from a distant station. For the large distances over which the pipes travel, three inches expansion is allowed for each one hundred feet of piping. This applies to all the piping in the building. The basement, which in the future will be a large garage, is heated by hot air. Great attention has been paid to a system for the removal of automobile exhaust gases.

A great difficulty to be surmounted in the construction of such a structure was the effect of the velocity of the wind on a tower of this height. The tower as it is today will stand a wind force of half its total load on the columns. This load reaches a force of near four million pounds on some of the steel girders that support the tower. Wind bracing has been taken care of effectively by the introduction of horizontal and diagonal bracing to the vertical members of the building.

Then the foundation of the building was considered. Solid rock was not found until a depth of sixty-two feet had been reached. As a result of water lying between the bed rock and upper soil it was deemed necessary to build a cofferdam, and by sinking one caisson to a greater depth than the others, the contractors were able to pour the cement without having to contend with the problem of its setting in water.

During the summer the numerous thunder storms which are frequent in this section of the country are accompanied by much lightning. As a structure of this height probably will be hit

(Continued on page 132)

Synthetic Methanol

Its manufacture and relation to American industry

By KENNETH A. KOBE, Ch. E. '26
Dupont Fellow, School of Chemistry, University of Minnesota

THE general situation of the hardwood distillation industry in regard to the manufacture of synthetic methanol abroad in competition with that produced at home has received great publicity, not only in technical journals, but also in the daily papers. The incident not only emphasizes the importance of undertaking research well in advance of the time of need, but provides an excellent illustration of how, in some fields at least, the laboratory may be counted upon to supplement our fast disappearing natural resources.

In order to understand the effect of the synthetic process on American industry, it is first necessary to understand how it is produced here at home. Methanol, formerly called methyl alcohol or wood alcohol, as the latter name infers, is obtained from wood. When hard wood is heated to 270-400°C in a retort in the absence of air, various products are obtained. At the lower temperature, fixed gases come off; which may be used as a gaseous fuel under the retort. The next fraction to come over is called "pyroligneous acids" and finally tars begin to come over, leaving the original wood in the retort as charcoal. The pyroligneous acids and tars are condensed and separated. The pyroligneous acid fraction contains a dilute aqueous solution of acetic acid, methanol and acetone. These constitutents are separated by fractional distillation and chemical treatment. The acetic acid is used in the preparation of metallic acetates, cellulose acetate, organic esters, lacquers and white lead. Acetone is used as a solvent in acetylene tanks, for nitrocellulose and lacquers. Methanol is used as a solvent, for making formaldehyde which is one of the raw materials from which Bakelite and Redmanol are made, and it is also used extensively in the dye industry. The charcoal produced is used mainly for metallurgical purposes.

Coal and water are the raw materials from which the synthetic methanol is produced, these raw materials being both plentiful and cheap, much more so than our ever decreasing hardwood forests. The coal is converted to coke, and steam is passed through the incandescent mass, forming water gas. $C + H_2O — CO + H_2$. The formation of methanol takes place according to the equation $CO + 2H_2 = CH_3OH$ so it is seen that one molecular volume of hydrogen must be added to the water gas. This hydrogen is produced by electrolysing a water solution of sulfuric acid or sodium hydroxide. "This gaseous mixture of two volumes of hydrogen to one of carbon monoxide is stored in the gas holder (1) and is withdrawn by a four-stage compressor (3) operated by an electric motor (2), and therein compressed to as high as 500 atmospheres (7,350 pounds per square inch). The gases are passed through a filtering device (4) where oil and other impurities are removed, then enter the autoclave containing the catalyst (5), which is maintained at the desired temperature by external electric heating. From there they pass through two water-cooled coils (6 and 7), the second coil being provided with a reservoir for the condensed liquid, which is drawn out through a tap (8). The gases that have not been condensed by the cooling are taken up by a circulating pump (9), which sends them again through the return line (10) into the catalyzing autoclave, a proper speed of circulation being maintained." The catalyst used to cause the union of the gases is zinc oxide, though others may be used with a decreased yield, however. If the contact chamber (5) is made of iron, side reactions giving other products will take place, so that the entire chamber must be lined with copper. The methanol produced by this method costs from 18-26 cents a gallon while the current price on a less pure product from wood is 57 cents.

The use of different mixtures of carbon monoxide and hydrogen and of different catalysts yields very interesting results. If the mixture of gases contains an excess of hydrogen, if the catalyst is a mixture of iron filings and a strong base as sodium hydroxide, and if the gases are passed through at a temperature of 400-420°C and a pressure of 150 atmospheres, a product called Synthol is obtained. Synthol consists of a mixture of higher alcohols and ketones with smaller amounts of aldehydes and acids. Higher alcohols may be used as a motor fuel in the same way as ethyl alcohol, but as they bear a greater resemblance to the liquid hydro-carbons found in gasoline, they do not have the disadvantages that ethyl alcohol possess. If Synthol is heated alone to 400°C in a steel autoclave for an hour, a petroleum like liquid, water and some gases are produced. This petroleum like liquid is called Synthin and greatly resembles an asphaltic base petroleum. These products may come into importance as our supply of natural petroleum decreases.

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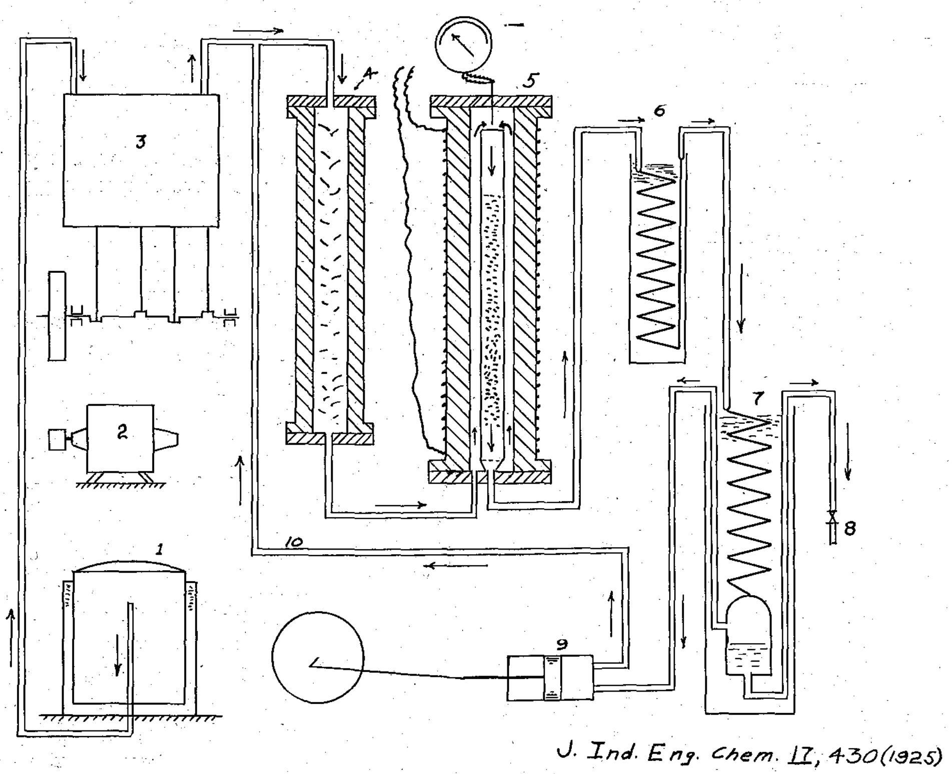


J. Ind. Eng. Chem. 17, 430 (1925)

ARRANGEMENT OF PLANT FOR PRODUCTION OF SYNTHETIC METHANOL.

News from the Technical Campus

Shipley Describes Doble Steam Car

The Doble steam car, the manufacture of which is soon to be resumed, was the subject of a recent lecture given by Professor C. S. Shipley to a gathering of engineering students.

In the Doble, Mr. Shipley said, kerosene is used to generate the three hundred pounds steam pressure normally employed, although this could readily be increased to one thousand pounds per square inch. After the steam is generated and super-heated, it is carried to the motor. The motor, situated in the rear, is a two-cylinder machine capable of developing one hundred and fifty horse power and is coupled directly to the rear axle.

Numerous fool-proof devices make the machine almost as easy to operate as the present day gasoline automobile. A thermometric cut-off serves to close the burner automatically if the water in the boiler becomes too low. Another device assures an ample steam pressure at all times.

The Doble possesses many distinctive features which designers of machines powered by combustion engines have been unable to achieve to the present day. The center of gravity is so low that it was practically impossible to cause the machine to skid regardless of the speed with which curves were rounded.

The natural flexibility of steam engines allows the operator to throw the machine into reverse should the brakes fail. Mr. Shipley reported that the machine could develop a speed of sixty miles per hour in a distance of three hundred feet.

Langmuir Speaks at Minn. A. C. S. Meeting

Dr. Irving Langmuir was the chief speaker at the 149th meeting of the Minnesota section of the American Chemical Society, held in the auditorium of the School of Chemistry on December 1. He presented a paper on the "Interaction of Hydrogen and Oxygen in Contact with Hot Tungsten." The meeting had an exceptionally large attendance.

Doctor Langmuir is assistant director of the research laboratory of the General Electric company. He is internationally known for his research work in the field of chemistry and physics. It would be hard to imagine a treatise on chemistry in which the Lewis-Langmuir theory of chemical valency was not used, for it has been a theory around which the rest of the subject has been built.

Engineers Elected to Advertising Fraternity

Alpha Delta Sigma, honorary professional advertising fraternity, has recently announced the election of two electrical engineers to its membership. Robert E. Stewart, a junior, and Wesley Gray, a senior, were initiated into the organization on December 12. Mr. Gray is the advertising manager of the TECHNO-LOG.

The fraternity limits its membership to students of outstanding merit, who are affiliated with the business departments of campus publications or who are majoring in advertising.

Roof Marking As an Aid to Aerial Navigation

THE MINNESOTA TECHNO-LOG has been asked to cooperate with the Daniel Guggenheim Fund for the Promotion of Aeronautics in a nation-wide campaign for roof-markings which will identify cities and towns to the aviator. Such identification is a first requisite for an air transportation system which will heighten the efficiency of American business by swifter means of communication.

In asking that industrial corporations should assist in roof-marking their buildings where practical, Harry F. Guggenheim states: "Sign posts of this kind for the airplane are an absolutely essential item in the safety of air transportation. The need for them has been repeatedly stressed by Colonel Charles A. Lindbergh as a result of his experience during his United States tour a year ago, and in subsequent cross-country flying. In the opinion of Colonel Lindbergh, who is a technical adviser of the Fund, this identification represents one of the most worth while steps that can be taken for the advancement of civil aviation.

As a basis for the work, the Fund, supported by the Postmaster General, has asked some 8,000 postmasters in towns with a population between 1,000 and 50,000 to take the initiative in seeing that their communities are identified by roof markings. To the organization or person responsible for the identification, the Fund has asked Colonel Lindbergh to send a certificate of appreciation.

In a printed bulletin, the Fund described the type of roof most suitable for marking and urges the use of block letters in chrome yellow with a black background. Besides the name of the town or city, the marking should include an arrow pointing due north with the letter "N" over it and a smaller letter indicating the airport if there is one.

Elliott Representative at A. I. E. E. Convention

The regional student convention of the fifth district of the A. I. E. E. was held at Chicago on Monday, December third. The fifth district, often referred to as the Great Lakes district, comprises all of the technical colleges in the states of Iowa, Minnesota, Indiana, Wisconsin, Michigan, and Illinois.

Minnesota was represented at the convention by Carroll L. Elliott, a senior electrical engineer. Mr. Elliott is the chairman of the Minnesota student branch of the A. I. E. E., and a pledge of Theta Tau engineering fraternity.

The convention was devoted largely to informal reports by each college representative on such subjects as finance, membership, student activities, and electrical shows. This session also went on record as wishing to encourage the presentation of student papers at these meetings. Although these papers are desired to be primarily of a technical nature, discussions of engineering curricula and similar matters also may be included.

On Wednesday evening, December 5, the student members of the A. I. E. E. assembled for their first inspection trip of the fall quarter, as the guests at a dinner program of the Northern States Power company, High Bridge station, of St. Paul.

Mr. G. O. House, president of the St. Paul branch of the company, was the principal speaker of the evening. He gave an illustrated talk on the advantages of the steam station, and pointed out its construction in detail.

After the dinner, the students were divided into groups of ten, and, with a guide for each group, were shown the details of the plant.

Honorary Engineering Fraternities Elect

Pi Tau Sigma, national mechanical engineering society announces the election of the following: From the senior class; M. P. Fedders, Gordon Keen and Manfred P. Hanson; from the junior class; R. H. Guppy, A. G. Ringer, and Raymond Sheppard.

Tau Beta Pi announces the election of the following men from the senior class: L. R. Amundson, L. B. Borchart, R. E. Deschner, D. G. Felthous, M. C. Fetzer, D. W. Glaser, Jon Gunnarsson, F. L. Hovde, Maoling Liu, C. L. Nelson, T. A. Petry, O. J. Peeifer, N. T. Rykken, C. J. Waits, and Peter Warhol. G. H. Shortly was the only man to be chosen from the junior class.

The
MINNESOTA TECHNO-LOG
University *of* Minnesota

Our Editorial Policy is to:

Support and promote all technical college activities wholeheartedly and constructively.

Promote a closer union between the alumni and the technical campus.

Encourage the proper display of technical college spirit.

Strive for the utmost cooperation between the faculty and the student body.

When Work Is Play

THERE is a lesson for grown-up men and women in that felicity of childhood to make play out of work. Many adults can recall when the "a-bringing home of the cows" was made the occasion for a buffalo stampede and the real wild west and lasso sort of cow punching, and the fun which made play of the harvest labor, and the snow house and snow man which made walk shoveling great sport, as well as the many play games that came of raking the leaves, running errands, beating rugs. Was there anything men call work which those same men as boys could not have made a rip-snorting good game of?

Making play of work is the real secret of happiness. Happiness is never attained through slaving today in the anticipation of being able, financially, to play tomorrow. The man who takes a pleasure in his work—makes play of it—is enjoying life in its full. He does not need to depend upon financial independence for his happiness. He is the man or woman whom the world has always mistaken for the inspired genius because "love of work," "ambitions," and "aspiration" are terms foreign to a world finding in work nothing but "toil," "slavery," "labor," "struggle," and "drudgery," and working for nothing but "repose," "relaxation," and a perpetual holiday.

Love of work is possible either in digging ditches or sculpturing eternal marble, but good work is only possible from men and women who make play of their work. To the eye and ear it seems paradoxical, but the mind has long conceived that human beings who make play of their work, play less at their work.

Loring and—

THOSE two gray creatures that squat amid glory, those two survivors of an era long since forgotten, those two witches that appall our senses,—when will they go? Like grim dinosaurs they frown upon our fair campus, impervious to onrushing time, their scanty raiment spreading a virginal blush over weather beaten features.

Have we not prayed for an incendiary? Did we not dream and hope that some inspired fiend would invade your hallowed corridors and deposit there infernal machines to carry you to a long deserved Elysium? And yet, like the poor, you are always with us. Symmetry—ah,—symmetry, what dire crimes have been wrought in thy name! But you, O Loring, are tall and fair, while you, famed—, are of heavier mold and crowned with verdigris. Perchance you fear to leave this world. Possibly long forgotten crimes lie folded beneath those inscrutable walls.

But you are old, the years have removed from memory of man the name of your erstwhile fair sister, O Loring. We do now by chant a requiem. Premature, it is true,—but stoutly earned. Depart then, Ye Twain—we bid you God's speed—may your Heaven, or what you will, adequately repay long years of service. But do be gone!

Extra Curricular Activities

"SUCCESS," said Mr. O. C. McCreery, assistant to Dean Nicholson, in his official welcome to freshman engineers, "may be measured best by the individual's contribution to human happiness." It is evident that scholastic achievement is not the only criterion by which success may be determined. In the final analysis, it is observed that the acquisition of book learning is but a portion of the knowledge which every individual should obtain from an engineering course. According to the opinion of numerous authorities throughout the country, the individual who is graduated from college a "student," has failed to attain the goal toward which the institution has endeavored to direct his footsteps. Seats of learning are concerned with the molding of the MAN,—a well rounded individual, of broad and general education, of many and diversified interests, of numerous abilities. Professional schools in particular have been subjected to a bombardment of criticism. It is claimed, and justly claimed, that the products of these institutions lack broadness of viewpoint,—the narrow bonds of their education having constricted their growth much like the shell of an oyster hampers and determines its physical expansion.

The MINNESOTA TECHNO-LOG has as its fundamental purpose the supplying of those parts of education which are inherently impossible for professional schools to provide. It strives to assist members of the undergraduate body to bridge the gap existing between college and professional life. The editorial department offers practice and training in the expression of ideas. The business department develops business technique and acquaints the undergraduate with the actualities to be encountered when this embryonic stage of development has been relegated to the past. In no other way is it possible to become acquainted so expeditiously with the various aspects of college life. Individuals working on the staff are enabled to pierce the professorial veil, behind which our savants deem it wise to conceal themselves, and there discover the true man. Many an undergraduate is prone to regard those dispensers of knowledge as an amorphous group.

"Neither fish, nor flesh, nor good red herring." It is most regrettable that the educational system in vogue does not foster a more intimate contact between instructor and student. The TECHNO-LOG tends to overcome this condition by enabling members of the staff to meet instructors non-scholastically and thus weld faculty and undergraduates into a homogeneous body.

The experience obtained on either the business or editorial staff is second in importance only to the actual curricular knowledge obtained in college. To work on the TECHNO-LOG is, in truth, an education in itself. And yet, so interesting is the work, and so broad its scope—that a most enjoyable relaxation is offered to overcome the inevitable monotony resulting from continuously poring over text books.

Now that the fall quarter has come to its conclusion, freshmen are urged to come to the TECHNO-LOG office in order to ascertain for themselves the possibilities which are presented.

A Suggestion

THE Engineering College ranks very high in comparison with the various other colleges in this country, and because of the national recognition that has been granted this institution, one expects to, and in most cases does, find the most advanced methods of teaching and the most modern equipment in use here. Presumably, the powers that be consider drafting one of the major requirements, for the young student spends the best part of three years learning the intricacies of the square and compass.

However, when the student registers for the various required courses in drawing he finds that the tradition of best equipment is not carried through. There is not one drafting room in the college that is scientifically lighted.

In an article in this issue Mr. C. A. Peterson stated that the United States Postal department has found overhead luminaires adequate to the need of mail sorters and just as efficient as the local installations used before. The same reasoning used in that article does not apply to drawing.

Granted that the light in the various rooms may be of the correct intensity, the position of the light in drawing is of more importance than brilliance. All light should come from the left—and then, if the instruments are used correctly, there is no shadow cast either by the instruments or by the hand of the man. Overhead lighting has a tendency to cast a shadow on both sides of the rule, and under those conditions, accurate work is not possible.

In an art in which such a premium is placed upon accuracy, and in which the student spends two-thirds of a year learning to use his tools, why is it not possible to start the beginners off on the right path by permitting them to see what they are doing?

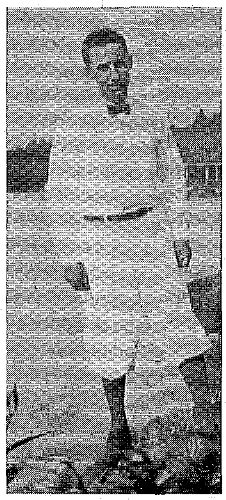
That Chassis

DURING the Christmas vacation the Main Engineering building was relieved of some decorations. Well and good. It pleases us to be able to walk down the hall in a straight line without having to dodge around the chassis of a car, even if it is a Cadillac.

Much has been said both for and against the removal of this car to the experimental building, where it can be used for the purpose of study. Many people seem to think that the car should remain in the Main Engineering building as a lasting reminder of the gift of General Motors company to the University of Minnesota.

These people would be on the right track if the car would remain there—but has it remained there? The answer to this question is *partly.* Visitors to the engineering department who wished to be able to show proof of having "been through the University" have been relieving the chassis of its component parts for the past year. The only action that could or would stop this slow reduction of a truly beautiful piece of machinery to a heap of junk was a drastic one.

The car was presented to the University so that the students of engineering could study such a car with its working parts all in place. As its new home is somewhat off the beaten path we may expect the car to remain intact.



Faculty Sketches

JOHN EDWARD NICHOLAS

JOHN EDWARD NICHOLAS, instructor in mechanical engineering, was born in Eckley, Pennsylvania, a small eastern city, on June twentieth, thirty-five years ago.

When he was but one year old his family moved to Europe and settled in Czecho-Slovakia, where at the age of six he entered the Bohemian public schools, which he attended for three years. In the following two years he attended German public schools and later he spent one year in a German *Gymnasium*. At the age of thirteen Mr. Nicholas returned to his birthplace and enrolled in the public schools of Eckley, from which he graduated in a year and a half. Three years later he graduated from the Mining and Mechanical institute at Freeland, Pennsylvania. At this institution Mr. Nicholas was well known for his likeable personality and marked scholastic ability. This result of his early training abroad earned for him the position of honor student, and with this a four-year scholarship at Lehigh University.

While pursuing his studies at Lehigh University, Mr. Nicholas definitely decided to make teaching his life work. However, he firmly believed that one who intended following this profession should first obtain practical experience, and so upon receiving his bachelor's degree in mechanical engineering in 1915, he accepted a position with the Bethlehem Steel corporation in Bethlehem, Pennsylvania. Here he started working under the master mechanics in the mechanical engineering department, devoting his time to the maintenance and repair of the entire plant. In 1918 he was transferred to their steel plant at Sparrow's Point, Maryland, where he supervised the installation of two six hundred-ton blast furnaces, a one hundred and forty inch plate mill, and a forty-inch blooming mill.

After six years with the Bethlehem Steel corporation Mr. Nicholas began his teaching career when he was appointed as a graduate student at the University of Illinois in 1922. Here he devoted half time to teaching and the other half to research and study under Professor Goodenough and Dr. Kunz. His first problem was on gears with the Lewis gear machine. A year later he was appointed instructor in mechanical engineering at Rice Institute at Houston, Texas. He taught for a year at Rice and in 1924 returned to graduate study, this time at the Massachusetts Institute of Technology. He devoted his first year at M. I. T. entirely to graduate work and research, specializing in thermodynamics and heat engineering. The following year he was appointed assistant instructor and continued working on his research problem on gears. The first results constituted his master's thesis, "Influence of Elasticity and Errors in Tooth Profile on Stresses in Gears," which appeared in "Mechanical Engineering" in September, 1926. He received his master of science degree on June 8, 1926.

In the fall of 1926 Mr. Nicholas came to the University of Minnesota, where he was appointed instructor in mechanical engineering. He has since devoted his time to teaching thermodynamics, heat engines, refrigeration, and junior laboratory.

On September 16, 1926, Mr. Nicholas climaxed the romantic part of his career when he was married to Miss Mildred Carpenter in the famous "Little Church Around the Corner" in New York city. They now have one child, Richard Carpenter, a husky lad of two years. Mr. Nicholas is an ardent sportsman and outdoor enthusiast, and a lover of literature and music. His favorite hobbies are fishing and golf. He is tremendously interested in research and the promotion of engineering education.

Around the World With Our Alumni

Architects

Paul W. Jones is now assistant professor of architecture at the North Dakota State College, at Fargo. His address is State College Station, Fargo, North Dakota.

'24—Otto C. Person, former business manager of the TECHNO-LOG, is with the Schuett-Meier company at 407 Thorpe Building, Minneapolis. He is classed as a structural engineer and specializes in schools and offices, and did most of the design for the Baker building. He is married and has one child.

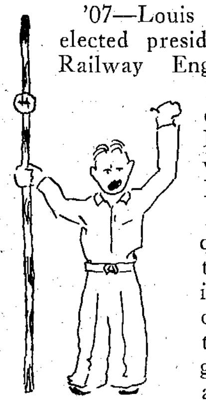
'27—A. S. Bull is with the Insulite company, makers of building insulation, of Detroit, Michigan.

'27—Robert F. Gustafson is now located in Milwaukee. He spent the major part of the summer at home recovering from a minor operation. While he was in school "Bob" was very active in Pi Alpha, honorary art fraternity, and in the Arabs. He was president of the latter organization when the play, "Broadcast," was presented.

'24—Edward Hawkins is now with George W. Stiles company at 169 E. Ontario St., Chicago, Illinois.

'25—Walter A. Kendall is still with Dick and Bauer, architects, at 200 3rd street, Milwaukee, Wis.

Civils



'07—Louis Yager was recently elected president of the American Railway Engineering Association. He is assistant chief engineer with the Northern Pacific Railway company of St. Paul, Minnesota.

C. Vernon Youngquist wrote in recently to tell us that the item in the December issue concerning the addition to his family was greatly exaggerated, and that so far he had no children. Sorry Vernon—we are still looking for the man that sent in that item, and when he is found, we will wreak vengeance that should satisfy even you.

'11—Martin J. Orbeck is still with Holland, Ackerman and Holland, consulting engineers, at Ann Arbor, Michigan.

'22—Earl H. Lund recently visited the campus. He is still with J. H. Wies Construction company at Omaha, Nebraska. Earl is married and has a two-year-old daughter.

'22—William L. Kelley Jr. is still with the landscape service at Long Lake, Minnesota. He recently paid a visit to the civil department for the expressed purpose of making sure that his two sons, three and one-half and one and one-half years of age, will be engineers in the future.

'22—Carlos W. Del Plaine is living at 6 Barton Ave. S. E., Minneapolis, Minnesota. He received his B.S. in '21, his C.E. in '22 and is now after his degree in medicine.

'25—Charles E. Prichard was married recently to Dorothy Dowling, of Minneapolis. They are at home at 3140 Emerson Ave. South, Minneapolis.

'23—G. O. Guesmer is still very busy. He claims that a move every six months will keep any man from gathering moss or anything else. He is now with the Byllesby Company at Minneapolis, but he has been located in Wisconsin, Michigan, West Virginia, and Virginia.

'23—Maurice Judd came to Minneapolis recently as manager of the local office of the Mason City Brick and Tile company of Iowa.

'24—Martin E. Nelson is now located at 508 North Morrison Street, Appleton, Wisconsin, instead of Grantsburg, Wisconsin.

'24—Ellwood L. Stiemart is now with the Illinois Bell Telephone company at Alton, Illinois. He may be located at the Y.M.C.A. there.

'25—M. E. Nordstrom is still with Crowin and company in spite of the recent notice in these columns. Sorry, M. E., that was our error!

'25—Vernon H. Olson is working on a bonding project involving a $7,000,000 job to be let by Uncle Sam for some building construction in Washington, D. C. Vernon is with the Hartford Accident and Indemnity company of Pittsburgh, Pa.

'26—C. H. Sandberg has been granted a leave of absence from the Santa Fe Railroad to accept a teaching fellowship in the Department of Civil Engineering.

'26—F. J. Halbkat, who was associate editor of the Techno-Log in 1926, wrote in recently from Joliet, Illinois, where he is employed by the Elgin, Joliet, and Eastern railroad, to say that there are now three other Minnesota men in the E. J. & E. drafting room. These men are K. D. Williams ('26), J. B. Ringwood and Frank Daley, both of the class of '28. Incidentally, Franklin's address is now the Y. M. C. A. at Joliet.

'26—K. W. Foster is working as a draftsman for the Northern Pacific railway company in St. Paul. He is married, and has one son, K. W. Foster, Junior. When he isn't working on the design of various bridges he plays golf, and from what we hear, it is darn good golf too.

'26—Paul C. Fenton is located at 309 Maple street, Sault Ste. Marie, Michigan. According to Paul, when one is in the Soo, he feels as if he were on top of the world, because visitors so seldom come there. He is acting as Junior engineer with the U. S. Engineers office and is doing dredging surveys and hydrographic work.

'26—Barton Juell is now gas distribution engineer with the Public Service company of Northern Illinois. He is secretary of the Minnesota Engineers Club in Chicago. His address is Room 1105, Chicago Trust building, Chicago.

'27—One of our sky-riders, Doug Campbell, who is stationed at the Hampton Roads naval air station, was in town recently on a short visit.

'27—Tauno Pajari is working on the Milwaukee railway bridge over the Missouri River at Chamberlain, South Dakota.

'27—Frank R. Lundsen writes, "Just now I am at Oconto, Wisconsin, where we are making a topographic survey of some of the northern Wisconsin rivers. Our most useful instrument is a good old-fashioned axe." Frank spent last summer on breakwater construction at Milwaukee harbor, and is now junior engineer with the U. S. Engineers office, 406 Federal Bldg., Milwaukee, Wisconsin.

'28—Walter F. Hagman is now living at 1418 E. 67th Place, Chicago. He is filling the position of draftsman with the McClintick Marshall company of Chicago.

'28—Leslie Wood has accepted a position with "Doc" Holman in the buildings and grounds department of the university.

'28—Clyde Parker, who has been with the Illinois highway department is taking a short vacation before starting work with the American Bridge company.

'28—Frank A. Tebo is working for the Minneapolis Bridge company on their present project, a reinforced concrete bridge over the Mississippi river between Anoka and Champlin on Highway No. 3.

Electricals

'03—Barry Dibble, who was located at Redlands, California, is now employed as a consulting engineer with the Mexican government. He is making a survey of power conditions in the state of Chihuahua.

'06—William A. Zimmer is still with the Northwestern Bell Telephone company. He was recently transferred from Omaha, Nebraska to Des Moines, Iowa.

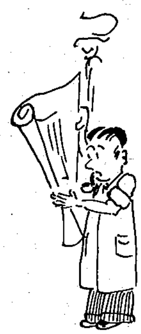
'08—William M. Weibler was one of the men with the Bell Telephone company who were transferred from Omaha to Des Moines, Iowa, on July 1, 1928.

'19—Edgar W. Christensen may be added to the list of Minnesota alumni that have left the ranks of the bachelor corps during the past year. He is still with the Northwestern Bell Telephone company at Omaha and must be planning on remaining there permanently, for he has recently built himself a home in the west end of that city.

'20—John E. Wallfred is now working for the chief engineer of the Iowa division of the Northwestern Bell Telephone company at Des Moines.

'20—Norman W. Kingsley is now assistant to the General Manager of the Iowa Area. He was recently transferred from Omaha, Nebraska, where he held the position of employment superintendent with the Northwestern Bell Telephone company.

'22—H. A. Dahl is still with the Westinghouse company at Wilkensburg. He is working in the heavy traction section of the engineering department.



'23—Gustav A. Johnson was recently transferred from Omaha, Nebraska, to Minneapolis. He is now equipment engineer in the office of the Minnesota chief engineer, of the Northwest Bell Telephone company.

'23—Roy Olson, formerly with the Western Electric company, is now employed by Cheever and Cox, patent lawyers, in Chicago.

'23—I. T. Monseth is now doing relay application work in the switchboard engineering department of the Westinghouse company at Wilkensburg, Pa.

'23—Richard F. Pulver is still power sales engineer with the Minnesota Power and Light company at Duluth, Minnesota.

'24—Charles J. Skarolid is now wire chief with the Bell Telephone company at Fargo, North Dakota. "Chuck" is an enthusiastic aviator and for a time was the president of the Steele Airways in Omaha.

'24—Clarence W. Teal is now with the assistant vice-president's office of the Northwest Bell Telephone company at Omaha, Nebraska. In spite of the transfer he claims that he is still doing the same type of work and still reports to the inventory and costs engineer.

'24—F. C. Anderson is branching out as a globe trotter—at least as much as his duties as instructor of electrical engineering at Lehigh University will let him. Last summer he traveled on the West coast and next summer he plans to go to Europe. He says, "This business of teaching hasn't turned my hair gray as yet." He is still single.

'24—H. G. Freehauf was in Minneapolis some time ago. He is located at Miami, Oklahoma as superintendent of utilities.

'25—Willard W. Wieland, an industrial sales engineer of the Ideal Electric company announces that he was recently married but he doesn't say who the fortunate girl was.

'25—C. E. Ellis is employed in the commercial department of fractional horsepower motors by the General Electrical company. He may be reached by addressing the company at Fort Wayne, Indiana.

'25—Grant C. Nierling, now with the General Electric company, has returned to Minneapolis for a short visit with his parents, before he leaves for South America. Grant will make his headquarters at Rio de Janeiro, Brazil.

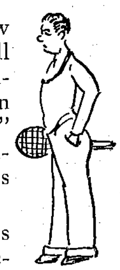
'25—Henry A. Wurzbach is now with the American Telegraph and Telephone company at Omaha, Nebraska. Before he went to Omaha, "Al" was secretary for the Y. M. C. A. on the farm campus in Saint Paul, Minnesota.

'25—Harry H. Schneckloth was recently transferred from Omaha, Nebraska to the Minnesota area. He is with the Chief Engineer of the Northwest Bell Telephone company at Minneapolis.

'26—R. A. Beveridge reports that he is at present fractional horsepower motor specialist for the General Electric company at Fort Wayne, Indiana. He is particularly interested in the application of the motors to mechanical devices of various description. Beveridge finds golf to be a very diverting pastime, but is somewhat concerned at his inability to smack the pill squarely on the nose, regardless of the fact that he calls to his aid every known or knowable mechanical principle.

'26—George L. Gaalaas is sales engineer in the synchronous division of the Ideal Electric company. We hope that he will continue to engineer sales for some time.

'26—Henry L. Tholstrup took the fatal step on the fifteenth of November when he married Cora Margaret Ahrendt at Northfield, Minnesota. They will be at home after December 15 at their home in Springfield, Massachusetts. Henry is with the Westinghouse company at Chicopee Falls and is doing research, development and production work in the radio department there.



'23—James P. Johnson is now with the Northwestern Bell Telephone company at Davenport, Iowa. From information that reached us recently "Jim" has not yet succumbed to feminine wiles, and is devoting his time to his car and tennis.

'23—Harold W. Fisher was transferred from Omaha, Nebraska to Minneapolis on July 1, 1928. He now holds the rank of traffic equipment engineer with the Northwest Bell Telephone company.

'27—Richard Robinson was married at Wilkinsburg, Pennsylvania sometime around the fourteenth of November.

'27—Erick Bergland enjoys his work in the Radio Engineering department of Westinghouse Electric company at Springfield, Massachusetts.

'27—Herbert F. Farmer is in the research department of the Westinghouse organization at East Pittsburgh. He is now the proud father of a particularly bright baby boy.

'27—E. L. Bottemiller writes that he is still enjoying his work in the testing department of the General Electric company at Schenectady.

'27—Seth Witts visited the electrical laboratory a few weeks ago. He is with the Northern States Power company in Minneapolis.

'27—Carl Everret Swanson was recently married to Miss Ethel Johnson of St. Paul. He recently returned to the Westinghouse fold and is now up in Chicopee Falls, Massachusetts, as a radio engineer.

'27—Paul R. Lee is still holding his position with Westinghouse Electric company. He says he is not bald yet and hasn't a single gray hair. He attributes this to his still being single.

Mechanicals

'17—F. W. Hvoslef wrote recently and is quoted, "I am still deeply involved in the problem of developing domestic oil burners and find it very much of a problem. I don't feel that this is of much interest, but I wonder what those who desire to throw off the burden of coal think?"

'22—John D. Clark was transferred on July 1, from Omaha, Nebraska, to Minneapolis. He is now motor vehicle supervisor for the Northwestern Bell Telephone company.

'23—Rudolph Kuhlman is now manager of the Providence Oil-O-Matic equipment company at Providence, Rhode Island.

'23—Graydon A. Bachmann is working for Kelvinator Incorporated as field representative in the northwest territory. He has two children now.

'23—Sheldon L. Hibbard is now engineer with the Clyde Iron Works at Duluth, Minnesota. He is married and has one child.

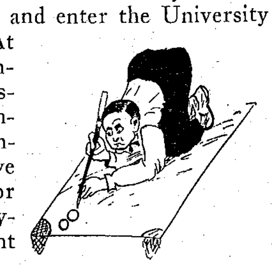
'26—Jay R. Pike is with the standards department of the Oakland Motor Car company. He may be reached, care of the company, at Pontiac, Michigan.

'26—W. B. Arness thinks that graduates of the university are overlooking the opportunities offered by the various steel companies. He is now mill metallurgist for the Halcomb Steel company at Syracuse, New York.

'27—Peter E. Spehr is a student at the Seabury Divinity school at Faribault, Minnesota. In preparation for his work he acts as minister in charge of the Saint James P. E. church in Saint Paul.

'28—John C. Brightfelt is in the railway control department of the General Electric company. His work covers the control of steel cars, gas-electric buses, and locomotives. He may be reached at 3704 Main street, Laurence Place, Efie, Pennsylvania.

'28—Werner L. Larson's new address is Anchorage, Alaska. He writes: "Here I am in Alaska, a mechanical engineering graduate working on a civil engineering project and having intentions of entering the electrical engineering field. You can never tell what is in store for you until you leave college and enter the University of Hardknocks. At present I am employed by the Jasper-Stacy company of San Francisco, who have the contract for the Eklutna Hydro-Electric plant near Anchorage.



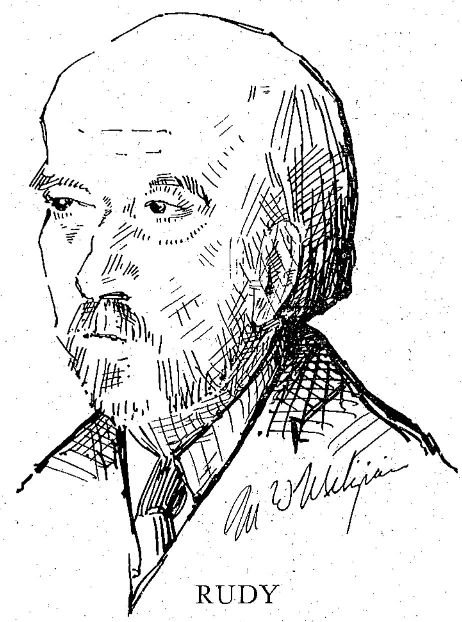
"Since I am as hungry as a Kodiak bear for something human, I wish some of you engineering soaks of the good old days would send a line or two my way when you've got the college blues. The cooing words of some lonesome co-ed would be especially welcomed."

Sorry, Werner, but the college hasn't changed that much. The co-eds in this college are still few and far between.

(*Continued on page 134*)

Themes

Themes selected by the editors of the TECHNO-LOG *from those written by freshman engineers during the fall quarter are published herewith*



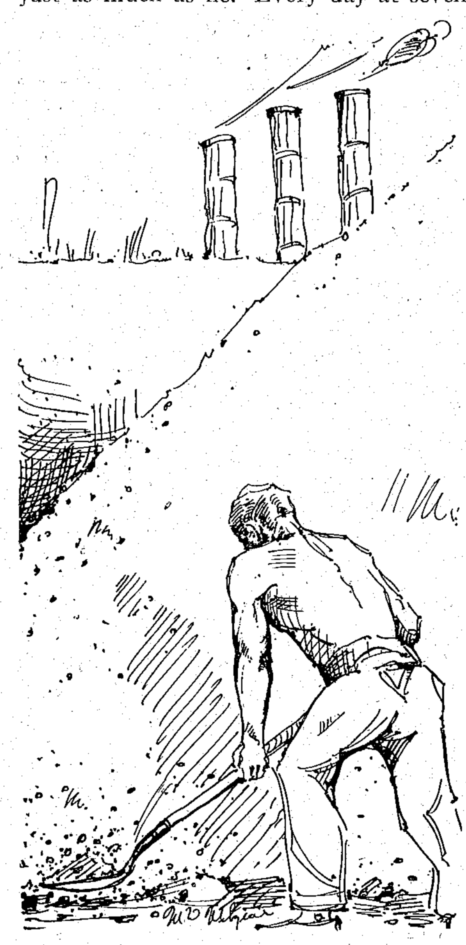
RUDY

Rudy

By STEWART FORD

WHEN one spends his summer laboring in a roundhouse, he has the opportunity to make many new acquaintances and a few real friends. In my short experience I have found that it is the type of people who have to work hard for a living who make the best friends. The fact that my father is an official made me well-known, but most of those who spoke to me did so simply because they thought it best to "get on the good side of me." I worked in the cinder pit helping an old German, whose last name I never learned, but who was generally known as "Rudy."

Rudy, I should judge, was about fifty years old and as hard as a rock. He could shovel more cinders in one hour than I could in two, but he always managed to make it look as if I were doing just as much as he. Every day at seven sharp his shovel would start to remove the night's collection of cinders, and Rudy could keep it up all day if he had to, but it wasn't necessary, for a couple of hours of steady shoveling usually cleans out most of the pits.



At first I could hardly understand the old German's speech, but as the weeks went on I became familiar with his broken English, and I found that for a fellow workman I had a first class philosopher. Absolutely nothing bothered Rudy. He had perfect control of his temper or else he didn't have any, for several times when I broke a shovel, Rudy was the first to see the funny side of the incident. I learned his ideas on politics, labor, war and love. His ideas were all sound logic, and his simple, broken way of telling them, along with his habit of getting excited and waving his arms as he spoke, made them all very vivid to me.

Rudy was no Beau Brummel for dress. My first look at him rather caused me to be uneasy, lest I should have to work with a rough appearing character. His clothes were all old, and his hat couldn't have been much older and still remain intact. It was a black shapeless affair with a large hole cut in the crown for ventilation. The shirt was of the type one sees every day,—gray with heavy seams and great pockets in which during the short interval when it wasn't in his mouth, Rudy carried his corncob pipe. The trousers were just one big patch. Rudy, being a bachelor, did all his own mending, and he had a weakness for patches. The one thing which made up for the whole outfit was the grade of shoes he wore. He would wear nothing but the best working shoes in the market. He said that his work depended on his arms and feet and he was going to take care of them.

At noon, every day, we ate lunch, Rudy's consisting of two monstrous sandwiches of his own making, two pieces of cake, an apple and an orange and a pint of tea. It was during this hour that I learned of Germany through Rudy. He told me of the labor questions there, and described every detail with the greatest care. I believe that my summer in the cinder pit with Rudy was more valuable educationally than my senior year in high school. His limited education made it hard for him to express himself, and made it hard for me to understand him, but we got along fine, nevertheless.

Rudy has been working in the cinder pit for five years. Though he is capable of a much better grade of work, he seems to think that his place is in the pit, and there he'll stay, for the foreman will not find anyone who can handle the job as easily and thoroughly as Rudy.

The Sloth

By HENRY YUTZY

INTERMITTENTLY there appears in the newspapers a cartoon titled, "Wonder What a ——— Thinks About." In the blank the cartoonist fills in any word he chooses—clock, wastebasket, robot, any word. Then he draws a series of pictures and prints in what he thinks might be the train of thought of the subject. When I read Beebe's article on the sloth, I remembered this cartoon and wondered what a sloth might think about. Of course Beebe's great reputation forces us to believe him, but isn't it interesting to think that behind that dull exterior there might be real intelligence? What if the sloth were not a dreamy fool slumbering his way through life? Isn't it possible that behind that foolish appearance is a philosophy that advocates the sleeping through life and laughs at men for their energy?

I have never been a sloth and so I take the naturalist's word about the sloth as the truth. But just to pass the time let's treat the sloth as a human being who resents Beebe's observations and plays a trick on him. Suppose that the sloth has learned of the explorer's intentions, isn't it possible that he might think this way? "This busybody is going to

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Activation of Reactions

(*Continued from page 114*)

point in connection with this theory. From the chemical equation noted above it is seen that the production of ions is necessary for the reaction to proceed by the mechanism proposed. Now it is well known that ions of a gas are produced only when the impinging electron has sufficient energy (called the ionizing potential) to cause the separation of the neutral molecule into a positive and negative particle. We would expect then that such chemical reaction should only happen at the ionizing potential or above. If then we could establish a discharge when we had electrons of controlled speed we might actually find that chemical reaction sets in only at the ionization potential. Such studies have been made on a few reaction and Mr. J. Wilson and the writer are carrying out such reactions in electron tubes on oxygen gas. These electron tubes are very similar to radio-tubes and they have filament grid and plates. We find that reaction indeed is much easier after the electrons from this filament have passed the ionized potential. It must of course be mentioned that we have given only the barest outline of both Professor Lind's theory and of our experiments. But it should be obvious that such studies will increase our information of chemical activation and that they will help to broaden our knowledge of the chemistry of hydrocarbons.

Themes

(*Continued from page 122*)

bother me and pry into my affairs, using me as an example of my kind. It will be too much bother to avoid him, so if he wants an example of sloth life, I'll give him a good one." Then suppose that the sloth tells his intentions to his family and all his friends by that mysterious animal telegraphy we read so much about. So, then, when Beebe arrives on the scene the band of conspirators proceeds to give him "the works." There is much stumbling around, many ridiculous and apparently natural actions,—all for his benefit. The naturalist, unsuspecting, writes down all these things as characteristic of the sloth.

So the sloth laughs at the man and believes he is a fool.

Postoffice Lighting

(*Continued from page 113*)

ten feet on centers in the enclosing globes described above. In spaces where close visual application is not required one watt or more per square foot is used depending upon the work, but it is really the letter sorters that need the best equipment.

It should be noted that letter sorting is an operation involving the rapid movement of the letters in front of the eyes and that the letters are nearly all white, having a high coefficient of reflection. In fact they may be considered as reflectors, for some have a glossy surface and some have windows of semi-transparent paper through which the address must be read. Under direct lighting with open reflectors and clear lamps, it has been observed that these addresses are just as readable at an intensity of five to eight foot candles as with higher intensities and causes less fatigue. With the frosted bulb, however, better diffusion takes place and the higher intensity, ten to fifteen foot candles, was found more desirable as it increases the speed of vision.

The ideal method of lighting, from a visual standpoint, is by the use of indirect fixtures where the ceiling is used as the diffuser and reflector. There are a few such installations in use in the substations in New York City. The intensity is from one and a half to five foot candles. It seems to satisfy, and oddly enough, the clerks seem unable to detect the difference between the low and the high intensities. The fixtures are cleaned frequently and the ceiling is kept up by whitewashing at regular intervals. In most buildings however, indirect lighting cannot be used on account of large areas of glass ceilings and because of the dust due to the handling and emptying of the mail bags, which necessitates excessive cost in cleaning the fixtures.

The writer is of the opinion, however, that sooner or later, indirect lighting will be more generally used. It takes time to sell the idea that repainting ceilings and walls and that labor spent in cleaning luminaires is profitable.

If the trend of the past twenty years in lighting is to continue we may expect a gradual increase in intensities and that means more wire capacities.

The selection of enclosing globes is most important. In workrooms esthetic effects are negligible. Many different makes of installations are available which direct most of the light downward. It is important to select a globe which gives a uniform brightness over the areas exposed to the eye. A globe having an outline which produces light and dark areas will have a higher maximum brightness than one with a uniform brightness. The most desirable piece of glassware will have the lowest maximum brightness, the highest total output, and give the greatest downward distribution.

Maintenance is an important factor in post office lighting. Intensities frequently vary 50 per cent between cleaning periods so it has been found good business to clean glassware and lamp bulbs at regular intervals. An extreme case is mentioned where light was increased twenty-two per cent after cleaning was ordered. An inspection of the glassware, however, revealed the fact that the work had not been properly done and after washing the glassware thoroughly and renewing the lamps that had become blackened with age, the increase in intensity was 83 per cent. Sometime later the workroom walls and ceilings were painted white after which the intensity had increased to 130 per cent of what it was before the first cleaning. This case emphasizes the value of proper attention to maintenance of both room surfaces and luminaires.

Letters to the Editor

The many letters which come to the Editor have suggested the addition of a new department for the TECHNO-LOG, *in which the engineer may "speak his mind." Communications of general interest are welcomed and should be signed by the writer. A pseudonym will be used if desired.*

Editor of THE TECHNO-LOG
University of Minnesota.
Sir:

The department of psychology, finding itself possessed of leisure, and for the nonce wearied of guinea pigs; nauseated by the very appearance of white rats, has turned its per-critical eye upon the school of engineering. There, this hyper-critical eye did fall with particular invective upon the department of mathematics. After an investigation, whose extent may well be aspersed, the department of psychology set in motion the various machinations to bring about the desired coup. Somewhat unethical, or perhaps supremely ethical, were the media employed. The apogee of their Machiavellian tactics descended with dire results upon the heads of the much belated department of mathematics. In an inspired manifesto, the decree was solemnly pronounced that from here and henceforth classes in college algebra and trigonometry shall contain from fifty to seventy individuals.

Psychology has gone to great effort to establish itself a science, the success attained is a moot subject. At least, *logos* may be translated science. Hence it is hoped that scientifically the procedure of the department is justifiable. But conclusions based upon statistical analysis are frequently fallacious. Practically, the innovation seems destined to failure, for it is contrary to the results of constructive thought.

One example may well be offered to illuminate the argument. A recent class in trigonometry originally contained some fifty individuals. During the quarter, several men were forced to abandon the course for miscellaneous reasons, so that only forty-two individuals took the final examination. Of this number only 21.5 per cent passed the course,—in other words, thirty-three were flunked, while only nine were given satisfactory ratings. Had the class been smaller, the instructor by sheer power of will and determination could have forced a much greater number to complete the course successfully.

The individual student in a large class, labours under a double misconception. In the first place, he believes that it is practically impossible to be asked for a recitation on any specific day—he is inclined then, to engage in procrastination with a greater degree of determination than usual. Secondly, he argues that a certain percentage of the class, approximately fifty, will pass the course; he considers himself, and not egotistically, in the upper half of the bracket. But the day of reckoning approaches with all too great celerity. The average undergraduate does not absorb

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Letters

(Continued from page 128)

knowledge merely by allowing himself to be exposed—he must be cajoled and coerced into becoming an intelligent being.

The instructor under the new system is beset by countless furies which rage and fret seemingly capable of administering more misery than all the combined imps of Satan. In the first place, the instructor is unable even to ascertain the difficulties of the individual. His only possible solution lies in giving a daily quiz. The volume of resultant papers would require the services of a retinue of correctors or readers. The instructorial stipend will permit of but scant usage of readers,—the legislature remains aloof and extremely conservative.

The mental concept of the instructor pictures the situation as one which he must meet with seeming equanimity,—but indifference is the inevitable up-shot. He adopts an attitude of passive resistance, for the task confronting him is too hopeless to permit of favorable consummation.

An honor system may be used to advantage in a school of law,—in other institutions it has been found to engender more flagrant violation than the method employing proctorial supervision. Small classes have been used with gratifying results in mathematics—and although it is not denied that a variety of subjects may be taught effectually to large groups—nevertheless, the subject of mathematics, because of innate peculiarities, can not be effectively dispensed to classes of large size.

The department of psychology is urged to revert, for their amusement, to tachistoscopes and tactometers, to correlations and computations, and confine their experimentations to the lesser orders of mammalia.

Yours,
P. S.

Editor of the Techno-Log
University of Minnesota,
Minneapolis, Minnesota.

Dear sir:

The November issue of your celebrated (!) publication has but recently come to my attention. Of particular interest is the editorial entitled "When Homer Nods." To the composer of that article then, I direct this letter.

Do you, Sir, suggest the ancestry of Mr. Brisbane to be Olympian? Ah, you reply: "Merely a caption gesture." True, Sir, but nevertheless inaccurate, and the inaccuracy has been broadcast before. You might have said "Brisbane Bungles," and, my friend, I find you wholly uncharitable. Statements published for the edification of the masses, and for monetary reimbursement, are not published for the intelligentzia. Don Quixote, no longer cast your lance at wind-mills.

I feel that the editorial shows good criticism, but lack of insight. Why should you quibble with Mr. Brisbane over an island or two which remain unemancipated and anthropophagus. Highly civilized societies, as we understand the phrase, have abolished slavery and cannibalism, both works of man. Now, then, where is Mr. Brisbane wrong? I think because of the fact that poverty can never be abolished, since it is inherent in the human race—a tragedy of nature. Everything comes into the world in indigence. We are not all endowed with the same capacity for thought, and so long as men are thus unequal, some shrewd, some foolish, we shall have poverty. But for its purpose, Mr. Brisbane's article should remain unassailed. In other words, dear Sir, you have pointed your finger at the obvious and have marveled. Let him try to instruct the masses if he can invigorate them with a desire to overcome their destitution—let them try.

Your servant,
—M. H.

The Foshay Tower

(Continued from page 115)

several times during a severe electrical storm, all precautions have been taken to prevent any accident occurring. All the steel columns and girders of the building have been grounded so that any charges that will collect on the tower have an excellent connection with the ground.

One of the most interesting features of the building is the method used to illuminate it at night. This is accomplished by floodlighting—eight lights being used on each side of the tower. One light will illuminate the distance between the second and sixth floors, the next, the space between the sixth and ninth floors and so on to the top.

At the top of the tower an aeroplane beacon has been installed. This light is of two million candlepower, will make six revolutions per minute, and will be visible thirty-five miles away. A smaller beacon of three-quarters of a million candlepower is also being installed. Its purpose will be to guide planes to the Minneapolis airport.

On four sides near the top of the tower the name "Foshay" will stand out clearly at night. This sign is made up of neon tubes having a vertical height of ten feet. The height at which this sign is placed makes it visible on a clear night for a distance of fifteen miles. The tower is also wired so that it may be illuminated in colors at night.

Street entrances have been installed on two sides of the building. This is expected to lessen the crowding of the corridors during the busy hours. Elevators have been installed which are able to handle all the traffic to and from the building with ease.

Synthetic Methanol

(Continued from page 116)

We have seen how one of the products from the hardwood distillation industry has been commercially made at a greatly decreased cost. In a like manner acetic acid has been made from lime, carbon and water; by first producing calcium carbide which gives acetylene which is catalysed to acetaldehyde which gives acetic acid on oxidation, a much purer and cheaper product being obtained. Acetone may be made from this acetic acid by heating with lime. Only charcoal is left to the wood industry and its uses have decreased tremendously in late years. Thus a $100,000,000 industry with an annual production of $35,000,000 has been given a knockout blow by applied chemical research.

Though the first one to produce methanol on a commercial scale was a Frenchman, a German company took out the basis patents to the process in this country in 1913. During the war when enemy property was being confiscated, all chemical patents were sold to the Chemical Foundation, a corporation operating without profit, which distributes or leases these patents to any American manufacturer. Thus America may yet be able to meet foreign competition in the methanol market, but what has happened in one industry may happen in another for which no patents are held, so that American industry must learn that it does not pay to curtail research. As Arthur D. Little has forcefully pointed out—"The price of progress is research which alone assures the security of dividends."

(The original articles may be found in Industrial and Engineering Chemistry; concerning methanol, April, 1925; Synthol and Synthin, June, 1925.)

Ryerson Tells Student A.I.C.E. of German Chemical Plants

Dr. L. H. Ryerson of the School of Chemistry gave a short talk on the Leuna Werke, Germany's largest chemical plant, at the monthly meeting of the American Institute of Chemical Engineers on December 4. Dr. Ryerson, who received a Guggenheim Fellowship in 1927-28 spent last year doing research work at the Kaiser Wilhelm Institute in Berlin.

The Leuna Werke is located approximately four miles from the nearest town, and is a community of over 10,000 people in itself. Operations are carried on on a large scale, 1,500 tons of nitrogen gas being produced each day. About one third of the river's supply of water is used to supply the 320 tons of hydrogen needed each day, and consequently the recovery of water is carefully watched. Not only is fixed nitrogen made, but about 3,000 tons of methyl alcohol are produced each month and among other operations *braun kohl* is hydrogenated to obtain synthetic gasoline.

At the short business meeting that was held after the lecture Russell Heckman was elected recording secretary of the Minnesota student chapter.

(Continued from page 121)

'27—Lewis J. McKesson is now radio engineer with the Radio corporation of the Philippines and is located at Manila, Philippine Islands. He writes: "I am now enroute to Manila to install several short wave transmitters of 80 KW rating. Have spent my time since leaving school at Rocky Point, Long Island, doing experimental work with short waves for R.C.A. I will probably spend several years in the far east and will probably go to China as soon as the Manila job is finished. I like the work very much and will be glad to give any one any information I can regarding any phase of the radio work with R.C.A. I believe that it is a very good field for any one interested in radio." Incidentally, Lewis married Miss Ethel Dresser of Verndale, Minnesota, last summer, and she will be along on this trip.

'27—Richard Robinson recently joined the arc welding sales department of Westinghouse after completing their student course. There is a rumor abroad that Dick is soon to leave the bachelor ranks.

Robert Gibson recently went to Carnegie Tech as an instructor in Electrical engineering.

'28—Frank Seegar is now chief operator for the Chicago, Milwaukee and St. Paul railway. He is located at Missoula, Montana.

'28—Sheldon F. Johnson is now with the Westinghouse Electric and Manufacturing company. His new address is 437 Rebecca Avenue, Wilkinsburg, Pennsylvania.

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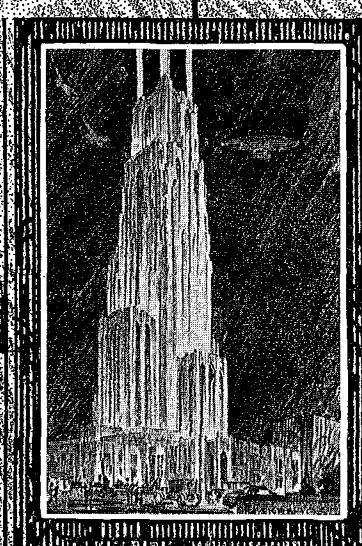

MEMBER - ENGINEERING - COLLEGE - MAGAZINES - ASSOCIATED

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

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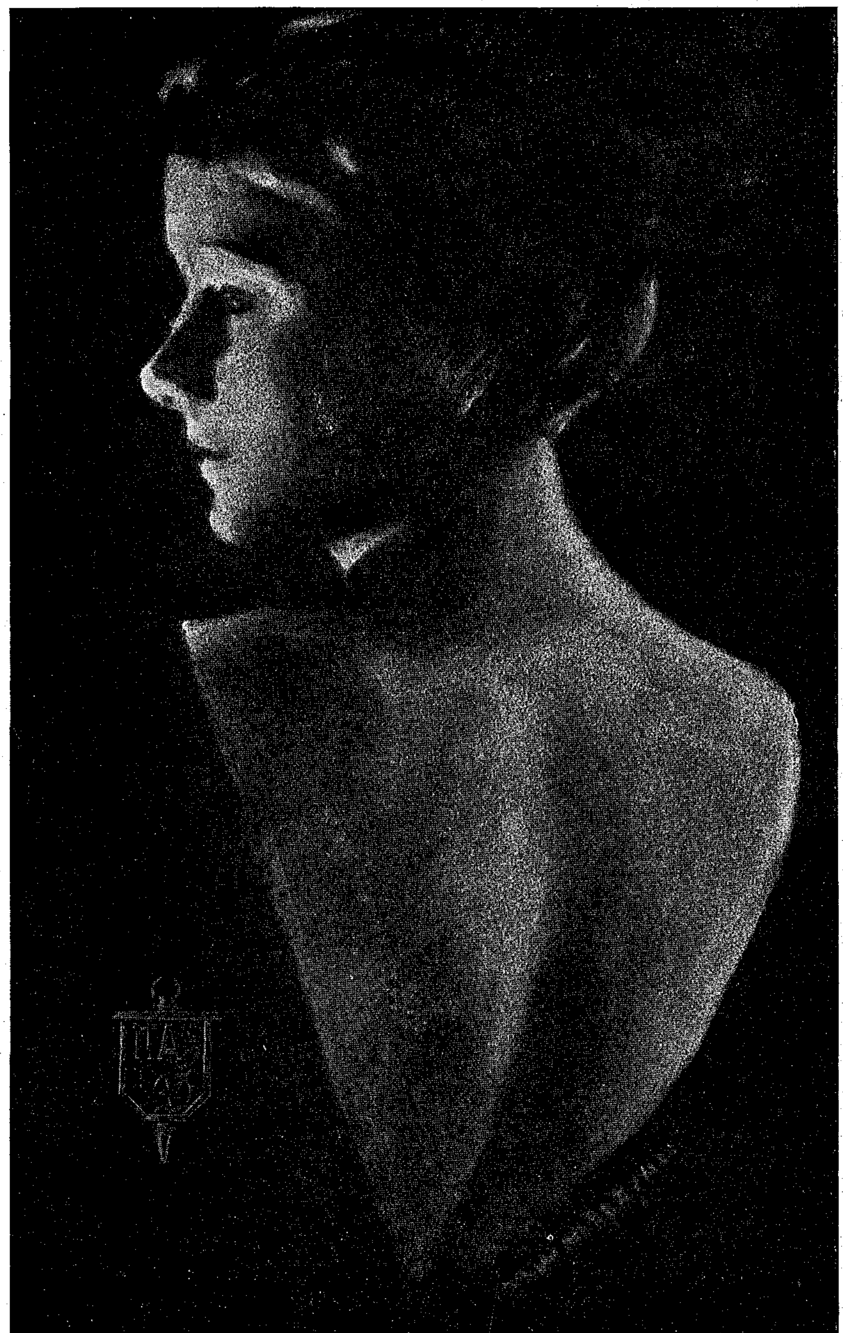


Body by Fisher

Sketched at the Jinx

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume IX FEBRUARY 1929 Number 5

Very Thin Films of Rubidium

By A. L. Johnsrud*
Member of the Technical Staff of Bell Telephone Laboratories

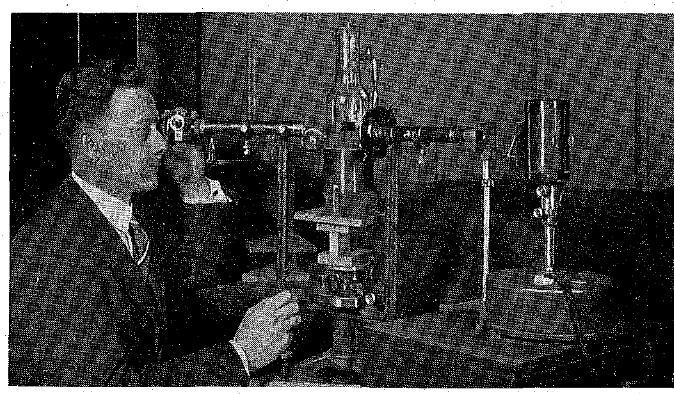
SOME of the recent developments in the art of communication, such as telephotography, talking motion-pictures, and television, have as an essential part a photo-electric cell whose function is to yield an electric current faithfully proportioned to the amount of light falling upon it. For the cell to yield this current most efficiently and in amounts large enough for practical use, a long process of development has been necessary. This in turn has been based on extensive research on fundamental problems in photoelectricity, carried on in Bell Telephone Laboratories under the direction of Dr. H. E. Ives.

Long preceding the recent concerted efforts in bringing photoelectric cells to a high state of development, it had been noticed that alkali metals were more efficient in yielding photoelectric currents when in thin films than when in bulk. It was therefore desired to know more about the relation between film thickness and photoelectric response.

The commonly used alkali metals include sodium, potassium, rubidium and caesium, all more or less photoelectrically sensitive. Rubidium lends itself best to the study of thin films. It volatilizes, diffuses and deposits in vacuo at temperatures in a range conveniently near room temperature, and in short time-intervals suitable for experimental purposes.

For the most effective study of the phenomena involved, there was constructed a large vacuum cell containing enough rubidium to allow a spontaneous deposit to take place on all internal surfaces until equilibrium at room temperatures had been reached. This deposit, so thin that it was quite invisible, covered not only the walls but a thin square piece of glass in the interior as well. Supporting this plate at opposite ends were platinum wires, sealed onto the front surface to make contact with the metal film. A tungsten filament, supported close behind the plate, provided radiant heat for driving off the rubidium whenever desired. The photoelectric current was collected on a large nickel anode which nearly enclosed the glass plate and filament, and an area of the cell wall was kept clean with a flame to provide a window for light to pass through to the plate.

It was found, as expected, that a heavy coating of rubidium, actually constituting a solid metallic surface, gave considerably smaller photoelectric currents than those obtained from thinner films. It was likewise noted that films which had not had time to deposit to their equilibrium thickness gave smaller photoelectric currents than those that had come to equilibrium. Two series of measurements of photoelectric current were therefore required—one while the thickness was diminishing from that of the heavy opaque coating to the equilibrium value, and the other while the rubidium was depositing on the freshly-cleaned glass plate. During each process the electrical conductivity along the surface of the glass plate was being measured. This approached the same value, regardless of the direction from which the equilibrium point was approached. The question then became "How thick is the film at its equilibrium value?"



Mr. Johnsrud operates the polariscope, by which the thickness of very thin rubidium films was measured.

It might be possible to calculate the thickness of the film from its lateral dimensions and its specific resistance. But was the assumption justified that such a thin layer of metal would conduct electricity in exactly the same manner as would a considerable volume of it? True, it obeyed Ohm's law in the dark, but its resistance might in some way be altered under illumination. This was especially probable since the thickness of the film was comparable to the diameter of the rubidium atoms themselves. Measurement of thickness by means of resistance was therefore considered unreliable in this particular case.

Here is where a new method of measurement had to be adopted, surpassing in fineness not only microscopes of the highest power, but interferometers as well. The measurement must reach the formerly inaccessible region between visible light and X-rays, radiations whose wave-lengths bear to each other roughly the ratio of ten thousand to one.

It seemed likely that the thickness of the film to be measured would be as little as one atomic diameter, one-half of one millionth of a millimeter. Waves of light convenient to work with are a thousand times as great as that in length. It was decided, therefore, to base the measurements of thickness on the principle that plane-polarized light, in passing through any film, experiences a rotation of its plane of polarization. The extent of the rotation is governed by the thickness of the film, the wave-length of the light and the angle of incidence. By using light of a single wave length (the green line of the mercury arc spectrum), and taking a set of observations at different angles of incidence with a polarization spectrometer, we were able to obtain accurate values of the thickness of the rubidium film. By interspersing optical and electrical measurements, we were able to measure the rate at which the film increased or diminished in thickness.

The following results were noted:

1. At room temperature, the thickness of the spontaneously deposited rubidium film was approximately one atomic diameter.
2. The depth of penetration of light into

(Continued on page 170)

*Mr. Johnsrud received the B. A. degree in Physics from the University of Minnesota in 1916.

The Northrup Memorial Auditorium

The Cyrus P. Northrup Memorial Auditorium which was made possible entirely through Student and Alumni subscription, nears completion

By F. M. Mann
Head of the Department of Architecture

No one will deny that an adequate auditorium is the greatest single need felt today in the University of Minnesota. With its numerous colleges, divisions, and departments, the natural tendency is to set up a diversity of interests, and to destroy the sense of community spirit and affection for the institution as a whole. The auditorium, a common meeting place belongs to all, and gives opportunity for expression of the University as a unit. This establishes the approach to the problem for the architect who is charged with the responsibility to create a design for a building that is to serve such a high purpose. The building he is to design must first be worthy and show unmistakably by its architectural character and by its location among the buildings of the University that here university life and character come to its focus.

In the future, perhaps more than is apparent today, the mall established by the Cass Gilbert group plan for the development of the new campus will constitute the heart and center not only of the physical plant, but of the major functioning of the great organism of the University. It is, therefore, wholly fitting that the auditorium was chosen to occupy the dominating position in this group plan, at the head of its great mall of the future. To enhance the dominance of its site the auditorium, together with its flanking buildings, administration, and its opposite future counterpart, were raised on a wide platform about six feet above the level of the ground of the Mall. It should be kept in mind that the architectural effect of the auditorium must be judged by what will be the ultimate appearance of this group constituted by the Auditorium with its two flanking buildings forming a unit on the broad raised platform which, in turn, is approached by a flight of steps extending the width of the mall, flanked by balustrades and appropriate accessories, the platform or "plaza" itself treated with plantings, pavements, and other accessories serving to tie the three buildings into one group. In judging the architectural quality of the auditorium, one must also remember that, in places, the familiar ghost Economy stalked there, wielding its irresistible, restraining influence. The exterior of a building is also controlled by its interior requirements. Here it was necessary to provide a maximum number of seats possible within reach of the spoken voice, consequently the building must be both wide and high.

ROOF TRUSS CONSTRUCTION
This illustration of the partially completed structure shows the proscenium girder at bottom, gridiron girder above it for supporting stage grillage and organ loft.

After many studies, it was decided that the most effective skyline of the building would be attained by crowning the front with the form of a gable. Visualizing the mall completed and surrounded by its future buildings, viewed from toward its farther end, the eye will sweep along the flanking buildings to the auditorium and follow up to its peak, the climax of the perspective, and thus, easily be held at its center.

Across the front of the building is a splendid colonnade of ten Ionic columns of stone which will be crowned by an attic to enhance both its height and width. This classic feature gives the building a dignified and monumental character. The top of the attic rises to a height of seventy-one feet above the pavement of the plaza. On the face of the broad attic above the colonnade will be cut an inscription appropriate to the dignity and greatness of the University and adding to the significance of the auditorium as the center of university life and culture.

Entering the building up its wide flight of steps and through its classic colonnade, we find ourselves in a magnificent memorial vestibule one hundred feet long and forty feet high from which monumental stairways at either end will lead to the upper levels. This will constitute the noblest and most monumental interior that will be constructed at the University, probably, for all time. In the memorial vestibule, it is expected that an appropriate sculptured memorial to Cyrus Northrup will find its place and establish the significance of the building as a memorial to that worthy and beloved figure in university history.

The auditorium proper will contain four thousand eight hundred seventy-two seats arranged on the main floor and in the single gallery, each seating approximately an equal number. The architectural treatment of the interior is fine and dignified, and of design and finish that will contribute an environment appropriate to its purposes.

The design calls for a stage of size and equipment such as will accommodate productions of whatever magnitude may be projected.

The opening of the proscenium arch is seventy-two feet wide and the stage is forty-two feet deep. In front of the stage is an orchestra pit to accommodate an orchestra of any size that may be required for major productions. In connection with the stage, there are numerous artists' rooms, chorus rooms, dressing rooms, etc.

In the basement there are two larger

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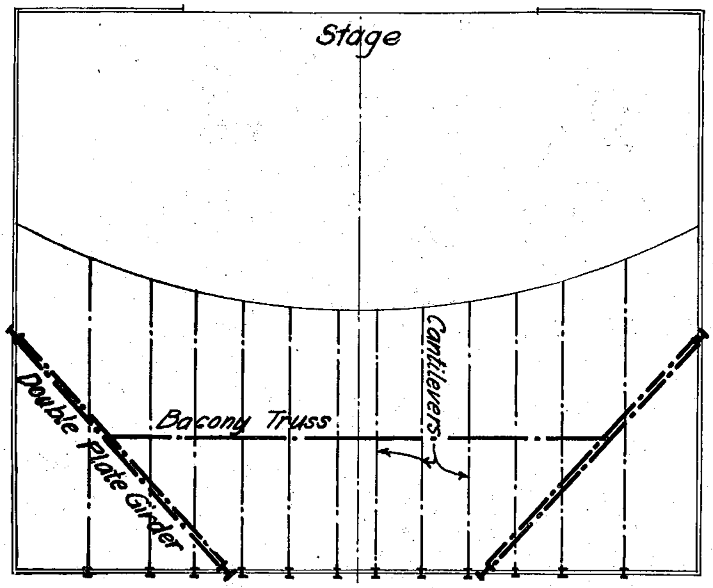

PLAN OF BALCONY FRAMING.

The Skeleton of the Auditorium

By JOSEPH A. WISE
Professor of Structural Engineering

THE new auditorium of the University of Minnesota has an enormous steel skeleton that will be hidden within its floors, walls and balcony. The balcony framing is the most interesting. That portion of the balcony extending over the orchestra floor is supported by a steel framework shown in the sketch, the object of which is to avoid any columns that would obstruct the view. The balcony floor, a series of concrete steps, is supported on the cantilevers, some of them trusses and others plate girders. These cantilevers, except the ones nearest the side walls, are supported by the balcony truss and are also fastened to the columns in the rear wall. The balcony truss in turn rests on two massive steel double plate girders, and the plate girders at their ends are supported by columns, hidden by the wall.

This portion of the balcony will cover a space 75 feet by 146 feet, will seat about 3500 people whose total weight will be 280 tons. The floor and seats will weigh about 600 tons. It is no wonder, therefore, that the double plate girders are heavier than if intended for a railway bridge. They are 8 feet high and 67′-6″ long. The webs are 2-⅝″ plates and there are 8 flange angles, 8″x6″x⅞″. At the center there is a 3⅞″ thickness of cover for each flange.

The balcony truss is about 107 feet long. Each flange is a 16″ Bethlehem "H" shape, weighing 301 lbs. per lineal foot. The height of the truss is 11 feet, center to center of flanges. The cantilevers transfer loads of 72½ to 100 tons each to this balcony truss. It is of the Warren type with very heavy gusset plates (⅞″ thick, two at each joint.)

The roof is 2⅛″ planking covered with 5 ply roofing, each ply being asphalt impregnated felt-mopped with hot asphalt before the next layer is placed. It is supported by purlins which in turn rest on the steel roof trusses. These trusses span more than 146 feet and rest on columns 126 feet high. The ornamental ceiling of the main auditorium is suspended from the roof trusses.

The stage opening is bridged by a proscenium arch plate girder shown clearly in the photograph. It spans 76 feet and is 6′-3½″ deep. Above this is another girder that supports the gridiron and rear wall. This gridiron is composed of 3″ steel channels spaced 6 inches apart, and is used for supporting and manipulating the stage "drops." The gridiron girder is 8′-3½″ deep and also spans 76 feet.

The columns rest on separate reinforced concrete footings. The footings rest mainly on a sandy gravel with some clay, a very firm and unyielding foundation bed. At one point, however, an old dump was uncovered, necessitating a change in original foundation plans. At this point the footings were placed 4 or 5 feet below the original grade. A reinforced concrete frame was used for the east and west wings of the building.

In erecting the steel framework, stiff leg derricks, counterweighted and placed on rollers so that they could be moved easily, were used. The south wall columns were first placed and the roof trusses were assembled and riveted at the base of the columns and then raised by the derricks. In raising the trusses, they were held at about the quarter points on the upper chord. The center of gravity of the trusses was only a short distance below the point where the lift lines were attached and thus while inherently stable, they were nevertheless not

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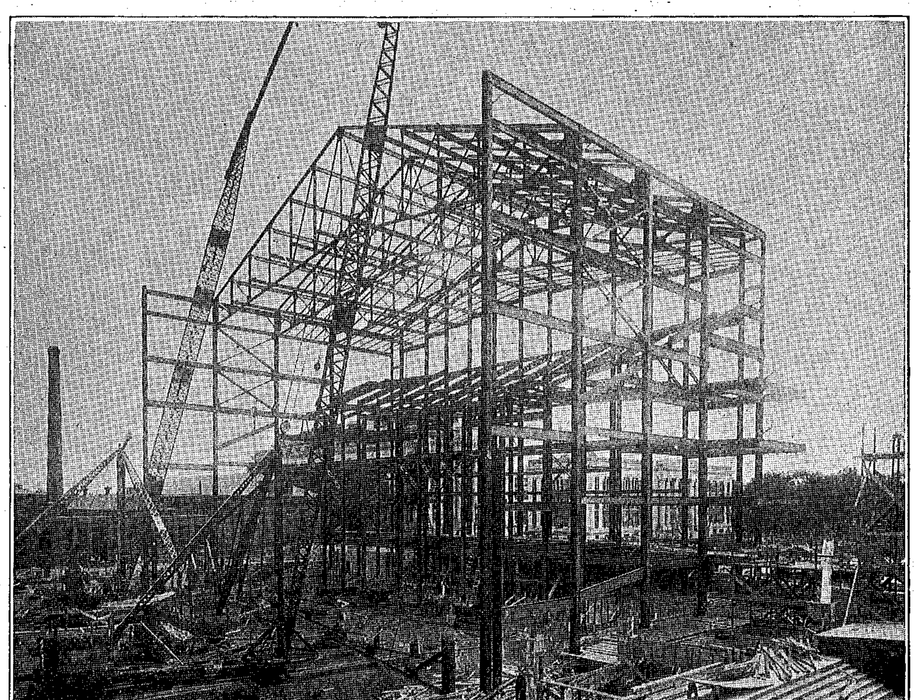
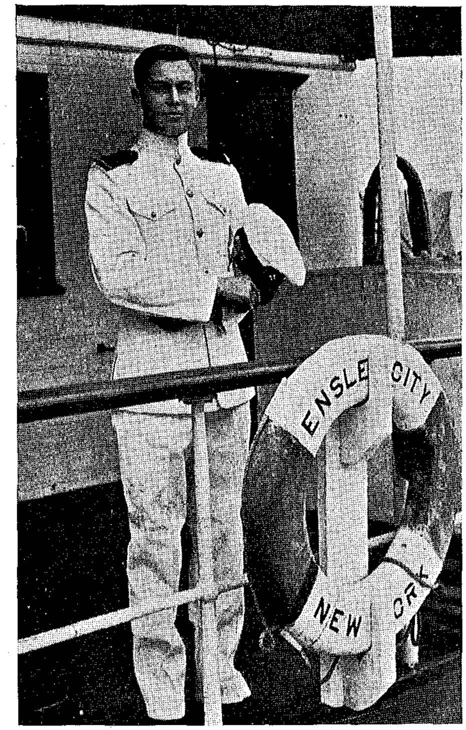


THE SKELETON OF THE AUDITORIUM
Stiff-legged derricks, placed on rollers so they could be moved easily, were used during the first months of construction to raise roof trusses to position.

Around the World With Sparks

An account of a Minnesota man's cruise as radio operator aboard a freighter

By WIN C. HILGEDICK, '26 E.E.



WIN C. HILGEDICK

THEY call me "Sparks," but that merely means that I was the one who signed as radio operator on the freighter *Annison City*, bound from New York to the Far East. "Sparks" designates the man who is privileged to be called at three A. X. to obtain the bearings that will see the ship through some blasted fog; he is the man who keeps the crew posted with the latest news (copied from a newspaper at the last port); he is the man the chief engineer blames when the circuit breaker trips and leaves the ship in darkness. But, best of all, he is the man whose time is his own from the time the ship touches the dock until he is at sea again, and in the last few years he has been the one who can tune down to the broadcast range and pull in some hot syncopation from home. The advantage in being the radio man is that you have more time off than anyone else to see the countries that you visit.

On this trip I was particularly fortunate in having just enough money to enable me to use the extra time to the best possible advantage.

We steamed away from New York on January 31, and as we left Ambrose Light and our escort behind us I could not help but wonder what the next few months had in store for me. However, we were now on our course, and such thoughts were rapidly driven from my mind as I settled down to work and tried to get New York with our position report. The first day out we ran into the Gulf stream, and the temperature warmed up to 70 degrees overnight. Weather reports, the time tick, press and position reports all took up my time. Although it is not characteristic of this month on the Atlantic, the weather was warm and clear; and as the ship plowed southward she rolled easily from side to side. This was surely a sailor's paradise.

Three days later we sighted San Salvador; 30 hours later, after passing between Cuba and Haiti, we rounded Cape Maisi and sailed out into the Caribbean, where a northeast breeze on our quarter helped us along to Colon and Balboa. It was in this latter city that we fueled for our 4600 mile stretch to Honolulu. This required four hours, so two of us hired a taxi and went over to Panama City, the capital of the Republic of Panama.

It would require a poet to do justice to the ruins of Old Panama, for the memory of stone houses and patios beggars description. However, the newer sections of the town rather spoil the picture for they are very modern. The United States government still maintains control over the water supply and the drainage system, as it did when the canal was being dug.

At six a. m. on February eighth the canal pilot came on board and we heaved anchor to begin our passage. Electric "mules" eased us through the three Gatun locks at the rate of fifteen minutes apiece, and we entered Gatun lake. Here the bare tops of trees could be seen protruding from the water on each side, and one needed very little imagination to picture the engineers flooding the countryside to bring the water level up to that of Culebra cut, and thereby saving five years on the canal contract. The vegetation along the banks of the canal is typically tropical, and here and there we saw alligators sunning themselves in the warm water along the edge.

Four and a half hours after entering Gatun we arrived at the Pedro Miguel Locks, with a fresh supply of water on board and ready to be lowered back to sea level. That night as we steamed out we saw the lights fade—the last lights that we were to see for fifteen days. I was still in communication with New York, and continued so for the next two weeks, until we passed out of range.

The first land was sighted at noon on the twenty-fifth when Mauna Kea became visible through the low clouds. The following morning found us pulling past Diamond Head Crater and into Honolulu.

Time will not permit full description of this interesting city, rightly called the "jewel of the Pacific." The island of Oahu has two high ranges of mountains, which give it the roughest and most jagged skyline of all the islands in the group, and immediately behind the town are several extinct volcanoes, rising abruptly from the ocean, and forming a background that is most impressive. The closest of these is known as Punchbowl Crater.

Between the ranges is the Nuaunu valley, and a road through this section leads to the famous Nuaunu Pali. Here it is possible to look out over the North Pacific, three thousand feet below. One entire day was devoted to driving and everywhere we went we saw the remains of the large lava stream that showed that the mountains that now reposed so peacefully around us had once been capable of death and destruction.

Along with the others I swam at Waikiki Beach, more for the novelty than for the swim, and with the others I tried to ride a surfboard and cursed the sharp coral. The beach is enclosed by a long reef which affords protection against the undertow and the sharks which infest southern waters.

Approximately half the population of the island is Japanese, and from the appearance of the streets, many of these possess curio shops. It is in these shops that the American tourist pays three prices for a tea set and six prices for a kimono. These people lend a distinctive touch to the city as they shuffle through the streets, dressed in their native costume.

The *Annison City* left Honolulu for the Philippine islands on the second of March, and almost immediately we began to encounter the long heavy northeast swell that is so prevalent in this part of the Pacific. For the next twelve days we saw nothing but blue sky and water until we passed the Marianna group. This group is only one of the hundreds of other groups of volcanic origin that dot the southern Pacific. As we passed through the island to the north was a large extinct volcano, which, according to the chart, was inhabited by approximately twenty copra workers. The island to the south had three steaming craters, and was apparently uninhabited.

On March nineteenth we entered the San Bernardino straits of the Philippine islands. On our right Pele vomited a cloud of black smoke which did its best to obscure the brilliant sun without success. Flying fish in hundreds could be seen shooting off on each side of the bow as we plowed along, while once in a while a fair sized water snake wriggled out of our way.

These islands are very mountainous and have many active craters; earthquakes are of common occurrence. Navigation here is very dangerous because the tidal currents often reach a speed of eight to ten knots.

The following morning we steamed past Battleship rock and Corregidor, famed in history as the spot where Dewey slipped under the guns of the Spanish fortress when he stormed Manila. Five hours later we had been scratched on the arm by the quarantine officer and were shaving, preparatory to going ashore.

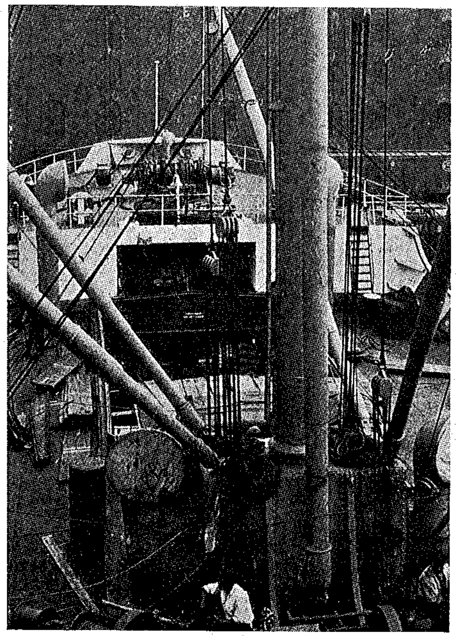
Manila has two distinct sections, the walled city and Manila proper. The walled city is the older part and contains sections of the old city that was under Spanish rule. A moat, now dry, and a wall averaging twenty feet in height surround the town. The newer part is across the river and is well built up and modern in every respect. Manila has several attractive buildings but no large ones. Bilibid prison, reputed to be the worst in the world is located here.

This city is noted for the number of reptiles that are allowed to live unmolested in almost every section of the town. House lizards are everywhere, and at night the little fellows can be seen on the walls and on the ceilings. The natives value them highly, for they keep the flies and mosquitoes at a minimum.

The hot season began while we were here. It lasts for two months and is followed by a period of seven months of uncertain weather when torrential rains come up on a few minutes' notice, last for an hour or so and then disappear as suddenly as they came. It is a rare day in the rainy season that does not produce at least one of these downpours.

Cebu, the last port in the Philippines was cleared on the third of April; then heading southwest the next day the *Annison City* rounded Mindanao, the home of the Moros. From here we went down the coast of Borneo.

On April fifth I was initiated into the ranks of deep-sea sailors, for it was on that date that I first crossed the equator. Father Neptune supervised the initiation of the neophytes, and under his skilful direction we were first bathed thoroughly in a mixture of fuel oil and sougee, shaved with a two foot razor, and as a climax, thrown over the side into a tarpaulin filled with water for a final cleaning. The second ceremony ended in throwing each other, from the mate down, into the tank. It really is an error in judgment to take one's first trip across the line in a freighter.



LOADING THE HOLD
The holds of the *Annison City* being loaded with steel for the Pacific Coast.

Later on the same day we put in to Balik Papin, Borneo for fuel oil. The interior of this part of Borneo has been penetrated for only a few miles, for the only means of transportation inland is a small river. While here we were informed that the Dyaks, contrary to popular belief, will not harm a white man unless they are first molested. Nevertheless, they are headhunters and select their victims from the neighboring tribes. Before a Dyak youth reaches the age of manhood he must have at least one head to his credit, and in spite of the reassurance that the native whites had given us, we decided that the town limits would be far enough for us to go.

While traveling around these different countries and talking with people of several different nationalities one always uses the English language. Almost every operator, whether Chinese or Chilean, can "savvy" English. If a Jap is talking to a Dutchman, he uses English; and it is surprising how many catch words he can use. He says ok, nd (nothing doing), fm (from), bnd (bound), wat (what), and many others. If two Dutchmen talk together, they use these abbreviations in their own language.

The Island of Java was reached on the seventh, Suerabaya being our first port. Here we began to use the true eastern coolie. Their customary clothing is a sarong with batik in attractive colors and odd shaped figures. One can't help pitying them as they labor over the cargo down in the suffocatingly hot holds, for the temperature averages 120 degrees on deck. They are used to it though, and as they work they chant rather monotonous and high-pitched songs in their native tongue. One often sees gangs of coolies pushing carts down the street to the tune of their pet songs.

Semarang, Cheribon, and Batavia were also ports of call, the last being the capital of Java where the Dutch engineers have built excellent railroads to connect the principal cities of the island.

After a week in Java we steamed north and dropped anchor in Singapore, the Gibraltar of the East.

At this time the Chinese were swarming south to the Straits Settlements because of the fighting in the north; and Singapore certainly got its share. The narrow streets of the Chinese quarter were cluttered with street bazaars and the crowds were almost impassable. Riots between the different Chinese factions were of frequent occurrence and even the friendly rivalry between the 'riksha men fostered more than one fight.

The botanical gardens of Singapore are considered the best in the world. Every specimen of tropical plant is represented there. Groves of palm trees of every type and flowers of the most beautiful colors grow close together, forming a jungle in which hundreds of monkeys play.

We lay in the road at Singapore for eight days loading tea, tin, and rubber. Chinese coasters and inter-islanders slipped in and out at all hours of the day, and sometimes the watch had interesting experiences at night.

We finally finished the loading of the cargo on the twenty-third and got under way at sundown. The next morning we picked up a pilot who took us up a river ten miles into the province of Selangor to Port Swettenham. A tug flying the Sultan's colors helped us to our anchorage, and we lay there for six hours loading latex. The only things here to authorize a name for the place were a couple of godowns, which took care of the products as they were floated down from the interior.

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Tantalum Alloys

Although not in widespread use at present, tantalum has tremendous possibilities as a hardener of alloys and for plating purposes.

By George P. Netherly, Ch. '29

FROM the point of view of an engineer, particularly of a chemical engineer, tantalum is a very interesting metal. It is strong enough to be used in the construction of equipment and it resists hydrochloric acid. Any metal which will resist hydrochloric acid is of especial interest to the chemical engineer. The fact that boiling concentrated sulphuric acid attacks tantalum is not important, for sulphuric acid can be handled in iron. The engineer's interest is lessened, however, when he learns that this metal is oxidized at a relatively low temperature—400 to 600 degrees Centigrade—and that it costs approximately one hundred dollars a pound.

One at once thinks of alloys as a means of avoiding these difficulties. For it seems possible that an alloy might be found which, while retaining the corrosion resistant properties of tantalum, would be less easily oxidized. Alloys might reduce the cost in several ways.

Since in preparing tantalum the chief difficulty is preparing a metal free from alloying elements, it should be much easier and less expensive to select the materials with which it is to be alloyed.

If a small amount of tantalum were found sufficient to confer chemical passivity on a more common metal, the alloys might not be prohibitive in cost, in spite of the cost of the tantalum.

An alloy might be prepared which could be used to cover a cheaper metal. Considering the high cost and short life of enamel-lined kettles, such an alloy could be rather expensive and still be a commercial success.

Experience with the elements of tungsten, molydenum, and vanadium seems to indicate that if some use could be found for the tantalum which would make its commercial production profitable even at high costs, experience in the production of the metal would lead to new methods of manufacture which would reduce the cost and make the metal available for still other uses.

Tantalum alloys, however, seem to be the antithesis of Mark Twain's famous remark about the weather—everybody does something about tantalum, but nobody talks about it. Those who speak at all, "say it with patents." There is little information in current literature and almost no specific information save that contained in patents. A number of alloys are listed, but no detailed information is given.

Tantalum is reported to alloy with platinum to give substances which are harder and more resistant to acids than platinum itself. Alloys with from 5% to 20% of tantalum are mentioned as being capable of withstanding heat and the action of fused potassium-bisulphate. They are more resistant to aqua regia than is pure platinum. 1% of tantalum increases the hardness of platinum 25%, and 2% of tantalum increases the hardness 40%. The usefulness of such an alloy would depend upon whether or not it had scrap value, since its cost would probably not be much less than that of pure platinum, and its properties do not appear to be enough better than those of platinum to enable it to replace that metal for laboratory use unless at a slightly lower, or at least equal, net cost.

An alloy of tantalum zirconium and iron is reported to be "suitable for heating" probably as an electrical resistance unit.

An alloy containing: tantalum 10% to 20%; zirconium iron, silicon, titanium, or vanadium 0% to 10%; a platinum metal 16%; and gold, copper, nickel, or iron 20%; is reported as a "passive alloy," i. e. one which does not readily react with most chemical reagents.

An alloy with iron, copper, titanium, silicon, and carbon is reported, but no properties are given.

Alloys with aluminum containing up to 5% of tantalum are reported. The hardness, ductility, and tensile strength of that metal are said to change. The amount and direction of the change is not reported, but we should expect, judging from the effects of tantalum on other metals, the alloy to be harder, tougher, and stronger than pure aluminum.

Other alloys, with molybdenum, iron, nickel, cobalt, copper, silver, and gold are reported. While few properties are given, it is interesting to note that in the majority of cases the makers of these alloys thought enough of them to take out patents. The patents are nearly all German, British, or American—though one or two are Canadian. Of these only the American patents are available to the writer, and the information in this article is chiefly due to such as were in print at the Patent Office.

Historically, the interest in tantalum alloys seems to have centered in two periods. The first from 1900 to 1914 (approximately) when the German company of Siemens-Halske was interested in the development of a filament for incandescent lamps. This period, judged from the number of patents taken out, reached its height in 1912-1913. When the tungsten filament was definitely established as satisfactory, interest in the field diminished, but since 1922 there has been a great effort to use alloys in high speed steels, in heating elements, and as corrosion resistant materials. The British patents are mostly assigned to the British Thompson-Houston company, but the American patents are scattered. The names of the Western Electric company, the Westinghouse Electric company, and the Haynes Stellite company all appear in the patent literature.

Tantalum, like iron, alloys with a great variety of metals and non-metals and is rather rare in the pure state. When we speak of iron, we generally mean an alloy of iron with carbon, silicon, and small amounts of phosphorus and sulphur. What is meant by the term tantalum is by no means certain, particularly in the period before 1918. After Balke, in 1922, described the properties of substantially pure tantalum, the term "tantalum" or at least "ductile tantalum" came to mean a product of at least 99.5% purity, but before that "tantalum" might mean almost any alloy of tantalum with carbon, nitrogen, oxygen or almost anything else.

For example, Sir William Crookes reported that in an attempt to bore a hole in a sheet of tantalum, a diamond drill was run at 5000 R.P.M. for three days and nights, but made a hole only .25 mm deep, and that the diamond had been damaged as much as the metal. This does not check with Balke's description of tantalum as a relatively soft, easily workable, ductile metal, but it is easily explained by the fact that tantalum unites with oxygen and nitrogen, particularly the latter, to give a very hard substance and since in all probability the metal which Crookes used had been worked in the air, the reported hardness was not that of tantalum, but that of the tantalum nitrogen combination, a material which might be worth investigating as a possible material for the wearing surfaces of grinding machinery.

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Research in Analytical Chemistry

Investigations into the many intricate problems of analytical chemistry are constantly being carried out in the School of Chemistry

By I. M. Kolthoff
Head of the Department of Analytical Chemistry

THE task of analytical chemistry is not only to develop new methods for the determinations and separation of elements, radicals or molecular compounds, but also to improve older methods.

Most analytical methods do not give theoretical results, and a systematic study of the errors inherent in the method is of fundamental importance in the development of accurate procedures. Formerly, analytical chemists tried to solve their difficulties entirely in an empirical way; if a method did not give theoretical results, the working conditions were varied until the results were satisfactory. Such a working system is absolutely inadequate, not only because a good result may be obtained by a compensation of errors but also because the empiric treatment prevents a sound development of analytical chemistry. It is very often assumed that an analytical chemist renders the same services to the household of science as a servant does in the house of the people who can afford to hire them. If an analysis has been made, the analyst takes a reliable textbook and follows the directions exactly as described. If the worker has had enough training and has acquired the right skill he can be certain of obtaining a good result; and finally the performance of an analysis is a question of routine and not science. However, this part of analytical chemistry is only the elementary and introductory one.

Analytical chemistry must be taught in a thorough way, because it is impossible to train a chemist who is not acquainted with analytical procedures. The value and significance of practically all the work that is done in the entire field of chemistry, is, in the first instance, dependent upon the accuracy of the analytical results. I agree with everyone that an elementary practical course in analytical chemistry is not very pleasant. It requires patience and skill to acquire the manipulations in this field. However, a student will never be able to do any substantial work in chemistry if he does not understand the analytical difficulties involved in his special problem.

Do not think that an elementary course in analytical chemistry only means the teaching of manipulations. The student must understand the reactions applied in his work; he has to be a keen observer and must be able to give a logical interpretation of all the phenomena he meets. It is not a hard task to teach a young man without any knowledge of chemistry the manipulations of weighing, quantitative precipitation, filtering, etc., but analytical chemistry requires more than the skill of the fine hand worker. An understanding of fundamentals of general inorganic and physical chemistry is a requirement, without which a course in analytical chemistry would be fruitless.

For this reason both Dr. Gieger and Dr. Sarver, in their courses, direct their efforts to teaching the student not only how to perform an analytical procedure, but also to understand the theoretical principles on which all the manipulations are based. It may be possible that the student does not appreciate the significance of such an education at the time when the course is offered; later on, however, when he has obtained a broader view on the whole field of chemistry he will be grateful for the thorough practical and theoretical training he received in his analytical courses.

In doing research in analytical chemistry a profound knowledge of physical, general and sometimes organic chemistry is required. Especially the understanding of physico-chemistry is of fundamental importance because: first, very often important applications of physico-chemical properties can be made; second, the problems in analytical chemistry very often can only be solved on a physico-chemical basis. In order to elucidate point one, I mention, for example, the application which has been made of potential measurements for the determination of ion activities and potentiometric titrations; the significance of the electrical conductivity of a solution with respect to conducto-metric titrations, ash determinations in sugar and other organic material, the evaluation of the salt content of tapwater and other aqueous solutions. These subjects can only be studied and developed on the basis of the fundamentals of electrochemistry. In this respect there is a close and mutual relationship between physical and analytical chemistry. A good analytical chemist who desires to raise the standard in his field of science must follow the progress of physical chemistry in order to keep up to date. The second point mentioned above is of fundamental importance in study of errors, deviations, and improvements of analytical methods.

It is a well known fact that in the precipitation of sulphate as barium sulphate the latter is never obtained in a pure state; it has the tendency to carry down some other constituents present in the solution. The barium sulphate is not an exceptional case, it is almost impossible to prepare absolutely pure precipitates or even easily soluble salts. What is the reason for the impurity of precipitates or recrystallized salts? The answer is, "Because they absorb some of the foreign substances from the solution." But this word absorption does not explain anything; it is a very convenient expression; a kind of wastebasket in which we throw all those phenomena which cannot be explained in an exact way. Quite generally we say that if a solid removes some solute from the solution, absorption takes place. But this word does not account for the mechanism of the process; absorption may be due to mechanical effects (mechanical inclusion and occlusion of mother liquor); to mixed crystal formation, electrical and molecular effects, and it is of the greatest importance for analytical chemistry to study these physico-chemical phenomena intensively.

This general and incomplete introduction may indicate, why apparently the research in our division is done on such divergent subjects. As a matter of fact there is a close correlation between most of these subjects we are studying, though at first glance it may seem that there is not unity.

The purity of salts and reagents is one of the subjects in which we must be interested. Much splendid physico-chemical work has been spoiled by the fact that the workers started with impure material. It is the task of the analytical chemist to develop means for purifying substances.

Nothing is absolute in this world and an absolutely pure substance does not exist. One may raise the objections and ask, "How about distilled water?" This, however, is impure; it immediately attracts carbon dioxide from the air and thus, contains dissolved gases, etc. In many cases we can be satisfied, if we can prepare substances containing no more than 0.01% impurity, and it is of importance to be able to prepare these high grade chemicals. This kind of work, though not very pleasant, requires much skill, patience and care, and the experimenter will meet with many disappointments. Still the work

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News from the Technical Campus

High Tension Test Course Offered

New Equipment Has Been Installed in the Electrical Engineering Laboratory to Handle Extremely High Voltages for New Elective Course

A course in high tension testing has been opened at the beginning of this quarter in the electrical engineering department and has six students enrolled. This course is given under the direction of Mr. F. W. Springer, but is not widely advertised as an elective course because of the danger involved. The work that is performed during the quarter has necessitated the addition of new testing equipment, adding much to the interest of the course. The additional equipment this year consists of a 500 millimeter sphere gap, a two-circuit voltage regulator with range 0-240 volts, and a 25,000 volt oil testing unit.

The 500 millimeter sphere equipment consists of two 500 millimeter brass spheres mounted on a vertical axis. The top sphere is mounted on heavy insulation over a wood frame and is in an immovable position. The lower sphere is mounted on brass tubing with a bushing at the lower end. This bushing travels on a threaded vertical rod with a pitch of two threads per centimeter. The circumference of the bushing is divided into fifty equal parts, and the gap setting can thereby be adjusted to one one-hundredth of a centimeter. This sphere gap was originally designed for use with the lower sphere grounded. Four high voltage insulators have been placed under the rod holding the lower sphere so that the equipment may be used with a 300,000 volt transformer, having the neutral point grounded. A resistance unit consisting of a number of carbon resistors in series is used to limit the current when the air between the air gaps breaks down and an arc is established. This sphere gap was built by the Westinghouse Electric and Manufacturing company.

Then there are the three transformers that are being used in the various tests. One 300,000 volt transformer has a neutral ground, giving about half the insulation stress. The other two are smaller, one being a 50,000 volt transformer and the other 25,000 volt.

The voltage regulator has two separate windings, the primary and the secondary, the secondary varying from 0 to 240 volts and the primary with 240.

Finally there is the oil testing set which is mounted in a cast aluminum case, and consists of a transformer, a double-pole self-restoring push switch, a control rheostat, a voltmeter calibrated in kilovolts, and an oil test cup fitted with standard testing electrodes and a feeler gage for setting, all of which are mounted on a panel at the top and inside of the case. The voltmeter, mounted flush with the panel, is calibrated to read the voltage induced in the high voltage winding. The mid-point of the high voltage winding and the control circuit is connected to the case, decreasing insulation stresses. It has generally been found in testing the oil insulation of transformers that the top portion of the liquid is the less resistant to insulation stresses.

Sanitary Engineers Talk at A. S. C. E. Banquet

A joint banquet meeting of the Northwest section and the student chapter of the A.S.C.E. was held in the Minnesota Union on Friday, January 25. Mr. Childs, chief engineer of the Metropolitan Drainage Commission, and Mr. Whittaker, sanitary engineer with the State Board of Health, gave interesting talks on the relation of sanitary engineering to the public and the proposed sewage disposal plants of the Twin Cities. Numerous slides were used to illustrate and explain the subjects.

"The plans drawn up by the Commission," said Mr. Childs, "are based on the probable population of the Metropolitan Drainage Area in 1970. They call for an intercepting sewer on each side of the river between St. Paul and Minneapolis, and a sewage disposal plant on Pig's Eye Island, the whole representing an investment of approximately $28,000,000."

Honorary Fraternities Announce Elections

Phi Lambda Upsilon, honorary chemistry fraternity, announces the election of the following men from the senior class: Fred Hovde, Max Kantor, Theodore Petry, and Harold Rehfeld.

The fall quarter initiation of Chi Epsilon, honorary civil engineering fraternity, was held on December 3, 1928. The new initiates included Professor Leonard F. Boon, honorary, and the following students, Rex S. Anderson, James B. Hanson, Raymond E. Hertel, Robert N. Lohn, George H. Meffert, Lyell R. Shellenbarger, and Rolland W. Stoebe. Immediately after the formal initiation the members held a reception banquet in the Curtis Hotel.

Bordeau Speaks at A. I. E. E. Meeting

Minnesota Alumnus Gives Illustrated Lecture on Manufacture and Applications of Synchronous Condensers and Motors for Power Factor Correction

Sanford P. Bordeau, a graduate of the Engineering college in 1925 and who is at present employed by the Electrical Machine Manufacturing company gave an illustrated lecture on "Manufacture and Use of Synchronous Condensers and Motors for Power Factor Correction" at a gathering of the A.I.E.E. held in the auditorium of the Electrical Engineering building on Wednesday evening, January 30.

In the short talk with which he prefaced the showing of the slides Mr. Bordeau spoke of the growing need for motors of a high power factor by power consumers. Hitherto power companies have generally preferred not to meter the magnetizing current used in the induction motors, as this type of current is not actually used by the consumer. It does, however, form a part of the load in the transmission lines and transformers and increases the line loss. There is a growing tendency among power companies to regulate their rates to the customer by the power factors of his motors. Moreover, the decreased voltage due to the increased current-resistance loss must be made up in increased current in order to produce the necessary power to run the motor.

Mr. Bordeau further stated that as a general rule the layman does not know anything about the principles entering into the use of a high power factor or the advantages derived from its application. The main method of approach in working up a sale for a capacitator, which supplies the magnetizing current and eliminates it from the main line, is to acquaint the prospect with characteristics of the two kinds of current, their relation to the high or low power factor, and the economies resulting therefrom. Besides the installation of a capacitator, the power factor may be increased by the use of a synchronous motor or by a synchronous capacitator.

Following this a further development of the same topic was given by Mr. Brooks of the General Electric company, during which the action of a fractional horsepower motor of the capacitator unit type was shown and compared with that of the general induction motor, both in regard to starting and operation under loads over the rated output.

Saibel Secures Rare Viola

Dr. Edward A. Saibel, instructor in the department of mathematics, has recently purchased a Thier viola. Johann Georg Thier, the famous Viennese artisan of the 1700's made the instrument. Thier made but few violas during his life time spending the major portion of his time working on violins and only making violas at the insistence of personal friends. The father of the celebrated composer Mozart encouraged his young son to study the viola and at his request Thier is said to have made an especially fine instrument for the youth who was destined to become famous.

The instrument was purchased through Georg Wendler, formerly of the Leipzig Gewand Haus orchestra. For the last century it has been in the possession of a family in Eurfert, Germany, and it was there that Herr Wendler was enabled to obtain the instrument. It was two months in transit and was brought into this country without duty because of its age.

F. B. Lindsay Appointed to Faculty Post

The College of Engineering has recently appointed Frank B. Lindsay instructor of mathematics in the department of mathematics and mechanics.

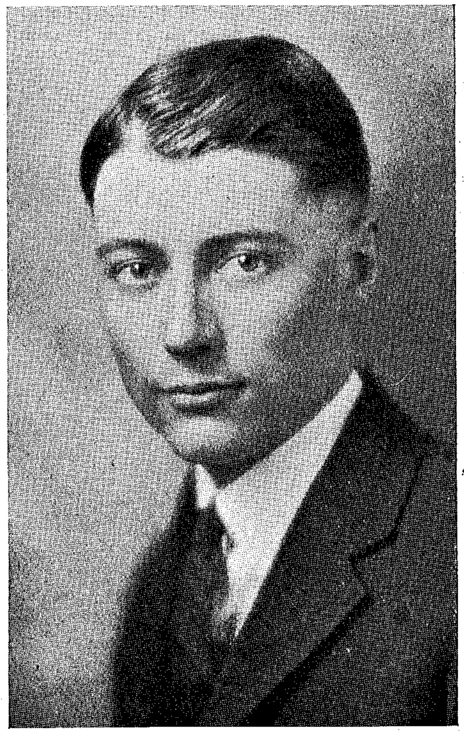
Mr. Lindsay obtained a B. A. degree with highest distinction from Indiana University in 1921. After teaching for several years in Florida, Mr. Lindsay returned to Indiana to pursue graduate work which he continued during the years of 1925 and 1926. In the fall of the latter year, he became principal of Smithville High School at Smithville, Indiana. During the summer he entered the graduate school of Purdue university where he continued his studies in mathematics and physics until his appointment at Minnesota at the beginning of the winter quarter.

Aero Club Organized

The opening of the winter quarter marked the appearance of a new club on the engineering campus—that of the aeronautical engineers.

Although the name of the club will not be decided until the next business meeting, the ideals of the club, as presented in the constitution, are well defined. The purposes of the organization are: the promotion of fellowship, the exchange of ideas, and the sharing of knowledge among the members. All men regularly registered in aeronautical engineering are eligible to membership.

The officers for this year are: president, W. Donaldson, vice-president, M. Meyers, secretary, R. W. Hill and treasurer, Lloyd Kernkamp.



ALBERT W. MORSE

Engineer Directs Eighth Gridiron Banquet

As the general chairman of the 1929 Gridiron banquet, which was held on February 14 at the Leamington, Albert W. Morse, senior electrical engineer, was in direct charge of one of the major activities of the University of Minnesota.

The Gridiron banquet, which is sponsored each year by Sigma Delta Chi, professional journalistic fraternity, is patterned after the Gridiron "razz session" which is held yearly by the newspapermen of Washington, D. C.

Invitations were sent to 300 prominent men, including students, alumni, faculty members and graduates of other colleges who are prominent in professional and business circles throughout the state. Discussions at the banquet centered about topics vitally affecting the welfare of the University, and were conducted under an oath of secrecy.

Mr. Morse, who is secretary of the Minnesota chapter of Sigma Delta Chi and president of Pi Delta Epsilon, national honorary fraternity in journalism, has been active in publication work and has held the positions of managing editor of the TECHNO-LOG, night editor of the *Minnesota Daily,* and important positions on the *Gopher,* the *Ski-U-Mah,* and the *Alumni Weekly.*

Mr. Morse is a Chi Phi, a Theta Tau, and a member of Mortar and Ball and the Shakopean Literary Society.

He has been active in the Arabs dramatic club, directing the publicity one year, and for several Engineers' Days he has edited the *Green Daily.*

G. E. Refrigerator Tested

The electrical engineering department has just finished testing a new General Electric refrigerator that has been installed in the laboratory. It has a single phase A. C. motor run on a current of approximately two amperes at 115 volts, having a power capacity of ten watts.

The refrigerator is supposed to produce temperatures as low as ten degrees below zero, and it was the purpose of the department to run a four day test and see if it would meet the specifications. It is recorded from the results of the test that a temperature of —21 degrees F was reached within the refrigerator one inch from the bottom of the cabinet, and a —31 degrees F was reached in the cooling unit.

These tests are preliminary to experiments that will be run testing the action of storage batteries, primary batteries, standard cells, relays, etc., at temperatures covering a comparatively wide range, and the refrigerator will be brought into play to supply the colder temperatures at which the work will be carried on. Up to this time, if any work was done in which a low temperature was required, the men were forced to work through open windows in order to utilize the outdoor temperature.

Jinx Held Sans Bathtubs

After many delays and changes in plans that threatened the success of the party, the Jinx ball was held on the night of January 25.

The ball met a setback when Dean Blitz decided, about two weeks before the night set for the party, that the chosen theme, "the bath-tub party," was apt to ruin the morals of the students.

After due deliberation the members decided to get far away from the old theme and derive inspiration from the Apaches, the famous gangsters of Paris, among whom bathtubs are unknown. The Dean's approval was then secured.

On the evening set, about eighty gaily dressed couples gathered in the center of the underworld of Minneapolis, the South Side Auditorium, and the Sixth Annual Jinx was on.

At twelve o'clock the grand march was formed with Dudley C. Bayliss, senior architect and president of the organization, accompanied by Janet Lieb, senior in the college of engineering, at the head of the line. After him in order came Lawrence E. Hovik, senior architect and vice-president, Milton Melzian, associate art editor of the TECHNO-LOG, Fred M. Hakenjos, art editor of the TECHNO-LOG, and Jack Tews, for some time cartoonist on the TECHNO-LOG Staff.

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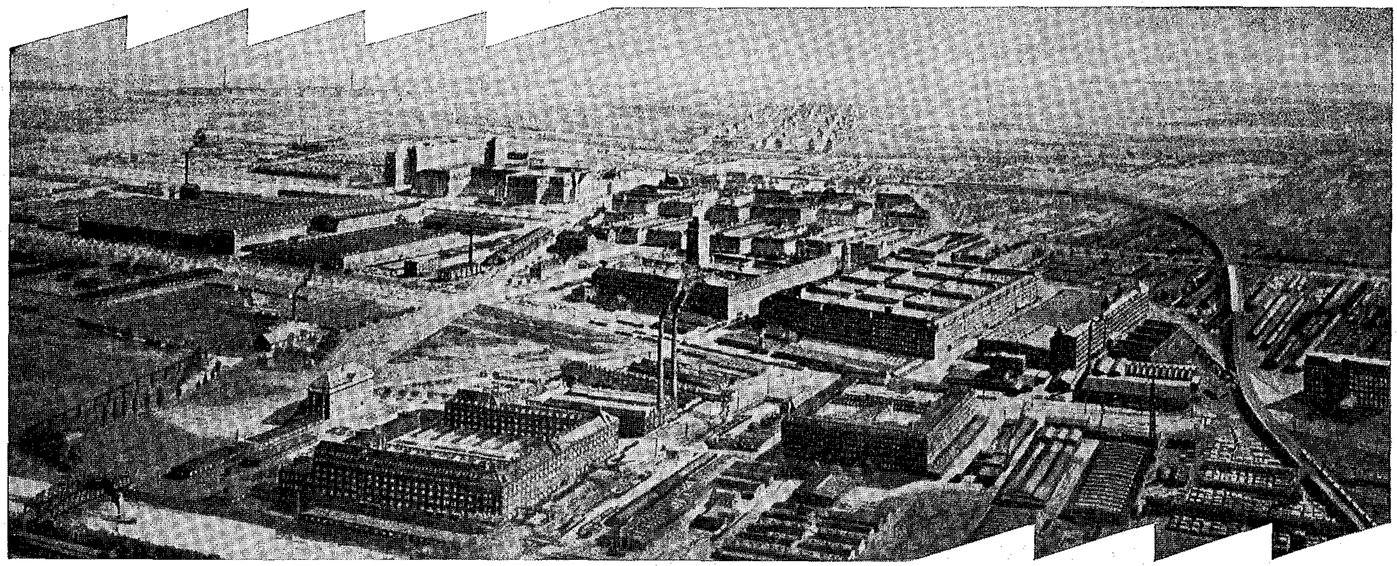


Siemens — Schuckert

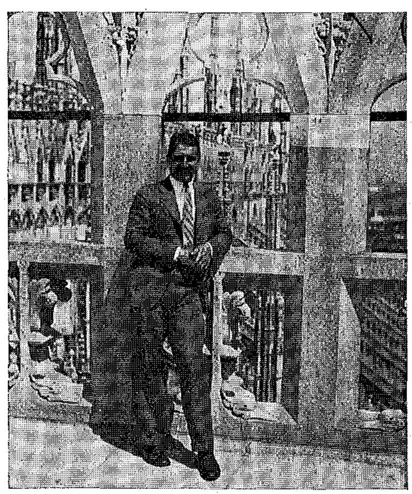
H. H. Hanft, a Minnesota alumnus of 1925, spent last year as an exchange engineer in the employ of Siemens-Schuckert.

IT was one day in 1927 that W. S. Rugg of Westinghouse and Dr. A. Stauch of the Siemens-Schuckert Company of Berlin, Germany, sat in an office at East Pittsburgh and planned to exchange engineers between the two companies. When Dr. Stauch returned to Europe the arrangements had been completed. Each year selected young engineers of Westinghouse were to travel to Germany for twelve months of service with the Siemens-Schuckert Company. And each year young engineers of the German organization were to arrive in the United States for engineering work with Westinghouse.

On September 17, 1927 H. H. Hanft, Railway Equipment Engineer, and W. M. Prudham, Switchboard Engineer, walked up the gang plank and sailed for Antwerp, the first two exchange engineers which Westinghouse has sent to Germany.

They landed at Antwerp and immediately proceeded to Brussels. A day there, and an overnight run to Berlin gave them their first taste of things continental. Their initiation into the mysteries of night travel was a revelation Chucked into a compartment with a family of four, they did "as the Romans do", made themselves at home and tried to sleep on the seats. But in engineering terms the experiment was unsuccessful for their neighbors beat them to it, and the combination of tightly closed windows and concerted snoring was too great a handicap.

Having been properly registered as an employe at the Siemens-Schuckert Works, Hanft was shown the drafting board where he was to spend three months at control drafting and design. Here he discovered that German as he had been taught in the United States, was not even distantly related to the language spoken in Berlin. With the chaps in the Office as his teachers, Hanft began his studies in speaking like a Berliner. But the language of the drafting room was not always the language of the drawing room and after three embarrassing situations he discovered the wisdom of learning from a dictionary the exact meaning of terms before using them.



Hugo H. Hanft, E.E. '25, standing on one of the exterior galleries of the Milan Cathedral.

In time, four months of locomotive layout by Hanft were followed by five months at miscellaneous railway calculations. And in the shops he discovered much of interest in manufacturing methods.

With a total of 110,000 employes, the Siemens organizations, Siemens & Halske and Siemens-Schuckert are considerably over twice as large as Westinghouse. Siemens & Halske produces scientific instruments, meters, relays, signal systems, and other apparatus not included in power apparatus. The Siemens-Schuckert-werke, in addition to manufacturing all classes of power and industrial equipment, include a civil and construction engineering organization. This part of the organization, the Siemens Baunion, installs steam and hydraulic power plants, subway and elevated railway systems, and undertakes other general construction work.

The development of a tool steel capable of drilling and turning glass, or the building of boilers generating steam at 3600 pounds pressure, and 2400 pound pressure steam turbines will illustrate the varied fields entered by Siemens-Schuckert. A cable works near Siemensstadt supplies the other plants with copper in the form of wire, bars and cables. Adjacent to the cable works in Gartenfeld is a rubber factory, supplying Siemens needs for rubber and kindred products.

In some parts of the shops blind workers do drilling, tapping and simple

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The
MINNESOTA TECHNO-LOG
University *of* Minnesota

Our Masthead—Present and Future

IN the past it was easy to get on the Techno-Log staff. It is still easy to get on the staff. In the past after a man had made the staff he was there forever, now he has to work to remain there.

At the beginning of the year the Techno-Log staff decided that only the men that were working would remain on the mast head. In the meantime effort has been made to speak to all of the men and tell them of this decision. As a result the number of men that are being honored by having their names on the masthead is decreased.

In the mixup and the dropping of men from the staff there may have been some injustice done. It is just possible that some of the men have only been asleep and have not realized that they were passing thir share of the burden off on to the shoulders of some one else. If this is so we hope that these men will continue to do their work and merit the replacing of their names on the mast head. The death rate has been high and will remain high for those who are not trying to improve the Techno-Log in every possible way and who are not giving the Techno-Log the best that they have in them.

The men who would like to work on the staff are asked and invited to come down and join us. The present staff needs help and welcomes all newcomers, the only qualification being willingness and a stick-to-itiveness that never says die. Work of course must be done, not much, but then not too little, at least some work for every issue.

Entrance Requirements

IT is probably just as well that many of the students attending classes in the main engineering building are of Scandinavian ancestry. Those races are noted for their ability to maintain their equilibrium while traveling on skis, and it seems to be a pre-requisite that all men descending to the ground floor of this building traverse a slide unequaled in the annals of sport.

The main difficulty seems to be that the tread of these steps which was probably constructed to an established formula but nevertheless is none too wide, is worn until it slopes downward at an alarming angle. In dry clear weather this difficulty may be overcome by taking the steps in one jump, but when the sun does not shine, and ice to a thickness of half an inch covers the stairs, the going becomes more difficult. One may get down safely by being very careful, clutching the concrete, and taking one's time—but with an armful of books one can't clutch; an instructor with his hand on the lock is watching the time—and besides, someone else is apt to upset calculations by forgetting that the slide is there.

As matters stand, these stairs benefit a minority group in the college—those men who pledged fraternities at the first of the quarter and who will soon go through a period of chastisement. After ten trips down, no man need worry about the paddles that his brothers-to-be will wield. He will be case-hardened.

Scholastic Honors for Athletes

COLLEGE is often known as a place where brains and brawn meet. The purpose of each is to uphold the honors of the institution, but in quite different manners. Usually the athletic type of man is not blessed with more than brawn, and therefore scholarship plays hard on his eligibility. Vice versa, seldom are honor students known as demons on the gridiron or in other forms of athletics. The fact is, that too many of our husky athletes are not interested in anything but athletics and harbor the excuse that practice and training require too much time and consequently leaves none for development of scholarship, and on the other hand our Phi Beta Kappa's and Tau Beta Pi's find themselves too busy to bother about physical exertion.

To possess both of these assets is almost superhuman. Mr. Rhodes realized this when he founded the Rhodes scholarships. Many scholarships reward students having outstanding scholastic ability, but very few recognize a man of athletic ability. A man who is able to go out for football during the fall and spring quarters, becoming an all-conference quarter-back, play varsity basketball during the winter quarter, and finish a course in chemical engineering with honors in the scheduled time, which is less than the ordinary person requires, together with upholding a social position on the campus is to be praised. Such a man is Fred Hovde. Being elected to Tau Beta Pi, honorary engineering fraternity, and Phi Lambda Upsilon, honorary chemical fraternity, it not enough; Rhodes scholarship is not all Mr. Hovde deserves. He is without doubt one of the most outstanding men the University of Minnesota has produced.

Why Are You Here?

WHY are you here? That is a question that all of us can try to answer and do ourselves no particular harm by the answering. If we are here, as most of us say, to get an education—the best possible education, why is it that so many men drop out of school? Why is it that so many men are dropped from the University?

The men that are dropped are perhaps in the wrong department and will be able to do excellent work in some other branch of learning, or perhaps these men became more interested in the good times that presented themselves than in the work that was to be done.

Winter quarter is the one in which the most of the social affairs of the students are held and while a certain amount of training in this line is of immense value to all men, the training is so easy to take and so hard to avoid that it often takes the upper hand. This is a true but terrible fact and is one that we should all try to put behind us and leave out of our thoughts.

Perhaps another hour's work each and every evening will raise our grades from an F to a D or from a D to a C and isn't that sufficient to warrant this additional hour's work?

Around the World With Our Alumni

Chemicals

'19—Arthur C. Beckel stopped in for a visit the other day while on his way to Brooklyn. He has been teaching at the North Dakota State Agricultural College but is now on his way to a new job in the organic department of Long Island University.

'19—T. R. Hogness, who is teaching at the University of California, will have a course in Photochemistry at the summer session of the University of Chicago.

'22—Betty Sullivan has been promoted to the position of head chemist at the Russel Miller Manufacturing company.

'22—Norman Cassel is spending a pleasant winter in Switzerland. He is there on business for the United Piece Dyeing company of Paterson, N. J.

'24—Winslow S. Anderson is now dean of men at Rollins college, Winter Park, Florida. "Doc," who took his M. S. in industrial chemistry at Minnesota with the intention of continuing in the teaching field, has at last received his wish. Until now he has been serving very efficiently as a national officer in his fraternity. Besides his administrative work at Rollins, he is teaching several classes there.

'24—Dr. Walter M. Lauer is now the proud father of a baby girl. He is not sure yet that Miss Lauer, who was born January 20, will join him in teaching the intricacies of organic chemistry to rather dumb Minnesota students.

'26—Joseph H. Kugler is with the Minnesota Mining and Manufacturing company at Minneapolis.

'27—Arthur A. Elston is working for the Dow Chemical company at Midland, Michigan. His address is 512 E. Elsworth St.

Civils

'15—Earle D. McKay was recently promoted to the managership of the Duluth office of the Universal Portland Cement company.

'22—Carlisle G. Fraser was married to Dorothy Larkin on December 29 at San Diego. Carlisle is working as an engineer with William C. Fraser, and he may be reached at 810 Guardian Life Building, St. Paul, Minnesota.

'23—Clifford L. Sampson is now transmission engineer with the Northwestern Bell Telephone company at Des Moines, Iowa.

'23—W. L. Maiser is acting as a construction engineer in Chicago. He married Miss Blanche E. Stodola of Minneapolis. From what he writes, we get the impression that he is not sold on the south, for he is building an apartment house for negroes in the heart of the negro district of Chicago.

'24—Archie R. McCrady, the St. Pat of 1924 has just published a book on Patent Office practice and has forwarded a copy to the Engineering Library. He is a patent lawyer for the Western Electric company at the Hawthorne plant. Archie is now the father of two baby girls.

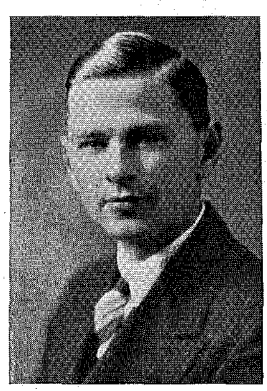
'26—B. A. Johnson is with McClintic Marshall company and is specializing in structural steel work.

'26—Edward C. Gould is another man of the '26 class that is with McClintic Marshall company of Chicago. His address is 621 E. 72nd street, Chicago, Illinois.

Two graduates of the school of Mines and Metallurgy, Thomas F. Andrews, above, and Maynard E. Heins were drowned recently when their boat upset while they were duck hunting near N'dola, northern Rhodesia.

"Tom" Andrews received his E. M. degree in geology in 1926. His senior thesis was on the "Theory of Ore Flotation" and on this thesis he won the Sigma Xi undergraduate prize, carrying with it his key in this fraternity and a remission of his first year's dues and initiation expense. Immediately on receiving his degree he went to Africa on a geological expedition where he remained for nearly a year, returning after the death of his father last winter. In June he and Mr. Heins joined a party of geologists who were going to Africa to take part in some new mining developments.

The party going out to take positions with the Roan Antelope Mining company which was opening up new mining development in northern Rhodesia, was made up for the most part of students and alumni of Minnesota who had majored in geology.



Mr. Andrews was a member of Theta Tau, professional engineering fraternity and was active on several university publications. He was Mines editor of the TECHNO-LOG for two years and spent some time on the *Gopher* staff.

Mr. Heins graduated in June, 1928, and was a member of Phi Tau Theta fraternity.

'26—Edward Young recently resigned his position with the District Engineer's office at Detroit, Michigan, to take a position with the Universal Portland Cement company. He will work out of the Minneapolis office.

'26—Conrad Cooper, one time center on the Minnesota football team, has resigned his position with the Minneapolis branch of the Universal Portland Cement company. He has accepted a position with an Industrial Efficiency company in New York.

Mechanicals

'14—J. A. Colvin is still with the engineering section of the Northern States Power company at Minneapolis. He was very active in the recent North Central Electric Association convention that was held in Minneapolis.

'14—Melvin Ovestrud recently resigned his position with the Twin City Forge and Foundry company at Stillwater, Minnesota, to become superintendent of the Pioneer Gravel Equipment company of Minneapolis.

'19—Art Baker is now working in an industrial survey with the St. Paul Association.

'25—Russell E. Backstrom married Miss Helen R. Parker (Int. Dec. '25) last September and after a motor trip through the state and Canada has settled down at Cloquet, Minnesota. He is employed by the Wood Conversion company, a subsidiary to Weyerhauser company, and is working in the engineering department. He invites all his former classmates who pass through Cloquet to stop in and visit him at 116 Avenue C

'26—Harold Rollins came to Minneapolis with Melvin Ovestrud as a draftsman for the Pioneer Gravel Equipment company.

'26—Word reaches us that George W. Mock has recently resigned his position with the Universal Portland Cement company of Duluth.

Mines

'10—Harry R. Bischoff recently spent a day at the School of Mines. He is is mining engineer at Haileybury, Ontario, Canada.

'12—George L. Harrington is with the Standard Oil company and is located in Argentina, S. A.

'12—Clark N. Woodis with his wife and two sons were the guests of the School of Mines during the past month. Clark is still ranching in Colorado.

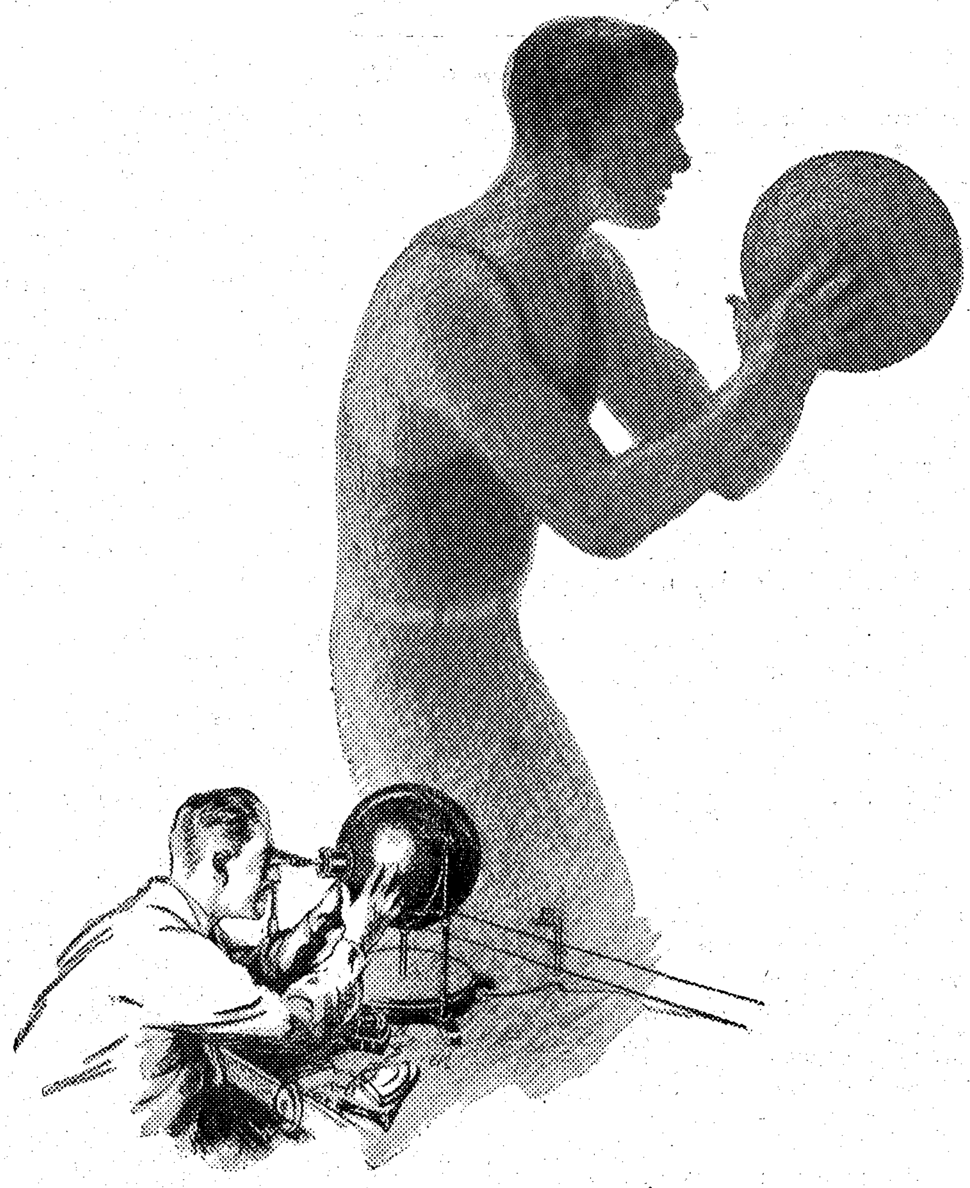
'15—William V. Butler is on leave of absence from his work in the Belgian Congo.

'23—Heneri E. LaTendresse is in Minneapolis on a business trip from Africa where he has been doing geological prospecting for the past five years.

'23—John L. Middleton recently returned from the Belgian Congo. After a short visit in Minneapolis and the States he plans on returning to a land where there is no winter.

'26—Ralph L. Johnson is sales engineer for the Marion Steam Shovel company and is now located at Albany, New York.

'27—T. E. Jerabek is employed in the experimental and development department of the Lincoln Electric company of Cleveland, Ohio. "Jerry" reports that he has taken out patents on a new automatic welding mechanism and assigned the patents to the Lincoln Electric.



Tantalum Alloys

(Continued from page 146)

The methods of manufacture of these alloys depends upon the type of alloy desired. In alloys where carbon is desired, or at least does no harm (such as steel), there is no difficulty in producing the alloys. They can be made by reducing tantalum compounds with carbon, and should not be particularly expensive. In cases where the alloy must be made from the pure metal, the price of the alloy would depend upon the price of the tantalum.

The following methods have been used in the production of tantalum alloys:

1. The fusing together of the metals to be alloyed. Because of the tendency of tantalum to combine with oxygen and nitrogen at high temperatures, this must be done in vacuum in an electric furnace.

The addition of tantalum oxide or the natural iron or manganese tantalate to a molten bath of the metal. Carbon or silicon must be present in the bath as they serve to reduce the oxide to the metal which alloys with the metal in the bath. This method is used in the manufacture of alloy steels.

The reduction of tantalite ($Fe(TaO_3)_2$) and wolframite ($FeWO_4$) mixed in equal proportions in the electric furnace with carbon, or by the aluminum thermite reaction. The resulting alloy of tantalum and tungsten can be purified and is used in the manufacture of alloy steels.

The reduction of tantalite with iron oxide in an electric furnace produces an iron alloy containing about 30% tantalum which can be used in the making of alloy steels.

Tantalum can be alloyed with nickel by mixing the powdered metals and pressing them into shape with great pressure. The resulting masses are heated to incandescence in vacuum. The alloys produced by this method are said to be hard to work.

A more convenient way of forming the alloy of nickel and tantalum is to fuse a mixture of nickel and tantalum oxides with carbon in an electric furnace. This forms the carbides of the metals. The carbides are then reduced by fusing in vacuum with more tantalum oxide. This produces a white malleable alloy. The difference in the properties of the tantalum-nickel alloys described is probably due to the fact that the alloys produced by pressing and heating were low in tantalum (5% to 20%) while those produced by the second method are naturally high in tantalum since in order to reduce the nickel carbide the tantalum must be at least fifty percent of the alloy.

The metal to be alloyed may be melted and a halide of the alloying metal mixed with calcium carbide added to it, or the halides of all the metals to be alloyed may be mixed with calcium carbide and added in small amounts to a previously heated crucible. When copper and potassium-fluotantalate (K_2TaF_5) were treated in this manner to form an alloy containing 20% tantalum, part of the tantalum separated out upon cooling and was left behind when the alloy was dissolved in acid. This method would be convenient for laboratory production of small amounts of a given alloy, but does not seem to be usable on a large scale.

Tantalum, like tungsten and molybdenum, possesses the property of hardening steel when present in small quantities. When used alone, the effect of tantalum is similar to that of chromium. A ternary steel of tantalum, iron and carbon would not be commercially practical unless tantalum were available at a price which would compete with that of chromium.

The properties of the useful alloys known as high speed steels are improved by the addition of tantalum. Their strength and hardness at red heat are increased, and their liability to crack while forging are greatly decreased. A typical high speed steel of this type contains:

Tungsten	18.400%
Chromium	14.800%
Tantalum	2.000%
Carbon	.780%
Sulphur	Trace
Phosphorus	.009%
Silicon	.400%
Manganese	.520%
Cobalt	.300%
Vanadium	.780%
Iron	The remainder

It is claimed that this steel can be hammered from ingots without showing cracks. It has a fine grained texture even when cast, and can be cast directly into milling cutters and similar tools which are strong and tough. It is difficult to break by impact, and lathe tests show it to be equal to the best high speed steels in cutting efficiency.

Another alloy of steel made in the same way contains:

Carbon	.20 to .50%
Chromium	.70 to 1.60%
Tantalum	.10 to .30%
Iron	The remainder

It is said to be exceptionally strong and tough and to be useful for springs, gun barrels and machine parts where sudden strains must be carried.

An alloy of tantalum and iron has been suggested as having valuable properties for use as a watch spring, as it is strong, non-magnetic, very hard, and resistant to wear and corrosion.

Another alloy suitable for cutting-tools contains:

Carbon	1.0 to 3.5%
Chromium	.6 to 2.0%
Cobalt	1.0 to 6.0%
Nickel, Molybdenum, Vanadium and Tantalum	up to 1%

Tantalum, however, does not seem to have met with any great success in the steel industry. Probably this is due to its cost for certainly the alloys mentioned have a number of interesting properties which should make them popular. Yet tantalum steel is of so little importance that it is not even mentioned in a discussion of alloy steels in "The Journal of the Royal Society of Arts for 1928."

A patent taken out by F. T. McCurdy in 1923 shows that tantalum greatly increases the cutting efficiency of the stellite alloys. In fact an increase of 33% is claimed in one case. The alloy is made by adding metallic tantalum or tantalum oxide to the ladle. This alloy seems to have a good chance of commercial success as stellite is a high priced material anyway and tantalum added in the form of the naturally occurring Manganese or iron tantalate should not increase the cost greatly.

The corrosion resistant alloys of tantalum are even more interesting. The surprizing thing is that pure tantalum, although it is incapable of being heated in air and is attacked by sulphuric acid, is on the market as a laboratory ware when alloys are known which have much more desirable properties than the pure metal.

For instance, an alloy of 95% nickel and 5% tantalum can be boiled in aqua regia without alteration and can be heated in air without oxidizing. The first attempt at making this alloy was by pressing the metallic powders and heating in a vacuum. This method would not be commercially practical, but there appears to be no reason why this alloy could not be made by the reduction of the carbides of the metals by the addition of tantalum oxide and the resulting alloy fused with enough nickel to bring it to the proper composition. Such alloys are said to be hard to work. That may account for their unpopularity. It has been suggested that if iron is added to

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The Northrup Memorial Auditorium

(Continued from page 142)

rooms, one designed for a broadcasting studio where music of the university band or a larger chorus may be broadcast; the other designed for meetings of learned societies such as find no proper accommodations on the university campus at the present time. In connection with the latter are smaller committee and round table rooms, and in connection with the broadcasting room, which, from its sound-proof construction would also serve admirably as a band practice room, are small rooms for the band library, band instruments, and band leader. These two groups of rooms are provided with separate outside entrances, and can be used independently of the other parts of the building.

On the various floors of the building there are rooms that may be used for any assigned purpose such as retiring rooms, office, exhibition rooms, etc. A matter of importance that has been carefully studied and provided for is the general circulation to permit easy, direct, and safe entrance and exit of crowds and access to the various parts of the building, and also the arrangement of the corridors to act as buffers against outside noise or disturbances.

One of the most vital considerations in the design of auditoriums is that of acoustics which, thanks to comparatively recent and scientific advance, is now upon a thoroughly scientific basis, and no longer a matter of mystery and vague theory. The question of satisfactory acoustics was one of the first to be considered, and determines, in large measure, the form and shape of the room itself. In the present instance, this has been a controlling factor, and after the design of the auditorium was developed to tentative form, the drawings were submitted to acoustical experts for scientific analysis and report. While a complete description could not be given here, it may be mentioned that the part of the auditorium room toward the proscenium arch has been given the approximate form of a paraboloid in order that the sound may be thrown forward in straight lines, avoiding cross reflections which result in reverberation, echo, and confusion. In the rear part, the flat side wall surfaces have been treated with sound absorbing materials. The scientific analysis showed that the form of auditorium adopted was particularly favorable for insurance of good acoustics and expectations are that the spoken voice without amplification can be heard distinctly and clearly in all parts of the room and that music will be heard without confusion or echo.

If resources permit the completion of the building in all its parts as designed, Minnesota will have probably the largest and best equipped auditorium of any university of this country. It will have architectural character, a degree of completeness, and quality of finish, together with comfort to the audience including seating and ventilation, that will make it a source of pride and satisfaction to the University of Minnesota, and to those alumni and friends whose subscriptions have made the building possible.

Prof. S. C. Lind of the School of Chemistry spoke before the Indianapolis Chamber of Commerce on the subject "New Possibilities among the Hydrcarbons" on a recent visit to that city.

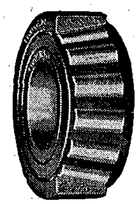
The Skeleton of the Auditorium

(Continued from page 143)

difficult to move into place on the columns. The counterweights were placed in the same plane as the boom when lifting so that no lateral forces were introduced that might tend to cause swaying of the trusses when they were lifted. The trusses were given 1½″ camber to take care of the deflection that would occur after the roof was placed. The end posts of the trusses were riveted to the columns, the process of riveting and releasing the trusses from the derricks, progressing simultaneously to avoid initial stresses.

The double plate girders were received complete from the shop and then were raised and riveted to the columns. The balcony truss was delivered from the shop in three sections which were connected, when in place, by 864 turned steel bolts, about one inch in diameter. Bolts were used in preference to rivets to insure perfect alignment of the truss. The cantilevers were then assembled and supported on the balcony truss.

A sketchy description cannot do justice to such a structure. A large volume could be written about the details and difficulties encountered in the design, and the process of erection. At best, this account can only serve to give some vague impression of the magnitude and complexity of the steel and concrete skeleton of the auditorium. Only a tiny percentage of those who enter the building will ever appreciate the thought and effort, intelligence and strength required to provide a safe, economical and beautiful structure, eminently suited for its purpose.



Tantalum Alloys

(Continued from page 146)

such an alloy, its working properties are improved without loss of corrosion resistance, but no data is available.

Another interesting alloy contains:

Zirconium	7%
Tantalum	53%
Columbium	40%

It is described as being extremely inert to chemical reagents since it is not attacked by hydrochloric, nitric, or sulphuric acids either hot or cold, by aqua regia, or by cold hydrofluoric acid. Nascent chlorine has substantially no effect, and it can be heated to white incandescence in the air without harm. It can be drawn into wires or rolled into sheets. This alloy is made by heating a mixture of the oxides in an electric furnace. The cooled melt is found to contain beads of the metal which can be collected and fused in a carbon free atmosphere.

An alloy of:

Tantalum	10 to 40%
Molybdenum	60 to 90%

has been suggested as a platinum substitute. It has a high tensile strength, is ductile, malleable, and resistant to hydrochloric, nitric, and sulphuric acids, to cold hydrofluoric acid as well as to the action of liquids and gases at high temperatures. This alloy is made by the melting of the metals in an electric furnace in a vacuum. The heating must be carefully controlled to prevent the metal from becoming brittle.

The resistant alloys were first preferred for filaments in electric lamps, but those patented lately seem to be intended for use as heating elements in domestic appliances and electric furnaces.

An alloy of approximately:

Tantalum	10 to 20%
Iron	10%
Nickel	70 to 80%

in which the tantalum may be replaced wholly or in part by columbium, forms a resistant alloy which can be heated to 800 degrees Centigrade for 900 hours without serious oxidation. In this case the tantalum is used to bring up the specific resistance of the material. It has long been known that an alloy of iron and nickel was not readily oxidized if the nickel was in excess of 60%, but the resistance is so low that the alloy must be drawn into wire so thin as to be unable to withstand shocks, or of so great a length that the heating element is bulky.

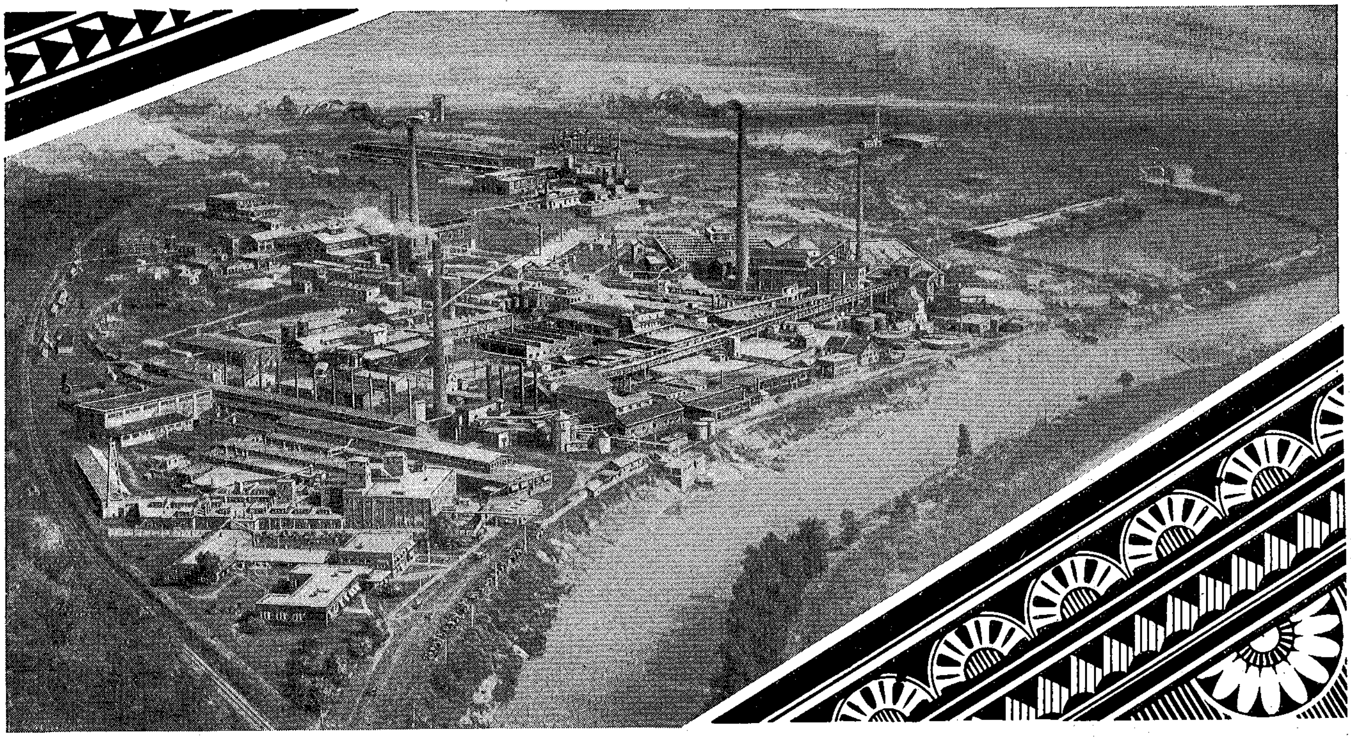
An alloy of:

Columbium or tantalum	14%
Iron	11%
Nickel	75%

has 56 to 60 times the resistance of copper and is tough and ductile. The addition of the tantalum not only increases the resistance of the material, but also increases its toughness and resistance to oxidation. The patent is held by the Western Electric Company, but no data is available as to whether or not they use such material in their products.

From the above consideration it is evident that the real data on the alloying effect of tantalum is not in the literature. There are not enough facts available to serve as a basis for any generalization as to the effects to be expected when tantalum is alloyed with a metal. The alloys listed seem to point to the possibility that in general tantalum increases the strength, hardness, and the resistance to corrosion of the metal with which it is alloyed. It frequently improves the malleability and ductibility.

In any case, the alloys of tantalum are numerous and interesting, and it is only a question of time before some of them come into commercial importance.



Research in Analytical Chemistry

(*Continued from page 147*)

must be done, and Mr. E. B. Sandell, who is working for his Master's degree, has taken up the subject of preparing pure materials, which can be used for highly accurate work in standardization problems. After many disillusions with the commercial so-called C. P. (chemically pure) products, which, as a rule, are not reliable, he has prepared different pure salts (99.99%) and soon we expect, by using these chemicals, to be able to answer some of our questions.

The problem of coprecipitation or absorption as outlined above opens an enormous wide and almost unexplored field. Mr. E. Pearson has chosen the subject on the so-called coprecipitation of zinc sulphide with copper sulphide. The theory teaches us that from a fairly weak acid mixture of copper and zinc salts only copper sulphide will be precipitated by hydrogen sulphide. As a rule, however, copper sulphide contains much zinc sulphide, for which we must account. So far we have found that the entire literature on this field is wrong; we have developed another theory and must prove now that it can explain for the facts observed. The preliminary results are very encouraging, though much more work has to be done. In the meantime, Mr. Pearson has made an extensive study of a rapid and accurate zinctitration, and is now an expert in this line.

Somewhat related to his subject are those of Miss Ruth Elmquist and Mr. Tohru Kameda. Miss Elmquist is studying some properties of lanthanum compounds and has met with difficulties in the analytical determination of this element. The classical method does not give very accurate results and she was fortunate enough to find that this is due to the fact that the lanthanumoxide formed by ignition of the oxalate is slowly transformed into a higher oxide in the air. The same holds for the oxide obtained by the precipitation of the lanthanum as hydrous oxide and ignition of the latter. Moreover, a study of the absorption phenomena in these precipitations was involved, and we are satisfied with the results obtained. We have a simple and highly accurate method for the determination of lanthanum and can explain the anomalies in the ordinary procedures. In connection with the determination of lanthanum by precipitation as hydroxide, it is of great importance to know the solubility and dissociation constant of hydroxide. Nobody has ever determined the latter, and we found tremendous difficulties in the accurate measurement of the electrical conductivity of extreme dilute solutions of strong bases. However, the problem has now been solved for the greatest part.

Mr. Kameda, who makes a special study of the hydrolysis of zinc salts, solubility and solubility product of zinc hydroxide and absorption phenomena in the precipitation of the hydrous zinc oxides, meets again with quite different problems. He has to measure the hydrogenion concentration in an unbuffered solution and, so far, nobody has succeeded in doing this accurately. After a careful and time-taking study, we expect to solve this difficulty.

In the meantime, we devote part of our work to the development of new methods or improving of existing ones. Last year, Dr. Barber took up the subject of the determination of sodium with uranyl-zinc acetate. This had led to the development of the only specific and rapid method for the determination of this element. At the present time, he is studying the procedure more in detail.

Mr. Sandell, who devotes part of his time to his standardization problem, uses the time remaining for finding a rapid and accurate method for the determination of manganese, vanadium, and chromium in steel. After many disappointments, we have now a rapid and specific method for the manganese determination, and we hope to find similar simple methods for the other constituents mentioned.

Mr. Roe, who is working for his Bachelor's thesis, spends his time with a somewhat similar subject under the direction of Dr. Geiger. He tries to remove the manganese with bismuthate and cannot confirm the statements in the literature which is a common situation in science.

Mr. Riley has just started with a problem for his doctor's thesis, the conductometric and potentiometric determination of dyestuffs. He has become a terrible sceptic, because he has found out that the labels of bottles containing C. P. products never can be relied upon. As a matter of fact, the purification of dyestuffs will be one of the hardest problems of his subject.

Dr. Sarver started with quite different work. All students who have taken a course in quantitative, know that in the titration of iron with dichromate using diphenylamine or diphenyl benzi-

(*Continued on page 170*)

Siemens—Schuckert

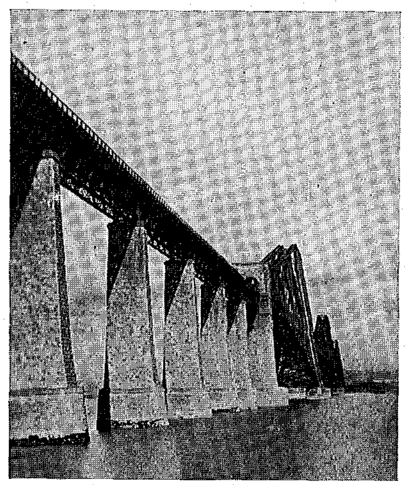
(Continued from page 150)

assembly. The most interesting part of the shops was that in which machines of almost human intelligence wove strands into telephone, telegraph, and submarine cables.

American methods of mass production and conveyor systems have been often installed. In many instances they have been greatly improved and adapted to suit better German labor and production methods. On one conveyor system, where small and medium sized industrial motors and vacuum cleaners were made, was installed a graphic recorder, which printed a continous record of the daily production in the superintendent's office.

The present economic situation in Germany has brought into being a policy of wide spread splitting of orders by large firms. The German State Railways recently purchased a large number of motors of a design which they approved, by placing with the Siemens organization the contract for armatures and ordering from A.E.G. (General Electric in Germany), the stators. On other construction work the A.E.G. built mechanical parts for a number of locomotives. The Siemens men then came to the A.E. G. plant and installed Siemens, Brown Boveri and Bergman electrical equipment, and Knorr air brakes. All products made by competing companies.

During the winter of 1927-28 H. E. Dralle, Westinghouse General Engineer,



The Firth of Forth Bridge, Scotland, as seen by Mr. Hanft on his travels through Europe.

on an inspection tour of the World's oil fields arrived in Berlin. Then in the Spring, shortly after Easter, Prudham and Hanft hiked for four days through the Harz Mountains. Setting out from Thale on the eastern edge of the Harz, they climbed to the top of the Brocken, the highest peak in the district. There the refreshment hall, topping the summit, was filled to overflowing with groups of boys and girls, laughing, chattering merrily, and singing to the accompaniment of numerous stringed instruments.

As they swung along the road next morning, Prudham stopped short, surprised by a herd of six wild deer at the head of the Ocker Valley. Hanft made a cautious stalk with his camera. Slowly he stole nearer. The deer moved slightly, but did not see him. Suddenly the strains of the wedding march from Lohengrin came from the fiddle of a "Wandervogel" who had remained unnoticed among the trees. When Hanft told the story he added, "he may have played it well, but it surely sounded out of place to me right then. From the way the deer ran, they obviously didn't like it."

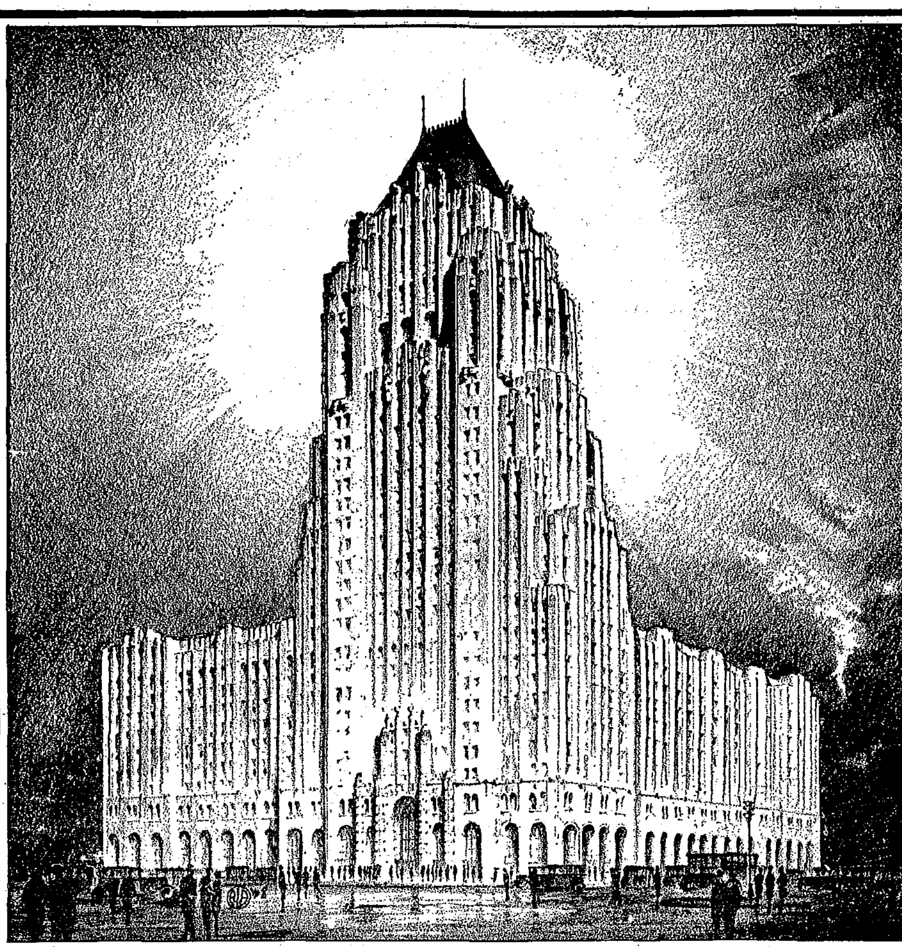
Later in the spring a vacation trip took Hanft and Prudham to Mayence and Heidelberg. An eight hour run over Basle brought them to Lucern, tired, and ready for a good rest. The Swiss innkeeper took them to a room and a deep-feathered bed, and they dropped into heavy sleep. Outside a clock in a

(Continued on page 164)

W. F. EAMES,
Design Engineer,
Carnegie Tech, '18

P. M. McCUSKER,
Headquarters Sales,
W. T. N. S., '21

C. M. PURDY,
Interdepartmental Contract Administration,
W. T. N. S., '26



YOUNGER COLLEGE MEN ON RECENT WESTINGHOUSE JOBS

R. P. JENSEN,
Construction Superintendent,
Armour Institute of Technology, '23

W. R. HARDING,
Motor Engineer,
U. of N. Carolina, '17

H. J. PETERSEN,
Control Engineer,
U. of Washington, '26

The Fisher Building

Where do young men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

IN architectural beauty and in completeness of accommodations for all classes of business and professional activities, Detroit's new Fisher Building has been pronounced ten years ahead of the times.

An important feature of its advanced development is the Westinghouse elevator system which serves the 26-story tower and the 11-story wings. Twenty-five elevators are installed, all with automatic control which brings each car to a smooth stop exactly level with the floor every time. A master control system, in addition, enables the chief operator to advance or retard speeds from his own station and to maintain accurate service schedules.

Lighting equipment, installed under the largest contract of its kind ever placed, is equally advanced. More than 12,000 Westinghouse Sollux units give light without glare throughout the entire structure.

Pumps and ventilating fans are driven by Westinghouse motors.

The complete electrification of the Fisher Building is the sort of a job that must go to an organization large enough to handle it. Westinghouse offers young men a type of opportunity that appeals to those with enterprise and talent.

Westinghouse

WESTINGHOUSE ELECTRIC

(Continued from page 162)
tower boomed. As Hanft describes the incident, "What seemed like hours later we half awoke, then suddenly sat up in bed. Outside our door in the hotel hall we heard yelling as people ran along the corridor.

"Prudham opened the door and bumped into a mammoth barefooted Frenchman, looking even more huge in a billowing nightshirt, half tucked into his knickers, a bag of golf clubs clutched to his breast. He saw Prudham, clutched his golf bag more closely, and started to run, shooting back over his shoulder in a volley of mixed French and German the news that the hotel was burning. As he disappeared he ended in English with 'and the two gentlemen will better do like verree quick'.

"We were in no condition to leave without embarrassing the natives, fire or no fire. Prudham touched the walls and found them cool. A few minutes they were still cool and we decided to sit tight and watch the fun.

"The big parade down the hotel stairs lasted five minutes. Then we watched the fire department water the roof next door. When we strolled down in the morning our golfing friend of the flowing night shirt was gone."

When traveling on Lake Maggiore from Locarno to Stresa, enroute to Milan, came the first difficulty with customs. Two young inspectors in elaborate uniforms insisted on opening Hanft's photographic plates in their search for cigarettes. Hanft remarks, "My Italian vocabulary included three words, 'train', 'ice cream', and 'no', so imagine my motions as I pantomimed a man taking pictures and tried to make my actions explain the contents of these small boxes to a thick headed inspector." The situation was save by the chief inspector who arrived just in time to save the plates.

Life in Berlin was most interesting to the two Westinghouse men. Opera, drama, music, movies, all were found highly developed. Some of the better theatres have revolving stages, an immense turntable forming the stage floor. Several scenes are set and changed by turning the stage floor. Scenes may change from one room to another without interrupting conversations as the actors walk through doorways connecting one scene with the next, or the advance of a scouting party through the wood may be most realistically shown by slowly turning the stage as the patrol creeps ahead.

On hot summer Sundays steamer excursions on the Spree river, flowing through Berlin, are the vogue. In the heyday of student life, it was these excursions which gave origin to the expression "Going on a Spree".

Hanft joined a rowing club and found that the Spree was subject to traffic rule enforcement. Acting as coxswain, he steered a shell down the left side of the river, and was promptly hailed, stopped and fined.

Each spring the fruit trees of Werder are in full bloom, and the Berliner throngs to a hill commanding a marvelous view of the blooming orchards. This has been equipped with a flight of stairs on one side, and a sand slide on the other. Sitting on the hill top the Berliner and his entire family enjoy the fruit wine made the summer before. While they are seated all is well, but let them attempt to stand and legs fail to behave. The reach the edge of the platform and start a most ungraceful roll down the sand slide one hundred and fifty feet to the bottom, head over heels. Herr Berliner, Frau Berliner and Kinder Berliner, jumbled into a mixture to be straightened out at the bottom by railroad employes who wait with a special train.

On a recent trip Dr. Hubert Alyea, national research fellow, gave speeches at several sections of the American Chemical Society on "Negative Catalysis."

News from the Technical Campus

(Continued from page 149)

Local Committees Promote Engineering Congress

The formation of local committees, organized to aid in recruit a large delegation of American engineers to attend the forthcoming World Engineering Congress at Tokio has been announced by Dr. Elmer A. Sperry, chairman of the American committee arranging participation in the event, and president of the society.

According to Dr. Sperry, the local committees represent every section of this country, Panama, Mexico and Canada where there are engineering activities, and include engineers of every branch of the profession. Dr. Sperry hopes that the various committees will be able to create a sustained interest between now and the opening date of the Tokio Congress on October 29, 1929.

The aim of the sponsors of the congress is to make it the largest gathering of scientists that has ever assembled.

Approximately 2000 feet of motion picture film from Japan, which has been recaptioned and arranged in sequences, has been secured. This film will be released for distribution to the cooperating committees during the present year.

Positions Open on Techno-Log Staff

As the result of a reorganization of the duties of some of the present staff members, several new positions have been created on the staff of the TECHNO-LOG.

As a few positions in the business and editorial departments remain open, anyone interested in publication work is invited to call at the TECHNO-LOG office during the next two weeks for a try-out.

Frumkin Addresses A. C. S.

Members of the American Chemical Society gathered at the auditorium of the School of Chemistry on the evening of January 11th at the 150th meeting of the Minnesota section to hear Professor A. Frumkin of the Karpov Institute, at Moscow, Russia. Mr. Frumkin spoke on "Electrical Phenomena and Orientation at Interfaces."

Professor Frumkin is at present visiting professor at the University of Wisconsin. His studies on surface phenomena are of great importance in the field of chemistry and physics, and of fundamental importance in colloid chemistry.

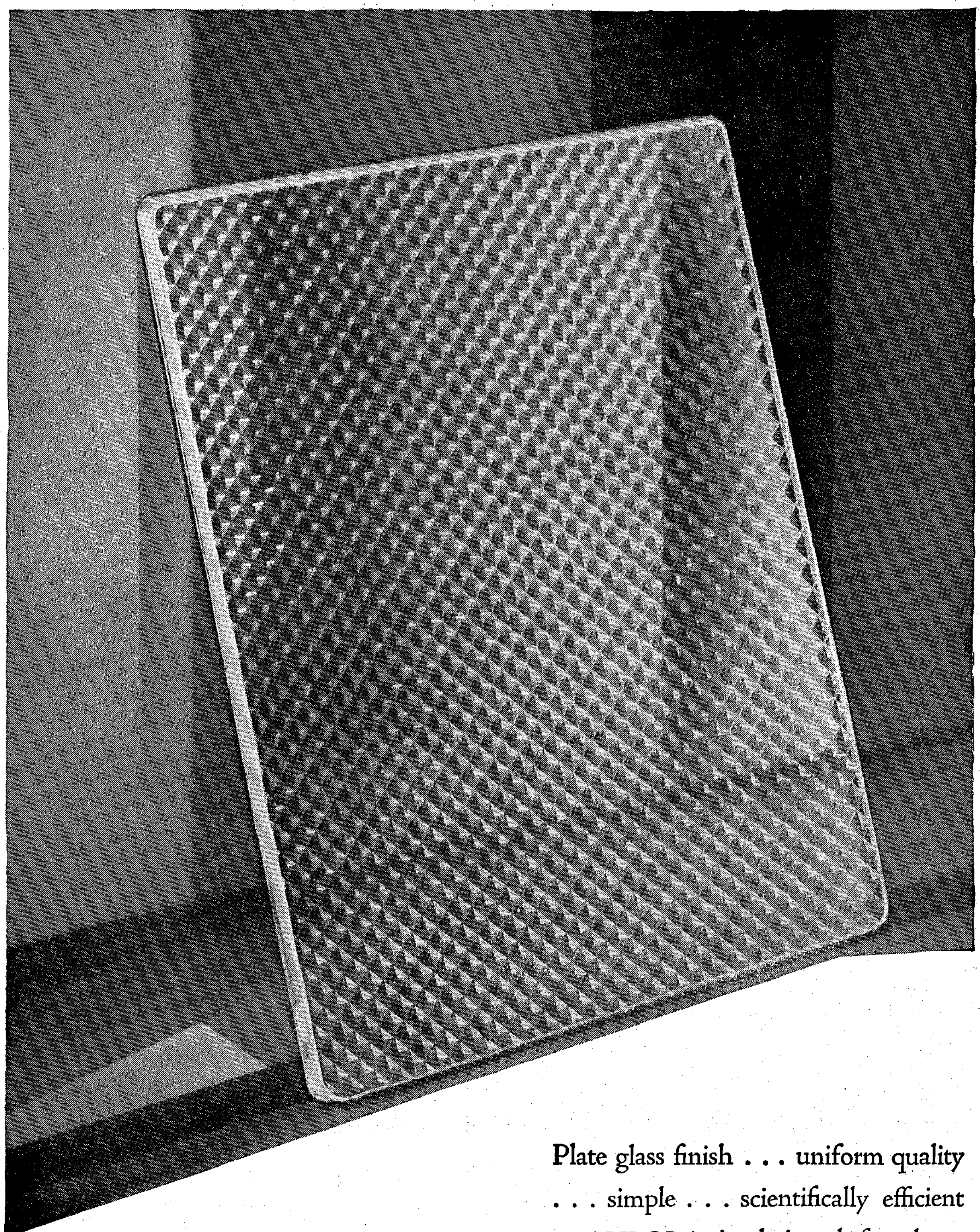
A. S. M. E. to Sponsor New Vacation Tour

Recent plans of the A. S. M. E. outline a Six-National Park Tour, which, according to the Society, will overshadow the Transcontinental Tour of 1926 and the Great Lakes Tour of 1928. The Parks to be visited are Grand Canyon, Yellowstone Park, Zion Canyon, Rocky Mountain Estes Park, Bryce Canyon, and Glacier National Park. In addition, the itinerary will include the Royal Gorge, Garden of the Gods, Pike's Peak and other places of scenic interest.

As the tour is now planned it will cover approximately 800 miles and require thirty days. Of these, sixteen days will be spent in the various parks, and four in Salt Lake City at the time of the spring meeting.

Australians have succeeded in burning peat containing as high as 64 per cent of moisture and having a heating value as low as 4000 B.t.u. per pound.

The Dusenburg eight develops 265 horsepower at 4200 r.p.m.



Around the World With Sparks

(Continued from page 145)

From Port Swettenham we crossed the straits to Sumatra and made Belewan Deli our port of call. This town is truly a jumping-off place, for, according to the stevedore, one jumps into some of the wildest country to be found in the east. There were many monkeys in the jungle that lined the banks of the rivers and good sized water snakes wriggled around the ship's sides. A short trip to Medan was made and we were all convinced that there was plenty of wild life near. We saw several crocodiles and one ourang-outang. Sumatra is the home of this species of ape.

This island, in contrast to Java has been but slightly settled and although it is much larger than Java, it has only one fortieth of the population. In one tribe, only four members had been converted to Christianity while the rest still practiced their custom of hunting for the heads of their enemies. The one other tribe on the island has been converted for the last hundred years. This is evidently the work of some European priest that wandered out here in the early part of the last century, but from what we were able to see in our short stay, the teaching they had received had done them little good, for they were forced to resort to their old practices as a matter of self-preservation.

I intend taking leave of the reader at this point, for now that the hold is full we will be making a direct trip back to civilization. Admittedly this story is sketchy, and jumps from place to place in rather an alarming fashion—but a cruise of better than half the distance around this globe cannot be condensed into a few hundred words. I am quite capable of raving on forever about the beauties of Panama, the gorgeous view from Nuaunu Pali and the stark aloofness of the tropical jungle, but better men than I have described these sights. This short sketch merely indicates a few of the sights that I saw on my first trip out, and I am hoping that, as the years go by, I may meet some of my former classmates in some of the odd corners of the world.

Aerial View of Chicago, Ill.

The Metropolitan City of the West

CHICAGO is a wonder city. It has grown like the proverbial mushroom—prairie giving place to pavement and tall buildings rising on every side.

The Otis organization has contributed in no small degree to this amazing record of growth. In keeping with the fact that "most of the famous buildings of the world are Otis-equipped" Chicago's major commercial structures reflect the trend toward safe and speedy Vertical Transportation with maximum safety.

State Street, Broadway, Picadilly—every famous street throughout the world—is lined with buildings wherein Otis Elevators are giving daily service in a safe, trouble-free manner—concrete examples of this company's determination to build nothing but the best—and the best is none too good to bear the world-famous Otis trade mark.

OTIS ELEVATOR COMPANY

OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

Films of Rubidium

(Continued from page 141)

solid rubidium as measured by the means and in accordance with the theory described in the text was found to be as great as twenty atomic diameters.

3. In spite of this penetration of the light, the photoelectric current emitted from solid rubidium was approximately the same as that derived from a film one atomic diameter thick.
4. A film of rubidium so thin as to yield a thickness measurement of less than one atomic diameter is electrically conducting. Since the underlying glass surface under those conditions must be only sparsely covered with atoms, it appears likely that the metal atoms are in rapid motion over the surface.

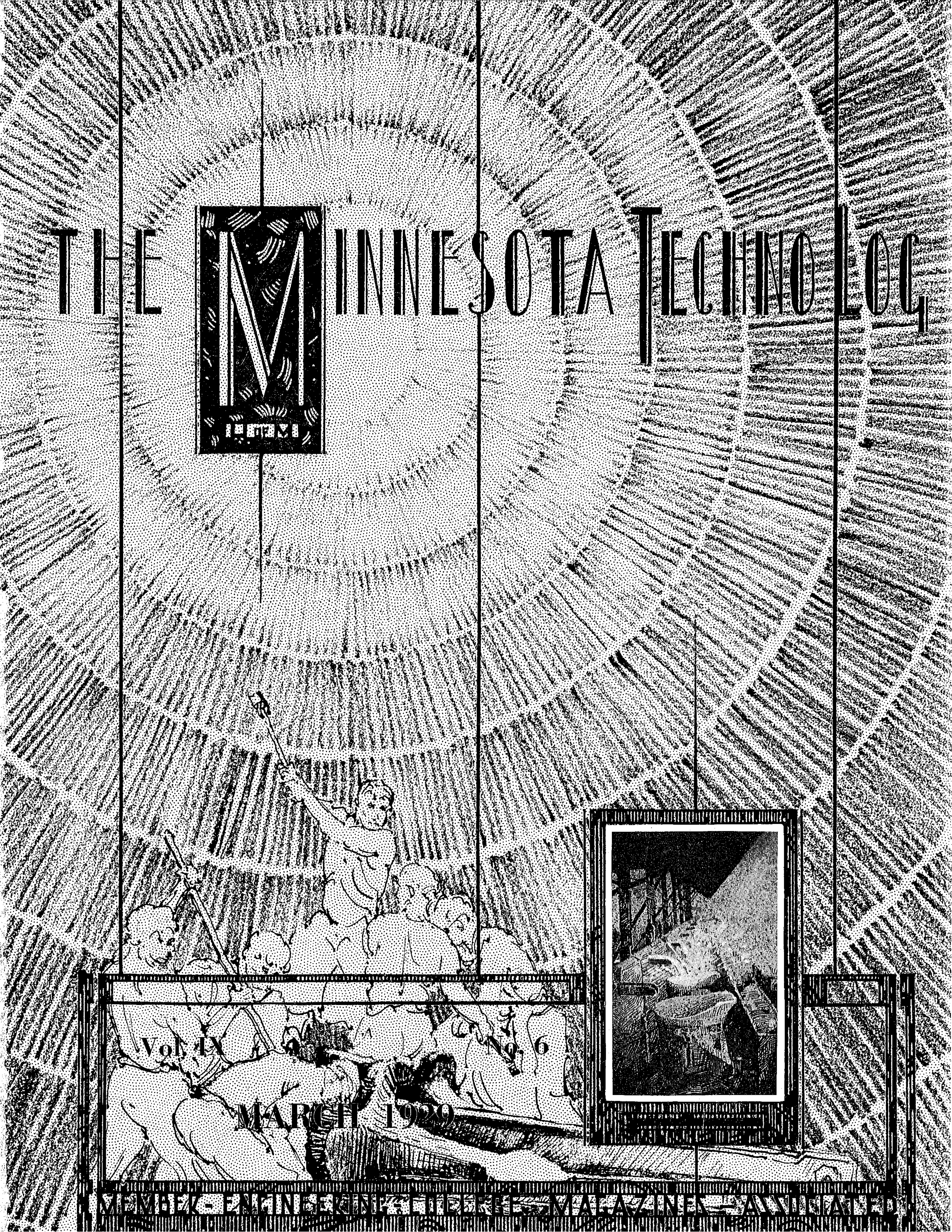
Research in Analytical Chemistry

(Continued from page 160)

dine as indicator, the latter often shows a poor color change. Now he is busy with a systematic study of the indicator properties which bring us in touch with all kinds of physico-chemical and organic problems. It is certainly not an easy subject. Moreover, he will take up quite a different subject, the spectrophotometric determination of different elements and compounds, in order to make a study of color reactions.

Finally, a few words about my own research. The most unpleasant part is to check new methods proposed in the literature. The only way to get an impression of the reliability of a new method and to keep up to date as far as the methodical part of our subject is concerned, is to imitate a new procedure. My main interest, however, lies on physico-chemical studies on the absorption by charcoal and other absorbents, measurements with regard to the development of the modern theory of strong electrolytes and the measurement of ion-concentrations, keeps me pretty busy.

In connection with the last subject, I may mention that Professor Ishimaru, from Tohoku College in Japan, who will work here for four months, just started with a study of the antimony-electrode for exact measurements of the hydrogenion concentration of a solution. If we are able to find reproducible and theoretical results and especially a simple outfit for the measurements, then the new electrode will be very promising for the future.


THE MINNESOTA TECHNO LOG
Vol. IX
No. 6
MARCH 1929
MEMBER - ENGINEERING COLLEGE MAGAZINES - ASSOCIATED

800,000 pounds of STEAM per hour from one unit!

N. Y. Times, Dec. 1928

NEW YORK EDISON BUYS 3 RECORD-SIZE BOILERS

Will Drive Largest Single-Unit Generating Machine in World at East 14th St. Plant.

Matthew S. Sloan, president of the New York Edison and associated companies, announced yesterday the closing of a contract with the International Combustion Engineering Company for three boilers that will be the largest ever built. Each will be about as high as an average eight-story building. They are to be installed in the East River generating station of the New York Edison Company at Fourteenth Street and will supply steam to drive the largest single-shaft, single-unit electric generating machine in the world, a 150,000 kilowatt turbo-generator now being built by the General Electric Company.

* * *

The over-all height of the new boilers, which are of the Double Ladd type with fin tube water walls, will be 95 feet, with furnaces 23 feet wide and extending back 65 feet. Each will supply a maximum of 800,000 pounds of steam an hour at a temperature of 700 degrees Fahrenheit, at 425 pounds a square inch pressure. The heighth of the boilers is approximately that of an eight-story building, allowing twelve feet for each floor.

With a heating surface of 60,000 square feet each, the compactness of the battery of boilers will make them not only the greatest producers of steam in the world but also the most economical for the space occupied and the coal consumed. Each of the boilers will require 80,000 pounds of coal an hour, or nearly 1,000 tons daily, if operated continuously at that rate.

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COMBUSTION ENGINEERING CORPORATION

International Combustion Building 200 Madison Ave., New York

A Subsidiary of

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COMBUSTION ENGINEERING

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

VOLUME IX — MINNEAPOLIS, MINN., MARCH, 1929 — NUMBER 6

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The MINNESOTA TECHNO-LOG
University of Minnesota
Volume IX | MARCH 1929 | Number 6

Future Engineering Education

By J. E. Nicholas
Instructor in Mechanical Engineering

A VERY young man who has just received his engineering degree, in applying for a job in some chosen field, meets with this question: "What experience have you had in our line?"—and then invariably he replies that he fired a boiler; or worked on the chain gang; or in some shoe factory, and if he is hired at all he is taken in as a possibility and given what is commonly called their "training course," which usually lasts a year or more; and at the end of this time he is either found wanting or else his choice was in the wrong field and proceeds to make immediate reparations, only to find that the same questions confront him.

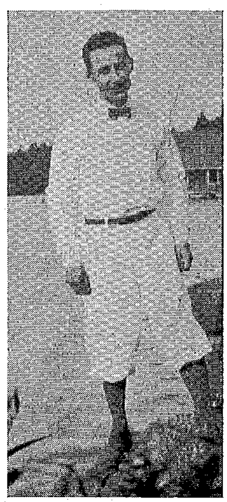
Is it then that his college or university engineering education has been inadequate or is he premature to cope with the problems that he meets?

Professor Lucke, in a recent article*, writes that "Engineering is a *profession* and as such stands beside law and medicine." Yet in both of these professions of law and medicine a student's preliminary requirements are the so-called pre-medical and pre-legal courses before entering the regular law or medical school, after the satisfactory completion of which the law student is required to pass the bar-examination and the medical student becomes an intern for one or two years in some hospital before any of these qualify to follow their professions of their own accord.

Is it logical then to assume that before we can class engineering as a profession so that it might stand beside law and medicine, that we have future engineering education based on some such parallel lines of requirements as those of our sister professions?

It may be argued at the outset that more than four or at most five years of engineering education would incur on the part of the student added expense to which probably none would subscribe—yet the law or medical student has no alternative and proceeds with the outlined program.

The amount of material to be handed out to a student in engineering in four years of his training has been considerably supplemented and been made more complex by new fields of engineering and abundant material of research. So that to be able to cope with this added material, and to digest it properly, requires unquestionably more than the allotted four years and a far better knowledge of English and certainly mathematics and physics, than he is able to get under the present curriculum. Aside from that it becomes evident that a student should have more than a reading knowledge of either French or German or both.


J. E. Nicholas

An engineer is an applied physicist—but it is not enough just to quote some law of physics. Mr. A. Fage in his "Airscrews in Theory and Experiment" says: "Since the purpose of mechanical philosophy is to give a clear and ordered exposition of mechanical phenomena, it follows that the validity of a theory depends on the truth and 'comprehensiveness' of the fundamental assumptions on which the theory is based. When the conception of the natural phenomena is imperfect or when these phenomena are completely understood, but are so complex that the problem cannot be solved by mathematical methods, the aid of experiment is sought." To understand the technical principles, to comprehend them mathematically, and to apply these principles to engineering economically, to know their limitations, becomes the immediate problem of the engineer and this involves time, patience, and perseverance, which no young student can hope to master in the limited time of four years.

To meet, then, these problems in the ever increasing field of engineering, to have a more thorough knowledge of the underlying principles, to class engineering as a profession on the same basis as law and medicine, calls for a new program, a new curriculum, based on the needs of sufficient time and training though it may lead to specialized fields in some limited division of engineering, as it indeed does lead to specialized fields in both law and medicine.

Engineering education of the present era seemingly absolves the engineer from his duty to the public or the government, and the result is that his status in the social or political world is an unknown quantity. To the average layman an engineer is one who runs a locomotive, a steam roller, or perhaps an elevator. Shall we then train the public to interest itself in the engineer or the engineer to interest himself in the public?

Obviously the latter method is more appropriate and engineering education should include the fundamentals of local, state and federal affairs, dealing with the immediate and past problems of these societies—together with the engineering duties to them and as being an integral part of his profession.

To quote President Lowell of Harvard: "Most people (and this surely includes the engineer) and perhaps in a peculiar degree the American people, tend in the busy life of the world to save themselves from strenuous thought by taking refuge in the opinions of their associates, of the men in like occupations, of the party or group to which they belong. This saves some of them, indeed, from eccentricity and irrational extremes; but it does not absolve men from the responsibility for the correctness of their opinions or save the nation from the consequences of their errors. The fact that others make the same mistake is no excuse. Yet people who go with the prevailing current of opinion seldom feel any responsibility still less contrition, when that current leads to wrong doing and disaster. Man has the ability to think for himself, to weigh reasons, to forecast in some degree the future, and to reflect upon the consequences of his acts—."

The requirements of the engineering profession are manifold—let us have the best—it will pay in the long run. Will the future of engineering education meet the requirements?

*Engineering—Mechanical Engineering Journal, Nov., 1926, p. 1089.

The Concept of Mathematics

By EDWARD A. SAIBEL
Instructor in Mathematics

IT is with the utmost trepidation that I approach this subject "The Concept of Mathematics," because first of all I must shatter your preconceived notions of the subject. You have been drilled and worked in mechanical operations ever since you have attended school; first it was addition and subtraction, then multiplication and division, in high school you were given algebra and the same routine followed, and in the University you studied the most advanced manipulation you will perhaps ever be forced to perform. And yet you have no conception of what this subject is about, because your simplifying of fractions, or your logarithmic computations, or your differentiation and integration have been only remotely connected with the vast over-reaching body of thought that has come to be called mathematics.

The subject you have been devoting so much time to had better have been called "optimistic manipulation," because you have never had a precise definition of the terms you have employed, or of the relations among them that you have used. You have never seen a correct proof of a single theorem. Your plane geometry in high school, which was supposed to have developed your mind along lines of logical thought, consisted of the slip-shod manipulation of insufficiently defined concepts and relations. In plain words, I mean, you never have gone through a single mathematically correct proof. I do not tell you this to make you lose confidence in the results you have obtained hitherto, but I do want to raise doubts in your mind to the point of forcing you to consciously think and examine some of your preconceived ideas.

Pedagogically speaking, perhaps the subject of mathematics must be handled in this way. That is, we familiarize you with unproved operations and results, and then allow those of you who are interested to dig down deeper and examine the underlying structure. But I see no reason for concealing the fact from you that such and such a proof is not quite complete, or that this and that concept needs considerable amplification. We have not really been teaching you false results, for proofs of all the theorems do exist and they are mathematically correct. (We shall see later that "mathematically correct" has but little connection with "true or false" as the terms are ordinarily used.)

Having been part of this pedagogical system myself for a short time, I am writing this article as much to ease a guilty conscience, as to introduce new concepts to you, but if I can succeed in making a few of you examine a little more deeply the things you have been taking for granted, I shall feel that this article has not been entirely in vain.

I am not going to give a dogmatic definition of mathematics, although I believe that several satisfactory descriptions of the subject might be given. I shall content myself with an illustration taken from Veblen and Young, showing the development of a simple mathematical system and the mathematical method. This will be followed by a hasty examination of our arithmetic upon which the so-called mathematical analysis is based. This gigantic superstructure consists of such topics as the calculus, differential equations, functions of a real and complex variable, etc.

> *Pure mathematics is not concerned with the truth or falsity of its propositions in the ordinary sense of the words true and false. A mathematical system is built up from primitive elements and relations and a set of unproved propositions. These may or may not have any connection with the world we live in as we know it by intuition, measurement, or other means.*
>
> *It is true that the needs of the physicist have been responsible for a large part of the development of mathematics and in the future will continue to be the source of much inspiration. For whatever demands the physicist or experimenter may make upon him, the mathematician can, in most cases, adjust his primitive propositions to bring about the desired results. In this article Mr. Saibel has put forth the case of the pure mathematician, which to most of us, in an engineering college, will open new lines of thought.*

Imagine a miniature world inhabited by people who reason as we do, that is, given the same set of premises, both they and we would draw the same conclusions. Suppose these people are scientifically inclined and make observations and experiments upon their world in order that they might have some conception of the underlying structure. Suppose they notice, among other things, that their world seems to be made up of seven fundamental elements (we would call them points, but the name is of no vital significance). Here, then, is a world consisting of only seven points, which are arranged in certain groups or collections. They also note that these groups or collections contain only three elements, that any two elements can be found in one and only one collection, that two collections have one and only one element in common. We would interpret this to mean that the points are arranged in groups of threes and each group of three points is a line, two points determine one and only one line, two lines have one and only one point in common, etc.

The process of observation, generalization, and refinement of thought would go until some day a Mr. Vincent Crummels of their world, with an eye for unities, would attempt to start from the fundamental elements and relations of his world, lay down postulates he believed to be true, and attempt to develop the geometry of his world from these fundamental elements, relations, and postulates. His fundamental element would be what we call the point, because he could not resolve this element into simpler quantities. And not being able to define this element in terms of simpler concepts, it must be the undefined element at the foundation of his system. You see, he had only a finite number of words and gestures, just as we have, with which to express himself. Hence he had to have a starting point and the starting point must be incapable of explanation or resolution into simpler concepts, therefore the term, indefinable.

Let us consider an analogous situation. Take any word in the unabridged dictionary. Look up its equivalents, look up their equivalents, and of course after several repetitions of this process you return to your original word, so that we must take certain words, which express whatever they may, objects, ideas, sensations, as fundamental and that means indefinable. We are, of course, always on the search for simple and more simple concepts,—we are always trying to resolve these fundamental concepts into simpler ones, but the process is necessarily a finite one in a finite length of time.

But to return to our miniature world. Now that this being has chosen his starting element, he must have a fundamental relation applicable to his element. Here we have the same situation, a relation must be either explainable in terms of other relations, or it must be indefinable, incapable of resolution into more simple relations. Thus here again we must start with one or more relations as undefined. This inhabitant of the seven point world, wishing to make these relations as simple as possible, just as we do, has chosen for his fundamental relation "belonging to the same collection" or as we would say "lying in the same line." He would then make the following assumptions or postulates, meaning unproved statements, concerning his primary element and relation. These statements expressed in our language are:

I. If A and B are distinct points of the world, there is at least one line containing A and B.

II. If A and B are distinct points of the world there is not more than one line containing both A and B.

III. Any two lines have at least one point of the world in common.

IV. There exists at least one line.

V. Every line contains at least three points of the world.

VI. All the points of the world do not lie on the same line.

VII. No line contains more than three points of the world.

The first question to ask concerning this set of assumptions is "Are they logically consistent?" By this I mean, can our assumptions all exist without conflicting among themselves. If I can give a concrete illustration that satisfies all the assumptions, the above question will have been answered in the affirmative, and the given postulates can all exist simultaneously.

Let the digits 0, 1, 2, 3, 4, 5, and 6 represent the seven points constituting the miniature world. Let them be arranged in the following array:

0 1 2 3 4 5 6
1 2 3 4 5 6 0
3 4 5 6 0 1 2

Now if the vertical rows are interpreted as lines, an inspection will show that every assumption is satisfied.

We are now in a position to derive some of the theorems a geometer of this hypothetical world would be led to deduce.

Theorem I: Any two distinct points determine one and only one line containing both of the points. Proof: This is a direct result of assumptions I and II.

Theorem II: Any two lines have one and only one point in common. Proof: Assumptions II and III combined.

Theorem III: There exist three points in the world which do not lie in the same line. Proof: Assumption IV tells us that there is a line. From Assumption V we know that this line contains at least three points, but Assumption VI says that there must be a point not on this line. Hence any two points on the line, and this other point, not on it, are three points not on the same line.

Without the use of Assumption VII, Theorem IV can be proved: Any world subject to assumptions I to VI must contain at least seven points. Making use of Assumption VII, we can show that the world must have only seven points.

If we now designate the seven points by A, B, C, D, E, F, and G and from the following array:

A B C D E F G
B C D E F G A
D E F G A B C

where the vertical columns denote lines, we have a system satisfying our assumptions and of which, consequently, the above theorems are true. The properties of this world can be clearly seen by an inspection of the accompanying diagram, Figure One, and if we interpret the dotted line FCD to be a line in our sense of the word, we observe a condition similar to our ordinary plane geometry. Note that in the figure each point is labeled with a letter and its corresponding number. The two systems

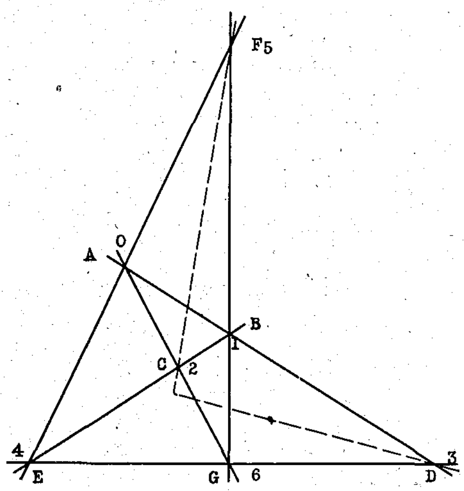


Figure One

correspond in every detail and are said to be "simply isomorphic." In the abstract sense they are equivalent, to the pure geometer they represent the same world. It is easy to see that an infinite number of such worlds can exist. To study the geometry of any one of them is sufficient to understand them all.

This miniature geometry which we have just been developing shows clearly what we must do in a geometry of our own world, or in that of any other world we wish to study. We must first choose a set of undefined elements and relations. We must lay down a set of unproved fundamental assumptions concerning these elements and relations. These assumptions must be logically consistent. We should also like to have them independent. By that I mean, the impossibility of deriving any one of the assumptions as a logical consequence of the others. This is necessary if we are to have a precise distinction between an assumption and a theorem. Having assumed undefined elements and relations and a set of unproved propositions, we are now in a position to derive theorems concerning our world by the ordinary processes of logic. This in brief is the mathematical method and the result is a system of mathematics.

From the standpoint of pure mathematics it has not concerned us to note whether our assumptions are true or false. To the pure mathematician this question has no significance. "True or false" to him means only correct or incorrect reasoning from the primitive propositions according to the rules of logic. If we happen to be interested in the structure of our own world, we see to it that the assumptions we lay down are borne out by experience, and we test our theorems by observation and experiment. This is the province of the physicist and applied mathematician.

You have perhaps noticed that in the miniature geometry we developed, the notion of measurement did not enter. This shatters another popular conception, namely, that mathematics is the science of quantity, or that it is the science of space and number. Some very important branches of mathematics such as projective geometry, the theory of abstract groups, or the algebra of logic have no necessary relation to quantity, in the ordinary understanding of the word, and the last two have no relation to space.

The mathematics of greatest interest to the engineer is the branch designated as analysis. It is in this subject that he finds all the tools with which to handle his theoretical or practical problems.

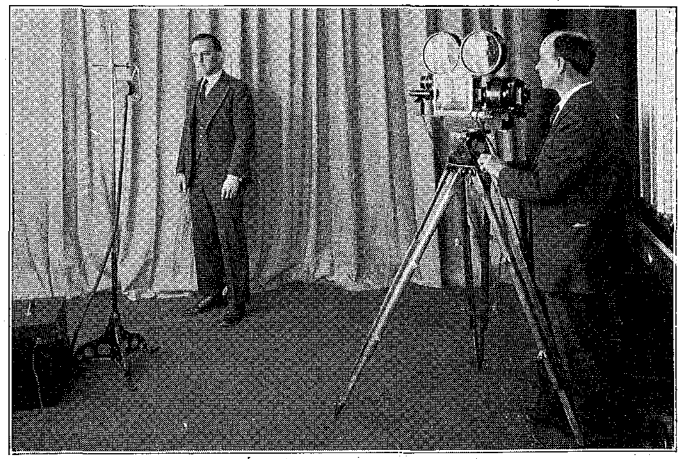
Within the last fifty years analysis has been "arithmetized." This was a process of utmost importance. It consisted in making analysis free from the intuitive notions derived from the idea of measurable quantity. Arithmetization reduced all analysis to the ultimate concept of the integral number. And from the integral number follows arithmetic, and from arithmetic follows the tremendous subject, mathematical analysis in all its ramifications, where each step is a strict logical deduction from previous results and at each stage of the process we have just what has been assumed and what has been proved.

Let us turn our conception now to the concept of the integral number. In the last part of the nineteenth century, Peano, an Italian mathematician, succeeded in reducing analysis to the theory of the natural numbers by means of three primitive or undefined ideas and by means of five undefined propositions, in addition to those of pure logic.

At the beginning of this century, Bertrand Russell succeeded in reducing Peano's concepts into simpler ones. He defines number in terms of the concepts "belonging to a class" and "similarity of classes." He considers mathematical induction as a definition and in his terms natural numbers are defined as those "to which proofs by mathematical induction can be applied." Russell is thus enabled to reduce the number of primitive propositions. The notion of order is next introduced and then follows the concept of a limit, which need not be defined in

(Continued on page 202)

Synchronized Pictures



The latest advances in the technique of making talking pictures have produced films which are superior to actual stage productions

By Claire C. Fox, E.E. '29

IN synchronizing sound with motion in motion pictures two very different and distinct methods are used. In the one, the sound is recorded on a disc similar to the ordinary disc phonograph record, only of greater diameter. The other is the photographic impression of the sound upon the film itself. The latter is in the form of a band one-tenth of an inch wide, and to one side of the film. At present there are two principal methods of recording the photographic impression of the sound upon the film. The one is called the "variable width" and the other is called the "variable density." These types will be discussed later in the article.

The problem is not primarily one of synchronizing sound and motion on the film as this is a mechanical feature readily accomplished. The real problem is the recording and producing of the sound of a satisfactory density and an adequate volume.

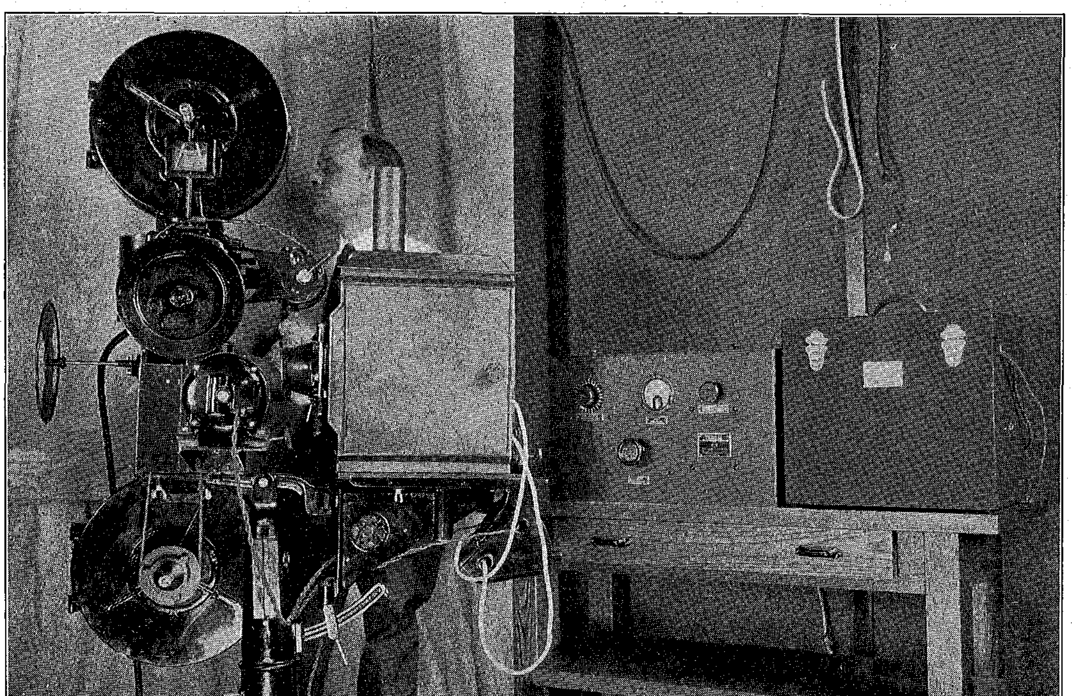
The producers find their greatest problem and item of expense in the recording of the sound and motion. It was necessary to build sound proof studios since the sensitive microphones would pick up all sounds produced while the scenes were being taken. The noise of the cameras themselves had to be corrected. While shooting a scene the arc light may start "singing" or a truck may rumble past the studio. These vibrations are picked up, recorded, and will not be detected until the scenes are reproduced.

The printing of the film with the sound band on it is extremely difficult. If the emulsion of the print is not of a perfect texture, or if it is dirty or scratched it will cause ground noises.

In the recording of the sound impressions on the film itself, the sound waves are picked up by "condenser" microphones whose diaphragms will vibrate. The amount of displacement of the diaphragm is proportional to the intensity of the sound. This movement will vary the capacity of the condenser and hence will alter the charge on the grid of the vacuum tube which is connected in series with the microphone. The resulting alternating current is proportional and in phase with the sound waves. If the microphone is of the carbon type, the movement of the diaphragm will vary the resistance of the microphone and will cause a modulated direct current, which may be considered as made up of direct and alternating components.

After the current is amplified approximately 100,000 times, it is impressed on an *aeo* light (this is in Movietone production). The aeo light is a gas tube excited by direct current and so designed that its intensity varies directly with the applied voltage. This light is allowed to pass through a narrow slit onto the moving film negative in the camera and the variations of light, and hence of sound, are recorded upon it. The film moves through the camera at 90 feet per minute or 18 inches per second.

If the sound to be recorded has a frequency of 60 cycles per second, the aeo light will flash 60 times, therefore there will be 60 light and 60 dark striations .15 inch wide. If the frequency is increased to 6000 cycles these striations would decrease to .0015 inch in width. This is known as the variable density method of recording sound. In this method the width of the bands determines the frequency and the difference in shade between the light and dark portions is a measure of the intensity of the sound. For example, a trombone would produce a series of wide dark lines as also would a bass singer in a varying degree. A tenor horn or a soprano singer would make a record consisting of narrow



THE PROJECTOR SET-UP
The projector is much more complicated than the ordinary film machine.

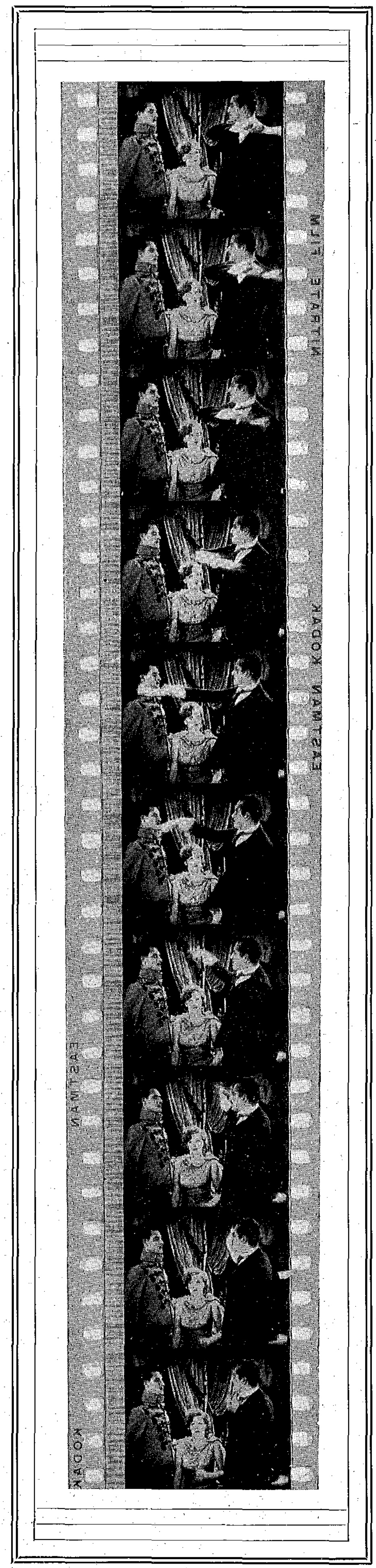
lines which, because of their extreme narrowness would not appear to be as photographically dense as the bass tones. The greater the contrast in density between the light and dark lines, the louder the sound.

Another method of recording the sound on the film is by the use of a delicate mirror which is hung on fine wires so it may oscillate freely. The amplified current which is produced in the same manner as in the "variable density" method is made to produce a quick changing magnetic field which in turn will act on the mirror and cause it to oscillate. A beam of light is projected on the mirror and from there it is reflected to the sound track of the negative film. Thus the record or the sound track is opaque on one side and transparent on the other. The division between the two sometimes resembles a saw with teeth of different lengths. The division line is always irregular and its shape depends on the pitch and volume of the sound recorded.

The problem of reproduction of the sound band type is to transform the sound impressions into an electric current which will vary exactly with the frequency and intensity of the sound waves which produced it. The sound reproducing apparatus, or "pick up" consists of a straight coil filament light source, the "slit assembly" which is a condenser lens, the "slit," a projection lens, the sound band on the film, and the photo-electric cell. The slit is the most important detail. Its purpose is to project a straight, exceedingly thin, perfectly horizontal line of light which will illuminate each line of the sound band without illuminating any portion of any other line or any space between lines as they pass it at the rate of 18 inches per second. This aperture is .0015 inch. The slit assembly is placed in position on the projector and sealed there.

The sound band will absorb light in exact proportion to its density at any point, hence it follows that in the beam of light, beyond the film, the light densities exactly represent the sound densities photographically impressed upon the film sound band. These beams of light project to a photo-electric cell which transforms them into an electric current.

This cell consists of a tightly sealed tube the interior of which (except for an opening to admit light rays) is coated with a silver deposit. Over this silver deposit is a coating of a special form of potassium which has the property of emitting electrons freely when light strikes it. The negative terminal of this tube is connected to this coating of silver, upon which is the light sensitive material; and this in turn is connected to the filament of the first amplifier tube. In the center of the tube hangs a ring



shaped conductor, to which is connected the positive terminal of the tube and in turn is connected to the grid of the first amplifier tube. Between the positive and negative sides of the cell is a difference of potential of 100 volts. However, the cell is filled with a rare gas, which, when no light enters the cell, is a very poor conductor of electricity. In fact, this gas acts as an insulator which will prevent any flow of current between the two electrodes of the tube. Therefore, when the projector is in operation and the beams of light coming through the sound band enter the cell, the light-sensitive material emits electrons which ionize the gas and cause it to become a conductor of electricity in exact proportion to the amount of ionization. In this lies the key to the transformation of light waves to electrical energy. The strength of the ionization is entirely dependent upon the light sensitive material at any infinitesmal fraction of a second, and since the resistance to the current flow is in exact proportion to the amount of ionization, it follows that the electric current set up will have precisely the same variations in value that the beam incident upon the light-sensitive material had. Thus light values are transformed into electrical values which contain all the infinite number of variations which go to make up music and voice. The current produced is extremely faint and must be amplified millions of times before it reaches the horns.

In the disc method of recording sound, the microphone current, after being magnified several thousand times, is utilized in controlling and operating an electromagnetic recording stylus. This small stylus chisels its movements on a revolving wax disc. The movement of the stylus is radially with respect to the disc, thus making a grove of a sinuous path. The width of these sinuousities corresponds to the loudness of the sound and their frequency, the pitch. This method has its disadvantage, namely, that the energy generated by the sound must be used to carve the record on the disc. This power generated is a faint power and any of it lost in the process will be deducted from the record. Because of this, this type cannot record overtones which are necessary in harmonics.

The disc system of reproduction has its principle of operation based on the fact that if a coil of wire is wound about an iron bar and the magnetic strength of the iron is changed an electric current will be induced in the coil in proportion to the change in the magnetic field. One method of obtaining this changing magnetic field is to place the bar across the poles of a U shaped magnet. This armature comes very close to the tips of the magnet, but does not touch them. The

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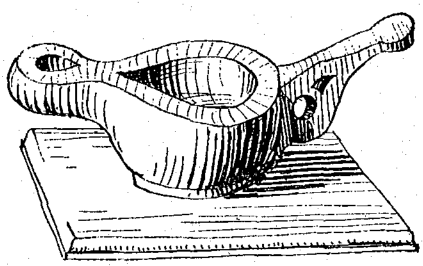
Electricity and Light

Light, one of the most important aids to man, was the result of patient investigation rather than chance discovery

By J. Robert Ginnaty, E.E. '29

PRIMEVAL man, men of the ancient civilizations, and the men of the present day have all had light, both natural and artificial, but all men have not had the same quantity or quality of artificial light.

Athenaeus, an ancient Greek philosopher, stated that the lamp was not an ancient invention of the Greeks but that it had come into general use in Greece for domestic purposes by the fourth century and that no doubt the lamp had been employed for lighting temples and other places where permanent light was required. These early lamps, no matter when or what their origin, were at best but crude affairs for lighting, giving off almost unbearable amounts of smoke and odor.



AN OLD ROMAN OIL LAMP

About twenty-five centuries ago, Thales, a Greek philosopher recorded the fact that if amber was rubbed, it would attract light objects to itself. The Greeks called amber *elektron* and this is where we get the word electricity. Then, about 250 years after this Aristotle, another Greek philosopher, mentioned the fact that lodestone would attract iron. And about 100 A. D. Plutarch, a Greek biographer, wrote about the fact that iron was sometimes attracted and at other times was repelled by a lodestone. These early experimenters did not even dream of the things that their discoveries would lead to—they did not even know that they were on the border of one of the greatest of the modern sciences. As time went on different men discovered new things about the lodestone, magnet, and rubbed amber.

In 1650 Otto Von Guericke made a machine consisting of a ball of sulphur mounted on a shaft so that it could be rotated. Guericke found, by experiment, that this ball when rotated and rubbed with the hands appeared as if it were phosphorescent and that electricity was generated; he also found that this electricity could be conducted from place to place on a chain that was allowed to rub upon the sulphur ball.

1709 saw Francis Hawksbee using a reproduction of Guericke's machine with the sulphur ball replaced by a hollow, exhausted glass globe. When Hawksbee ran his machine and rubbed the glass ball the globe became filled with a soft glow that was described as being pleasing to the eye. This was the first electric light that had been produced so that it could be seen continuously; of course, all of the ancient experimenters of this era had seen light produced by the rubbing of amber to get small electric-static sparks. Hawksbee was much mystified to find that when he took his hands away from the glass that the glow stopped and also that as soon as the machine was allowed to stop spinning that the glow stopped; he was much more surprised to find that if after the glow had disappeared he brought his hand up to the globe that there would be rings and layers of light flash and flicker around the inside of the ball. This was the last noticeable progress made for nearly a hundred years.

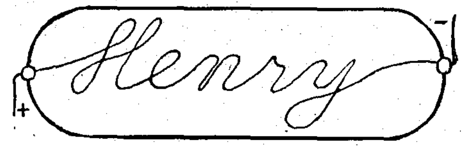
Then Alexandro Volta, a professor of physics in the University of Pavia, Italy, made a pile of silver and zinc discs with cloths, wet with salt water, between them. This was in 1799 and in 1800 he described his pile in a letter to the Royal Society in London. Thirteen years after this discovery of Volta's, Sir Humphry Davy brought the terminals of a powerful battery together and produced a jet of flame which played between these terminals and made a very strong, continuous light. Davy next made his terminals of pieces of carbon so that they would not wear out so quickly and produced light. This light was the forerunner of the present day carbon arc lamp. People in all parts of the known world went around rejoicing in the new light but were doomed to disappointment because the battery cost and size made the common use of a light of this kind out of the question. It has been estimated that the cost of running such a light was about $13.00 per hour.

However, as time continued on its merry course new methods of producing light from electricity were constantly being introduced and in the year of 1840 Grove made an experimental lamp by attaching the ends of a coil of platinum wire to copper wires, the lower parts of which were well varnished for insulation. The platinum wire was covered with a glass tumbler and the open end set in a glass dish partly filled with water. This prevented draughts of air from cooling the incandescent platinum and the small amount of oxygen of the air in the tumbler reduced the amount of oxidation of the platinum that would otherwise occur. With a voltaic cell, Grove lighted the Auditorium of the Royal Institution with a number of these lamps during one of the lectures that he gave there.

Many schemes have been used to produce light from electricity and many more will perhaps be used but one of the least used substances in the electrical production of light is incandescent gas. In 1850 Geissler first operated his small tubes from an induction coil and this form of light has been with us in almost its original form ever since, and has been a play thing of experimenters and scientists.

In 1879, twenty-nine years later, a man named Crookes modified these tubes in many ways including the obtaining of a high vacua in the tube and in 1891, Tesla delivered his famous lectures on high voltage and high frequency all of which led up to the beginning of Moore's work on gaseous electric lamps in 1893.

With the appearance of the arc and incandescent lamps it was thought that electricity had reached the limit in giving the world a system of illumination that could leave nothing more to be desired and which eclipsed the old lamps of the ancients as much as the sun eclipsed the arc. But to be entirely satisfactory artificial light must be steady, must be of a suitable intrinsic brilliancy, and must have a suitable color. The arc lamp lacked some color and was a very bright splotch of light held in one place and methods of reflection and defusion were not as well known then as they now are, so the arc lamp was not used to any great extent except in out door lighting.



A NEON LAMP FOR ADVERTISING PURPOSES

The incandescent lamp had the same faults and in addition its filament was extremely brittle. These faults of light-

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The Importance of Temperature Scale

A correct temperature standard is of the very greatest importance in calibrating measuring instruments accurately

By L. H. MILLER
Associate Professor of Physics

THE problem of establishing a correct temperature scale has been in progress since the year 1870. It is only a few years ago that the last work was completed which provides us now with a very satisfactory temperature standard.

As I entered a street car the other morning and heard a conversation on the weather, I almost decided that the correct temperature scale had not yet been established. One man said that his thermometer registered 25 degrees below zero, while another claimed that his had registered 30 below at the same time. By the time one listens to these various ratings of the temperature he does not know to just what degree he should shiver and shake.

However, these differences in atmospheric conditions are a minor matter, and may be explained in a number of ways. The reading will depend whether a given thermometer may be located in a high or a low place, whether it is near a body of water or not, or what location it may have in respect to certain buildings. Government specifications require that thermometers must not only be accurate, but that they should be placed sixteen feet above the roof of the building housing the weather station, enclosed in a shelter having shutters on all sides permitting free circulation and protecting it from direct radiations of the sun.

Then again there is a big chance that there may be a difference in thermometers themselves. If one pays more for a thermometer it should be more reliable. However, once in a while a cheap thermometer may have a correct scale and once in a while an expensive thermometer may give incorrect readings. Again, a thermometer may read correctly at one part of the scale and incorrectly at another part. Glass is very erratic in its action and properties and this effect will enter more in the case of cheap thermometers than in the case of the higher grade. Certain annealing processes take place in the glass as it gets older. If this entirely can be eliminated by the artificial methods of ageing used by manufacturers of thermometers, the calibration of the thermometer will not change. These treatments of course add to the costs of the instrument.

Improper handling has often rendered thermometers inacurate. Of course there is only one way to be sure of the accuracy of your thermometer, and that is to have it tested by a reliable laboratory.

Probably there are many who do not appreciate the importance and difficulty of establishing an accurate and standard scale. The unit on the temperature scale, called the degree, is formed by dividing the temperature interval between the freezing and boiling points of water into an equal number of parts and designating one of these parts as a degree. This temperature interval is only about one-forty-fifth of the temperature scale which we use from absolute zero up to the temperature of the sun, or to our highest furnace temperatures.

We have no one type of thermometer which can operate over this entire working range. In reality it requires three different types, the thermocouple, the gas thermometer, and the radiation pyrometer. We extend the temperature scale by overlapping the ranges of these different devices. It is evident that a small inaccuracy in establishing the degree from so small an interval as between the freezing and boiling points of water and extending the temperature scale by the above method could cause an accumulative error of considerable magnitude by the time the higher values have been obtained. In fact with the hydrogen gas thermometer it used to be that the error in temperature measure increased until at these higher temperatures the inaccuracy amounted to several hundred degrees. High temperature products could not be manufactured profitably with such poor control of temperatures.

By a theoretical and experimental study of the principles involved in establishing a correct temperature scale a correction factor has now been determined whereby we can now use the hydrogen gas thermometer, apply this factor, and now measure these same high temperatures with no greater error than 45 or 50 degrees. We may consider today that practically our entire high temperature industry owes its profitable existence to the establishment of what we may call the Kelvin temperature scale.

From time to time many inquiries have come to me for a considerable number of different temperatures both natural and technical which I will present at this time since they seem to be of such general interest.

Not only was it important that there should be a correct standard by which the instruments used to measure these temperatures, should have been calibrated but that they should fulfill certain specifications in order to measure the temperature correctly, and that the observer should know how to arrange the instruments and make correct observations.

The values which I am presenting are according to the Fahrenheit scale and supposed to be authoritative, although there are a few which are still under discussion.

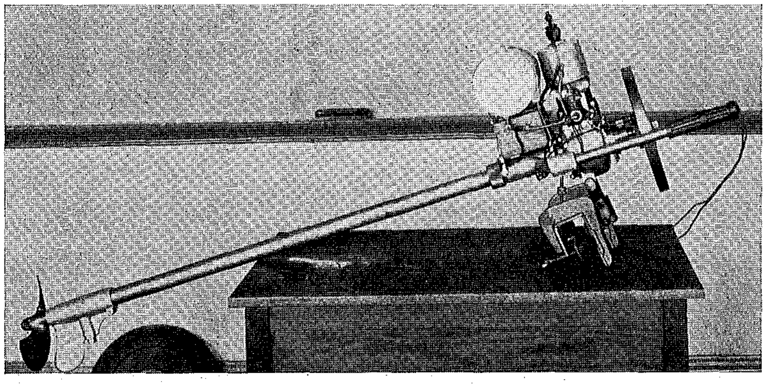
Absolute zero is a temperature at which there is supposed to be no heat remaining. It is -459.4°F or 459.4° below the zero on the Fahrenheit scale. The lowest temperature supposed to have been obtained artificially was by Dr. Onnes in Holland when he produced solid Helium at -457.9° which is only 1.5° above absolute zero.

Alchohol freezes at -179.7°F. When a cake of ice rests in a room melting at an ordinary temperature (e. g., 70°F), it is 32° F within the ice and will so continue, as long as there is any of the solid ice remaining. Likewise pure water boiling under ordinary pressure conditions is said to have a boiling temperature around 212° or less according to the atmospheric pressure and as long as there is liquid present and heat is being supplied it maintains that temperature of boiling. Likewise liquid air placed in a vessel in a room has a boiling temperature of –313.6°F. Enough heat comes from the vessel and surroundings to evaporate it at this temperature.

The temperature at the North Pole is –60°F but this is not the coldest on the earth's surface. There is what is called the cold pole located in Siberia near Verkhoyansk where the lowest value recorded has been –90°F. The lowest upper air temperatures have been measured by balloons with recording instruments attached, the altitude being around six or eight miles and the temperature indicated was –133°F. The highest authoritative natural temperature on the earth's surface has been obtained in Africa, in the Jefara desert at Azizia, 136.4°F.

The temperature of the Great Lakes at a depth of several hundred feet is 39.2°F while in the Ocean it has been found to be 33.8°F. A temperature of 180°F has been measured in an oil well in Tampico, Mexico, while in California a well 7000 feet deep registered 212°F.

The sun's temperature has been claimed to be from 7000°F to 10,000°F. This is one value under discussion.



THE GOPHER MOTOR ASSEMBLY

The Gopher Rowboat Motor

Eighty-five motors will be made on a production basis by the students this year

By D. A. ROGERS
Instructor in Mechanical Engineering

THE instruction of machine shop practice varies considerably in the different university shop courses. Most of the machine work is limited to having the student making a given number of bench or machine jobs or exercises and perhaps the making or building of some given machine shop project.

After about six years of considerable experimental work we have chosen this small outboard rowboat motor as a machine shop project for the sophomore year in mechanical engineering.

When the motor was first introduced in the machine shop as a project it was optional whether the student wanted to make one or not. Because of the tooling at that time it took a student of considerable previous machine shop experience to complete a motor in the short time given him.

At present each student is required to do a certain part of the work toward the production of enough parts to complete rowboat motors for the entire class taking machine shop practice. Last year we produced a complete motor ready to use in every sixty student shop hours.

Our method of handling the job here at the University is as follows: The students as a class are first given a number of elementary jobs to do, all students working on the same class of work at the same time. The nature of the work in shop is at first so laid out as to teach various standard machine shop methods, after which the entire group is put on productive work.

For an example, one student is chosen to produce all the flywheels for the entire group. This year our program calls for 85 complete motors. In this event, the student, after sufficient instruction will be held responsible for 85 finished flywheels from the time they come from our foundry until they are finally finished, inspected and put in stock.

Each of the major motor parts are produced accordingly, and an effort is being made to place the different kinds of work within the shop ability of the various students of the class.

No parts of the motor are accepted without first being inspected and must conform to all the detail drawing specifications and checked against the special gauges for that particular part in question.

Every part of the rowboat motor is being made at the University shops with the exception of the carburetor, spark plug, gas and water line fittings and a few other miscellaneous parts such as some of the standard screws and nuts, etc.

From time to time a number of the cast parts have been replaced by blanked and formed sheet metal stampings in the way of eliminating a number of difficult machine operations. Some of the special tools, jigs, fixtures and dies that are now in use were made by the students in their advanced machine shop work.

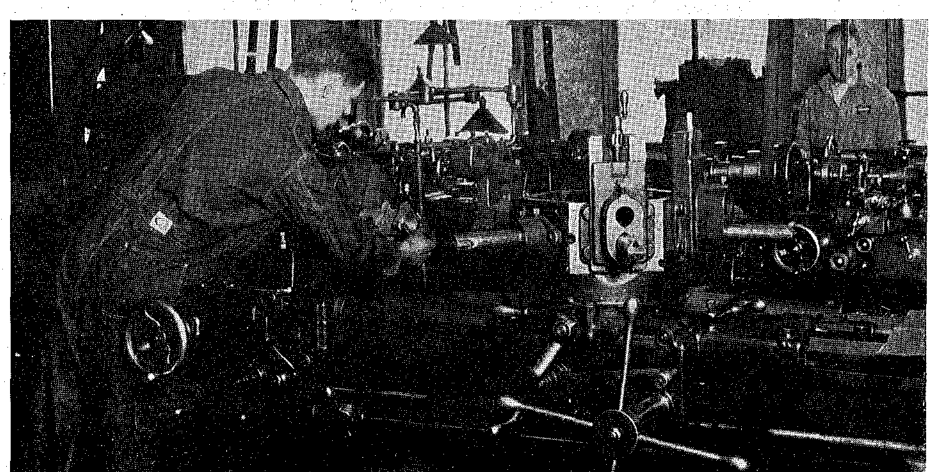
At present we have a complete set of tools to handle the motor as if it were being made in a commercial shop on production basis, including drill jigs, milling fixtures, forging dies, blanking, forming and drawing dies, special semi-automatic turret-lathe tools and metal match plate patterns.

After the required quota of motor parts is completed and the unit assemblies are taken care of, the parts are then ready for general assembly after which each motor is given the first final inspection. Assembling is also handled on a production basis; each student doing his part toward the final assembly. The motors are then ready for running in under their own power. After running them from one half to one hour they are given a final inspection and test.

The time for assembling, running, and testing the entire group of motors requires only about two or three days, due to the fact that all the motor parts are manufactured so that they are interchangeable. This makes it possible to give the student the practice of the possibilities of mass production.

Commercially the rowboat motor is designed to retail at about seventy-five dollars—however, each of the motors becomes the possession of the student in the class after the university is paid the cost of the materials used.

All castings are made in the foundry as regular class exercises. Heat treatment of the crank shaft and piston pins is carried on the forge shop. The jigs for the machine shop are made by the tool construction class. Before any machine work is done on the piston or the cylinder castings they are annealed at a temperature of one thousand degrees fahrenheit to relieve any casting strains and to facilitate machining. Piston pins and gears are machined from mild steel and case hardened by carbonizing to a specified depth.

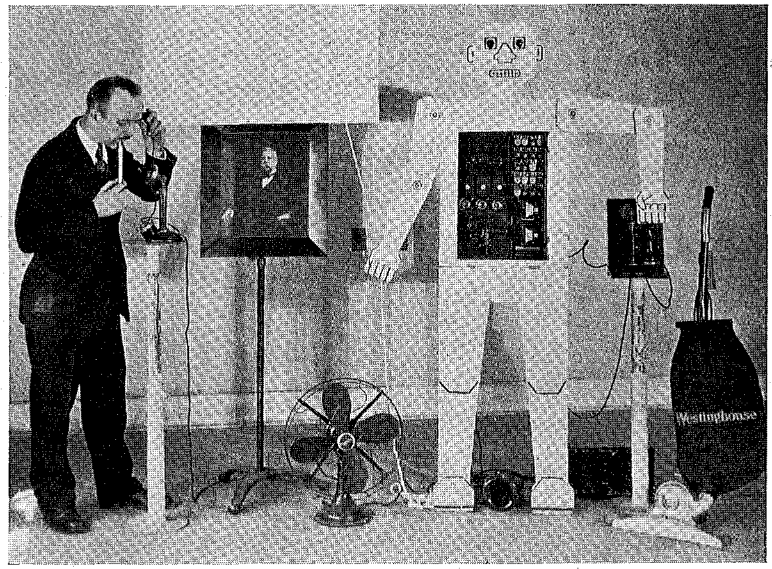


A STUDENT MACHINING A CASTING FOR THE ROWBOAT MOTOR

The 1929 Electrical Engineering Party

Some novel and interesting features of this biennial party are discussed by the chairman of the committee on stunts and exhibits

By WESLEY GRAY, E.E. '29



THE TELEVOX IN OPERATION

ONCE every two years, it becomes the privilege of the students of electrical engineering to entertain their friends and the friends of the university at a most spectacular and educational affair known as the Electrical Engineering Party. After eight parties dating from 1913 this biennial function has become a lasting institution at Minnesota which is looked upon with great pride by the students and faculty. Its success in previous years is evidenced by the fact that the last party and open house was attended by more than five thousand people. With hopes for a bigger and better party this year plans are under way for having many new and interesting features.

The dates selected for the 1929 Electrical Engineering Party are April 19 and 20. The theme of the party is entirely electrical. The exhibits and stunts are primarily those of the students and manufacturers. The student exhibits endeavor to show the development of new and unusual application of electrical phenomena, while those of the manufacturer attempt to demonstrate recent practical developments in the electrical industry.

Undoubtedly one of the most novel and interesting of the manufacturers exhibits this year will be the *Televox,* the uncannily human automaton invented by R. J. Wensley, engineer of the Westinghouse Electric and Manufacturing company, which is to be demonstrated by James L. McCoy, Westinghouse engineer, who has been associated with Mr. Wensley in supervisory control work and switchboard engineering. The *Televox* is not a toy or an engineering curiosity but an electrical slave, which was created to meet very definite industrial requirements such as the control from a distance of the machinery in unattended, automatic, electric power substations. Three such electrical men are now working 24 hours a day, watching the height of water in three reservoirs in Washington, D. C., and reporting by telephone to the war department when called upon to do so.

Mr. McCoy in his demonstration at the Electrical Engineering Party will show that the *Televox* is so highly trained that it will answer the telephone, listen to its master's voice and then execute its command. He will order it to light and extinguish it, start and stop an electric fan and a vacuum cleaner, and to perform various other startling operations. It is interesting to note that all these orders are given by telephone and this uncannily human device, with its veins of copper, bones of porcelain, binding posts for ears, and hard rubber for skin, will obey its master more faithfully than many modern servants.

The application of this clever device about the home and its value to the busy business man or the ambitious housewife can almost tax one's imagination. Let us imagine some such following scene. At the office or perhaps some downtown department store, we grasp the telephone and call a number. The phone at home is so arranged that when the bell jingles the mechanical man will lift off the receiver by means of a relay. We now have the Televox on the wire. A whistle blast in the "mike" which means to *Televox* "Are you there?" receives an affirmative answer in the form of a buzz meaning "All Set." Thereupon orders may be given by different blasts and notes to open the draft in the furnace or to start the percolator. A buzz from the *Televox* indicates that all orders have been carried out.

These operations have been tried and demonstrated repeatedly but their commercial use at present is hardly practical. The Westinghouse company, however, assures us the time may come when we will carry in the desk or possibly in the pocket, a supply of whistles which will enable us to call the office or the home and issue orders with firm assurance that they will be carried out.

Another interesting exhibit this year will be one on airport lighting. This

(*Continued on page 204*)

1929 CLASS ELECTRICAL ENGINEERS

The
MINNESOTA TECHNO-LOG
University of Minnesota

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Tongue-tied Technicians

PROMINENT graduates bemoan the fact that they are incapable of oral expression,—employers regret that engineers in their service can not speak before a small gathering with any degree of ease. And the cause of the condition? Deficient training.

The time when the engineer was employed merely to compile statistics and juggle figures belongs to the decade of hoop skirts and wasp waists. Engineers of today are specifically trained for leadership,—yet how can there be true leadership when the individual is lacking in those fundamentals of self-expression without which there can be no transmission of ideas, no stimulation of action?

A prominent contractor, who every year comes into contact with scores of civil, mechanical and electrical engineers, insists that a four year academic course should be made prerequisite to all engineering study. Outstanding among his arguments is the fact that the graduate engineer can neither write a letter, prepare a paper, or talk informally on topics with which all engineers are undoubtedly familiar.

The new order of engineers has received more training in self-expression than the older graduates. Rhetoric and composition are courses required of every engineering student. However, they are not yet sufficiently stressed, and oral composition in particular has been woefully neglected. A glance at the curriculum assures us that courses are offered in public speaking, but the classes are poorly attended, and what is more, poorly conducted. Poorly conducted because of the number of individuals in each class. It has been affirmed that it is impossible to teach mathematics to large classes. Pedagogically speaking, it is far more difficult to offer instruction in oral composition to large, unwieldy groups, for the benefits to be derived from such a course can only be obtained by a great amount of practice. One can not listen to lectures on the art of dissertation and presume to be enabled to discourse with ease. *Practice* and *more practice* become necessarily the by-words for this type of success,—and in classes of large size, the opportunities for practice are far too limited.

Since there is a demand and since engineers can not fulfill this demand, it should be the policy of every engineering institution to include in its curriculum required courses in public speaking,—courses which are in truth elemental, and virtually a necessity. Here lies an opportunity for curricular advancement and the development of a more perfect product.

What of the Graduate?

AT this particular time of the year the senior engineers are being interviewed or are interviewing the representatives of the many industrial concerns who employ graduates of engineering colleges. These interviewers are here to select a few men for their concerns,—they want men of ability —men who will meet the demands of their company.

Any member of a graduating class will be able to fill the scholastic demands of any company and this brings us to the point where the question is, "How shall I get a job with ——— company?"

The answer to that question is easy. Sell yourself to the man. That is just what he wants you to do and if you can sell yourself to him better than the fellow who has a "Tau Bet" key there will be no doubt but what you will get the job that you want.

Let's get together and do some intensive selling in the next few weeks.

Unspecialized Curricula

THE frequency with which engineers pursue work in foreign fields, that is branches of engineering in which they have not been specifically trained, is an interesting fact. Numerous examples exist of individuals, who, after studying one phase of engineering, devote their lives to another branch of the profession. A recent graduate of civil engineering is now the electrical expert of a great western railroad. A mechanical graduate has become chief highway engineer in one of the central states. A young mining engineer has designed and supervised the construction of numerous concrete bridges. And there are innumerable other cases that might be mentioned.

They suggest that specialization is not a sovereign alchemist. Moreover, they infer that there lies a grave danger in developing a student to the extent that he feels himself possessed of all knowledge in a given field, and has no need for further study. In engineering pursuits, in particular, there is a continuous demand for energy. Lethargy of brain and of body are alike conducive to failure. Thus, the ambition for constant improvement becomes a faculty of achievement which must be nourished if true success is to be attained.

An engineering education should give to the student a knowledge of the tools at his disposal, and an intimate acquaintance with their use, but it should not suggest that four years of study offers an open sesame to a particular branch of engineering,—that in four years can be absorbed all knowledge, beyond which lies an intellectual void. In college, fundamental principles should be learned, their correct use mastered and the mind so developed that it works precisely and logically. The means having been shown and the mind stimulated with a desire for knowledge,—specialization will follow of necessity throughout the individual's lifetime. The method of attack is of fundamental importance, and should be stressed with insistance throughout all undergraduate training. But without a certain inquisitiveness, a certain love of mastery there can be no specialization, just as it is impossible to effect improvement in any mind that is unwilling to strive.

Let an engineering curriculum be devised then to give adequate training in the fundamentals: mathematics, mechanics in its various branches, physics and chemistry. To broaden the intellect and offer cultural training, let there be instruction in history and economics, philosophy and ethics, anthropology and psychology, music and art, and also in the various modes of self-expression such as drawing, and graphic and oral composition. All should be studied to initiate the student into the various realms of learning and ultimately develop the engineer —a trained leader.

Around the World With Our Alumni

Civils

'26—R. C. Bolstad has been many places and done many things since he joined the United States Geodetic Survey in 1927. Washington, Florida, Maine, and New York have been the scenes of his labors and while he was stationed in the latter city he was one of the party that made the revision survey of Jamaica bay. Upon the completion of this work he was transferred back to Washington, D. C.

'26—Carl P. Liese is working for the Marion Steam Shovel company as district representative. He does his work from the office of the Motor Power Equipment company, Ford Road, St. Paul.

'28—Eric F. Peterson is teaching surveying in the Duluth Junior college. He plans on returning to Minnesota for a few months next year.

'28—Don Kopplin is with the Winston-Dear company and is now on a quarry stripping job at La Salle, Illinois. He writes, "We have had quite a bit of cold weather up here in the past two weeks, but the worst trouble that we have on our job is when it rains for a day or so at a time. That is when the dumps get softened up, and then the dump tracks look like a snake and we can't keep the dump cars on the track, or the dump tracks where they belong. The day after it rains it may drop to zero and then our tracks freeze into the mud and have to be dug out with picks. We operate a day and night shift of ten hours each, and move around 100,000 to 125,000 yards every month. We are stripping a cement quarry for the Marquette Cement company and have a similar job with the Lehigh Portland Cement company, which is located about two miles closer to La Salle."

Chemists

'20—John S. Busch has accepted a position with the Wood Conversion company at Cloquet, Minnesota. He is the chief chemist there.

'20—Frank J. Dobrovolny, who received both his master's and doctor's degrees here, visited the university on the 11th and 12th of February. He is working for the Roessler and Hassacher company of Perth Amboy, New Jersey. The purpose of his visit was to interview men of the senior class for the company with whom he is working.

'21—Albert M. Chaney received his master's degree in chemical engineering in 1925. He is back this year after three years' absence to do graduate work toward a Ph.D. in chemical engineering.

'21—Ruth Elmquist left a few weeks ago for Washington, D. C., to take a position at the Bureau of Home Economics. She is at present living at the Government hotel. In a letter she says that she believes she will enjoy the work as the laboratories are well equipped and money has been appropriated for a new building to house the bureau. Miss Elmquist received her M. S. degree in chemistry in 1924 and studied in London and Paris the following year. Upon her return from abroad she became an assistant in the analytical chemistry department and last year during the absence of Dr. Sarver was an instructor. She states that she plans to return to Minnesota to work for her doctor's degree.

'21—Esther Bauer-Kock who studied abroad with Miss Elmquist is now doing research work in analytical chemistry at the Hercules Powder company at Brunswick, Georgia.

'22—Ernest B. Kester is now located at Baltimore, Md., where he is employed by the Baltimore Gas Engineering corporation.

'23—Clifford E. Peterson is now located at Canton, N. C. He is working in the research department of the Champion Fibre company.

'25—Homer Hamm is attending Johns Hopkins University and working for his Ph.D. In his spare time he holds down a job with the Bureau of Standards at Washington.

'26—John L. Tronson has received a promotion and now holds down the job of assistant laboratory manager at the Goodrich Rubber and Tire company. His address is 453 Crestwood Avenue, Akron, Ohio.

'26—Parmalee S. Haugsrud, who received his degree in chemical engineering in '28, is now working in the water softening and purification department of the Reiter company in Elgin, Illinois.

'27—William Ohlweiler is now assistant supervisor of the phenyl glycine operation for the Dupont company. Address his mail to Box 565, Penns Grove, New Jersey.

'27—Henry Bercowitz has returned from the Dupont company at Buffalo, New York, to his old job as junior chemical engineer at the Federal Food and Drug Laboratory in Philadelphia.

'27—W. E. Seestrom is a chemical engineer with the Proctor and Gamble company at Ivorydale, Ohio.

'28—F. A. Rorman is doing research work under a fellowship at Columbia university.

'28—George Swenson is another alumnus with the Minnesota Mining and Manufacturing company.

Dr. Frank C. Whitmore, who was formerly an instructor in the School of Chemistry here, has been appointed dean of chemistry and physics at Pennsylvania State College.

'28—Robert Gerlicher is working for the Goodrich Rubber and Tire company at Akron, Ohio. Although he has no official title as yet it is reported that Bob is doing very good work.

Frederick Rohrman, who received his M.S. degree in '28, has a fellowship in the chemical engineering department at Columbia. He saws that he likes his work very well and that he has passed his first examination for his Ph.D. degree.

Electricals

'23—Henry W. Hecht is now assistant to the manager at the Montevideo office of the Northern States Power company.

'23—Clifford L. Sampson is with the Northwestern Bell Telephone company at Des Moines, Iowa. He is doing transmission work with the chief engineer of the Iowa area.

'24—J. M. Juran is with the quality inspection department of the Western Electric company and is stationed at Chicago, Ill. He was married on June 5, 1926, to Miss Sadie Shapiro of Minneapolis, and has one child, Robert Arnold, born June 11, 1928. He is now Hawthorne Works chess champion and secretary of the Chicago Chess League. He writes, "This plant is working strong, and the average employment for the year will be 30,000. Our new project is the talking movie equipment, and 4000 machines are to be turned out this year."

'25—R. W. Keller has been located in the general engineering department of the East Pittsburgh plant of Westinghouse since January first. For the past two years he has been in the engineering department of the Sharon plant.

'25—Emil Steinert is living, singly, at 447 Silvu Street, Sharon, Pennsylvania. He works for the Westinghouse organization in the instrument and miscellaneous transformer section.

'25—L. D. Solomonson is acting as lieutenant in the Coast Artillery at Fort McArthur, San Pedro, California. He served for three years at the station in Honolulu before taking his new post. He has one son, now two years old.

'26—E. C. Wentz is still with the instrument and transformer section of the Westinghouse shops at Sharon, Pennsylvania. He can be reached at 148 Jefferson Street in that city.

'28—Russel C. Bouck is operating a substation on the Chicago, Milwaukee and St. Paul electrified line at Drexel, Montana. He claims that it is rather a lonesome job and he would like to hear from some of the gang.

Mechanicals

'26—Richard E. Wiley is assistant metallurgist at the National Tube company. He was married recently, and may be reached at the company's office at Elyria, Ohio.

'26—M. S. Boreen, who is with the Westinghouse company, wrote in recently to say, "I am employed in the sales department, handling industrial heating apparatus. This work offers unusual prospects, both from the manufacturing and the central station point of view. From the manufacturing stand the field is young and seems to prosper, while central stations are beginning to realize its possibilities, for it offers an ideal load for 'off-peak' periods." Boreen may be reached at 245½ W. Park Ave., Mansfield, Ohio.

(Continued on page 196)

News from the Technical Campus

Lind Attends Radium Conference

Dr. Lind of the School of Chemistry recently attended a conference on the "Hazards of Radium Paint" held in Washington, D. C., by the United States Public Health Service.

According to Dr. Lind the meeting resulted from a general conference held last December which met to investigate the cause of the deaths of a great number of girls employed in radium painting. It is believed that the radium contained in the paint used in painting dials of clocks and watches was absorbed by the body of persons using it and was seriously injurious to certain vital organs, thereby causing death. It has been found that small amounts of radium do not injure the human body, but it is thought that where a person is exposed to it for a great length of time as are persons using radium paint, the human body will absorb enough radium to cause serious effects.

It was proposed at the conference that attempts at determining the amount of radium contained in the human body be made. Dr. James E. Ives has spent three weeks here studying radium measurement with Dr. Lind and Mr. Erikson, professor of mechanics and an authority on radium. The work is being carried on under the supervision of Dr. L. R. Thompson, chief of the division of individual hygiene.

Other members of the conference were Dr. Failla of the Memorial Hospital of New York, William Duane of Harvard, Professor Schlundt of the University of Missouri, Dr. Gish of the Carnegie Magnetic Laboratories in Washington, L. F. Curtiss of the United States Bureau of Standards, and Dr. Martland of the New Jersey Bureau of Public Health.

Miners Hold Annual Winter Shindig

On March 1, the Sophomore Class of the School of Mines held the annual Miners' Shindig. Tiny Roberts, 320 pound miner, served beer in a style, which, according to the Miners, gave an atmosphere of more than one-half of one per cent to the beverage that crossed the bar.

Robert W. Geehan was in charge of general arrangements. He was assisted by George Minder, Paul Jerobek, Gordon Scott, and E. T. Ericson.

Glockler Addresses Chemical Colloquium

At the last meeting of the Chemistry Colloquium, Dr. Glockler gave an interesting discussion on the effect of electrical discharges on gases. In his lecture he brought out that gases like ethane could be converted into compounds of longer carbon chains by passing them through ozonizers. He also said that the process was a very slow one in that it took a month to produce one liter of a dark viscous oil by the passing of butane through an electrical charge.

The Chemistry Colloquium meets once every two weeks and is attended by faculty members, graduates, and a few undergratuates of the School of Chemistry. Each time there is a principal speaker who gives a lecture on the work he has carried out in a particular branch of research. At the close of the talk, the members of the audience join in a discussion of the subject, asking questions and presenting other phases of the problem that have been studied.

Some of the other topics that have been discussed at these meetings are: Dynamic Measurement of Surface Tension by Dr. Taylor; The Absorption of Aromatic Compounds by Charcoal by Dr. Kolthoff; Artificial Zeolites for Water Softening by Dr. Mann; Oxidation in the Benzene Series by Gaseous Oxygen by Dr. Stephens, and the Mechanism of Inhibition in Chain Reactions by H. N. Alyea.

Herty Addresses A. C. S.

The Minnesota section of the American Chemical Society and the northwest section of the American Society for Steel Treating held a joint meeting on Friday, February 8th, at the School of Chemistry. The feature of the meeting was a lecture on "The Physical Chemistry of Steel Making" delivered by Dr. C. H. Herty, Jr., of the United States Bureau of Mines.

Dr. Herty is supervising ferrous metallurgist of the U. S. Bureau of Mines and is in charge of the investigations on the physical chemistry of steel making which are being conducted at the bureau. The subject has aroused a great deal of interest in recent years because of the importance attached to exact knowledge of the phenomena occurring in the process of steel manufacture.

Word has been received that the fall meeting of the American Chemical Society will be held in Minneapolis the week of September 9th, 1929. This will be the first meeting of the society in Minnesota since 1910.

Engineers Inspect Transformers

Engineers of the Northern States Power company have recently been at work on the transformers in the electrical engineering laboratory in an effort to improve the dielectric strength of the oils in which the transformers are immersed. It has been known for some time that the presence of dirt, air, and moisture decreases the insulating power of the oil over 200 per cent. In connection with this it has been observed that the continued electric discharges of limited current strength have a pronounced tendency to increase the break down strength of oil until a final breakdown value has been reached.

The apparatus, which has been designed to eliminate the impurities from the oil, consists of eight to ten frames fastened in a rigid support. Between every frame there are four blotters through which the oil must flow. At each end is an encasing frame connected to inlet and outlet pipes which carry the oil to and from the transformer. The oil is forced through the blotters under thirty pounds pressure and three to four hours of actual pumping are required to cleanse the fifty barrels of oil used in the 300,000 volt transformer.

As a result of the purification process, the oil, which had previously broken down in a spark of one-tenth inch at a voltage between seven and twelve thousand, now holds up under 30,000 volts.

Aeronautical Prizes Established Here

The aeronautic division of the American Society of Mechanical Engineers announces three annual prizes to students of engineering for the best papers submitted on civil aeronautic subjects. The papers must be by student associates of the American Society of Mechanical Engineers, but need not be prepared especially for the contest. Papers that have been contributed either in whole or in part to any other society or publication will not be considered.

Papers submitted may be historical, analytical, experimental, or practical in character, and may deal with any of the following civil aeronautic subdivisions: aerodynamics, airships, airports, airways, aeronautic instruments or equipment, management, airplane design, power plant design, aircraft operation, air transportation, aerial photography, etc.

(*Continued on page 198*)

Confidence is a matter of knowledge

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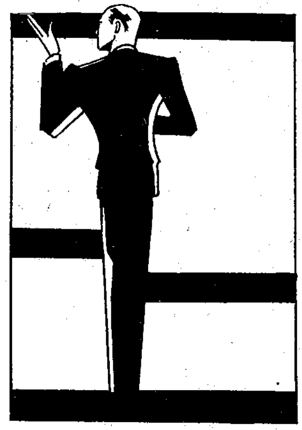

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AT A SPECIAL PRE-SEASON PRICE

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One or two trousers or extra knickers

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NICOLLET at FOURTH

Timoshenko Lectures at Minnesota

By F. B. LINDSAY
Instructor in Mathematics

STUDENTS of mechanics at the University of Minnesota enjoyed a real treat in the series of three lectures upon the theory of vibration delivered by Professor S. Timoshenko of the University of Michigan February 4-6. Professor Timoshenko, formerly of the faculty of the University of Petrograd and the Polytechnic Institute at Kiev, combines superior knowledge of his subject with clarity of presentation and charm of personality.

The climax of Professor Timoshenko's visit came at the dinner in his honor under the auspices of the Society for the Promotion of Engineering Education at the Campus Club on Tuesday evening, February 5. Professor Timoshenko discussed the status of engineering education in Russia. The Academy at Petrograd, Professor Timoshenko reminded his hearers, is older than the German Universities and owes much of its priority in engineering science to the brilliant work of the French emigrés who fled during the Revolution and Napoleonic era to the then only safe spot in all Europe.

Despite the monarchial government of Russia, the Academy was in fact very democratic, the professors governing the college without outside interference. Any student of ability was welcomed and the university degree opened all offices to the meritorious. Hence the engineering school became a recruiting station for competent men to fill positions of importance in the empire. The Bolsheviki, however, altered the independence of the faculty. A governing body accorded equal representation to professors, students and janitors. Students were divided into two classes: some of workers and sons of non-workers, i. e., the children of manual laborers and of the professional groups. The number of students, sons of non-workers, has been rigidly limited so that a high degree of competition exists for the available scholarships. But the many places open to workers have at no time been filled.

The situation of the engineering schools in Russia since the overthrow of the czarist regime has been further embarrassed by the declaration of the Bolsheviki that preliminary education is needless for entrance to the specialized courses. The people were told that requirements for entrance to the institutes were only bourgeoise schemes to hinder the common people from obtaining technical education. In consequence many sincere illiterates matriculated. Of course the faculty has had to consume time teaching rudiments of mathematics and physics instead of devoting attention to technical education.

Additional obstacles to education in Russia today are the vesting of sole power in the hands of communist students—an insignificant percentage of the total student body, and the insecurity of tenure of professors who must face suspicion and denunciation without any recourse. After the revolution of 1905, compulsory elementary education was imposed upon Russia. But as soon as the soviets gained independence, the peasant and laboring classes abolished schools as a needless expense. This has created a dearth of recruits from which higher institutions may draw students.

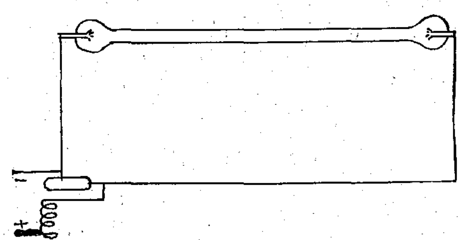
In the conclusion of his last lecture, Professor Timoshenko compared technical education in the United States and Europe. Knowing our reputation for practical emphasis, Professor Timoshenko expected to find in America an intensely utilitarian outlook upon all problems. To his surprise he discovered mathematics in this country more "pure" than in Europe where applied mathematics is generally studied. On the other hand, he found many engineers more practical than in Europe, if deficiency in theoretical principles denotes practicality. He suggested a greater degree of cooperation between theoretical and applied science in the interest of a more practical engineering education. It was his hope that at the next international congress of applied mathematics more representatives of the United States might be present. In his own person, Professor Timoshenko admirably combines that familiarity with laboratory technique and adaptation to actual situations, with the grasp of theoretical principles essential to the adequate solution of intricate problems in applied mechanics. The achievement of this great scientist is further revealed in his ready command of an unusual foreign language to convey his ideas: for he has mastered English, with its strange vocabulary and illogical structure, for the presentation of his discoveries and conclusions in the theory of vibration.

Electricity and Light

(Continued from page 182)

ing led to a continuation of the search for a perfect illuminating device that would turn all the received electrical energy into light and none into heat. Moore bethought himself of the old time Geissler tubes and gaseous filament lamps. In 1904 Moore brought out the first long tube lamp on a commercial scale and the first of these lamps was installed in a hardware store in Newark, N. J. It consisted of a glass tube one and three quarters inches in diameter and 180 feet long. Air at a pressure of about one-thousandth part of an atmosphere, was in the tube, from which was obtained a pale pink color. High voltage (about 16,000 volts) alternating current was supplied by a transformer to two carbon electrodes inside the ends of the tube. The air pressure had to be maintained within one two-thousandth part of atmospheric pressure above and below the normal pressure of one-thousandth atmospheric pressure, and as the rarefied air in the tube combined chemically with the carbon electrodes, means had to be devised to maintain the air in the tube at this slight pressure as well as within the narrow limits required. This was accomplished by means of a device known as the feeder valve.

As there was a constant loss of about 400 watts in the transformer, and an additional loss of about 250 watts in the



SHORT COLOR MATCHING TUBE CIRCUIT

two electrodes, the total consumption of the 180 foot tube was about 2250 watts. On account of the fixed losses in the transformer and electrodes the longer tubes were the more efficient, although the tubes were made in sizes from 40 to 200 feet. It is generally granted by the majority of authorities that the vacuum tube as a device for changing electricity into light is very efficient. The greater number of men place the vacuum tube at about 70 percent and the incandescent lamp at about two percent. The 200 foot tube filled with nitrogen had an efficiency of about 10 lumens per watt and gave a golden yellow light compared to the pinkish light of air and the pure white light given by carbon dioxide. Nitrogen was supplied to the long nitrogen filled tube by removing the oxygen from the air that the tube used. The carbon dioxide tube, on account of its daylight color value, made an excellent light under which accurate color matching could be done. A short tube is made for this purpose and this is the only use which the Moore tube now has, owing to the simpler tungsten filament incandescent lamp. The Moore long tube lamp, although it is not in general use at the present time, has many good points and there is still the possibility of its return to favor. Its life is very long, under good conditions is about 10,000 hours.

The intensity of its light ranges between zero and 25 candle-power per foot, although the average candle-power is about 10.5 candle-power per foot of length. The Moore tube is the nearest approach yet invented, to the much desired cold light, as exemplified in nature by the firefly, and in the matter of diffu-

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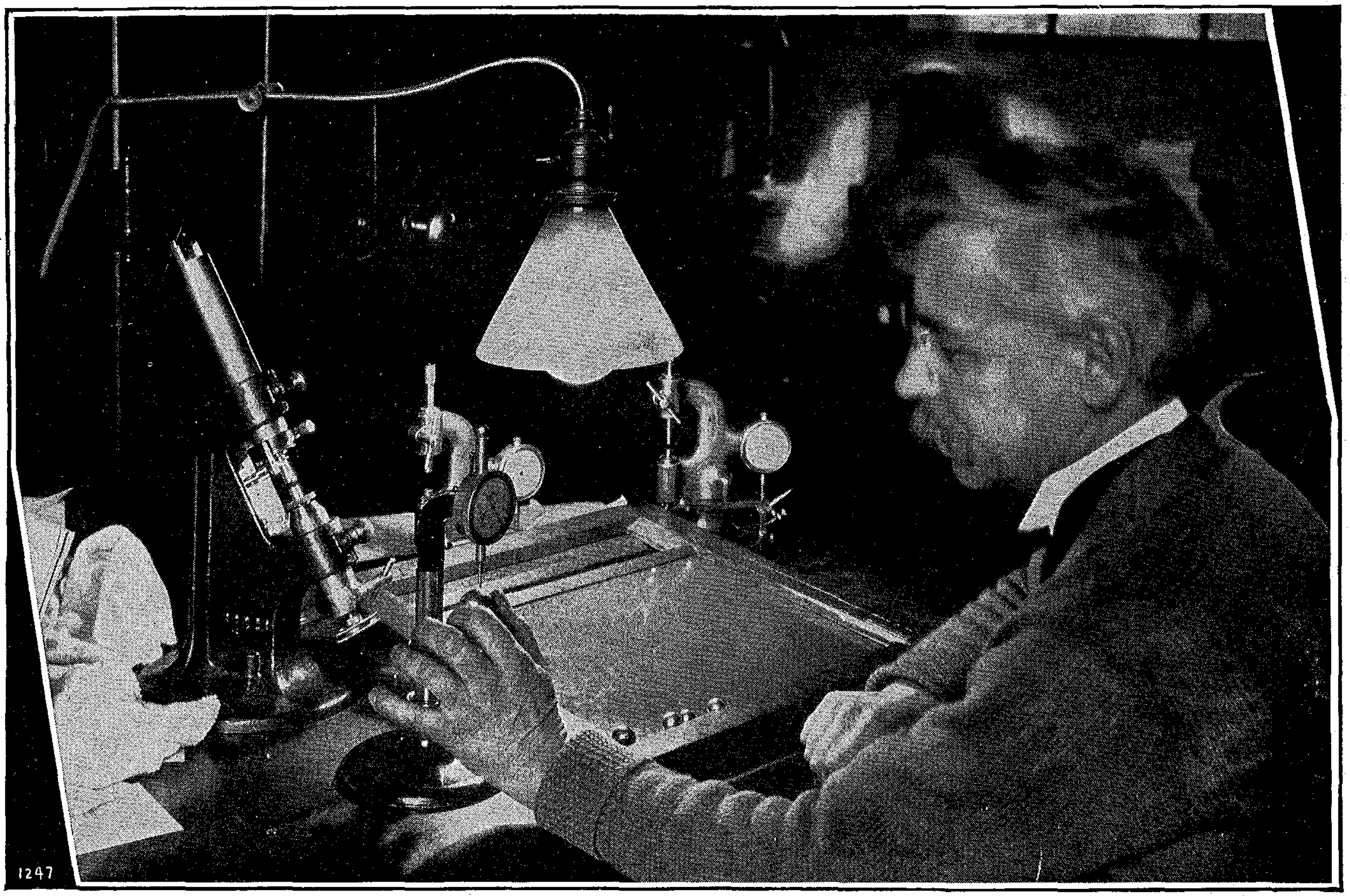
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Around the World With Our Alumni

(Continued from page 188)

Chemists

'25—Ernest Jewett is very busy looking for that mysterious .56%. He is employed by the Proctor & Gamble company at Ivorydale, Ohio.

'26—Roger Wheeler, former captain of the Minnesota football team, is now employed in the paint and varnish department of the Dupont company at Chicago.

'27—Henery Bercowitz is working at the patent office in Washington, D. C. He is as ambitious as ever and is studying law at the George Washington University with the intention of taking the Bar examination.

'28—Robert Elston is with the Dow Chemical company at Midland, Michigan.

'28—Roy P. Hella is working as a chemist for the Northwestern Paper company and is located at Cloquet, Minnesota.

Electricals

'23—George J. Schottler is a patent attorney with the firm of Emery, Booth, Janney, and Varney. His address is 149 Broadway, New York City.

'25—Richard G. Edwards is another Minnesota man who has located in a warm sunny climate. He is working as a sub-station designer.

'26—Ray Christen was in New York City last fall attending a "long lines" school. He is now back in Detroit on the payroll of the American Telegraph and Telephone company.

'27—"Sandy" Beyer is now located in New York. "Sandy" is enrolled in the General Electric training course.

'28—Don Stevens was in the Twin Cities recently, and spent most of the time renewing acquaintance with his friends around the Electrical building.

'28—Art Burris appeared in Minneapolis recently as an envoy of the Westinghouse Manufacturing company and spent a week interviewing the senior class. His address is 437 Rebecca Ave., Wilkinsburg, Pennsylvania.

'28—Jack Cooper is now located with the Southern California Edison company at Bodfish, Kern county, California. He is assistant operator at the Borel Hydro-Electric plant.

'28—"Art" Burris has been visiting the campus for the past two weeks while on a vacation from his work in the industrial sales division of the Westinghouse company at Wilkinsburg, Pennsylvania. Art was engineering representative on the All-University council last year.

'28—"Herb" Hathaway wrote in recently to say that everything was running smoothly down in Schenectady since part of the class of '28 had arrived. However, since then he has paid a flying visit to the campus and renewed his acquaintance with the unfortunates who still go to school. His address is 117 Nott Terrace, Schenectady, N. Y.

'28—S. R. Hamilton recently changed his address from 307 East End Avenue, Pittsburgh, Pennsylvania, to 1411 Macon Avenue, Regent Square, Swissvale, Pennsylvania.

'28—Carl J. Schliep is a student engineer in the sales department of the Ideal Electric and Manufacturing company at Mansfield, Ohio. He was married to Miss Carol Nelson of Kirkhaven, Minnesota, last September.

'28—Arthur M. Braaten reports that he is with the Radio Corporation of America and located at Riverhead, New York. He works in the receiver design department.

'28—Glen Brown left his business in Milwaukee long enough to come back to the campus for a visit recently.

'28—Several of the new men with the Westinghouse student course are from Minnesota. Among these are John Elmburg, Art Burris, John McCrea, Clarence Neill, D. O. Johnson and Carl E. Swanson. Elmberg and Swanson visited the campus during the Christmas holidays.

News from the Technical Campus

(*Continued from page 190*)

New Departure Adds to Present Plant

One of the largest factory extension programs in the East this year is that announced by the New Departure Manufacturing Company of Bristol, Conn., makers of New Departure Ball Bearings. The new buildings will add 250,000 square feet of floor space to the main works at Bristol and approximately 80,000 square feet to the Meriden plant. The new addition to the Forge plant at Bristol has just been completed and added 25,000 square feet, so that the total of increased floor space within the year will reach the imposing figure of 355,200 square feet or slightly over eight acres.

When the new buildings are completed the total floor space of the plants at Bristol, Meriden and Hartford if placed in a one story building 40 feet wide would extend away for about eleven miles. The new building at Bristol will be 404 feet long by 128 feet wide and will house the finish race grinding department, replacing the one story building of somewhat less floor area devoted to that purpose. At the Meriden plant the extension will be on the northeast side of the present factory and will be 220 feet by 106 feet in size, four stories high. This addition will house an extension of all manufacturing operations.

The New Departure Manufacturing Company is already the largest manufacturer of anti-friction bearings in the world and one of the most important concerns in the Accessory Division of the General Motors Corporation.

Radio Fraternity Installs Chapter on Campus

A chapter of Synton, national professional radio fraternity, was formally installed on the Minnesota campus recently by a delegation from the grand lodge at the University of Illinois.

Synton was established at the University of Illinois in 1923 where it had been in existence since before the war. The Minnesota chapter was formerly a radio club which has been active on the Minnesota campus for over a year.

Seven men who were initiated into the organization as charter members are: Cyril M. Braum, E. C. Carsberg, Francis J. Fox, Wesley Gray, Melnor C. Rudser, F. W. Suhr, and Irving Vigness.

Purdue University received a charter about the same time as the Minnesota chapter and will probably have a chapter installed within the next month.

Oscillograph Added to E. E. Equipment

The most recent addition to the equipment of the department of electrical engineering is a cathode ray oscillograph. The department already has several of the less expensive electromagnetic oscillographs. These operate with a beam of light that is caused to move over a screen or photographic plate or film in a manner that depends on the motion of the current carrying element in the magnetic field, which element carries a current proportional to the phenomenon being recorded. On account of the inertia of this current carrying element, these machines are limited to phenomena varying at a rate not greater than 10,000 cycles per second. In the cathode ray oscil-

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(*Continued from page 198*)
lograph, however, the cathode ray is made to move over a similar recording medium in a manner depending upon the force exerted between it and a directly applied electrostatic or electromagnetic field that is proportional to the phenomenon being recorded. There are no mechanical moving parts having inertia to limit the response of the beam to the phenomenon recorded, as the deflecting fields are applied directly to the beam, and the electrons which constitute the particles of the cathode ray itself have the inertia effect so small, that for oscillating purposes, they are negligible. As a result, the upper limit of movement of the beam available for recording purposes may be measured in millions of cycles per second.

Design considerations prohibit all the desirable features from being combined in one instrument; and for this reason there are several types of cathode ray oscillographs made, depending upon the factors used and the factors sacrificed. The main consideration upon which a general classification may be based, is the selection between greater deflection sensibility or greater photographic sensibility. The greater the velocity of the cathode rays is, the greater will be the photographic sensibility and the lower will be the deflection sensibility. Likewise, the slower is the velocity, the less will be the photographic sensibility and the greater will be the deflection sensibility. That type having the higher velocity of cathode rays is known as the low voltage, hot cathode type; while the latter is called the high voltage, cold cathode type. To this last-named group belongs the new oscillograph.

This General Electric oscillograph is one of ten—the only ones of this kind being built in the country at this time for practical use. It is designed to be self-contained and quite easily taken to any desired work, mounted as it is on two portable trucks with all of its auxiliary equipment, where it may be operated in the daylight. The cathode tube is mounted in an electrostatically shielded dark room and emerges herefrom in the form of a conical metal bell. This bell contains a photographic film holder supported at the head. An indicating vacuum gauge of the thermocouple type is set directly under the conical bell in sight of the operator. On the truck underneath are mounted the transformer for exciting the cathode ray tube, the oscillator for timing the wave, and the control panel. On a second truck are placed the rough vacuum pump with its driving motor, the synchronous switch, and the water circulating pump. The two units together weigh about 700 pounds and require four kilowatts at 110 volts, 60 cycles.

Electricity and Light

(Continued from page 194)

siveness, color, steadiness, efficiency, and safety is on a parity with a number of other electrical illuminants; it is unaffected by heat, cold, or moisture.

The lamp is of a low intrinsic brilliancy, emitting soft mellow light with no bright spots to blind the eye, hence is very suitable for illuminating auditoriums, theatres, hotel lobbies, stores, etc.

Various types of lamps will be found in the drawings many of which Moore has devised and tried out. In recent years Moore has given up the long tube lamp and is now working on the short positive column lamp to be used on the low tension circuit used for lighting at the present time.

The Moore tubes operate as follows: 220 volts cannot jump from four to five inches through the gas column but it can go from six to seven mm. and produce electrons which are the means of starting the current flowing in the gas column. As soon as the current flows in the gas column there is a column of positive light produced. In these lamps the pressure of the neon gas used is about 20 mm. If the rated line watts falls below or rises above 30 percent of the normal value the light ceases to operate due to too low or too high a gas pressure, as the case may be.

At the present time there are other forms of vapor tubes in use, i.e., the neon glow tube, the mercury vapor lamp, the mercury arc rectifier, etc. These lamps are used as indicators, rectifiers, and for lighting purposes at times, although the mercury arc lamp is very low in the red end of the spectra and is very high in the ultra violet end of the spectra, due to this fact it is used to purify water and to kill bacteria.

Artificial light, to be considered good, must come up to certain standards, i.e., it must be steady, must be of a suitable intrinsic brilliancy, and it must have a suitable color. It has been said that the ideal artificial light, from a purely utilitarian standpoint, should represent average sunlight.

Mathematics

(Continued from page 179)

terms involving number, but solely in terms of order relations. The concept of fractional, negative, irrational, and complex numbers is then developed and so on until the complexity of the most recondite branches of analysis are reached.

Whether or not Russell's work, which is still being disputed, will stand the test of time, is of course a question, but we are reaching closer to the belief that mathematicians have held since the days of Pythagoras,—that all traditional pure mathematics can be derived from the ordinary integers and perhaps even from more simple concepts.

While the Gardiner Cup air races are being held May 27 to 30 at the Parks airport at St. Louis, the aeronautical division of the A.S.M.E. will hold a meeting to discuss the technical problems of the industry. The group that is sponsoring the meeting include a number of the men who financed the transatlantic flight of Colonel Lindbergh.

Engineers Prominent in Winter Sports

HOCKEY

The University hockey team has captured its fourth Conference title during six years under the Iverson system. Followers of the squad expect the mid-western championship will also be obtained when the University sextet meets Marquette, the present title-holder, on March 14 and 15.

Lloyd A. Russ, a senior electrical engineer, and Lloyd J. Westin, a junior, are members of the first squad. Russ, who has been on the squad for two years, and who won his letter last year, has been playing an excellent game as goal guard. Russ has played in seven games this season so far, and has been scored against only three times. Russ in addition to his work on the hockey squad, holds down the position of Circulation Manager of the Techno-Log.

Westin has showed himself a fast and able skater and should develop into a powerful offensive man. At the beginning of the season, "Red" Fenton E. E. '30 appeared to be certain of a regular position, but a subsequent operation placed him under a heavy handicap.

BASKETBALL

Weighted down by a barrage of alibis, the basketball season has not been of the most successful. Fred Hovde, Ch. E. '29, scholar, athlete, and social light, has played in every game. Hovde combined speed and floor generalship in a way which made him one of the most valuable men on the squad. Glen Williams, E. E. '29, has alternated at center with "Swede" Nelson, an architect.

GYMNASTICS

The gymnastic team has suffered heavily during the past year from ineligibility. Among the survivors are John Wald, a junior engineer, and William Reichow, a sophomore electrical engineer.

John Wald, who won his letter in '27 in gymnastics has been the most consistent point winner during the past year, although somewhat handicapped by injuries. He has another year of competition before him.

"Bill" Reichow has been doing some clever twists on the parallel bars, and has perfected a flying roll on the rings that is seldom attempted even by professionals.

Electrical Party

(*Continued from page 185*)

will show the different types of spot lights and floods used on a well equipped landing field to insure the safety of night flyers. Negotiations are also under way with the Western Electric Company to obtain a "Movietone" exhibit.

Other exhibits will include the General Electric company oscillograph by means of which voltage and current waves may be analyzed. The latest type of G. E. refrigerators will also be an added attraction in the manufacturer's class.

The student exhibits will form by far the largest group presented at the party. These depend largely on the ingenuity of the student and are usually zealously guarded from outsiders until the eve of the party. Popular ones from other years will be, picture transmission by radio, artificial lightning from a million volt, million cycle tesla coil; electric welding, frying eggs on ice, and "electrocuted hot dogs."

Two other feature attractions will be a television exhibit, and a car controlled entirely by radio.

Synchronized Pictures

(Continued from page 181)

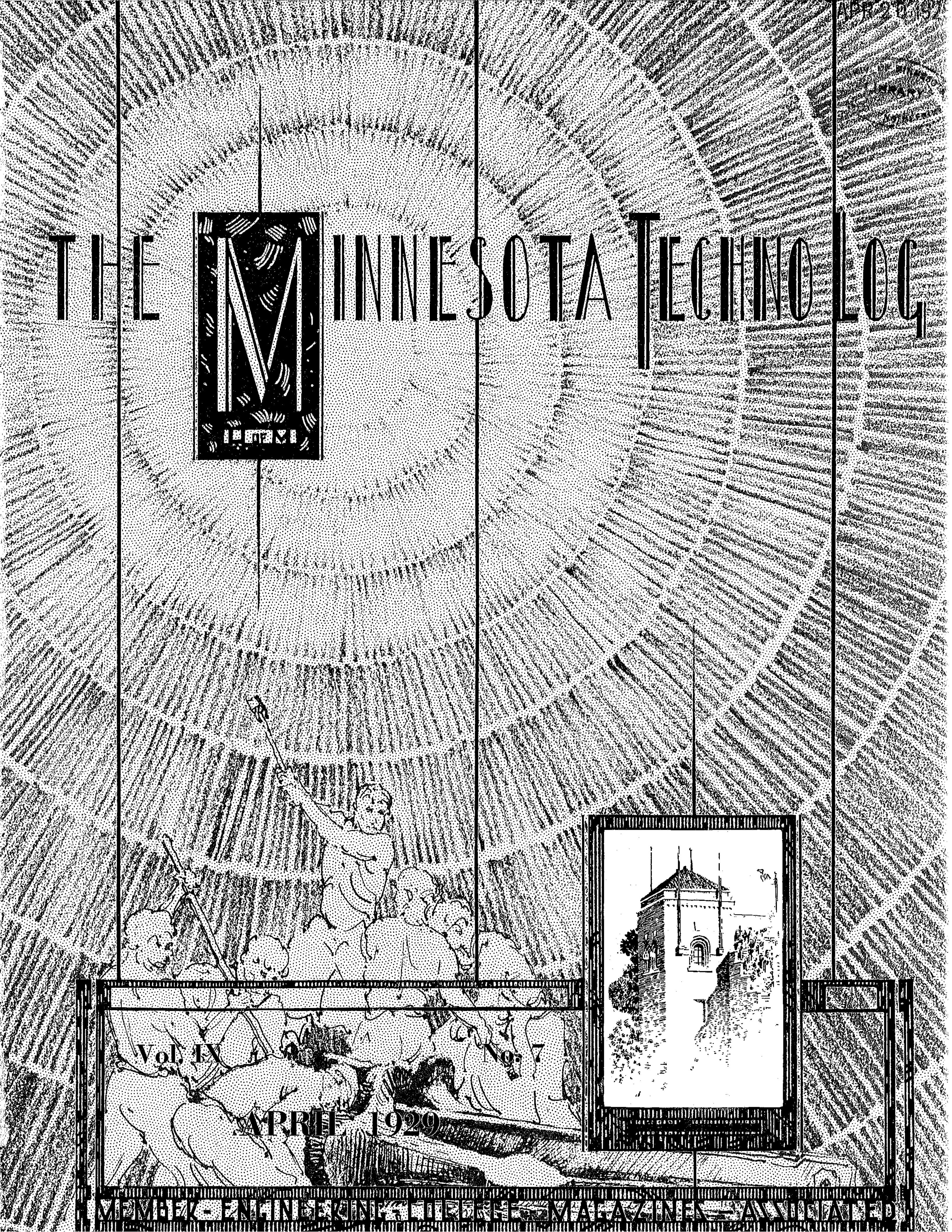
armature is pivoted on a knife edge fulcrum and is directly linked with the needle which follows the sinuous path recorded on the disc. Thus as the needle moves back and forth in its grooves it will vary the distance between the pole tip and the armature and hence vary the strength of the flux through the armature.

This changing field will then induce a current in exact proportion to the movement of the needle and hence to the variations of the sounds recorded on the disc. The current flow is extremely small and, as in the other method, it is then necessary to amplify it millions of times before it reaches the horns.

Both of these systems of sound projection use the same type of amplifying units and horns. In fact, most theatres utilize both systems. It is but a simple matter to switch from the disc system to the sound band system or vice versa. The horns which are placed behind the screen are four in number and are set at different angles so as to send the sound to all points in the theatre. The screen is made of cloth which is of such a texture that it has good reflecting qualities and yet will allow the sound to pass through it freely. The diaphragms of the loud speakers used are not of the common flat type, but are cupped at the end and have a flange at the other. The cupped part of the diaphragm is used for an air cushion effect by having a ball fit into the cupped part and kept a slight distance from it. When the diaphragm vibrates, the air between the cupped part and the ball acts as a cushion and prevents it from rattling. However, this ingenious piece of mechanism has its limitations. It cannot stand overloading. In sounds of great volume it is liable to destroy itself; in low frequency sounds it will rattle for the reason that the vibrations being few for the given time, fewer than the vibrations in the case of higher frequency sounds, the air effect between the cupped diaphragm and the ball is not as pronounced.

The R.C.A. has a system, known as the *photophone* which does not use the horn type of speaker but which uses the cone type which has a greater range of frequency and has a superior tone quality. In this system the sound waves produced are sent out into space directly from the cone as they are generated and free from any modification. In the horn system, the air waves are generated by the vibration of the diaphragm, then they must pass out through the horn which is about 14 feet in length (coiled). In the passage they are modified, and even distorted so that when they reach the listener's ear they are not true.

The present stage of excellence in synchronized pictures is indeed such that provided the projection of the pictures and the projection of the accompanying sound be completely handled by the projectionist, the effect is measurably superior to what the actuality would be. This is because of the fact that those seated in the rear of the huge theatre auditoriums may have both in the matter of seeing and hearing a speaker or singer clearly when he is personally present on the stage. The screen image is not only brilliantly illuminated but is also usually magnified to more than life size and so may be seen clearly from any part of the largest auditoriums. Because the sound can be amplified to almost any desired volume, there will be no difficulty in hearing, even from the most distant seats.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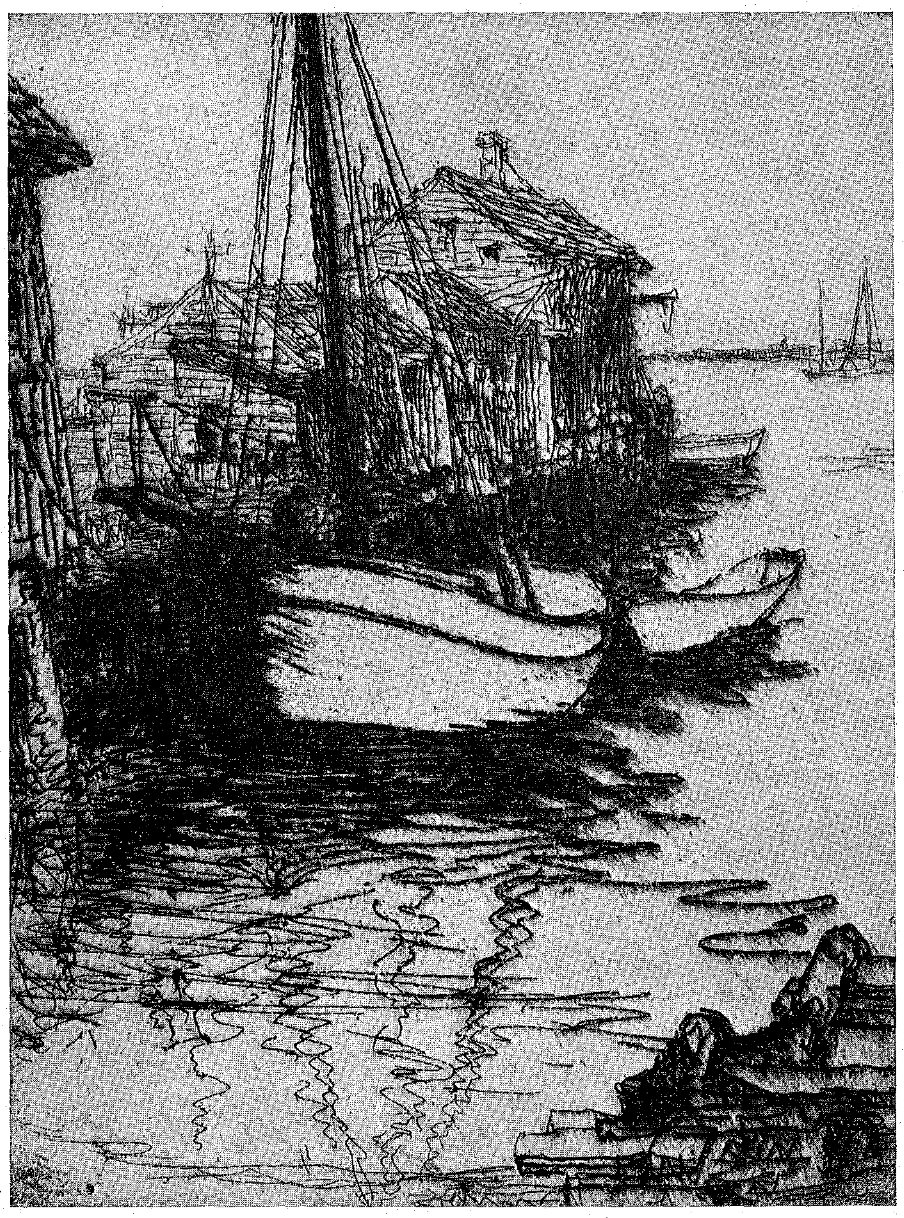

—From an Etching by S. Chatwood Burton.

Waterfront

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume IX APRIL 1929 Number 7

Continuity in the Universe

By Wm. O. Beal
Professor of Astronomy

IN our imagination we can see events witnessed many years ago, pass in rapid review. Events that took weeks or months in their actual unfolding are seen with the mind's eye in a moment of time. Indeed out of our experience we create a sequence of events in our imagination and parade them before our inner selves. Our hopes, our fears, our ambitions, and a multitude of other causes produce day dreaming as well as dreams in the night.

One remarkable fact about this ability of man is that he can thus break away from the present time and place, and view events, actual or otherwise, at another time and place, no matter how remote. The historians, the geologists, the astronomers are trying to bring before us a moving picture of the outstanding events in the history of the human race, of the earth upon which we live, of the galaxy of which our sun, is but an humble member. Likewise the architect, the statesman, the idealist are giving us a vision of events that may occur in the near or distant future.

Let us call this ability of man to view in his imagination events that are happening now in a distant part of the universe, a discontinuity in space. In the same manner the ability to see the events that occurred at this place in a distant past, a discontinuity in time. The term discontinuity implies the concept of continuity. In the universe of realities as we know it, a mass-particle may go from one position in space to another position only by passing through all of the adjacent points along a linear path joining the two positions. In thus passing from one position to another a sequence of events is established of which we say that one occurred before or after another. In this way the continuous flow of time is visualized.

When we consider that the location of an object is always described with respect to other objects and that these objects are observed to have relative motions it is obvious that continuities in space and time take place conjointly in a four dimensional continuism, called space-time.

It is my purpose in this paper to present some illustrations from nature of continuities and discontinuities.

At Harvard College Observatory Anna Cannon has classified the spectra of more than a quarter of a million stars, into about forty-five classes and subclasses. The basic fact brought out in this classification is that no matter what star you choose, another star can be found whose spectrum differs from it by the least observable difference. The spectra of all the stars represent a branching continuous series. It has generally been assumed that during the life history of any single star its spectrum would go through a continuous series of changes corresponding closely to the Harvard sequence of spectra of all stars.

There are thousands of stars in the universe whose apparent brightness is variable. In general their luminosity fluctuates more or less periodically in a continuous manner. Even in those cases called Nova where the star may become ten thousand times brighter within a few days, the change in brightness is a continuous one. Likewise there is a continuous change in the type of its spectrum that goes on simultaneously with the change in its luminosity.

By passing the light of a star through a spectroscope and measuring the changes in the intensity of its radiation from one end of the spectrum to the other with a bolometer it is possible to plot the relation between wave length and energy. From the curve the wave length of maximum intensity of radiation can be determined. By Wien's law the absolute temperature of the source is inversely proportional to the wave length of maximum radiation. In this way the effective surface temperatures of many stars have been obtained. It has been found that the stars can be arranged in a continuous sequence according to surface temperature from about 2000 C. to about 20000 C. Here we meet a remarkable correlation between the arrangement of the stars according to their temperature, and the arrangement according to their spectral classification, indicating that a change in surface temperature of a star would cause a change in its spectrum. This leads to the supposition that the spectral type of a star is not primarily dependent upon its chemical composition, but upon its surface temperature.

By determining the distance of a star, its apparent brightness, and its surface temperature, it is possible to know its approximate size. Thus we find that the diameters of stars range all the way from about 400 million miles down to less than the diameter of Jupiter, perhaps to thirty thousand miles. The stars have been loosely classified as super-giants, giants, medium sized, dwarfs and pygmies. Here again we have correlation, that of size with spectral type. But this difficulty was encountered that some of the cooler red stars were dwarfs and some were giants or super-giants. A more careful examination of the spectra of these stars revealed characteristic but minute differences in the spectra of dwarf and giant stars of the same spectral type. By the aid of laboratory experiments this difference was explained as due to difference in pressure and density of the gases forming the outer atmosphere of the stars, the dwarf stars showing the greater density and pressure.

These facts led Professor Russell of Princeton to formulate the hypothesis that in the normal life history of a star it decreases in size from a giant to a dwarf, but that while decreasing in size its surface temperature increases to a maximum at medium size, and then decreases as it becomes a dwarf star.

It would be a great help to this discussion if astronomers possessed more complete knowledge regarding the masses of the stars. As it is our knowledge is meagre and fragmentary. Such as it is, however, it indicates that the masses of stars range from one hundred times to one-tenth that of our sun, the largest stars being the most massive and the smallest stars the least massive. This confirms the statement above that the larger the star the less is its mean density, for the volumes of stars are proportional to the cubes of their diameters.

If these correlations correspond to reality we have the conclusion that a star decreases in mass as it grows older. What becomes of its mass? The only available answer is that it is transformed

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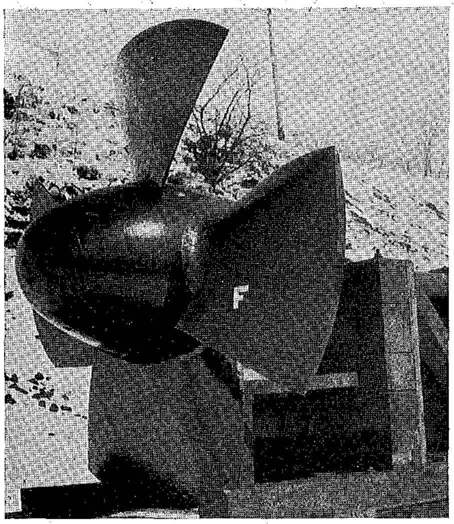


A RUNNER UNIT

A Modern Hydro-Electric Plant

A senior electrical engineer describes a recently constructed hydro-electric plant.

By CARROLL L. ELLIOTT, E.E. '29

THE Chippewa Falls plant of the Northern States Power company system, a 21,600 Kw. hydro-electric installation, is located near Chippewa Falls, Wisconsin, on the Chippewa River approximately 100 miles east of the Twin Cities as measured along the 110,000 volt transmission lines. It is one of the larger of the Northern States Power company's hydro plants which number twenty in all with a total capacity of 130,000 Kw.

The outstanding engineering features connected with this project are the large propeller-type adjustable-vane water-wheels, the unusually large tainter gates on the spillway, and the fact that the flow at this plant is directly dependent upon the tailwater and overflow of the Wissota Plant, located only three miles above and which has a rated capacity of 36,180 Kw. The Wissota plant was put into operation in 1916.

The headwater level at the Chippewa Falls Plant is approximately the same as the tailwater level at Wissota and there is practically no pondage or reserve storage in the three mile stretch of river between the two dams. The maximum wheel discharge of the Chippewa Falls plant is about 12,000 cu. ft. per second and the normal operating head on the turbines is 29.6 feet. The maximum flow of the Chippewa River is approximately 60,000 cu. ft. per second.

From preliminary investigations and borings, it was thought that the river bed was good solid granite, but when construction began, it was found that the granite was badly fissured. Because of these crevices, a considerable amount of excavating and concreting was required beyond the amount of the original estimate.

No provision was made in the present development for navigation or for log sluicing. The stream has never been navigable and logging has become practically an industry of the past on this river.

There is no fishway in the dam because the Wisconsin conservation commission does not require it. It has been found that fish ladders are not used as much by game fish as by the less desirable species.

The spillway has a maximum height of about 18 feet and a base width of about 30 feet. A rounded crest and a flat lower curve give free flow for the waste water. The upstream face is carried down as a 3 foot cut-off wall into solid rock while at the top it has a cantilever shelf which forms a sill for a portable coffer dam which may be used in making repairs to the gates.

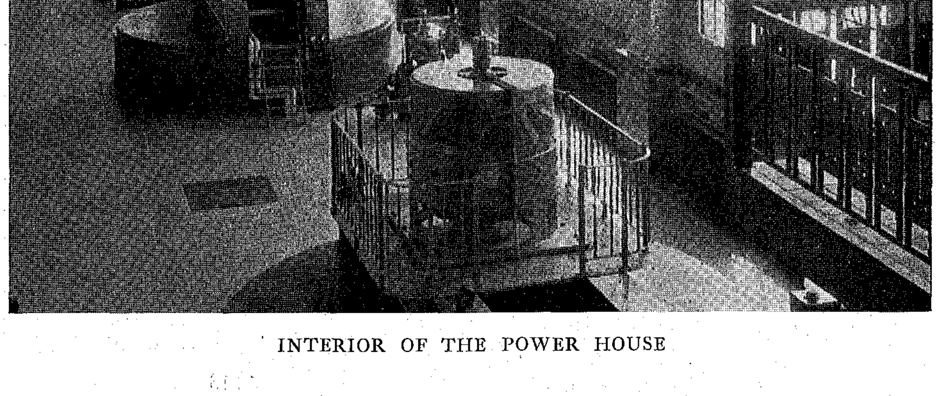
Along the crest of the spillway is a row of thirteen tainter gates of unusual size each 40 feet long and 13½ feet deep having their tops normally six inches above the flow line. These gates have rubber seals at the sides which move in grooves formed in the piers, and when lowered, the gates seat on 8x10 inch oak sills inbedded in the crest of the dam.

The flow capacity of the spillway is 90,000 cubic feet per second at the normal pond level, and may be increased to 110,000 cu. ft. per second by a 2-foot increase in the pond elevation. The gates are equipped for both motor and hand operation. The motors of the two gates nearest the station are arranged for remote control from the station switchboard in order to provide for promptly releasing the excess water in case of loss of load or the necessity of quickly shutting down one or more turbines.

A drainage tunnel is carried through the dam and has 4-inch drain holes extending down to a longitudinal drain of broken stone, which is laid on the rock surface. Any leakage at the heel, if under pressure, will find its way up into the drainage tunnel.

Short flaring rectangular intakes open into the scroll cases of the turbines, which are of the semi-scroll type, having two curved passages leading into each wheel chamber. The head gates consist of special stop logs built up of steel

(Continued on page 236)



INTERIOR OF THE POWER HOUSE

Report of the Drainage Commission

The Metropolitan Drainage Commission, Which Was Established in 1927 for the Purpose of Studying the Subject of Sewage Disposal of the Twin Cities, Has Recently Published Its Second Annual Report.

By FREDERIC BASS
Professor of Municipal and Sanitary Engineering

THE second annual report of the Metropolitan Drainage Commission presents the results of studies extending over a period of a year and a half on the subject of the disposal of sewage of the Cities of Minneapolis and St. Paul and certain adjacent areas. It includes not only the studies of the Commission itself, but also those of the Minnesota State Board of Health, which with the cooperation of the Minnesota Commissioner of Game and Fish and the Wisconsin State Board of Health, investigated several phases of the existing pollution in the river from Minneapolis to La Crosse.

As a conclusion from these studies the recommendation is made that the Twin Cities combine in a Metropolitan drainage district without delay for the purpose of jointly building intercepting sewers and treatment plants in order to remove the existing nuisance and to preserve the wholesomeness of the river in the future.

The Metropolitan Drainage Commission was created by an act of the Minnesota Legislature; Chapter 181 of the General Laws of 1927, the purpose being to study the subject of sewage disposal of the Twin Cities. The resulting report comprises studies of population, of quantity and strength of sewage, of characteristics of flow in the Mississippi River, of the self-purification of the river from Minneapolis to La Crosse, of possible methods of relieving the river by sewage treatment, of estimates of cost and finally the recommendation of a definite construction program to provide for the future up to the year 1970. Immediate formation of a Metropolitan district and immediate initiation of construction are advocated.

The chapters of the report are as follows:

Chapter I—*The Mississippi River.* In this chapter the characteristics of flow of the river are set forth; low flow, flood flow and frequencies of flow for various quantities. The effort of the various tributaries, headwater reservoirs and dams on the flow are estimated.

Chapter II—*The Population of the District.* Detailed figures showing present amounts and densities of population in the entire district and also in existing sewer districts are given in tables and charts. The growth of the district is shown and from it and from comparisons with other large cities a forecast is made of future growth up to the year 1970.

Chapter III—*The Metropolitan District.* The studies made by the city-planning commissions of Minneapolis and St. Paul together with other information are summarized to indicate the probable effect of the character as well as the amount of future growth on the sewage disposal problem.

Chapter IV—*Water Supplies.* Since the function of the sewage treatment plant is to treat sewage, which varies to a considerable extent in proportion to the amount of water used in the community, the statistics of the water used are set forth in some detail.

Chapter V—*Sewerage Systems.* The existing sewerage systems in the district and the areas which they serve are shown in detail. Sixty districts are defined. Slightly over sixty per cent of the area is now served with sewers.

CHAPTER VI—*Sewage Quantities.* The sewage flowing in the sewers in dry weather was carefully measured by means of weirs at the outlets. The various sources of sewage, such as industrial and commercial, domestic, ground water and storm water are evaluated. The dry weather flow from buildings, the ground water inevitably seeping into the pipes, and a small amount of storm water estimated from a study of rainfall statistics form the basis of calculation for the carrying capacities of the intercepting sewers. At time of storms, which cover in the aggregate about two per cent of the average year, a considerable amount of storm water will overflow at the present outlets into the river. During the remaining ninety-eight per cent of the time, the entire volume of the sewage will be collected and carried to the treatment plant by the interceptors.

Chapter VII—*Interceptors.* Plans, grades, profiles, sizes of the interceptors or collecting sewers are described in detail.

Chapter VIII—*Analytical Data Sewage.* Sewages from different cities vary considerably in strength, that is to say, in demand for the dissolved oxygen carried by the river. Nearly five hundred composite samples were collected and analyzed in the laboratory of the Commission. The analyses covered also the other important features of bacteriological content and suspended matters. The chemical characteristics of the water supply were also noted as they affect treatment processes.

Chapter IX—*Sewage Treatment.* This is an interesting condensed chapter summarizing the science and art of sewage treatment at the present time. The adaptation of the various available processes to differing conditions is discussed.

Chapter X—*Operating Rates.* This is a short discussion of the size and dimensions of the two types of plant, considered in relation to the amount of sewage to be treated. The types considered are: (a) sedimentation and trickling filters and (b) activated sludge.

Chapter XI—*The Extent of Treatment Required.* This vital feature of this problem is here presented in its many aspects. The character of the "biological cycle," that eternal revolution of the wheel of nature which builds up living matter from mineral, by the energy from the sun and through the agency of myriad life forms, and the inevitable return of living forms to death and mineral is discussed. The return to mineral or inorganic matter requires oxygen. This oxygen, taken from the river and supplanted by the gases of decay, produces a nuisance; the depletion of oxygen inhibits fish life.

So with a known amount of water containing a known amount of oxygen on one hand, and a known amount of sewage demanding or consuming a known amount of oxygen per cubic foot or gallon, on the other, it can be seen that any reasonably desired amount of oxygen may be left in the river provided the sewage receives the oxygen elsewhere, which in this case is the treatment plant which takes the oxygen from the atmosphere.

Standards are set up to maintain a reasonable amount of oxygen in the river in the future by recommending a proposed progressive program of treatment plant construction.

CHAPTER XII—*Sewage Treatment Plant Sites.* The question of what to do having been determined, that of finding suitable topographical conditions for the plant or plants remains. The governing conditions of area, elevation, accessi-

(Continued on page 226)

Temperature Control in Field House

By REALTO CHERNE, M.E. '29

SINCE temperature, humidity and air motion are three vital factors which affect human comfort and since human comfort is the paramount issue in heat control, the problem of heating and ventilating a structure the size of the University of Minnesota Field House is one of far reaching importance. It is known that large groups of people, even when at rest, give off great quantities of heat. During the indoor sport season this heat gain is more than offset by heat loss through the walls and especially through and around windows. However, air changes must be effected or other evils will arise, namely, odors and bad air.

I need not dwell at great length upon the size of the field house or the method used to supply heat, for most Minnesotans have been present at games and in idle moments wondered what the large sheet iron ducts were for. Perhaps the noise of the fans caused no little irritation to those sitting near—although they are mounted to prevent the sound vibrations from being amplified.

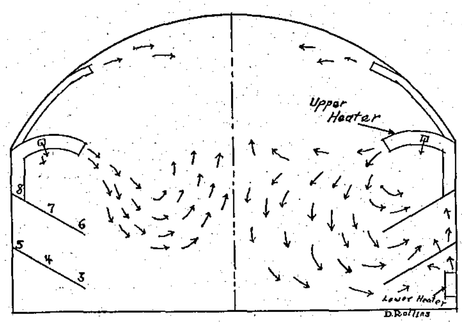
The following paragraph is taken from the official specifications as outlined by Pillsbury Engineering Corporation:

"The main portion of the building shall be heated by twelve fan units located above the second balcony arranged normally for recirculation, but with provision for taking air from outside if desired. They are supplemented by unit heaters located under the first balcony."

A series of tests were run on this building during the winter quarter by a group of senior mechanicals under the personal direction of Professor F. B. Rowley. The chief purpose of these tests was to determine the action of both cool and warm air in the system. In the following paragraphs we will give a portion of the data and an interpretation of the results. It is well to prefix the discussion by saying that faults evident in the system are more in regulation than in equipment installation.

For the purpose of obtaining a temperature gradient from top to bottom, a thermo-couple was suspended from the top with provision for lowering and raising the common junction (the point at which the temperature is taken). The balcony temperatures were obtained by means of thermometers placed at different levels. Smoke bombs were placed near the fans and the air currents traced by following the paths taken by the smoke when leaving the ducts. By placing thermometers in both balconies on either side it was found that the temperatures at equivalent elevations from the ground were equal or within a few degrees of each other. For this reason only the data of one side will be discussed here.

It is desirable to keep the playing floor at about 55 degrees F.; keep the roof temperature equal to the upper balcony temperature; and keep the balcony temperatures below 65 degrees F. If the playing floor varies greatly from the correct temperature, the players will be affected. If the roof temperature is high, the heat loss will be correspondingly high since it is proportional to the temperature difference between outside and inside air. If the balcony temperatures vary much above 65 degrees it will soon be uncomfortable for the spectators; if it varies below, the people will be cold. The above temperatures are only correct for air in constant motion and containing the proper moisture content.



(1) (2)

At the present time the following method of heating is employed: first, all heaters and fans are turned on until the proper temperature is reached; second, the large upper fans are turned off, and the steam is left on. If the man in charge is lucky, he may have the correct conditions when the spectators arrive. This method of control is obviously very poor. Below is data obtained with the system operating under these conditions.

(a) Center temperatures:

Height above floor (ft.)	*Temp. reading degrees F.*
1	56.8
10	59.9
20	62.6
30	64.5
40	65.4
50	66.7
60	68.8
70	69.6
80	70.8
90	70.8
97	72.5

(b) Thermometers in balcony:

Therm. No.	*Reading degrees F.*
3	62.5
4	65.5
5	67.0
6	70.5
8	74.0

(c) Smoke test as shown in sketch, part 1.

Analysis of these data show:

From (a) 1. The playing floor temperature is correct.

2. The temperature at the top is too high.

3. The difference in temperatures between the top and bottom is 16.5 degrees. This is much too great, as will be indicated later.

From (b) 1. The temperature in the lower balcony, shown by 3, 4 and 5, is in the comfort zone.

2. The temperature of the upper balcony, as shown by 6 and 8, is far above that required for comfort.

From (c) The smoke in the air currents showed that the heat was going to the roof instead of circulating about the balconies as it should.

The results of this test show that most of the heat injected is lost because it is concentrated near the top of the building where it is not needed. We should observe, however, that if the roof temperature becomes too low there will be ceiling condensation. This lower limit is below what is considered comfortable in the upper balcony. It is interesting to note that the problem of ceiling condensation is what necessitated the costly repairs on the Minneapolis municipal auditorium last winter. The hazard is eliminated by proper insulation.

For the purpose of contrast, I will next give the results of a test in which the steam was shut off in the upper heaters and the large fans were allowed to run. The steam was on in the lower heaters.

(a) The temperature difference between top and bottom was only seven degrees as compared with 16.5 obtained before.

(b) The temperatures in both balconies varied between 62 degrees and 65 degrees F.

(c) The smoke test result is shown in the sketch part (2).

A study of the air paths alone would convince one that this method is a much better one than the one used at present. It is noted that the air is recirculated and is in motion on both balconies. A constant supply of heat is filtering up

(Continued on page 240)

Steel Slabs for Column Bases

By GEORGE C. PRIESTER *and* C. H. SANDBERG

Department of Mathematics and Mechanics

WHERE steel columns are used in structures it is becoming a common practice to use rolled steel slabs with or without grillage beams to transfer the column load to the concrete footings. This method of distributing the load over the footings has certain advantages. One of which is that it effects a saving in the depth of excavation for the footings over the older methods where rather deep I beam grillages were used. The calculations necessary to find the required thickness of these steel slabs requires a knowledge of the column load and its distribution to the footings.

As no adequate theory exists and because the empirical methods used for determining this thickness does not give comparable results, the authors have endeavored to carry out some experimental work in the hope that it would be possible to determine the manner in which the load is distributed over the footings. In this paper there will be discussed the methods now used for calculating the thickness of the steel slabs and a preliminary outline showing the methods and means used by the authors to determine the load distribution by tests.

The several methods now used in calculating the thickness of steel plates give widely divergent results as will be shown. For purposes of illustration a 14 inch H column with a load of 1,000,000 pounds will be assumed to be carried by a steel slab and transmitted to a concrete base whose allowable unit stress is 500 lbs. per sq. in.

According to the "Tables Governing Design of Structural Steel in Tier Buildings" published by the American Bridge Company, the plate required would be 44 by 46 by 5 inches. From the tables of "Rolled Steel Slabs for Column Bases Manufactured by the Bethlehem Steel Company" a 14 inch H column under the same conditions requires a plate whose dimensions are 44 by 45 by 5 inches. The maximum bending unit stresses are assumed to be 16,000 lbs. per sq. in. in the first case and 18,000 lbs. per sq. in. in the second. The method of calculating the thickness of the plate is not given. From a formula in the Kidder-Nolan handbook, the required thickness is found to be 9.6 inches using a bending unit stress of 16,000 lbs. per sq. in. From Carnegie Steel company's "pocket companion" the thickness is found to be 5.8 inches. In making the calculation from the American Institute of Steel Construction's handbook, "Steel Construction" the required thickness for the plate is found to be 5.5 inches.

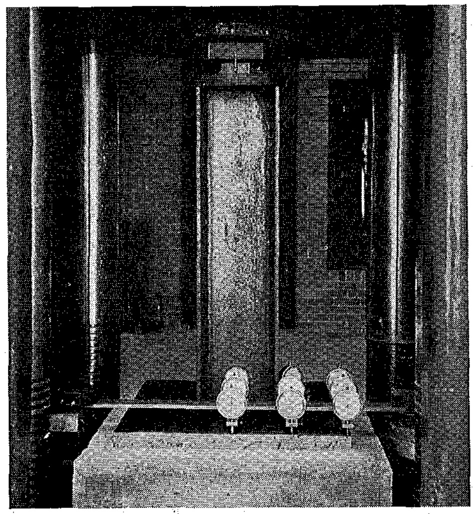


FIGURE 1

The set-up with a 9 inch concrete base and a 1 inch steel plate loaded by a 6 inch H section.

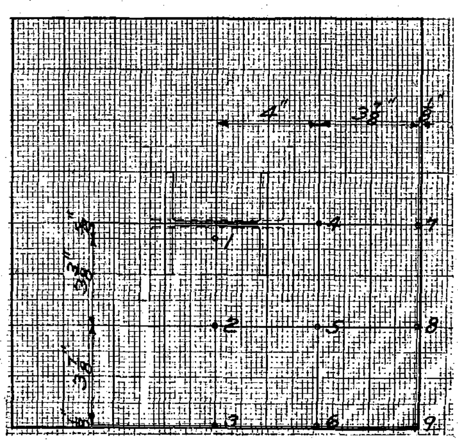


FIGURE 2

From the above results one can readily see that there are appreciable differences in some of the results obtained and in no case is there a rational development of the formula for determining the plate's thickness. To develop a satisfactory formula it is necessary to know the manner of distribution of the load from the column to the foundation. In this experimental work which was begun last November the authors have attempted to determine this distribution. The method consists in placing a steel plate on an elastic foundation in a testing machine and subjecting the plate to a columnar load. The deflection of the steel plate is found by a set of Ames dials which may be read to one-ten thousandth of an inch.

Some other types of bases used are wood and insulite. Four thicknesses of plates are used, namely ¼ inch, ½ inch, ¾ inch and 1 inch, also two sizes of H columns, 4 inch and 6 inch. By proper placing of the dials and reading the before and after application of a load it is possible to determine the shape of the plate produced by a given load. Figure 2 shows the location of the dials and the position of the column with reference to the plate. Figure 3 shows the deflection of the plate by contour lines. From this figure it is evident that the load is not uniformly distributed over the contact area of the plate and concrete. The numbers on the contour lines indicate the deflection in 10,000ths of an inch for a total load of 60,000 lbs. transmitted to a one inch plate by a 4 inch H-column. The plate is 16 inches square and the concrete base 22 inches square. It is of interest to note that in some cases the corners and edges of the plate are deflected upward, that is, only the central portion of the plate transmits pressure. The surface of the plate outside of the dotted contour in figure 3 is not in contact with the concrete.

While the above investigation is by no means complete it is evident that by an extensive program of tests it will be possible to determine the manner of load distribution under column bases. From this it should be possible to develop a more satisfactory means of determining the proper size and thickness of steel slabs to be used for column bases.

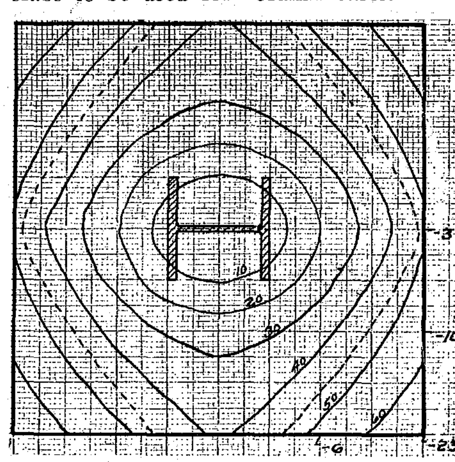


FIGURE 3

1929 Electrical Party

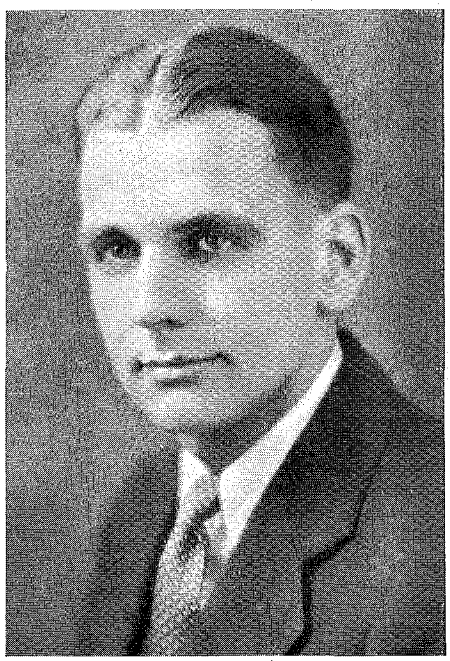
The ninth biennial electrical party which is to be held on April 19 and 20 will feature the most recent advances in electrical engineering.

By WILLIAM H. PAINTER, E.E. '30

BACKED by the tradition established by eight successful predecessors, committees for the 1929 Electrical Engineering Party have swung into the final rush of preparation for the event. Since early in the fall ideas have been formulating, and every indication points to the most spectacular and successful party that has yet been staged by the disciples of Ohm and Wheatstone. Under the efficient direction of John C. Newhouse, '29, a large corps of students has been working strenuously to round up a collection of exhibits calculated to make the layman gasp and stare, and at the same time impress him with the quality of work being carried on in the laboratories and classrooms of the electrical engineering department.

That the electrical party stands high in the regard of the profession is shown by the announcement by Mr. Newhouse that this year's show will contain the most elaborate industrial exhibit in the history of the event. The General Electric company, the Westinghouse Electric and Manufacturing company, the Western Electric company, the Bell Telephone System and the Northern States Power company have already signified their intention of entering displays, while a number of other concerns are expected to have material on hand when the party opens. In spite of this expansion of the industrial work, the greater part of the show will be given over to student exhibits which will rival the commercial entries in interest and workmanship.

Friday and Saturday, April 19 and 20, are the days which have been selected. Warned by the conflict which occurred in 1927, when Engineers' Day and the party were scheduled for the same dates, Mr. Newhouse wisely selected dates which give the electrical exhibition precedence over all other campus events of the spring quarter, and which will be certain to focus the attention of the whole University on the technical campus. In accordance with a long established custom, admittance on the opening night will be only by invitation of the students and faculty of the electrical engineering department The party will be thrown open to the general public on Saturday night, and preparations are being made to handle a crowd of more than five thousand people. A new feature this year will be the private showing for University students only which will be held on Friday afternoon preceding the general opening. The traditional opening-night dance, which last year overflowed the capacity of the Engineering auditorium, is to be held in the Minnesota Union from 9 until 12 o'clock on April 19. Negotiations are under way to secure the best of campus music for the dance, and all University students are cordially invited to attend the function.



JOHN C. NEWHOUSE

As the visitor approaches the Electrical building, he will be amazed and somewhat startled to see what appear to be tongues of flame licking out high on one of the radio towers. There will be no necessity for calling out the fire department, however, since it is a part of the show. A pipe line has been run from the basement through a conduit shaft to the tower. Through this pipe steam will be forced, and colored lights on the roof will be focused on the jet to produce the desired effect. After he enters the building, the stranger will be greeted by strange and weird effects which will tend to make him doubt his sanity. In one case he will be shown into a darkened room, where an electric light seems to be suspended. The light will go out, and when he reaches for the bulb, he will be mystified to find it is not there. This "vanishing lamp" is calculated to puzzle the most skeptical. Still harder to explain will be the automatically opening door. As a person approaches this door, he is surprised to see it silently swing open, only to close again after he has passed through. These and many similar novel and baffling stunts will be mixed judiciously with the more practical exhibits, in order that all who attend may be royally entertained, and at the same time add to their store of knowledge of the power of electricity.

Probably the most popular man at the party will be Mr. Televox. That is the name given to the automaton invented by R. J. Wensley of the Westinghouse company. This mechanical servant, the culmination of long years of research and experiment, is not, as so many people think, a mere toy or curiosity designed for the amusement of tired engineers. On the contrary, its practical application has been demonstrated repeatedly, and Mr. Televox will go through his paces for the edification of the visitors. He will demonstrate his familiarity with switchboard work, as well as his accomplishments in the more domestic tasks of running a vacuum cleaner, starting and stopping electric fans and operating lights. Being still a young man, Mr. Televox will be chaperoned by James L. McCoy, Westinghouse engineer, who will be hard pressed to protect his young charge from the admiring adulation of Minnesota co-eds.

Three other members of the Televox family, who are at present engaged in regulating the water supply of the city of Washington, D. C., were invited to attend the show, but the fact that they are working 24 hours a day and are required to make periodical reports to the War Department prevents their coming. Mr. Televox himself will be here only for the Friday exhibition, leaving late that night for a Saturday engagement in Kansas.

Rivaling the mechanical man in the interest of both the ladies and gentlemen at the party will be the exhibit of the latest types of electric refrigeration by the General Electric company. Full size models, with various parts cut away, will reveal the secrets of iceless refrigeration. This same concern will also mystify the patrons with pictures of waves of all sorts and forms chasing each other across a screen. This will be accomplished by means of the latest type of oscillograph, an instrument which shows graphically the wave forms of currents and voltages. The scope of this instrument has been greatly widened but recently. One of its newest applications is in teaching deaf mutes to talk. The voice of the instructor is thrown upon the screen, and by means of a mechanical larynx the pupil attempts to imitate the wave form, thus producing the same sounds.

A complete exhibit of the various types of equipment developed for lighting airports will be on display, and if negotiations with the Western Electric company are successfully completed, a "Movietone" unit will be installed to explain the intricacies of the talking motion picture. An automatic traffic signal, intended for installation on through traffic streets, but which will change at the blast of an auto horn to permit traffic from the side streets to move, is to be shown, but it is expected to have little regulatory effect upon the surging crowds at the party. The principle of the newly popular neon lights will be demonstrated in another commercial exhibit. Unlike the ordinary lamps, these lights require little current but demand a high voltage (about 14,000 volts) to ionize the neon gas with which the tubes are filled. This produces a penetrating red glow; if blue is desired, the addition of mercury brings about the desired effect.

A short while ago, C. E. Skinner, the assistant chief of the research department of the Westinghouse company, talked before the student branch of the A.I.E.E. on the subject of photo-electric cells and their practical applications. Since his appearance, interest in this subject has been greatly heightened. This is shown by the number of exhibits both commercial and student, that employ these sensitive cells in their operation. One type of traffic signal has a beam of light playing across the street on a photo-electric cell. When a car goes by, the beam is interrupted and relays are set in operation which change the signal to favor the motorist.

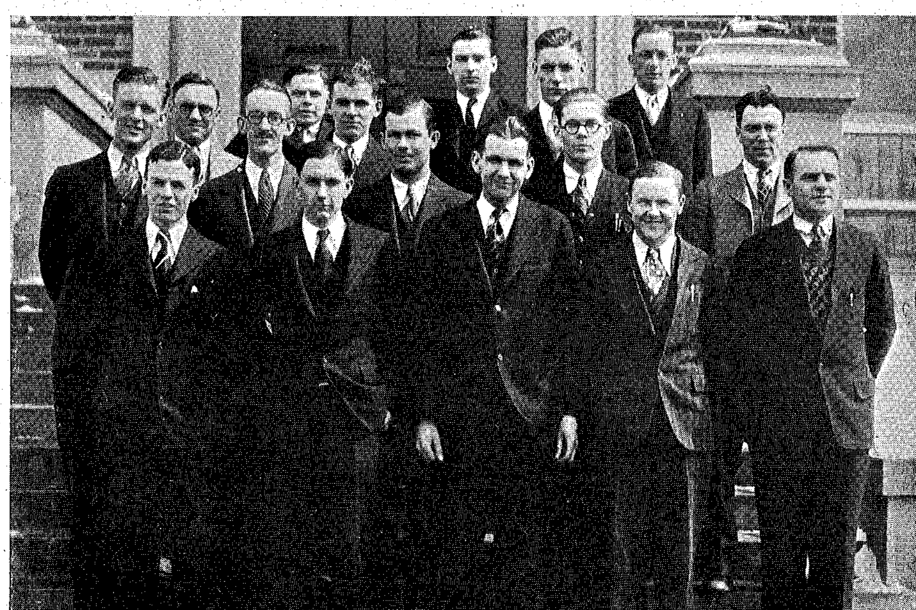
Much the same idea is embodied in an automatic bean sorter which will be shown. This instrument will separate black beans from white ones with an accuracy far greater than human. The small amount of light reflected from the black beans causes a plunger to move out and push them aside. An ideal street lighting layout will be demonstrated which will turn on and off automatically depending upon the amount of light present. The intensity of light affects one of the sensitive cells in such a manner as to cause the operation of the system. This principle has recently been applied in school room lighting. A photo-electric cell placed near the window turns on the artificial light whenever the intensity of the natural light diminishes beyond a certain point.

COMMITTEES FOR THE 1929 ELECTRICAL PARTY

Manager - - John C. Newhouse
A.I.E.E. Representative - - - - - - - - Carroll L. Elliott
Student Exhibits and Stunts - - - - - - - - - Wesley Gray
Invitations - W. G. Warrington
Manufacturers Exhibits - - - - - - - - - Glenn Williams
Illumination - - - Lloyd Russ
Electrical Engineer - - - - - - - - - - - Robert Campbell
Radio - - - - James E. Specht
Communications - - - C. C. Fox
Education - - - E. B. Saxhaug
Signal Corps - - Donald Raney
Reception - - Wm. D. McIlvaine
Publicity - - William H. Painter
Finance - - - - - Paul Saxon
Dance - - Raymond C. Freeman
Programs - George H. Doleman
Decorations - - - J. T. Bailey
High Tension - - L. E. Peterson
Junior Representative - - - - - - - - - - Homer Brown
Sophomore Representative - - - - - - - - - R. M. Hanson

A little known service which is maintained by the electrical engineering department is the official state headlight testing service. A state law requires that no headlight, tail-light, spotlight, or other similar equipment for autos may be sold in Minnesota without first having passed the rigid tests which are given here. A demonstration of some of the kinds of lamps tested, as well as the methods of testing them, will be given. Of particular interest to out-of-town guests will be the farm lighting set. An electric generator which is driven by a windmill generates current for charging a set of batteries, thus serving to bring to the farm many of the conveniences heretofore available only in the city.

Other student exhibits will include many stunts that have proved their interest at previous shows, together with new developments. Following the announcement that within a few months television sets will be placed upon the open market, great interest will attach to the demonstration of visual radio to be conducted by a member of the senior class. A radio car, which is being assembled from odds and ends picked up almost at random, and which is operated by remote control, will add to the traffic hazards of the onlookers, while lightning will be created upon demand by the operators of the million-volt Tesla coil. An exhibition of antiquated sub-station equipment, a vanishing lamp, a talking arc, and an engine using electric solenoids in place of cylinders will be displayed. The magnetic cannon, a device which might have ended the World War much sooner had it been used, will parade its death-dealing qualities, and the truth about the rumor that the engineers have a "skeleton in their closet" will be made known. Other stunts will all contribute toward making the 1929 Electrical Party an event long to be remembered.



COMMITTEE CHAIRMEN FOR THE PARTY
Left to Right: Russ, Brown, Peterson, Painter, McIlvaine, Campbell, Specht, Freeman, Gray, Newhouse, Williams, Saxon, Warrington, Raney, Fox, Elliott.

The History of Paper Making

Shafts of Stone, Clay Tablets, and in Some Cases, Even Human Skin Were Used for Written Records Before the Discovery of Paper

By LEONARD D. SCOTT, Ch. E. '29

THE first real advance in the direction of modern paper was made when man began to use the leaves of olive, palm, poplar and other trees. They were cut into strips, soaked in boiling water and rubbed over wood to make them soft and pliable.

Then it was discovered that a type of crude paper could be made from a plant known as papyrus. It is not known just when the discovery of this fact was made, but there is evidence that it was known as early as 2,000 B.C. This plant grew in great profusion along the banks of the River Nile. It was the bulrush of which was made the cradle in which the infant Moses was hidden from Pharaoh's soldiers. The plant, a tall, smooth-stemmed reed of triangular form, grew to a height of ten or fifteen feet and terminated in a tufted plume of leaves and flowers. It had been used for making mats, sail cloth, cordage and clothes. Its pith had been used as a food.

To make paper from papyrus, according to Pliny, the outer rind was first removed, exposing an interior made up of some twenty successive fiber layers. These were separated with a pointed instrument, laid side by side on a smooth table, then crossed at right angles with a second set of strips. They were then dampened, pressure was applied for a number of hours, and the sheets were removed and rubbed with a piece of ivory or smooth stone until the desired surface was obtained. The inner layers of the plant made the finest paper, whereas the extreme outer layers were so coarse that they were suitable only for cordage. The sheets were then glued together to form the papyrus rolls known as volumers. These were often eighty or ninety feet in length.

Papyrus is mentioned by Philostratus as a staple manufacture of Alexandria in A. D. 244 and it continued to be used in Italy until the twelfth century. When the Romans undertook the manufacture of papyrus they made a great improvement in the sheets by sizing them with flour to which a few drops of vinegar had been added. At this same time the Chinese were making a paper similar to papyrus, using for their basic material carefully cut continuous slices from the pith of the papyrifera.

The manufacture of parchment came next. It seems that Eumenes II, king of Pergamus, desired to establish a library which would excel the great library at Alexandria in Egypt. But when the Egyptian ruler, Ptolemy Epiphanes learned of the plan he refused to ship any more of the valuable papyrus to Pergamus. So there remained nothing for Eumenes to do but manufacture a substitute for it. This was done by taking the skins of sheep and goats, steeping them in lime-pits, stretching them upon frames and further reducing their thickness by paring and scraping with sharp instruments. When the skins had been reduced to about half their original thickness they were dried for use. Vellum was made in a similar manner from the skins of young calves. As early as 1085 B.C., the Hebrews wrote on the skins of animals and the Medes also used a substance resembling parchment at this time. Parchment was used in England for many years for all deeds of real estate.

THE Chinese are now generally conceded the discovery of the art of making paper, of the sort familiar to us, from fibrous matter reduced to a pulp. The Chinese encyclopaedist, Fang Mi-Chah, says that first the Chinese wrote on boards and then a paper from silk wastes. The statesman Ts'ai Lun in 105 A. D. invented a process of making paper from "bark, hemp, rags and old fish nets." Then they used a type of mulberry tree for their paper manufacture. The process was as follows: branches of the tree were boiled in lye to remove the bark. They were then steeped in water for several days after which the outer part was scraped off and the inner part boiled in lye until it was separated into fibers. These were washed, worked into a pulp by hand and beaten with a mallet. The pulp was then mixed with rice and a root called "oveni." A mold made of bulrushes was dipped into a vat containing the pulp, which was taken out in a thin layer and dried in the sun.

About 704 A. D., the Arabs captured the city of Samarcand from the Chinese. Among the Chinese prisoners were some paper makers from whom the Arabs learned the secret of paper making. They improved the process to a certain extent, using cotton fiber and perhaps linen. The "Gharibu l'Hadith," a treatise on rare and curious words in the sayings of Mohammed, written in the year 866 is probably the oldest paper manuscript in existence. It is preserved in the University library of Leyden. Crusaders who visited Byzantium, Palestine and Syria brought the process to Europe and the Moors established paper mills at Toledo when they invaded the Spanish peninsula. After the expulsion of the sons of the prophet, however, paper making declined in Spain but was revived in Italy, a famous paper mill being established in Padua in 1340.

The art of making paper was introduced into France in 1189 A. D. The French followed the art with such zeal and industry that they were soon in a position to supply the wants of all the surrounding countries. The people of the Netherlands were stimulated by the example of the French and for a long time, the French and Dutch papers were the best and indeed practically the only papers produced in Europe.

As far as Europe was concerned rags alone were used in the manufacture of paper. Cotton and linen rags were those mainly used. The rags were wetted down and allowed to ferment. Then they were boiled in wood ashes, placed in bags, and immersed in running streams. Having thus removed the alkali and much of the dirt, the mass was beaten, two or three pounds at a time, on wooden blocks with heavy sticks. Sheets were formed by immersing in the pulp a rectangular sieve with meshes formed of strips of bamboo. Sufficient fiber was picked up on the sieve to form a sheet, the drying of which was done by exposure to sun and air.

IN 1151 the stamping mill was invented in Spain. This was soon applied to the paper industry, greatly increasing the rate of production. The stamps were cumbersome machines driven by water power which was rather plentiful in certain parts of Spain. In the Netherlands, however, sufficient power was not available to drive these machines and so necessity was once more the mother of invention. They invented a machine subsequently known as the "Hollander," which is a revolving cylinder containing sharp, steel blades. This machine, which was capable of being driven by the Dutch windmills, proved to be much more efficient than the heavy stamper which it gradually replaced. The Hollander was invented in 1759. Woven wire molds were invented and introduced in 1755 by the English printer, Baskerville.

It is said that the German, Ullman Stromer, became interested in the manufacture of paper while visiting in Italy.

When he came back to Germany he erected the first paper mill in that country. This is thought to have been in 1336. He employed Italian workmen for the most part. He erected another mill in Nuremberg in 1390, which was renowned for its size. It had eighteen stampers. Paper making was rather tardy in getting a start in Russia. In 1712, the versatile Peter the Great of Russia visited the paper mills at Dresden and was so pleased with it that he engaged paper makers whom he sent to Moscow to establish a paper mill at his own expense.

THERE is much uncertainty as to the date of the introduction of paper making into England. The earliest reference to paper making in England appears in these lines in Wynken de Worde's book, "De Proprietatibus Rerum," which was issued in 1498:

"And John Tate, the Younger, joye mote he brok!
Whiche late hathe in England, doo make this paper Thynne
That now in our Englysh, this book is printed Inne."

Tate's mill is said to have been located at Hartford, England. Little is known of it. Tate died in 1498 and paper making evidently declined to the vanishing point until 1588 when Spielman came from Germany, obtained a charter from the crown and erected a mill at Dartford, England. He was subsequently knighted by Queen Elizabeth. After his death, paper making again languished until around 1670. During all this time the people of England were almost entirely dependent upon France for their supply of paper. Then came the war with France and high paper duties opened the way for British manufacture. The situation was further improved by the French Protestant refugees who fled to England from persecution in their own land. Among them were many highly-skilled paper makers. The first British patent for paper making was granted to Charles Hildegard in 1665 for "the way and art of making blue paper used by sugar bakers and others." Other patents followed.

The first paper mill to be established in America was that of William Rittenhouse at Germantown, Pennsylvania, in 1690. The paper from this mill was made from linen rags and the capacity was about two hundred and fifty pounds per day. Another mill was erected in 1714 in Delaware by a Mr. Wilcox who is said to have furnished Benjamin Franklin with paper. The mills then began to increase in number until in 1770 there were forty mills in the states of Pennsylvania, New Jersey and Delaware.

These mills all used rags for their paper, and so it is not surprising that a shortage of rags soon became pronounced in the thrifty but impoverished North Atlantic states. At the outbreak of the Revolutionary War the situation became very acute. John Adams, in a letter from Philadelphia to his wife in Massachusetts April 15, 1776, wrote, "I send you, now and then, a few sheets of paper; but this article is as scarce here as with you." And Gen. Philip Schuyler, writing to George Washington from Albany on August 27, 1775, said: "Excuse these scraps of paper; necessity obliges me to use them, having no other fit to write on." Paper was of prime necessity for musket wadding and cartridges. The several states passed laws exempting paper-makers from military service. It is said that a group of soldiers searching for paper invaded the garret of a house in which Benjamin Franklin had once lived. There they found twenty-five hundred copies of a sermon by Rev. Gilbert Tenant upon "Defensive War." These were used for "wadding" in the bloody battle which raged about the old Tenant church. The sermon proved to be one of the most effective that was ever delivered. The situation became worse as the war progressed and it was on this account that the journal of the second session of the New York Assembly in 1781 was not printed.

THE year 1801 brought some relief when Matthew Kooper in France developed a way of extracting printing and writing ink from waste paper which up to this time had all been thrown away. He is also said to have made "most perfect paper from straw, wood and other vegetables, without the addition of any other known paper stuff." Other men, previous to this time had seen that paper could probably be made of such things as wood, straw, etc.; but as is often the case with radical innovations, nothing was done about it. In 1719, Reaumur seems to have been the first author who perceived that paper might be produced from wood. He observed that the fabric of wasps' nests was taken from wood. In 1734, Seba, a Flemish naturalist, mentioned wood as a source of paper. In 1751, M. Guettard of France published his experiments and showed specimens of paper made of bark, leaves and wood of different trees and shrubs. In 1756 the first attempt to make paper from straw was made in Germany.

Then, in 1789, Louis Robert, a workman in a paper mill in France announced that he had discovered a way to make paper with machines. The value of the machine was recognized by the French government, which rewarded him 8,000 francs. Difficulty was met with in financing the project, however, so he sold his patent rights to Messrs. Henry and Seely Fourdrinier in England. They further perfected the machine which subsequently came to be known as the Fourdrinier machine.

The device was not brought to America directly, however. In 1820, the Gilpins, paper makers at Brandywine, were the first to introduce paper machinery from England and France, but even then the project was so expensive that it met with little encouragement. The mills rapidly increased in number in this country, however, and eventually machinery was installed. In 1829, Reuben Fairchild of Trumbull, Connecticut, invented the paper-agitator now used on paper machines. It consists of a semi-cylindrical cradle vibrating so as to prevent the fibres from being arranged parallel to each other and thereby making a paper weaker in one direction than the other. In 1830, Thomas Gilpin of Philadelphia invented the internally heated rolls called "calendars," which are used for giving the polished surface to paper.

In 1774 Scheele discovered chlorine. Its bleaching action was discovered by Bertholet in 1785, and soon after this it was used to bleach the rags which went to make up the paper. Previous to this time the color of the paper had been that of the rags of which it was made, modified to a certain extent, of course, by the washing and boiling. Bluing is used to give the paper a snowy-white color, and its value as such was accidently discovered in this way: about 1746, a Mrs. Buttonshaw, the wife of an English paper-maker, accidently dropped the contents of a bag of bluing into a tub of pulp. Frightened at what she had done, she discreetly held her peace and awaited results. But when the paper from that particular pulp sold in London at an advance of several shillings she decided that it was time to break the silence. As a result the grateful husband bought his wife a costly scarlet cloak the next time he visited old London-town and the paper industry advanced one more step.

IN 1884 Keller, in Germany, patented a machine for grinding wood for the manufacture of pulp. The patent was then sold to Henry Voelter's Sons, who afterwards used the pulp in the manufacture of newspaper. The Voelters further improved the machine and patents were obtained in the United States in 1858. Prejudice had to be overcome in this country before wood pulp could be used for paper. The sulfite process was invented by Benjamin C. Tilghman, a Philadelphia chemist. Although the process worked successfully in the laboratory, he got into difficulties in making

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News from the Technical Campus

Comstock Attends Mines Convention

E. H. Comstock, professor of mine plant and mechanics recently attended the 137th meeting of the American Institute of Mining and Metallurgical Engineers held in New York City.

To afford relaxation, two evenings were devoted to social activities. The annual smoker was held on February 18th at the Hotel Astor and offered an opportunity to renew old acquaintances. According to Mr. Comstock, the room was crowded with small groups of alumni from different institutions talking over old times, obtaining information on some nearly forgotten classmate, or listening to plans for the future. In one such group were gathered fifteen or twenty alumni of the School of Mines and Metallurgy from the University of Minnesota.

The other social evening was Wednesday. During the annual dinner, the presentation of the various honorary rewards was made. Mr. Comstock believes that the most singular honor was accorded to John Hays Hammond who was presented with the William Lawrence Saunders gold medal "for his notable work as an engineer and developer of mines at home and abroad, his industrial leadership and his public services." This was the third award of the medal, the first being to David W. Brewster and the second to Herbert Hoover.

The remainder of the meeting was devoted to the technical papers presented in the various sectional sessions. These were on such subjects as iron and steel, non-metallic minerals, lead and zinc, mining methods, milling methods, geophysics, mine ventilation, petroleum engineering, petroleum economics, and economic geology. In addition, various committees of the American Society for Testing Materials held meetings, and there were sessions of the Institute of Metals Division. On Tuesday morning was held the annual meeting at which time a bust of Herbert Hoover, a former president of the Institute was unveiled.

When asked concerning his general impressions, Mr. Comstock replied, "Attendance at a meeting such as this is decidedly worth while, not alone for the technical knowledge gained, but for the friendships formed, and the opportunity afforded to touch elbows with those who have achieved and are achieving in the field of mining and metallurgical engineering."

Minnesota Man Takes Standards Position

Dr. Ralph L. Dowdell, assistant professor of metallography in the School of Mines and Metallurgy, has been granted leave of absence beginning April first to take the position of senior physical metallurgist with the United States Bureau of Standards.

Dr. Dowdell graduated in 1918 from the School of Mines with the degree of metallurgical engineer. For a year after his graduation, he served as assistant metallurgical engineer for the United States Bureau of Mines at the Lake Superior station.

He was appointed as instructor of metallography at Minnesota in 1919, and in 1926 he was appointed to the position which he now holds. During the summer of 1926 he held the position of research associate with the U. S. Bureau of Standards.

A. S. M. E. to Test Safety Devices for Elevators

The American Society of Mechanical Engineers has undertaken a series of tests to perfect safety devices for elevators and elevating equipment. The work is being carried on by two groups of scientists in the United States Bureau of Standards working in co-operation with city and state authorities, manufacturers, architects and insurance underwriters.

According to the bureau of Standards, three-fourths of the elevator accidents are those in which individuals fall through open doors into the shaft when the car is absent, or are crushed between the moving car and the sill. Because of this fact the work has centered around various locking devices to prevent the car from leaving the landing unless the shaftway door is closed and locked, and to prevent the door from being opened unless the car is at rest at the landing.

At the same time investigations and tests undertaken about two and a half years ago under the direction of the A.S.M.E. special research committee on elevator safety are progressing and have increased the efficiency of the devices placed under and about the car to halt it automatically if it falls out of control. These tests, which are being conducted on a model elevator installation, are being financed by elevator and insurance concerns, and related groups, and have led to the revision of the safety code in use among insurance concerns heretofore.

Taylor is Awarded Guggenheim Prize

Dr. Nelson W. Taylor of the physical chemistry department has been awarded one of the John Simon Guggenheim memorial fellowships. Between fifty and sixty of these fellowships are awarded each year by Senator Guggenheim in various branches of learning, especially in the sciences, arts, history and archeology. These fellowships are tenable in almost all parts of the world and Dr. Taylor is going to study at the Kaiser Wilhelm Institute in Germany. The committee in charge of the fellowships allows one a great deal of freedom of travel and he will therefore spend time consulting with authorities in London, England; Oslo, Norway, and Zurich, Switzerland.

Dr. Taylor is going to make a special study of the chemical factors governing ore deposits. He first became interested in that subject while taking a course in economic geology under Dr. Emmons. It has been found that in over four hundred mining districts from all over the world the minerals, especially the sulphides, are deposited in strata of a chronological order. It is believed that this is due to the varying solubilities of the various sulphides. Dr. Taylor has already done much studying on this theory.

Dr. Taylor has been an assistant professor in physical chemistry here for two years. He received his B. S. in chemistry and physics at the University of Saskatchewan in 1918, studied at the University of California and received his Ph.D. there. He taught problems of magnetism there for two years prior to his coming to Minnesota.

Sheard Talks on Campus

Dr. Charles Sheard, head of the section of biophysics at the Mayo Foundation at Rochester, Minn., and professor of physiological optics at the University of Minnesota, spoke to an audience of about a hundred and fifty people on Tuesday evening, March 19, 1929, on the subject "Spectroscopy and the use of the Spectrophotometer in Biology."

Dr. Sheard is interested in the application of exact physical and physiochemical methods to biological problems, and has investigated the effects of light on plant and animal tissues.

Forty-three Attend Short Course Here

M. E. Todd, assistant professor of electrical power engineering gave a short course for electrical metermen during the spring vacation. The course was offered by the Extension Division of the University of Minnesota.

A total of forty-three individuals registered for the course which is an increase of 25 per cent in registration over that of last year. Representatives from various meter companies, outside speakers, instructors and others brought the total attendance to over seventy individuals. Those registering for the course were principally employees of various public service companies and municipal plants throughout North and South Dakota and Minnesota.

The course dealt with electrical fundamentals, the technical requirements of electric metering, the theory of operation, methods of testing and maintaining electric meters, and a survey of the latest types of meters and metering devices. According to Mr. Todd the session was the most successful of those given so far, more enthusiasm and interest being shown than at previous meetings.

The success of the session owes much to the following men who assisted Mr. Todd: W. L. Wadsworth and J. J. Mercke of the Northern States Power Company; J. W. Lapham of the North Central Electric Association and J. C. McElroy of the Minnesota Power and Light company of Duluth.

Elections Bring Heavy Vote

In the recent elections held in the College of Engineering, Marvin Louis Kline was elected to the all-University council, Lester J. Rowell was named St. Patrick and George H. Meffert was elected chairman of Engineer's Day.

The election as of Kline was marked by a close political struggle, Kline receiving but twenty votes more than Curtiss E. Crippen. The total vote cast was only 508 which is less than fifty per cent of the total enrollment in the college.

George H. Meffert defeated Francis Mullen for the chairmanship of Engineer's Day by the greatest margin of the day's ballotting. The count was 104 for Meffert and 66 for Mullen.

In the contest for St. Patrick, the tabulations showed 59 voted for Lester Rowell, 47 for Raymond Freeman, 44 for Lloyd Russ, circulation manager of the MINNESOTA TECHNO-LOG, 42 for Pat Moore and 20 for Remus Owens.

According to campus politicians the recent election brought out the heaviest vote that was ever polled in the engineering colleges, and was preceded by heated electioneering.

Skinner Addresses Local A. I. E. E.

Mr. C. E. Skinner, director of the Westinghouse engineering department, spoke to the Minnesota section of the A.I.E.E. and the Minnesota branch at a joint dinner meeting held in the Minnesota Union on March 11.

Mr. Skinner spoke on the "Recent Research Developments" in the electrical industry. He sketched the development of electrical manufacturing saying that the "business is scarcely half a century old and yet the value of its products amounts to billions of dollars per year and the number of employees runs into hundreds of thousands . . . the most amazing branch of electrical manufacturing in the rapidity of its growth and the influence of its product, is that of radio, which got its real incentive just eight years ago with the beginning of radio broadcasting. As a result of intensive engineering, including research in this field, there has been developed a business amounting to hundreds of millions of dollars per year and the gainful employment of thousands of persons."

Mr. Skinner stressed in particular the extensive experimentation that is being done in attempting to perfect radio installations in airplanes. According to Mr. Elliott, the meeting was one of the most interesting of the season.

Jansky Takes U. S. Post

The nomination of C. M. Jansky, assistant professor of radio engineering, to the Federal Radio Commission was recently approved by the senate interstate commerce committee. Professor Jansky was nominated to the commission by ex-president Coolidge shortly before the inauguration of President Hoover.

Controversy over the appointment was commenced when the political status of Mr. Jansky was examined. He was nominated as a democrat but upon appearing before the commission, Mr. Jansky stated that he had no particular party preferences.

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Faculty Sketches

OSCAR E. HARDER

OSCAR E. HARDER, professor of metallography in the school of Mines, was born February 3, 1883, Arkansas. Nine years later the Harder family journeyed to western Texas. It was not long, however, until the family moved again, this time to Oklahoma Territory, where they settled in what was then known as Potowatomie Country.

During the next few years, Mr. Harder attended the rural schools and in 1900 he entered the University of Oklahoma and enrolled in the preparatory department. During the following year, Mr. Harder attended the Fort Smith Commercial College taking a course in commercial law and bookkeeping. On the first of the year, he entered the Oklahoma Agricultural College and enrolled as a freshman taking special work in shorthand and typewriting.

In the year 1902, Mr. Harder accepted his first instructorial position,—that of rural school teacher. After spending another year at the Agricultural College, Mr. Harder returned to his chosen profession to teach in the Central Normal School at Edmund, Oklahoma.

In 1906 Mr. Harder entered the University of Oklahoma and was enrolled as a freshman. Four years later, he received a bachelor's degree with major in chemistry. He was then appointed instructor in chemistry at Oklahoma for the 1910-11 term, but in the latter year became food analyst for the Kansas board of health with the rank of associate professor at the University of Kansas. In the Spring of 1911, Mr. Harder was awarded his master's degree at Oklahoma having his major in chemistry and minor in bacteriology. Entering the graduate school at the University of Illinois with a fellowship in applied chemistry, he continued his studies for two years and was granted the Ph.D. degree in 1915.

In the same year the American Society for Testing Materials engaged Mr. Harder to study the impurities affecting fine aggregate for concrete. This work was performed at the Structural Materials Research Laboratory of the Lewis Institute at Chicago. While on this investigation, he developed what has come to be known as the calorimetric test for organic impurities in sands, which was later adopted by the A.S.T.M. as a tentative standard test.

In 1918 Dr. Harder became research chemist for the N. K. Fairbanks company in which position he made a study of various catalyzers for the hardening of fats and oils. In the fall of that year he went to the Mellon Institute of Industrial Research where he held the alloy fellowship and gave special attention to the element uranium.

The University of Minnesota secured the services of Dr. Harder in September, 1919, as associate professor of metallography in the school of Mines. He was advanced to a full professorship in 1923.

The Henry Marion Howe gold medal for the best paper published during the year in the periodical of the American Society for Steel Testing was awarded to him for his paper on "The Decomposition of the Austerite Structure in Steels." A list of publications written by Mr. Harder include among others laboratory manuals of general chemistry, articles on the alloys of chromium, copper and nickel, and numerous papers on steel and their properties.

Doctor Harder maintains membership in numerous scientific organizations. These include the American Society for Steel Treating, the American Association for the Advancement of Science, American Chemical Society, American Institute of Mining and Metallurgical Engineers, American Society for Testing Materials, and the Association for the Promotion of Engineering Education. He is a member of the Engineers' Club of Minneapolis, Sigma Xi, Phi Lambda Upsilon and Alpha Chi Sigma fraternities.

The Minnesota Techno-Log

UNIVERSITY *of* MINNESOTA

Why Guess?

IT is a sad state of affairs when engineers, who are supposed to be the most precise men in an exactingly accurate profession revert to the childish pastime of guessing, yet this is a condition which does exist in all our junior college laboratory courses.

Admitting the argument that is often advanced that the laboratory training is a bore, a nuisance, and what have you to the man who is not interested in the analytic side of engineering, there is no justification for that man reporting, as facts, results that most probably were determined in a bad dream.

Laboratory courses are a form of mental training much the same as the mathematics courses one suffers through, and, as such, are as important as any other subjects in the curriculum. Slipshod methods and sight tests do nothing for a man but weaken what powers of analysis he was born with, but because the coin test is a short and sometimes accurate method of determination it is resorted to in practically all courses where an analytic method can be faked.

The worst offenders are the men in the freshman and sophomore sections, though every once in a while one hears a junior or even a senior tell of the bull report that has been passed. Their argument that they have saved time and a lot of work is logical, but they have not taken into account the time and work that they will spend after graduation trying to regain a right sense of proportion.

Engineering ethics demand that the man be honest, and no man can be honest with his fellows who is not honest with himself. The man who guesses may get by for a time, but sooner or later he will fall down on a job that is important to somebody besides himself, and his chances after that will be few and far between, for in modern life a man is only allowed one failure, and then he is through for good.

Spring Activities

WHEN we were very young, our parents read us stories from Grimm and Hans Christian Anderson. The time when those tales gave us pleasure is past, but every now and then one will remind us of a lesson that is applicable in our present life.

Remember the story about the two little pigs? Apparently they had the same dreams that most of us have, for they left home to make their own way in the world. As with us, their first need was a house, and each pig built according to his own ideas. One built his house of straw; the other went to a bit more trouble and built a strong shelter of brick. You remember the result—the wolf came through the straw hut and ate the lazy one; the other was not bothered because the wolf could not get at him.

There are many freshmen in this college that are in much the same situation as the animals in the story. They are embarking on their first trip through the extra-curricular life of the school, and they are finding that it is not as easy as the life they have lived heretofore.

The spring quarter is the busiest in the college calendar, for every activity in the college is in full swing. The Electrical Show and Engineer's day committees and the Arabs club are all busy, each preparing for their own particular spring program.

Every man in the college has a lurking desire to be in the game and the freshmen that are going into the extra-curricular mill for the first time are to be envied the pleasure that they will get from the work under the upperclassmen: BUT—they should remember that the activities that they pick are going to take time from class and preparatory work, and that, if they are going to build on the foundation that they have started, they will have to make this time up on spring nights that were meant for anything but study.

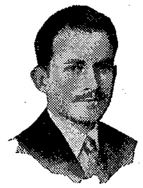
Most of the men that are going into the different committees have made their decision and each man will work according to his temperament. The wise man will balance his program between activities and study, the other will give all of his time to activities and the lighter side of life. It is a safe bet that the latter will spend most of the summer making up the work that he will miss this spring.

Alumni! Help!

AS most of the alumni know, the June issue of the Techno-Log contains a complete directory of the men who have graduated in engineering at Minnesota. To keep this directory up to date, cards are sent out each year to all alumni, and each year approximately fifty per cent of the men that receive them fail to return them. The result, for us, is complaints on the accuracy of the issue.

Sometimes it is impossible to avoid mistakes. Illegible writing, and other causes are contributory factors, but the greatest share of the errors that occur in this issue can be traced back to men who have moved and have not sent in cards to the Engineering office.

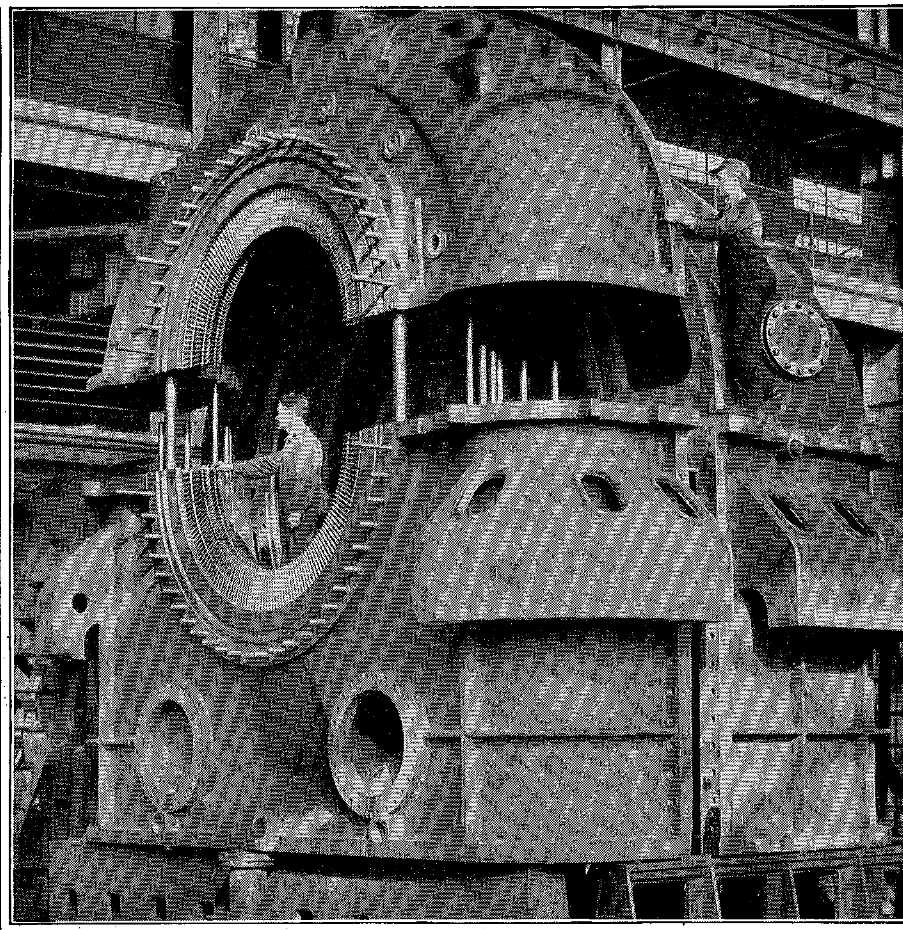
We are asking your co-operation again this year, and given that, we will promise you the best directory that has been published. In the last analysis, it is up to the alumni to make this issue a success, and the staff, not being mind readers or clairvoyants, cannot accomplish the impossible. Send those cards in now!



P. G. ROBERTS,
Production Engineer,
Penn State, '25

C. W. GUTH,
Mechanical Engineer,
Colorado School of Mines, '22

ROBT. REYNOLDS,
Turbine Engineering,
Pratt Institute, '20



E. F. STALCUP,
Headquarters Sales,
Kansas State, '21

C. E. WARE,
Contract Administration,
Penn State, '17

H. B. MAYNARD,
Manufacturing Operations,
Cornell, '23

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

The Duke Power Company Turbine-Generators

Where do young college men get in a large industrial organization? Have they opportunity to exercise creative talent? Is individual work recognized?

THE largest steam-turbine generator units to be installed south of the Mason-Dixon line are now being built for one of the most unusual organizations of its kind in the world. The Duke Power Company is famous for the efficiency of its powerplants—and for the fact that its profits are distributed largely to charity.

At a horseshoe bend in the Catawba River in the heart of the Piedmont Carolinas, the Duke Power Company is building a generating plant which, if present plans are carried out, will be the largest of its kind in the southeastern United States. The ultimate capacity will probably be 600,000 horsepower. The first two units, which Westinghouse is now building, each are to have a generating capacity of 55,000 kilowatts. They will develop 150,000 horsepower.

By operating at practically full capacity during the entire 24 hours of the day, letting the company's hydro-electric plants handle variations in the quantity of power required, the new units will reduce current costs to a minimum.

The large jobs go to large organizations. Westinghouse holds a strong appeal for young men of enterprise and genius because it almost daily provides contacts with outstanding developments in all branches of the electric field.

Westinghouse

Report of the Drainage Commission

(Continued from page 215)

bility, foundation conditions, probability of flooding, nearness to residence districts are stated and five or six locations compared.

Chapters XIII and XIV—*Prices and Costs.* Careful comparison of unit costs of construction locally and in other communities are made in detail for many different divisions of the project.

Chapter XV—*Projects.* In order to center attention on definite proposals, twenty-one separate projects are illustrated by maps and estimates of cost and compared.

Chapter XVI—*Comparison of Projects.* In the comparison of projects the costs and the results obtainable by each project are stated. The judgment of the Commission in balancing costs and advantages is finally narrowed to one project, 12, that of carrying all sewage to a point below St. Paul, the Pig's Eye Lake site and there building gradually, as needs dictate, a treatment plant, the ultimate cost of which is estimated to be, for complete treatment in the year 1970, including all interceptors leading to it and all incidental, administrative and engineering expenses, approximately $28,000,000, using a treatment plant of the activated sludge type.

Chapters XVII, XVIII and Appendices A, B and C are devoted to Estimated flows, South St. Paul, Consulting Engineer's Report, Act creating Commission and Financial Statement of present commission.

The investigation by the Minnesota State Board of Health, in cooperation with others, of the pollution of the Mississippi from Minneapolis to La Crosse is published as a separate section. It enters into a general discussion of river pollution and purification; a description of the methods of investigation and work done follows. The problem is discussed from the standpoint of public health, of fish and aquatic life, of live stock, of nuisance and economic considerations and is concluded by a statement of requirements or standards.

The report is illustrated by over three hundred and fifty charts, tables and photographs and constitutes a document of permanent value not only to students of engineering, but to the people of the Twin Cities who must bear the cost of the proposed works and to communities elsewhere for whom it sets a standard of inquiry and investigation.

The members of the Commission, appointed by the Governor, are: Charles F. Keyes, Chairman, Oscar Claussen, Russell H. Bennett, George M. Shepard, U. of M. '09, Clarence D. Tearse. The chief engineer and secretary of the Commission is Mr. J. A. Childs, C. E., U. of M., '09.

The bill introduced into the Legislature for the organization of the Metropolitan Sanitary District is, as required by the state constitution, in general form. It provides for the initiation of proceedings by the State Board of Health which is authorized to file a petition to the district court setting forth the conditions justifying the creation of such a district. If the district court finds the conditions justifiable, it may order the creation of such a district, upon affirmation by the Supreme court. The members of the Board of Trustees to the district shall thereupon be appointed; one by the governor and two each by the councils of the two cities. The terms of the trustees are six years, a salary of $1,200 annually being provided, and $1,800 for the chairman who shall be elected by the Board.

The duties of this Board shall be to construct and operate a system of sewers and treatment plants which shall prevent a nuisance and health menace from the river. It shall have the power to enter land for making surveys, to utilize land now state or city property without compensation, to acquire private property and to enter into contracts for construction.

The Board is required to make detailed plans and cost estimates, to assign the costs to the cities benefited and to assess taxes accordingly. Annual taxes exclusive of those used for retirement and interest of bond issues shall not exceed one and one-half mills. The Board has the power to incur indebtedness not exceeding 2 per cent of the total value of the assessed value of real and personal property of the district excluding money and credits with the approval of the city councils of the cities, except in the first year when without such approval it may borrow an amount equivalent to not more than one-half mill on the real and personal property valuation.

The existing Metropolitan Drainage Commission shall continue to exist and operate until the organization of the Board here provided for is accomplished.

Savings by uniting

Considerable savings both in construction and operating costs will be realized by both Minneapolis and St. Paul by uniting regardless of the site or sites which may be selected for the treatment works. The savings in construction costs alone in certain arrangements may ultimately be as great as $2,000,000 to a single city.

Financing

Several construction programs have been developed to show what might be accomplished and financed by various tax levies. These computations indicate that a practical working program can be financed by an average annual tax levy of two mills for Minneapolis and St. Paul and that this amount would be sufficient to defray all the costs of collecting and treating the sewage from these two cities.

South St. Paul and Newport

Large packing and stockyard industries are located at South St. Paul and Newport. The waste from these packing industries constitutes about one-tenth of the total volume of sewage from the Metropolitan Area and because it is relatively strong, contributes about one-fourth of the total pollution. If the entire cost of collecting and treating this waste to a degree proportionate to that indicated for St. Paul and Minneapolis were borne by South St. Paul and Newport their taxes would be raised about 25 mills.

The Commission recommended that South St. Paul and Newport be omitted from the district at this time, confining the district to St. Paul and Minneapolis, but suggested that South St. Paul and Newport be permitted to contract with the district for the treatment of their waste; also that ultimately the cost of treatment to the various communities in the district be placed on a pollutional basis. Objections have been raised to this proposal, particularly by the St. Paul city council and certain civic bodies who feel that the packing industry at South St. Paul and Newport is a very important adjunct to the business interests of the Twin Cities and the entire northwest and that the burden of paying for the cost of treatment of this waste should be borne by both cities on an assessed valuation basis. Should Minneapolis and St. Paul assume the added cost of the treating of this waste, the annual tax levy might be increased as much as 0.4 of a mill, which would mean that Minneapolis and St. Paul would be paying about 98 per cent of the cost of treating the waste from South St. Paul and Newport.

It is obvious that the polluted condition of the river cannot be satisfactorily corrected without reducing the polluting effect of this waste. The packers have indicated that they will study their problem with the view to making alterations in the industry by means of which the amount of polluting material discharged from the plants will be reduced.

(Continued on page 240)

Around the World With Our Alumni

Architects

'19—Ralph W. Hamett brought his wife to the Twin Cities over the recent holidays. It is really distressing the way these men fall from grace, but when they do, the best we can do is to wish them all the luck in the world. There you have it, Ralph.

'22—Paul Damberg has left his position with E. H. Berg, architect of Eveleth, Minnesota, and has joined Lang, Raugland, and Lewis of Minneapolis. Paul is married and is living at 1400 Portland Avenue, Minneapolis.

'24—Paul E. Nystrom is working with the same firm as Bruce R. Church in Madison, Wisconsin.

'25—Elton K. Crowell is selling Singer sewing machines in Minneapolis and is sales manager of the Franklin Avenue shop. Elton is married, but so far there are no children.

'25—Aubrey Grisson is still a bachelor and is cooking meals that other people can stand—a feat worthy of any architect. Although we have no information as to his present address, we hear that he is very successful in business.

'28—John McDonald Ramey spent all last summer fishing and generally bumming all over northern Minnesota after his graduation last June. He finally settled down with a civil engineer and they are in business together in Milwaukee.

'28—Bruce R. Church is working in Madison, Wisconsin, with the firm of Law, Law and Potter.

'28—Charles E. Peterson sent an interesting note to the office the other day. He write, "At present I am back in San Francisco after a summer's surveying in Sequoia National Park and am working with Reid Brothers, Architects as a delineator and designer on theatre buildings. I like the work and am getting well paid for it. My appointment as a junior landscape architect with the National Park service is imminent, and I will then have the position for which I have been waiting so long." We are sure that all the men in the '28 class will join with the Techno-log in wishing Charlie all the success in the world with his new work. Incidentally, he may be reached at 15 Hillivay Avenue, San Francisco, California.

Civils

'20—D. J. Bleifuss is designing hydro-electric plants for the Aluminum Company of America. So far we have not received his new address, but he might be reached, care of the company, at Pittsburgh, Pennsylvania.

'24—Hibbert M. Hill, a former instructor in the civil engineering department, is working with a district engineer's office as associate engineer for Uncle Sam. He is preparing reports on the Mississippi, Chippewa, Saint Croix, and Wisconsin Rivers with respect to power, flood control, irrigation and navigation. No work has been started as yet and these reports are merely looking forward to future development. It will be remembered that Hill won his letter in swimming while he was at Minnesota, and apparently his liking for water has continued.

'25—George A. Nelson is another one of our alumni who has done his share of traveling since leaving school. He has been in Alaska, the Hawaiian Islands, and while in this country has been located in Seattle and San Francisco. Although he is now in the Hawaiian Islands doing deep sea sounding, he may be reached through 510 Custom House, San Francisco, California.

It is with real regret that we learn of the death of Clifford S. Johnson, of the '26 civil class. For the past year Clifford has been fighting to regain his health after an attack of tuberculosis and he finally died on February 19. He was buried at Annandale, Minnesota, on February 22. I am sure that all the members of his class will join with the TECHNO-LOG *in mourning the passing of a real man and a true engineer.*

'25—Joe P. Lushene is still with the U. S. Coast and Geodetic Survey, but he has changed his address to Washington, D. C. He is engaged in latitude and longitude determination.

'25—William L. Auxer is now working as an instrument man in the maintenance department of the U.P.R.R. with his headquarters at Cheyenne, Wyoming. "Bill" is now a married man and has a promising young engineer two and a half years old to look after.

'25—Norman R. Moore has resigned his position with the Pennsylvania railroad and is now employed by the C. and N. W. R. R. with headquarters in Chicago. His address is 229 Highland Avenue, Elmhurst, Illinois.

'26—F. J. Halbkat is working with the estimating division of the bureau of construction in the Detroit Edison company. His new address is at Webster Hall, Detroit, Michigan. Best of luck with the new work, F. J.

'26—Ed. F. Young came back to Minneapolis recently to work for the Minneapolis branch of the Portland Cement company. He is a field engineer in the service bureau and from what we hear, he likes the new work better than he did his work for the United States Engineers office. (Maybe it's the town and not the job!—Ed.)

'26—George Gibeau is in the maintenance department of the Soo line. His address is: 149 Hamilton Avenue, Fond du Lac, Wisconsin.

'26—C. W. Bunnell is now with the Metropolitan Sewage Commission. He is setting line and grade for some tunnel work at Milwaukee, Wisconsin.

'26—J. R. Hoffman has been transferred from Milwaukee to Green Bay, Wisconsin. He is still with the Chicago, Milwaukee and St. Paul railroad.

'26—George Ohman is in charge of dredging operations for the U. S. army engineers at Green Bay, Wisconsin. His headquarters are still in Milwaukee, and he may be reached at 406 Federal Building in that city.

'26—Edward Brownell, who has been engaged in hydrographic investigations for the H. M. Byllesby company, resigned recently.

'27—Kenneth A. Johnsen is still with the Illinois Highway department, and to the best of our knowledge is still located in the Courier News Building at Elgin, Illinois.

Miners

'00—O. J. Egleston is acting as general manager of the Fairbanks Exploration company at Fairbanks, Alaska. From the looks of this address and some of the following locations one would be justified in thinking that the miners are the true pioneers—they are scattered from Dan to Bersheeba in the true sense of the phrase.

'11—H. J. Rahilly is assistant general superintendent for the Anaconda Copper Company. He recently underwent an operation for appendicitis but is recovering and will be on the job again soon.

'15—W. V. Butler sailed from New York on March 2 en route to the Belgian Congo where he is associated with the Societe Forestiere et Miniere du Congo. He will spend a few days at the home office of the company at Brussels, Belgium.

'23—John L. Middleton has been spending his vacation in Minneapolis. He will soon return to his work at Ingenieur de la Forminiere Likati, Bas Uele, Belgian Congo, by way of Cairo, Egypt.

'26—Mark W. Thomassen is a salesman with Ingersol-Rand company at Knoxville, Tennessee. He was called to Minneapolis recently by the death of his mother.

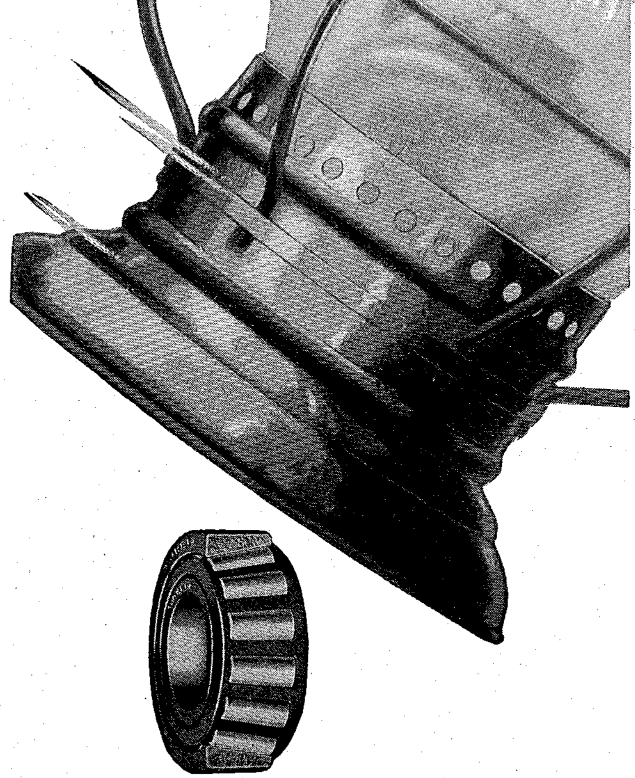
'27—James T. Gow has been acting as instructor at Purdue university in the School of Chemistry. He became the proud father of a baby girl on February 22. Congratulations, old man, and best of luck!

'27—E. T. Pixler is another graduate who has gone to South America in search of a living, and incidentally, minerals. He is with the Breden Copper company in Chile, South America.

'28—Wilmer Hedlund is working as a mining engineer with the Breden Copper company in Chile, South America.

'27—L. A. Weom started work with the Fairbanks-Morse company in St. Paul at the beginning of the year, and says that he enjoys his work very much. "Al" spent the last three months on the campus taking mechanical subjects in preparation for his shift from electrical work.

Closed—the Road to Waste



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Engineers As Patent Attorneys

By ARCHIE R. MCREADY

I NOTICE in the TECHNO-LOG from time to time articles relative to patents, the Patent Office, and patent attorneys. The subject is only remotely related to engineering, so I don't know whether the reason for the continued appearance of these articles is due to a continuing interest in the subject on the part of TECHNO-LOG readers or simply to the fact that patent attorneys are loquacious and write the articles just to be doing something and the TECHNO-LOG publishes them out of a desire to avoid hurting their feelings. For the purposes of the present article, I need not decide this question, as the TECHNO-LOG will probably publish it anyway, it being the season of the year when copy is scarce.

The profession of Patent law is related to engineering in the same way that the mule is related to—let us say, to the horse, the other member of the family being general law. In other words, it is a hybrid of engineering and law. But entry into the patent law field is more readily effected through the gate of engineering than of law. Without mixing any more of what Professor Wilcox would call agricultural metaphors, let me explain that while a patent attorney is not necessarily either an attorney-at-law nor an engineer, he should be both, and probably the great majority of those now entering the profession have an engineering degree and are also members of the bar. And since it requires only, say, half the assiduousness to learn enough law to pass a bar examination than it does to graduate in engineering, and also since law may be studied at evening schools whereas engineering usually cannot, it usually happens that patent attorneys are recruited from the ranks of engineering graduates who study law after they leave engineering school rather than from law graduates who study engineering.

> EDITOR'S NOTE: *The author of this article will be remembered as the "St. Pat" of 1924 and a former member of the* TECHNO-LOG *staff. He entered the Patent Office as an examiner shortly after graduating, and is now a patent attorney in the employ of the Western Electric Company at Chicago. His book, "Patent Office Practice," was published last year.*

The result is that the profession of patent law is one to be considered by the engineering graduate.

One entering this field may become either an examiner within the Patent Office or an attorney practicing before the Patent Office and in lawsuits involving patents. The merits of the prospects within the Patent Office were set forth in an article by Alfred J. Jacobi in the January TECHNO-LOG, and I have only to add that the salaries in the upper grades within the Patent Office have been approximately doubled within the last six years, so that the position of patent examiner now is not only one of dignity but is also sufficiently remunerative to warrant consideration by those who are interested in such things as monetary rewards.

The field outside of the Patent Office is excellent, with the difference that the hours are longer, the vacations shorter, and the pay checks fatter than in the office. For this reason a considerable number of the men who enter the office do so merely for training, and resign after a few years to enter outside practice. How this situation will be affected by the recent salary increases remains to be seen.

I have no statistics available, but it is my understanding that patent law is the most learned and most highly paid of the learned professions. There was, I understand, a statement to that effect in a Government bulletin published some time ago, but I don't have it at hand, so you'll have to take my word for it. I believe that engineering graduates who go into patent law earn considerably more on the average than those who go into engineering. If anyone wants to dispute that statement I can't argue with him—it merely represents my opinion based on my own observations and the observations of others.

But even if I happen to be substantially correct in the above statements, I do not want to be understood as advising all engineering graduates to go into patent law. I think a majority of them will be better off in engineering. Patent law, like general law, is largely a business of words, and success in patent law may depend upon a large and ready vo-

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Continuity in the Universe

(Continued from page 213)

into radiant energy, and sent out into the universe. Only an infinitesimal fraction of this radiant energy will ever strike another star. No matter whether we regard the universe as boundless and infinite as Newton did, or finite and limited as Einstein does, the energy of the universe is being dissipated unless nature has some way of reconverting the radiant energy into matter again. It has been suggested that the cosmic rays recently discovered by Millikan have been generated at the birth of atoms from radiant energy. If this be true then there is a cycle in which the energy of the universe runs.

Whether the universe of space is bounded or infinite, whether time is limited or eternal, whether the universe is gradually running down, or continually being restored by transformations between mass radiant energy makes little difference in our thinking, for it is impossible for the human mind to comprehend these processes initiated or terminated. Infinity of space, eternity of time, a starless universe are to us essential discontinuities.

In the past it has generally been assumed that the beginning of a star was the condensation of a nebula. As aeons of time elapsed there was a decrease in size by shrinking, or by the transformation of its mass into radiant energy. But there is a compensating phenomena whose influence we cannot now measure. We know that the earth is continually sweeping up meteoric matter and thus adding to its mass. Doubtless every large body is continually doing the same thing. Out in space, particularly in the direction of the Milky Way, are black areas in which almost no stars are seen. These are almost certainly clouds of opaque, non-luminous, meteoric matter or dust. When a star in the course of its journeys here and there, back and forth, through the galaxy of which it is a member, passes through one of these clouds, it certainly would add much material to its mass. How much we have no means of knowing. But some bold speculators propose that the life history of a star may be partly or altogether reversed, that it may increase in size and mass from a dwarf to a giant and go through the corresponding changes in spectral type in the reverse order to that which has formerly been supposed.

Imagine a visitor from Mars spending one day on the earth in Minneapolis, and that in his honor people of all sizes and ages were paraded before him. He would not see the infant grow to the adult and old age. The life history of a man would have to be inferred from observation. If our Martian visitor had never had any experience with life as we know it, he might make the mistake of assuming that a man was created full sized, and that as a man became older he grew smaller by a process of gradually reducing.

In a similar way we see great numbers of stars at various stages in their life history. Perhaps we have been mistaken in assuming that stars are created

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(*Continued from page 232*)

as giants in size and mass out of nebulae. Perhaps they have grown from small nuclei by the gradual accretion of meteoric matter.

The outstanding marvel of marvels in nature is the life stream on this planet. Through century after century, millenium after millenium in apparent endless succession this life stream flows continuously on. The individual plant, animal, man flares up as a torch but ere it burns out, the life spark is passed on to kindle the fire in another. The individual with its personality becoming highly developed seems to have two discontinuities or terminals, a beginning and an end boundary of what is otherwise a continuous existence. Man has done his best to solve the mysteries enveloping his own life. In general we regard an individual personality as unique and original, and not the reincarnation of another personality whose physical habitation had fallen apart. On the other hand mankind has quite universally believed that the human personality had a continuous and perhaps endless existence through and beyond that critical point in its life called death. It is doubtless very fortunate for us that we cannot draw aside the veil of the unknown at this point and look into the fifth dimension. All of our conceptions of the continuous existence of man's personality beyond the death of the body are pictures of humans with human experiences, either glorified or debased.

In connection with the life stream on this planet we are faced with a similar difficulty. In our imagination we may trace that life stream backwards through our parents toward its source, but we cannot go back even in imagination and see the source. The believer in evolution does not know how primitive cell life got started on this planet. For all he knows it may have ridden into our atmosphere on a meteoric dust particle, or have been a fortuitous combination of molecules in a salty sea, or a miraculous creation out of a fifth dimension. In any case we are all agreed that there was a time in the history of the solar system when the sun existed without the earth revolving about it; that between that time and the present the earth was born, and that since the birth of the earth life has appeared upon it.

So far as we know the thoughts of mankind from most ancient times to the present, man has felt the necessity of gods or a God to explain the mysteries of the existence of the objects and phenomena of nature about him. Modern science has enabled us to describe the sequence and manner of occurrence of many events. But our vastly greater knowledge of the physical universe has not decreased one bit the ancient necessity of God to account for the origin of matter, energy, and personality, as well as their characteristic ways of behavior.

In closing this excursion into the unknown, I cannot do better than repeat some of the ideas already expressed, by quoting from the English poet, J. Stark Browne:

"A clamorous appeal rings out to the sky,
'Tis the voice of Humanity's age-long cry:
'Let us know, O ye Gods! of our whence and why;
And a numberless multitude makes reply:
'No Gods are there here; we are stars of the sky;
In the depths of a fathomless space we lie;
Like you we are born, and like you we would die;
And our aeons of time, as they pass us by,
Are too short to discover the whence and why.' "

A Modern Hydro-Electric Plant

(Continued from page 214)

frames 18x3x1 feet, filled with concrete and which are lowered into slots in the piers with a crane. Below the wheel chambers are draft tubes of the hydraucone type. The tailrace channel is 270 feet wide and is excavated to give free discharge from the draft tubes.

The power house is located at the north end of the V-shaped dam and is an integral part of the dam. The width of the building is 52 feet over all, including the enclosed trash racks. The power house super-structure is 320 feet long and has a steel frame with walls of red hollow tile having a rough exterior surface. The dam proper is 572 feet long.

Six main generating units are installed, each consisting of a vertical shaft turbine of 5,000 h.p. capacity at full gate opening and 29.6 feet head, 138 r.p.m., direct connected to a 3,600 Kw., 4,500 Kv-a., 4,000 volt, 3 phase, 60 cycle generator. Each generator is supplied with a direct connected compound wound exciter capable of delivering 50 Kw. at 250 volts.

The generator and exciter windings are designed to withstand successfully the voltage reached when the generator is suddenly relieved of full load at 80 per cent power factor at rated voltage, when the generator and exciter rheostats are at minimum settings for this load, provided that a maximum increase of speed of 40 per cent and the resulting excessive voltage are reduced to normal within one minute.

A notable feature of this plant is the use of six of the largest propeller type turbines with adjustable vanes ever built in this country. Adjustment of the vanes is readily made by hand, but requires that the wheel be shut down while the adjustment is being made. In certain similar turbines manufactured in Europe, this runner setting is controlled through the governor while the turbine is running, but this arrangement involves a complicated mechanism and is not in common use in this country.

The turbine runner is of the axial flow suction type made with a cast steel hub and cast steel vanes. Each vane rotates in the hub, and is controlled by a common operating mechanism so that all blades will be tilted at the same angle.

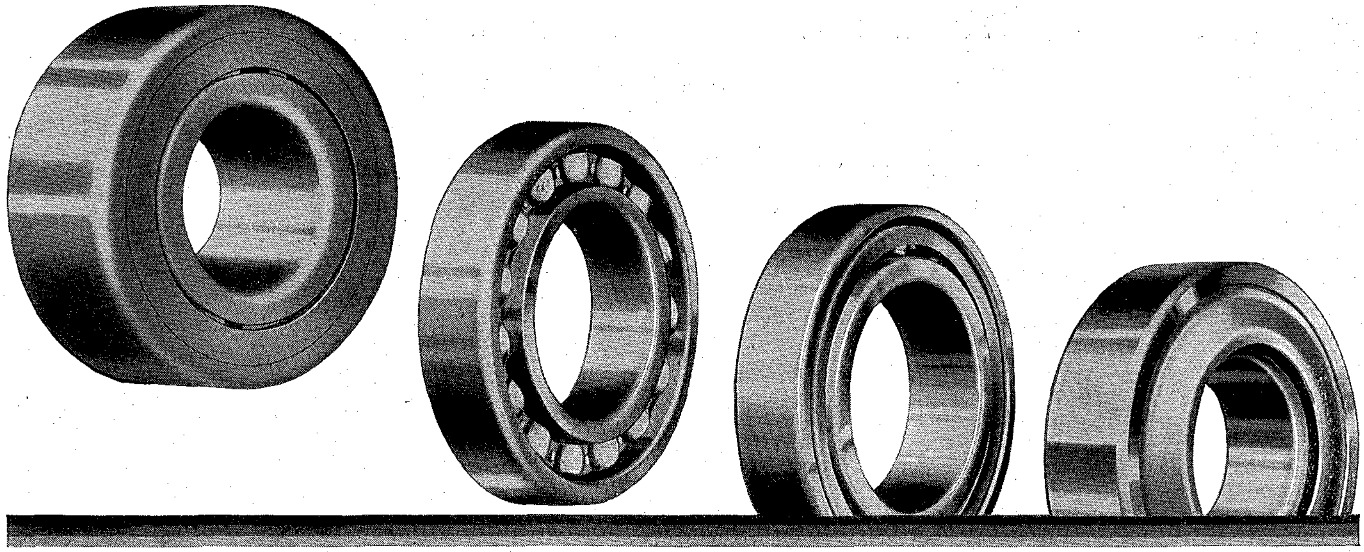
For low heads, there are no hydraulic limits to the size of the Francis wheel, but there are very tangible economic limits. At low heads with the correspondingly low speeds, extremely large generators are required and mechanical as well as structural difficulties are incurred in the design of both the turbine and the power house.

The Nagler high speed turbine and similar types are adapted to heads up to 60 feet, and operate at a high efficiency at the lower heads. The settings for Nagler turbines must be about as large as for Francis wheels because of the similar quantities of water passing through the wheels in either case.

The six generators at this plant all have identical electrical layouts. The generated energy passes through an oil circuit breaker to a T— connection, from which leads are run to a set of disconnects on each of two identical buses. The generators are differentially protected; i. e., an internal fault in the windings will trip the machine off the line, but no balanced overload can trip the machine. Several automatic protective devices have been installed—for example, an overheated bearing operates a thermal relay and shuts down the machine or a failure in governor oil pressure will shut down the machine. The neutral of each generator is brought out through an oil circuit breaker to a common generator ground bus.

The output of the plant is passed through a 30,000 Kv-a. transformer bank, which changes the voltage from 4,000 to 110,000. There is an oil circuit breaker on the low side of this bank but none on the high side. Relay protection is provided which opens this breaker when trouble occurs on the transmission line.

The plant is connected by a 110,000 volt line to a transmission substation located at Wissota from which point two similar lines are tied into a 110,000 volt loop which encircles the Twin Cities. Thus the energy generated at Chippewa Falls is indirectly available for distribution throughout the interconnected system.



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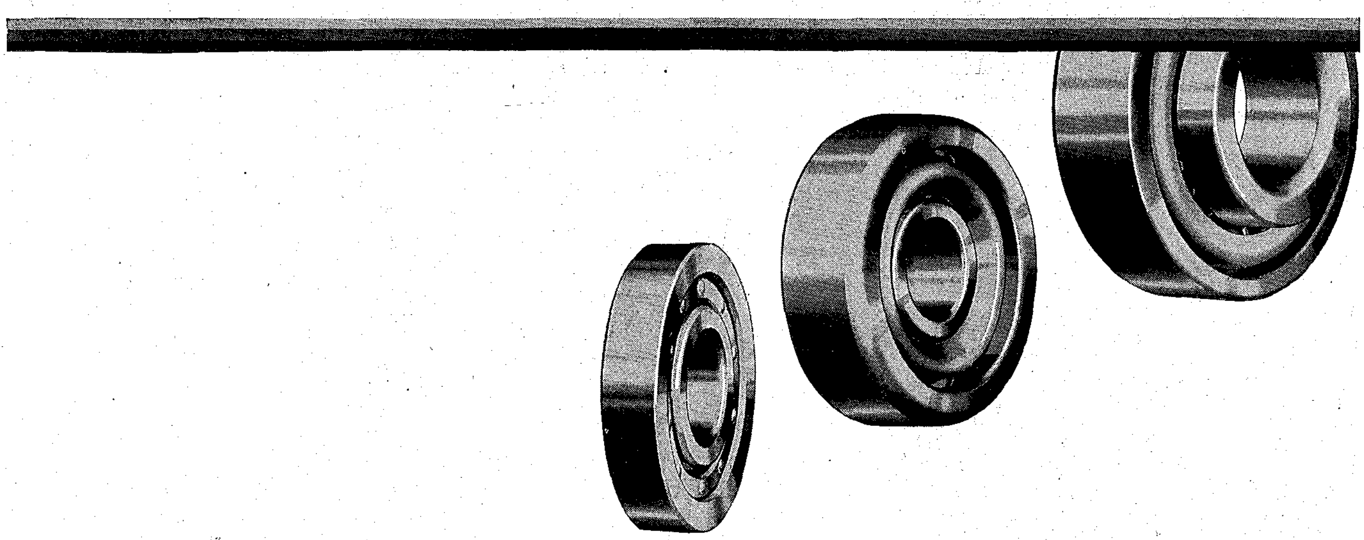

NEW DEPARTURE

BALL BEARINGS

1276

The History of Paper Making

(Continued from page 221)

a practical application of his invention, lost interest in the affair and went to work in another field. Fry and Ekman, in Sweden, perfected the process about 1870. It subsequently came into extensive use.

The invention of the soda process is accredited to M. Meliner in France about 1865 according to one author. But in 1851 Hugh Burgess and his partner, Charles Watt, patented a similar process. It was simply stated at the time as a way of producing "of a good pulp by boiling wood in caustic alkali at a high temperature."

The manufacture of wall paper wos begun about 1640 as a substitute for the ancient hangings of tapestry. It appeared in the colonies as early as 1737, but, as may be expected, to no large extent. At this time, also, the paper was not pasted on the walls but was suspended against the walls or hung in wooden frames. Its use was frowned upon by the church as a "sinful display of luxury and pride." History pertaining to these specialized uses of paper is meager and conflicting. Athanasius Kircher, a Jesuit, mentioned that in 1646, he had paper, among other things, made of asbestos. In 1849, W. Brindly in England obtained a patent for a mode of rendering paper water-proof, by saturating the web of the paper with linseed oil and drying at a high temperature. In 1854 Maniere obtained a patent in England for making a fire-proof paper. The invention consisted in using asbestos, very finely divided, with the pulp of rags. Esparto or waterbroom, a fibrous grass used largely for making print paper in England was first used for this purpose in 1852.

From an engineering standpoint, it is interesting to follow the economic growth of the paper industry. Papyrus and the very early paper was, weight for weight, much more valuable than paper is now. It was used to a very limited extent. Then came the invention of the printing press which gave a great impetus to paper manufacture. The price of paper decreased and a great demand for cotton, linen and woolen rags was created. In this country in 1790 the average mill had two vats and employed ten men and as many boys and girls. The annual product was two or three thousand reams of writing, printing and wrapping paper. Such a mill required a capital of about $10,000. Print paper commanded a price of from three to three and a half dollars per ream. Wages were about five dollars per week in the United States and the total value of the paper produced annually was about $1,700,000. In 1820 the value was estimated at $3,000,000 in spite of a great increase in paper importations from Europe. In 1842 a convention of paper makers was held in New York City and they estimated the value of paper produced to be $15,000,000 per annum.

The decade from 1860 to 1870 was memorable in the annals of paper making in the United States. Immediately following the outbreak of the Civil War the enormous rise in the price of cotton caused paper to be used in a variety of new ways. Paper twine, collars, cuffs, shirt fronts, bonnets, buttons and petticoats selling at fifteen cents each, were a few of the new uses. In 1862 the price of newspaper was eight cents per pound; ten months later the price was seventeen cents and in 1864 news paper sold at twenty-eight cents per pound with finer papers over twice as expensive. Then

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Temperature Control in the Field House

(Continued from page 216)

from the lower heaters to supplant that lost through the walls. Further study shows that the balcony temperatures were within the comfort zone and the ceiling temperature was as low as can be expected with the system.

Space will not allow the presentation of complete data to substantiate the following discussion.

To accomplish the feat of turning off the upper heaters, a man must climb 50 feet of ladder 12 times and each time turn off four hand valves. He must repeat the procedure when turning on the steam. This method is quite impractical. It is evident that much steam could be saved if some method of automatic unit control were installed. A thermostatic valve on the main leading to each of the 12 upper heating groups would accomplish this at a comparatively small expense. The valve could be calibrated so that the steam would be entirely shut off when the temperature of the upper balcony comes near that desired. One thermostat placed in the upper balcony could be made to control all of the heaters.

If the system were to be redesigned, I think the bulk of the heat would be admitted below the lower balcony. These lower heaters could be supplemented by small upper heaters. The University of Wisconsin Field House will have a system of such design.

In this article I have not attempted to give complete data on the installation, but merely to present a few of the interesting problems which confront the heating and ventilating engineer in such a design.

Engineers As Attorneys

(Continued from page 230)

cabulary, as well as such factors as personality, fluency in speech, and a facility at grasping ideas in the abstract. The candidate should also have the necessary energy to study law evenings. To those who have such qualifications, or some of them, patent law merits consideration in choosing a career. Offhand, I should think that anyone who has finished the engineering course at Minnesota and who has also shown sufficient interest in writing to be on the staff of any of the University publications should be a good prospect. I am not enough of an analyst to lay down any rules, and can only give my opinions, which may be summed up thusly: if the graduate has made Tau Beta Pi or has special aptitude for engineering work, he should stay in engineering, as his chances to excel are above the average; if he has not excelled in his engineering studies but has a knack for writing or debating he would probably do well as a patent attorney.

Drainage Commission

(Continued from page 226)

The discharge of the packing plant waste is not particularly detrimental to either Minneapolis or St. Paul for the reason that the plants are located downstream from both cities. The fact that the packing plant waste might ultimately be mixed with and treated in the same plant with the sewage from these cities would not require a change in the design of the intercepting sewers or treatment works. There is no reason from an engineering viewpoint which would interfere with St. Paul and Minneapolis proceeding with the installation of a system thus relieving the offensive condition of the river at their very doors. It is not unlikely that once a system for Minneapolis and St. Paul has been installed that these cities would be in position to contract with the packing industry on a basis which would be acceptable to it and without increasing noticeably the cost to the Twin Cities, particularly if the packers are successful in reducing the polluting effect of their waste.

News from the Technical Campus

(*Continued from page 223*)

Brewer Takes Chemical Post at North Dakota

Dr. R. E. Brewer, former instructor in technological chemistry at the University of Minnesota, left at the close of the winter quarter to enter the employ of the Lehigh Briquetting company of Lehigh, North Dakota. Mr. Brewer received his Ph.D. in industrial chemistry in 1928 after being with the University as an instructor since 1921.

The Lehigh Briquetting company is establishing four plants in the state of North Dakota to produce briquettes from lignite, by a carbonization process. The by-products of the process are not being utilized at present, with the exception of the pitch, which is used in the making of briquettes. Another by-product, a heavy oil, is being stored until the other plants are established when it is believed that by a cracking process the state of North Dakota will be supplied with a high percentage of its gasoline requirements. Mr. Brewer states that it is a growing industry and that the extensive lignite field of North Dakota will supply a great deal of fuel to the northwest.

Techno-Log Staff Positions Open

There are several positions now open on the TECHNO-LOG staff for the remainder of the year, and the men filling these positions satisfactorily will have a distinct advantage when the appointments are made for next year's staff. Among the positions to be filled are those of exchange editor, departmental editors, and alumni assistants.

Candidates for the position of managing editor and business manager for the publication for 1929-30 must have their petitions in the hands of the present business managers by 5 P. M. April 18. In petitioning the candidate should state his qualifications for the position applied for, and the policy he will pursue if elected. Selection from among the candidates will be made at the next regular TECHNO-LOG board meeting.

Dr. Kirk, secretary of the Minnesota section of the A. C. S., states that the roll of the Minnesota section contains about 220 names at the present time and that there will probably be over three hundred members before the fall of 1929.

History of Paper Making

(*Continued from page 238*)

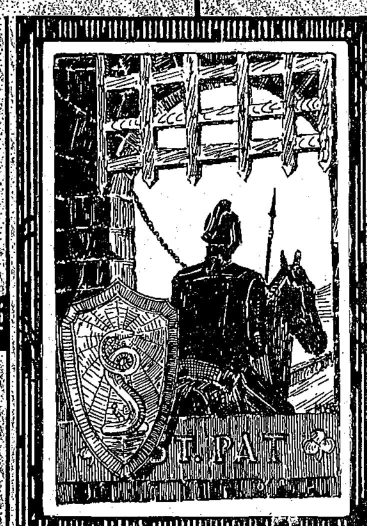
from 1865 to 1870 prices declined rapidly. Between 1870 and 1885 wood pulp began to be used in paper making, with further great reductions in paper prices.

In 1916, 100,000 people were employed in the pulp and paper industry and the product was valued at $350,000,000 per year. But even at these enormous figures production had not reached its peak for in 1923 the value of the paper products was placed at about one billion dollars per year. Since 1923 there has no doubt been a further increase.

So, we have traced the evolution of paper from the papyrus plant in ancient Egypt to the pulp woods of the new world; from a costly material used by a few ancient scholars and ecclesiastics to one of the most common things in the life of John Doe of the modern world; and from a position of relative unimportance to a position of vital importance in the dissemination of information and the transaction of the affairs of mankind.

A machine for centrifugally casting iron pipes by the Briede process has been perfected.

THE MINNESOTA TECHNO LOG



Vol. IX No. 8

MAY 1929

MEMBER-ENGINEERING-COLLEGE-MAGAZINES-ASSOCIATED

THE MINNESOTA
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MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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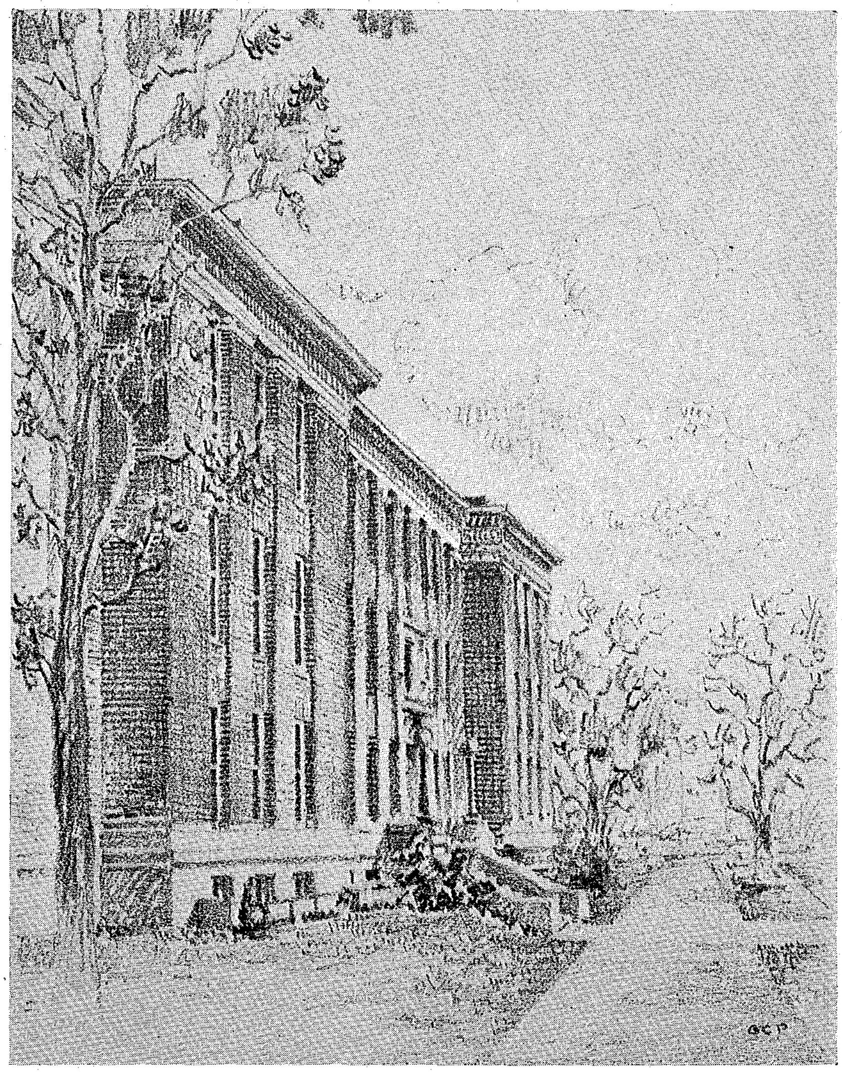


The Main Engineering Building

The MINNESOTA TECHNO-LOG

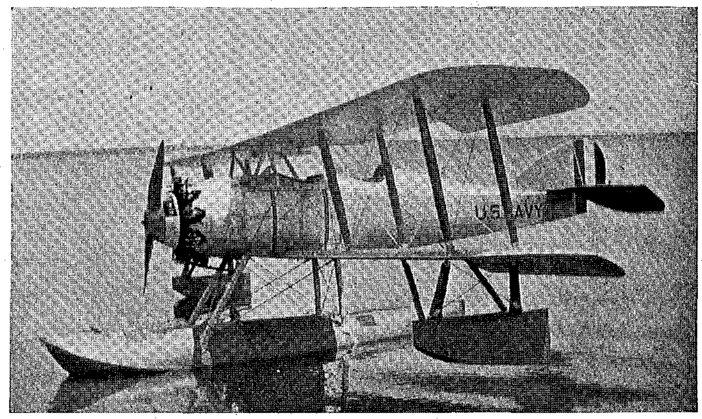
University of Minnesota

Volume IX MAY 1929 Number 8

Progress in the Art of Flying

A talk given recently over the University Broadcasting Station WLB

By CHARLES BOEHNLEIN



THE UO-1 TYPE SCOUT PLANE USED BY THE U. S. NAVY
Until recently, these light seaplanes have been the eyes of the fleet. Now land planes are superseding them.

MANY writers since the dawn of civilization have told of man's desire to fly, but aside from indicating that this desire has been present for a long time, these myths and legends have meant little in man's conquest of the air. It remained for the Mongolfier brothers to devise a practical method of flight, and on discovering that heated air rises through a cooler atmosphere, they made their hot air balloon and flew it on a November evening in the year 1782.

My time is too limited to give a description of the various types of balloons and other primitive aircraft that followed this discovery, and I will devote the remainder of this talk to attempts to navigate with heavier than air craft.

Because the only models at hand were the birds, the early inventors tried to contrive machines which would take them into the air under muscular power. These inventions proved themselves failures, and although Von Helmholtz proved that man cannot lift himself in this manner, many inventors are still attempting the impossible.

The first man to point out the correct manner of flight was Otto Lienthal, a German civil engineer. With his brother, Gustave, he performed many experiments, and in 1889 he published his epoch-making book, "Bird Flight as the Basis of the Flying Art." This book pointed out the fact that the curved wing was more efficient than the flat plane and that mechanical flight would not be possible until man discorded wing flapping devices for a type of craft that would approximate the soaring flight of birds.

SERVICING AN N-9 TRAINING SEAPLANE
This type of machine is used for student training. Gas consumption is high, averaging 20 gallons per hour of flight.

Lienthal's first glider, with wings covered with fabric on a light wooden frame had a surface area of 160 square feet and weighed 40 pounds. With this glider he would run down hill against the wind and when he had obtained sufficient speed the machine would take to the air. "The feat," Lienthal wrote, "requires practice. In the beginning the height should not be too great and the wings too large or the wind will soon show that it is not to be trifled with." Lienthal continued his gliding experiments until the eleventh day of August, 1896, when a gust of wind, striking the glider while it was high in the air, sent it down out of control. The accident broke his spine, and he died a short time afterward.

Just before Lienthal's death a young English marine engineer by the name of Pilcher, took up the art of gliding and by his experiments contributed much to it.

The result of the gliding experiments made by Lienthal was felt in this country. In 1894 a civil engineer by the name of Octave Chanute, published a book entitled "Progress in Flying Machines." In 1896 Chanute tried out his first glider which was of the Lienthal

(Continued on page 266)

A Radio Controlled Car

The radio controlled car which was one of the features of the recent electrical party, was designed and constructed by a group of senior electrical engineers.

By W. H. GILLE, W. T. DEVOY AND C. A. JACOBSON
Electrical Engineering, '29

THE "car" itself was a bicycle with a "side car." The frame work for the side car was made mostly of 3/4″ angle iron and such material as could be obtained in the work shop of the Electrical Engineering building, and consisted of an upper and lower shelf. The lower shelf being used for batteries and the upper for the radio set and the relays.

The drive motor was a 12 volt Dodge motor-generator, borrowed, for the occasion, from the Northern Auto Electric company of St. Paul. The series fields were not used, armature connections being direct to the main brushes. The mechanical connection was made by reversing the two drive sprockets of the bicycle. The small sprocket was fastened to a large "V" belt pulley and the two as a unit mounted in the pedal shaft bearings. The motor was belted to this pulley by means of a round belt. The total reduction was about 15-1 which was found to be too high. A ratio of 30-1 would have been more nearly right.

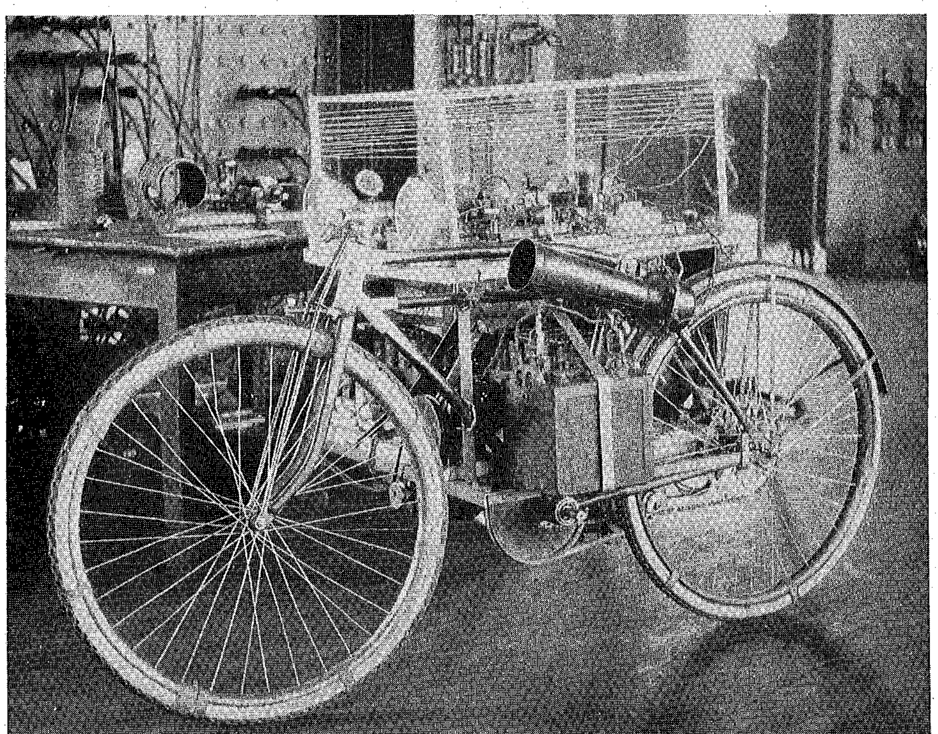
The steering power was furnished by a 6 volt Westinghouse automobile generator which was belted to a 50-1 worm gear mechanism. The mechanism was connected to the front wheels by means of two cranks and a connecting rod. The total reduction ratio was 150-1. This motor was connected to 12 volts which made action of the steering mechanism more positive.

The battery system consisted of two 6-volt automobile batteries, 96 volts of storage "B" batteries, and 45 volts of dry "B's" which were connected as shown in the diagram.

We were fortunate in being able to use an Automatic Telephone connector switch for the selection of operations. The use of this connector switch simplified matters very much. It gave us the choice of one hundred operations, any one of which could be performed at any time or in any sequence. The only other ways that the selection of operations could be performed are either by using a rotating switch or by the use of separate wave lengths and receiving sets for each operation. Both of these other methods are cumbersome and do not afford the flexibility that was required.

The connector switch was supplied with voltage from one of the 48 volt "B" batteries. The relay in the plate circuit of the last tube was connected in place of the regular telephone line and dial. The various operation circuits were completed through the connector switch brush which was connected through a set of points on the "E" relay to ground. The purpose of the "E" relay was to open the brush circuit while the brush was moving so as to prevent interference with any other circuit than the one selected. As the contacts on the switch would not stand more than 1/2 ampere, secondary relays had to be used in all the circuits. Automobile cut-outs with the current coils removed were used for most of these relays.

The radio connecting link was accomplished by means of a simple Hartly oscillator and a three tube receiving set. A UX 210 was used in the oscillator with 400 volts on the plate. The output was tuned to 180 meters. The impulses were sent out by a telephone dial in the plate supply, which in turn were picked up by a loop antenna and a three tube receiver, detector and two stages of audio amplification. The detector was made to oscillate by capacity feed back through two turns of the loop. The loop was wound horizontally around a frame fastened to the corners of the top shelf of the car. UX 201-A tubes were used in the detector and the first audio and a 112 in the last stage. Change in plate current in the 112 tube to operate the relay, was brought about by placing a grid leak and condenser in the grid circuit. The grid return was brought to the negative filament with no C bias. The value of the grid leak is very critical so a 100,000 ohm variable resistor was used with a .004MF condenser. The value of the condenser is not critical but if this resistance is too low the plate current change is not affected enough and if the resistance is too high, the relays become sluggish in their operation. 120 volts of "B" batteries was used on the detector and the 112, while 147 volts and 4 1/2 volts of "C" were impressed on the first audio. This combination resulted in the dropping of the current through a 5000 ohm relay from ten milliamperes to two milliamperes when the oscillator was tuned to produce a beat note of about 1000 cycles in the detector tube. This change was ample to operate the relay as it was set to close on seven milliamperes and release on five milliamperes. The grid



THE RADIO CONTROLLED CAR
On the table to the left can be seen the oscillator which was used to direct the maneuvers of the car.

leak method was found to be the most satisfactory way of producing a change of plate current in the last tube.

The relay control mechanism for the driving motor was constructed in the following manner: The field was connected to a 12 volt battery at all times through a special designed reversing relay, by which means the motor was reversed. This relay was designed with a "snap" arrangement so that the armature would remain in the position that it was last pulled to until again actuated. The change of positions was brought about by energizing one of two magnets placed on either side of the armature. Thus by dialing one number the car was made ready to start in a forward direction and another number made connections for the backward direction. The closing of a relay in the armature circuit started the car moving. This relay was held closed by an auxiliary set of points mounted on its own armature. The purpose of this holding arrangement was to permit other operations to be performed while the car was in motion. The car was stopped by energizing a second relay whose back contacts were connected in series with the holding points. The stop light was connected to the front contact of this same relay. Thus the car could be reversed, started, or stopped and steered at will, the operations all being independent of each other.

The electrical control of the steering motor was somewhat the same as that for the drive motor except that the armature of the double acting field reversing relay was held in the center or off position until one of the control magnets were energized. The armature circuit was completed whenever the field was excited, by a relay, the actuating winding of which was connected in parallel with the field coils. Thus the motor was started in either one direction or the other by simply actuating the reversing relay.

The lights were turned off and on by the same type of a "snap" relay that was used to reverse the fields of the drive motor. This was done so that they could be left on while other operations were being performed. The horn was sounded by the ordinary relay circuit.

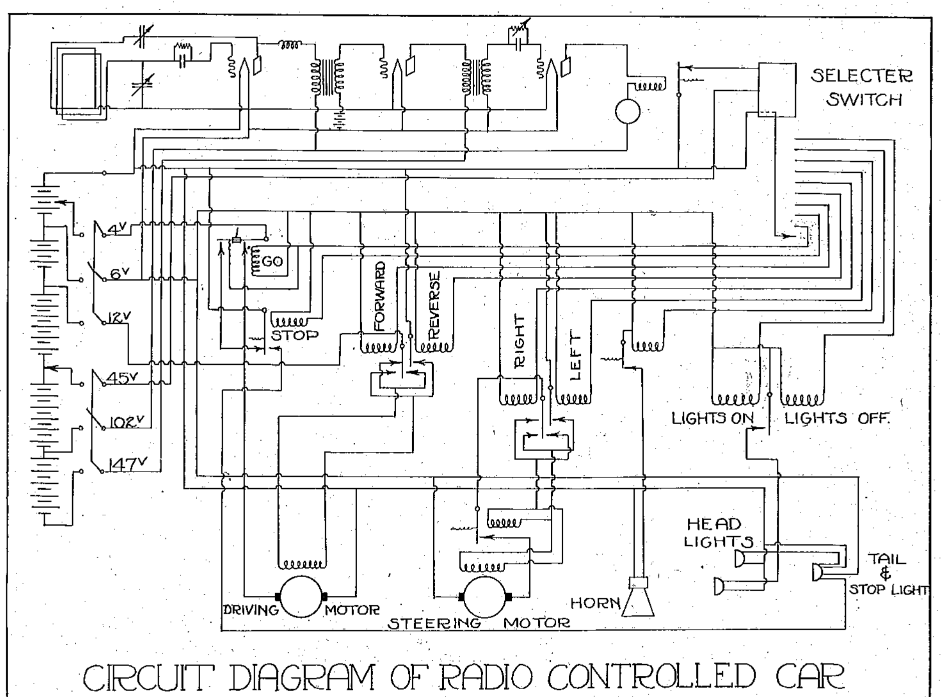
Many problems of operation and design were encountered. The design and construction of some system to reverse the motors was one of the biggest problems. We first thought of using a center tap battery and two ordinary relays. This was abandoned because of complicated circuits and because of the need of twice the amount of batteries. When the "snap" relay idea was discovered, we had some trouble in constructing the "snap" part of it. The final successful relay was made to operate by placing a compression spring about one-fourth the length of the armature between the top of the armature and a stationary support above it. The spring was made from a piece of thin spring bronze and was held in place by slots cut in the support and in top of the armature.

Another problem was to get a relay operating in the plate circuit of the last tube. Under ordinary conditions there is very little change in the average value of the plate current of the power tube. This is due to the fact that the incoming audio signal imposes an A. C. component on top of the already existing D. C. component; hence there is no change in the average value of the resulting current. Using an abnormal "C" bias gives some change, but not enough. The final grid leak and condenser idea was developed from trying to put a rectifier of some sort in the grid circuit. This rectifier idea is inherent in the three element vacuum tube itself, and is made possible by the grid leak and condenser. The relay, itself, had to be mounted in rubber to prevent microphonic action between it and the detector.

The actual operation of the car was as follows: No. 12 pulled the reversing relay to the forward position and No. 13 was reverse. No. 14 was dialed to start the car moving. Nos. 11, 15, and all numbers ending in 0 stopped it. Nos. 16, 18, 21 and 25 steered it to the left and Nos. 17, 19, 23 and 27 steered it to the right. 51 was "horn," 54 was "lights on" and 56 was "lights off." We were very fortunate in being able to add to the last digit by simply dialing the number which, when added, to the last digit already dialed would produce the new last digit wanted. Thus if 54 was dialed and 56 was wanted, all that was necessary was to dial a 2. Hence to start the car forward all that was necessary was to dial 1-2-2 and another 1 stopped it or another 2 steered it to the left. The release of the connector switch was accomplished by placing a push button switch in series with the dial which opened the circuit when the button was depressed. The time element of the "B" relay on the connector switch made this possible. It is so designed that when the dial circuit is opened for more than about one half second, the connector brush shaft will drop back. The dialing impulses are not that long, and hence only cause the pulsing magnets to operate, but if the circuit was opened by the push button switch for more than the time duration of the dialing impulse the connector switch would drop back. This made it possible to dial an altogether new number.

All the operations of the car were successful except the horn. This, being a vibrator type, caused so much electrical interference with the radio set that when it was once started it could not be stopped. The radio connecting link worked very well considering the amount of iron in the building and the many other electrical disturbances going on at the time.

The successful construction and operation of this car has proved one of the most interesting experiences that has fallen to the lot of the men concerned. It took a lot of time and painstaking effort, it is true, but when we were done, we had the satisfaction of knowing that the contraption that we had made was a success.



CIRCUIT DIAGRAM OF RADIO CONTROLLED CAR

A Bridge Oddity

The present bridge over the Mississippi at Hastings, Minnesota, is probably the only one of its kind in the world.

By Paul Kingston, CE '29

IN writing this paper we have had in mind two important facts. They are: first to discuss a bridge engineering oddity, to bring out any engineering facts of interest, and to show the conditions that go to make up such an engineering project; secondly, to bring out the relation of the engineering project to the national, state, and muncipal government.

Because it was found almost impossible to obtain any written matter on the subject, it was necessary to make a personal inspection of the brige and to interview several people who were acquainted with the subject. In this way we obtained information pertaining to the present bridge, and an insight into the plans for a new one.

If we make a survey of the bridge engineering that has been done in the past seventy-five years we will find a record of unparalleled achievements. To bring out this general development it may be well to select some particular location, and to treat it in the light of the past, the present, and the future.

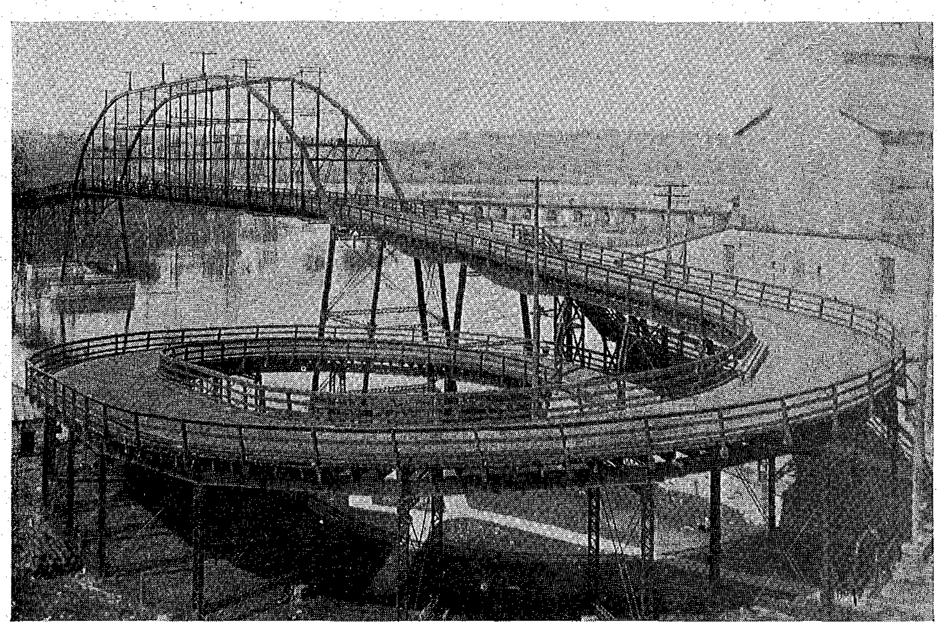
While the art of bridge building is as old as that of house building, as a science it is hardly a hundred years old. At first all of the work on design was more or less done by empirical methods.

Today all of the old empirical methods have been developed into exact sciences of graphics and statics. There is no field of stress analysis that has not been looked into and studied to a great extent. This extended engineering progress would seem very great even to such an engineering mind as that of Rankine.

In this short span of years the wooden structures have been replaced by cast and wrought iron, and this material has in turn given way to structural steel. Today we find that the demand is greatest for reinforced concrete structures for they seem to be the best of all the types of bridge construction. They have not been in use long enough to determine their economic value.

The project that I have taken to illustrate this tremendous development, as well as to feature a particular oddity in bridge engineering is the curious spiral bridge at Hastings, Minnesota. Up until thirty-three years ago it was necessary to cross the Mississippi river at Hastings, by means of a ferry. This, a rope ferry, provided transportation for vehicles, live stock, and the like. This ferry was operated by a crotch on the end of a line, which was used to pull the craft across the river.

Hastings had grown into a town of four thousand population before the need of the bridge became apparent. As the traffic conditions continued to grow, so did the need of a bridge. As late as the year 1890 no official action had been taken, as to the construction of a bridge.



SPIRAL BRIDGE AT HASTINGS, MINNESOTA

The picture shows the spiral approach which is the outstanding feature of this bridge. This type of approach was used to eliminate a long approach running into the business district.

A study of engineering problems will show that these are the conditions that exist in most cases. In any engineering project there must first be a demand, or a need for the construction. Some person must have the foresight to see the need of the development, and the future conditions to be met. From this point on, the need of the development must be made apparent to the people, their approval secured, then official action must be taken. During a period of two years a number of attempts were made to secure the bridge for Hastings, but all of the attempts failed. The failures were due to the lack of finance and public interest. Nothing was done until a year later when a meeting was held at the court house. At this time the citizens of the city met with a Mr. Johnson, who was probably the United States District Engineer, and the plans for a bridge were gone over and outlined to him. The main question was that of finance and Mr. Johnson estimated the cost of a bridge at $40,000. This cost seemed to be satisfactory with the committee that was working with the citizens. A new bill was then drawn up and forwarded to Representative D. S. Hall, and in a short time the bill was passed through both of the houses at Washington. Now work was to be started and no money was at hand, but this was taken care of by a bond issue.

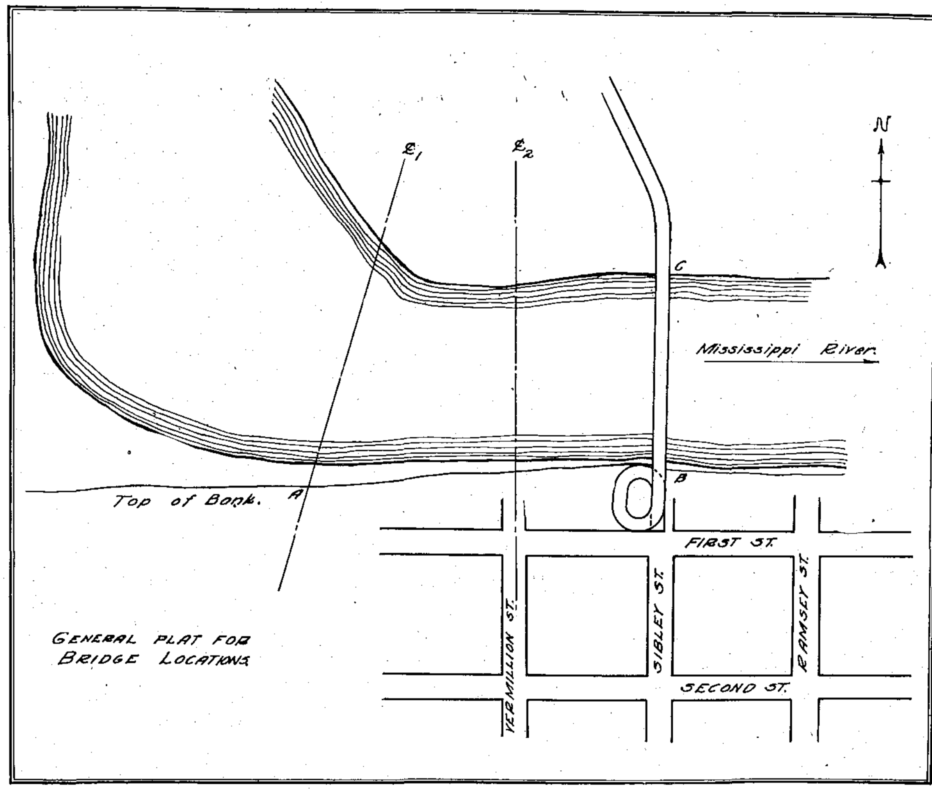
In any undertaking in the engineering field the question of money to do the work comes up. In the case of public construction capital is obtained from one of three sources, namely, national, state, or municipal sources. It may be seen that the cost may be shared by the three sources if the benefits derived affect more than the muncipality in which the development is going on. Here we have set forth the second great division in construction, that of finance. As was stated above, the financial question was settled with a bond issue. At an election bonds were issued to the extent of $40,000, and an Eastern bonding company bought them.

When the capital was raised and the Congressional bill passed the question of the actual design was brought up. The geological and topographical conditions were found to be such that a high level bridge could not be built without having a long approach at both ends. The city of Hastings is built right up to the south bank of the Mississippi river, and for this reason a long approach could not be used on the south side. On the north bank there is low open country and the type of approach makes no difference. For this reason, the approach within the city was the one that caused the trouble. The business men would not stand for a straight approach, for this would overshadow the business district and bring the landing two blocks farther up Sibley street than it now is.

To obtain the truth as to the actual originator of the idea of the spiral, Mr. Oscar Claussen of St. Paul was interviewed. When the plans for the bridge were to be made, the conditions that were to be met were presented to a number of bridge contracting companies. Mr. Hortan, who was with the Chicago Bridge and Iron works, made a study of the conditions and suggested the idea of the spiral approach. Mr. Hortan's suggestion was put to use by Mr. Claussen and he worked up the general plans. The plans contained the piers and the abutments, the elevation above high water mark, the approaches, loads to be carried and the like.

As was stated the bill authorizing the construction of a bridge at a cerain locality must be passed in Congress. This is the very first step in obtaining the permit. When the general plans have been drawn up they must be sent to the War Department. At the present time three copies must be sent, as well as three copies of the map of the locality where the bridge is being constructed. The plans do not have to show the details of construction, but just those features that affect navigation in the stream. If the bridge is being built by a corporation, the papers of incorporation must also be submitted. These plans are then inspected by the War Department engineers and on their recommendation a permit is issued by the Secretary of War. In no case are the general plans to be changed during construction without the approval of the United States District Engineer. If the contract for the construction is not let within one year after the time the permit has been issued, the permit becomes void. It also becomes void if the work is not completed within three years. The conditions to be met may have been different on the Hastings bridge, as the bill providing for this procedure was passed after the bridge was constructed. But in any case the plans had to be submitted to the War Department.

After the plans had been approved by the War Department public notice was made for bids on the construction. The construction job was awarded to the lowest bidder which was the Wisconsin Bridge and Iron works. John Giest, who was the engineer in charge of the work, had much to do with the actual design of the steel. The contract was let for approximately $39,000, but in the actual construction it ran up to $41,000. The spiral bridge, which is the only one of its kind in the world, is only one of the unique bridges on which John Giest worked. He was the designer of the unique lift bridge at Milwaukee, and the long spans on the Great Northern Railroad at Albans Falls in Idaho.



PLAT OF POSSIBLE LOCATIONS FOR NEW BRIDGE

General plat of bridge locations showing present bridge location as well as proposed locations. The proposed locations to be along center line one or two, the most probable location being along center line two.

The actual construction on the Hastings bridge was started September 25, 1894, at which time a crew of four men began breaking stone. All of the construction work was completed before the end of the following March.

One will notice that this bridge cost but $41,000. Mr. Claussen said: "This low cost was due to the fact that the United States was passing through a period of financial depression when the bridge was built and the worst financial conditions were experienced at this time. In all probability this is the most economical bridge that ever spanned the Mississippi river."

It will be found interesting to make a study of the bridge and the general construction details. When one first sees the bridge the thing that impresses him is the spiral approach. It cannot be said that aesthetics in design were taken into consideration in the building of the bridge, although the elimination of the long approach in the city may be termed aesthetics in city planning, and the placing of a park in the spiral has added much to the appearance of the bridge. The spiral part was erected in a corner lot 120x60 feet.

The bridge begins at the foot of Sibley street. The first section is 120 feet in length and has a rise of 7¾ feet in this distance. This 120 foot section is straight, and is made up of two stone retaining walls, which are filled in with dirt. The spiral which is built from structural shapes starts at the end of the dirt approach and winds its way on a curve of 60 feet, and a grade of five feet in one hundred. It continues this way for 385 feet until it becomes tangent to the straight part of the bridge. There are 36 columns made up in pairs on which the stringers for the spiral rest. On these stringers the floor beams of the bridge are placed, and on these the floor is constructed. At the 14th pair of columns the spiral becomes tangent to the straight part of the bridge. The columns rest on stone abutments and are pin connected to the cast iron bearing plates. From the point where the spiral ends there is a 6 per cent grade for 120 feet. At the end of this span the main channel span starts. This span of 120 feet is made up of plate girder sections and is supported by four pairs of columns and the main channel tower.

The main span is a curved chord Pratt truss, and measures 380 feet between pins. The truss is 48 feet high and has 15 panels. The top chord is made up of two 15 inch channels with an 18x⅜ inch cover plate, while the under side of the chord member is a lattice arrangement. The lower chord members are all made up of eye-bar con-

(Continued on page 268)

The Minnesota Techno-Log

UNIVERSITY *of* MINNESOTA

Why Continue It?

ONCE again the heinous crime of posting final grades has been committed. Once again the intellectuals have basked in the false glory of their only pride. Once again the average student has hung his head on witnessing the reports of the "better-than-thous."

Probably postal authorities are not perfectly reliable. The Powers realizing that such may be the case are loath to give exclusive transmission of such valuable information into their hands. Possibly psychologists are again at work and have abused their statistics so as to prove thus and so—that a student's pride will not permit him to receive poor marks,—that he will apply himself more assiduously to his studies in order that he may be glorified in the eyes of fellow sufferers

As a matter of fact, the tradition lacks any saving virtue. The results of a quarter's work are a personal matter and should remain so.

Prearranged Warfare

SOME ten years ago, the world witnessed the close of a gigantic struggle which brought into relief all the basest of human emotions. Again the fact was evidenced that man's instinct for self-preservation is probably the most powerful factor in shaping the course of his actions. When existence is threatened, egoism devises tortuous weapons with which to continue its being,—every taboo is forgotten, civilization is discarded with one gesture, and man again becomes the savage beast determined to conquer by whatever means possible.

Recently assembled in Geneva, peace time headquarters of war lords, the preparatory commission on disarmament of the League of Nations. In secret session and with all solemnity was passed a proposal to prohibit the use of poison gases in war under reciprocal conditions, and absolute prohibition of bacteriological warfare.

A fine humanitarian procedure. But nevertheless ridiculous, for it attempts to alter with a word the character of man as the light of history has shown him. With back to the wall, fighting for egoism—the individual is filled with the desire of preserving his life and keeping it free from all pain, under which is included all want and privation. Everything that opposes this egoism awakens his dislike, his anger, his hate; this is the mortal enemy which he strives to annihilate. Then it is seen how politeness which is used to cover the ordinary outcroppings of egoism is thrown into the discard. And man is revealed with all his primordial animal instincts.

This egoism which is based on the individual's belief that he is an all in all to himself, is only a logical outgrowth of the circumstances under which he observes himself. To the individual, events appear to cluster about himself. He inspects himself subjectively, while everything else is seen through his mind's eye and hence objectively. Now it must be that the members of the commission on disarmament are possessed of a super-abundance of egoism. Each individual must believe himself to be the center of world affairs, when the ego is so fully developed as to attempt to influence human nature. This, however, is the subjective view which exaggerates the self-importance of the individual. Could the commission members observe themselves objectively but for a minute they would realize that they are of very little importance,—merely one two-billionth part of the human race.

Each individual is given a certain amount of egoism which strives to insure his preservation despite the attempts of all society. When a group of individuals have their common existence threatened, national or state egoism develops, as powerful and effective as the egoism of the individual. It knows no law, no God,—except preservation. Gases, bacteriological warfare,—anything, no matter how horrible in effect will be adopted that the state may continue. How foolish then, how absurd—but what a fine gesture—for a group of individuals to proclaim:

"Thou shalt not protect thine own life."

Amerindian Advocates Action

CHIEF TWO-GUNS-WHITE-CALF of buffalo nickel fame was interviewed. Said he concerning recent Gans-Curtis debacle in Washington:

"These white squaws make much thunder over nothing. One is third and wants to be second. Tell them all to go into wigwam, sit in circle, then no first, no last. Thunder dies and the braves can sleep."

Good philosophy.

Freshmen engineers laid plans for festivities. Thunder was heard,—few tickets were sold. Rain became evident, the dance was called off. Red skin Two-Guns-White-Calf was interviewed. Said he:

"Paleface make big dreams, no make plans. Little papoose forget dreams when hear big thunder. Make plans, then give dance."

Good advice.

Welcome Marquette

It is with a great deal of pleasure that we congratulate the Marquette Engineer on its provisional membership in Engineering College Magazines Association, and wish them all the luck in the world in their quest for active membership at the fall convention.

Eventually, Why Not—?

IF any professor in the Engineering College is asked to enumerate the subjects he considers most important to the young engineer, he is sure to reply that next to a thorough foundation in mathematics, English is absolutely necessary. With such a unanimity of opinion in the faculty, it seems strange that the English department is confined to the teaching of six courses, three of which are required, while the department of mathematics and mechanics offers more than sixty courses and requires that the average student take at least six.

Distasteful as English is to the average freshman, by the time he has become a junior and has worked on various committees where it is necessary to request, by letter, some favor from a man he does not know and has not seen, he comes to the conclusion that English is not as useless as it at first appears. In fact, several of our present juniors have been heard to wish that they had been required to take at least three additional quarters of the subject.

There is another and smaller group in this college composed of those men who plan on making advertising or engineering journalism their life work. To them, an adequate training in English is absolutely necessary and they are willing to take any courses that can be worked into their program.

These men are in a quandary, for they are also interested in engineering. The English courses that they want are only given in the department of journalism and these courses, which are designed for journalists and which run in sequence cannot always be worked into the small time alloted to electives in our college.

There are at least two solutions for this problem. The first is the expansion of the department of English and either compulsory courses in that department for all engineers, or, what might be better, an elimination of several courses now required and an elective substitution of English in the vacancy so created.

The other remedy is more stringent, but we believe that it will be a necessity in the very near future. Engineering is becoming more of a specialized field every year and soon the colleges will, of necessity, find a five year general course necessary to impart the fundamentals of the highly specialized fields now developing. It is our earnest belief that when this day comes the study of our own language will be allotted much more time than is given to it now.

Faculty Sketches

ISAAC M. KOLTHOFF

ISAAC M. KOLTHOFF was born at Almelo, Holland, in February, 1874. This town, situated near the coast, and not very far from the German border is still the home of the Kolthoff family.

At the age of five Mr. Kolthoff started school, and after twelve years, which is the length of the general educational course in Holland, he graduated from the public school. He then entered a technical high school, and not being well satisfied with it, he entered the University of Utrecht. Here he took his preliminary examination, and in 1918 he received his doctor's degree in chemistry.

The public schools of Holland give students an intense and practical training along scientific lines, stressing chemistry, physics, mathematics and astronomy. As a result of his early training, Dr. Kolthoff became interested in science and while he was still a boy he did much work along this line.

Chemistry was his favorite study and as the result of his interest he developed a well equipped laboratory in the kitchen of his home. All progressed favorably until one morning his father was awakened by a strong odor of hydrogen sulphide in the house as the result of a reaction being carried on by the young scientist. This was the end of the home laboratory. Another incident which did not help in the development of the laboratory took place when he destroyed an old but accurate barometer to obtain mercury to carry out an experiment with exactness.

In spite of his love for science Dr. Kolthoff was always an ardent lover of athletics. While in high school he was very enthusiastic over the game of soccer which he played very well. He still maintains that to master great problems in science and in other fields, one must first have a body to support the mind; and that in order that this body and mind be able to develop and function properly they both must have their exercise. In the spring and summer Dr. Kolthoff rides horseback regularly and he also plays a great deal of tennis.

He cannot see anything interesting in golf, and he says he would rather play one game well than be mediocre in several. During the winter when the weather is too severe for outdoor sport he devotes a great deal of his spare time to fencing, which he considers not only very vigorous and healthful exercise, but also an art.

Dr. Kolthoff is still unmarried and claims that his work and his recreation leave him no time for domestic affairs.

His first visit to America was in 1924 when he remained in the country only three months and was no further west than Chicago. In October, 1927, he came to the University of Minnesota. His specialty is analytical chemistry and he is considered an authority on hydrogen ion concentration.

Dr. Kolthoff is a member of several scientific societies, both here and abroad. Upon his visit to this country in 1924 he was made an honorary member of the American Pharmaceutical Association. In 1928 he was made a member of Sigma Xi. His name also appears on the roll of the American Chemical Society.

The Arabs

SPRING is with us again, and with the spring one of the major activities of the engineering college is at hand.

Few of the juniors and seniors of the college need to be told about the Arabs, for most of them, at one time or another during their college careers, have been accessories after the fact in an Arab production. They have known the club for a long while, and every man who can spare the time is out enjoying the fun and trying to put the show over.

It is to the underclassmen who do not know of the Arabs that this editorial is addressed. They have never known the thrill of seeing the curtain rise on a show that they have produced, and realizing that they have had a definite part in bringing the spirit of the college before the public. In missing that, they have missed something that they should have to make their school careers complete.

The feature of the Arabs organization that most engineers like is the fact that they are dependent on no man for aid in placing their production before the public. From the manuscript itself to the smallest detail of the production, the work is entirely that of the engineers. This fact gives each man a personal interest in the work that he is doing, and when, on the opening night, he hears the result of his efforts applauded by an appreciative audience he receives a thrill that lasts him a lifetime.

This year's production will be presented on May 30, 31, and June 1, and although the time left is rather short, there are still openings in the cast and chorus for the right men. If you have ever felt the urge to express yourself in dramatics, the Arabs are the men with whom you should work, and, no matter how little the experience you have had or how low your estimate of your own abilities, get out for the rehearsals, and in the language of the show, "Give yourself a break."

The Arabs is the first club that the returning alumnus asks about, and there is no other organization on the campus that is so carefully watched by friends of the college in the Twin Cities. It is strange how the news of a new production and the announcement that starts rehearsals will bring in numbers of letters all wishing the club success. The tie that binds the men to the show seems to extend beyond the campus and to hold the older graduate to the fortunes of a new crowd that he has never seen and does not know.

Mystery Shrouds 1929 Arabs Play

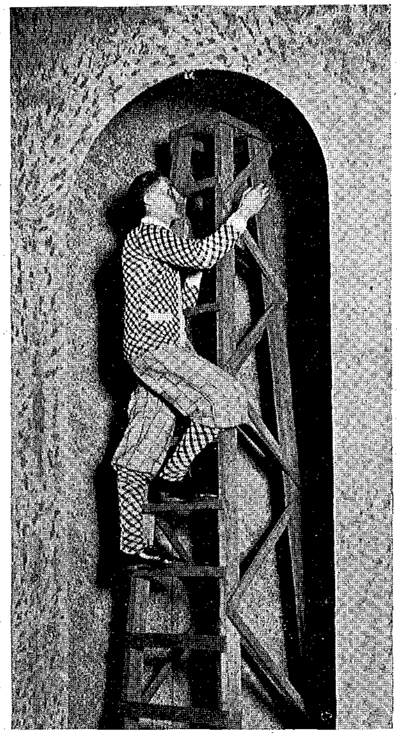
With all Arabs pledged to secrecy, details of the play which was written by Francis J. Fox and J. Robert Ginnaty will not be divulged until shortly before its opening.

By ARABELLA

ONCE more the engineering auditorium reverberates to the sound of dancing feet, and once more the sophisticates of the college scratch their heads as they "dope out" harmony, script and scenery, in preparation for the annual play of the Arabs.

It started, as all good things have done, back in days no longer in the memory of any undergraduate. In 1922 the brighter spirits of the college decided that the crying need of the school was not only a good five cent cigar, but a dramatic organization that could and would put on the stage an unconventional type of play—a play that should be written by engineers, and would portray the engineering viewpoint to a skeptical public.

A club was formed, and the armory stage, the best on the campus at that time, was engaged for the occasion. Engineers labored at the technical end of a business that they knew nothing about until they had mastered the fundamentals; they wrote music, and orchestrated it for musicians of their own school; they built scenery, and after devising lighting that would show it to the best advantage, they turned to another phase of the game that was even more foreign to them than the actual details of production had been. The script called for a chorus, and the same engineers who had labored on the set discarded their boots for slippers, that they might walk as the coeds walked, and trained their voices that they might talk in the falsetto of the opposite sex. Finally order appeared out of chaos, and the "Caliph of Kolynos" was presented.



JOHN ENGINEER
The male lead in "Broadcast."

A brawny engineer as the French detesting coed "Gertie the Gamma."

The supposition of the founders that the public would prove skeptical was well grounded, but the people that came to laugh at the club remained to laugh with them. The play was one of the most successful presentations of that year and another engineering tradition was established.

Since that time, six plays have been presented, and a short review of their titles will indicate that the new members were carrying on the ideals of the club. Starting with the "Caliph of Kolynos" in 1922, the club went to the "Blue God" in 1923, "Riquiqui" in 1924, and "Mona Lizzie" in 1925. Unfortunately, a dispute over the eligibility of some of the men played in this production resulted in the banishment of the club for a year.

The club, used by this time to overcoming difficulties, made this year of rest a stepping stone to the most elaborate production ever staged at Minnesota up to that time. Officials of the group, looking over the expense sheets of the production, shuddered as they thought of what might happen to the club if the show was not a success, but their fears were not justified. "Broadcast," in 1927, was a spectacle that kept the campus talking all through the spring quarter. No one who saw "Broadcast" forgets the racy dialogue between St. Peter and Seven Corner Sadie as she passed him on the way to Hell, or the chorus that disappeared into thin air in front of the audience. But best of all, no one who worked on that production will ever forget the thrill he had as, peeking through the asbestos, he saw the auditorium fill until the standing room at the back had been sold out.

Last year the club repeated again on "High Pressure," and although the dates for this comedy included the date of one of the worst blizzards that hit Minnesota last winter, those that braved the storm were well repaid. George Burch, the Sadie of "Broadcast," held the audience spellbound as he danced and sang, and the Street-sweeper's chorus revived memories of the Electron and Proton dance.

Another year is here, and with it, the chance to stage a musical comedy that will thrill the campus as no other show has done this year. Last year the club lost, by graduation, many of the men who have worked hard since 1927, but new men have taken their places on both the production staff and the cast and are ready to attempt something impossible.

Seven Corner Sadie, the vivacious vamp of "Broadcast."

News from the Technical Campus

Aeronauts Meet in Detroit

Wilbur C. Donaldson, '31, flew to Chicago last month, then journeyed leisurely to Detroit by train. In Detroit two dozen undergraduate aeronauts from thirteen colleges met to organize the Intercollegiate Aeronautical Association. Other colleges who sent delegates are: New York State, Carnegie Institute of Technology, Detroit, Yale, Harvard, Toronto, Ohio, Purdue, Michigan, Brown, and the Massachusetts Institute of Technology.

At the meeting a charter was drawn up and an executive committee appointed. Mr. Donaldson, who was chosen as a member of this committee, said that the executive committee will meet this coming fall to draft a constitution and consider the admission of student clubs to the newly formed I.A.A. The purpose of the organization is to promote cooperation among the various independent undergraduate flying clubs. Among other plans, is will consider the establishment of an employment bureau for aeronautical engineers at Washington.

At the conference spoke Edward Pearson Warner, assistant secretary of the navy for aeronautics. Mr. Warner promises the I. A. A. the support of the National Aeronautical Association and urged flying clubs to join the national organization in order to secure lower insurance rates.

Grover C. Loening, president of Loening Aeronautical Engineering corporation, also spoke. He suggested that manufacturers would be willing to give planes to sound flying clubs having insurance and hangar space for the free publicity and advertising the gifts would engender. Mr. Loening also announced a prize of $5000 to be given for the best college flying activities to be awarded principally on the basis of flying hours. Colonel Augustus Lindberg and Harry Guggenheim will select the winner.

Mr. McCall, president of the Border Cities Aero Club also spoke at the conference. Ht outlined conditions existing in Canada, saying that every club which purchases a plane is given another by the government. As a result of this, fifteen Canadian flying clubs were organized last year, each flew an average of 2000 miles.

Among other speakers was Mr. Evans, chairman of the National Gliders' Association, who spoke on "Gliding as a Sport in Colleges." Pictures were shown of Germany's record making glide of fourteen hours, of Michigan's longest flight of four hours. According to Mr. Evans, gliding is of material aid in the piloting a plane. Said he: ". . . . it increases the individual's speed of reaction time and delicacy of control . . . and shows clearly how heavier than air machines are affected by air currents."

At the Detroit Aero Show, college flyers met Eddie Stinson and Captain Wilkins. Flyer Stinson urged beginners to carry neither insurance nor parachutes. He said: "Ninety-nine out of every hundred cases in which the pilot loses control are caused because he relies on his parachute rather than his head."

The Minnesota Society of Aeronautical Engineers of which aeronaut Donaldson is president, was organized but recently. It has forty members out of the sixty-five men registered for aeronautical engineering and will soon have pins and insignia.

Engineers Elect

Among the results of the recent elections, the following are of interest to engineers:

For the all-university council Francis Mullen obtained a narrow margin over George Meffert. In the School of Mines Lyle Christenson defeated C. Myron Landin.

W. Gerald Warrington, able business manager of THE MINNESOTA TECHNO-LOG was elected to represent the technical schools on the board of publications.

To the TECHNO-LOG Board of Control were named Carl Sweet (Chem.), Robert Campbell (Electrical), John Skidmore (Civil), R. H. S. Guppy (Mech.) and R. M. Hanson (Arch.).

Engineer's Bookstore representatives were chosen as follows: Leonard Melkers (Arch.), Clinton McMullen (Chem.), James Bailey (electrical) and Ralph Baskerville (mechanical).

Alyea Leaves Minn.

Dr. H. N. Alyea who has been conducting research work in chemistry at the University will leave during the month for Montclair, New Jersey. Mr. Alyea, who has been studying various phenomena in the field of photo-chemistry, is considered an authority on the use of negative catalyzers. His work at the University has been conducted under a National Research Fellowship. Dr. Alyea came to Minnesota from the Nobel Institute in Europe where he had been working toward his Ph.D. degree.

A. C. S. Meets in Columbus

The American Chemical Society met at Columbus, Ohio, the week of April 29 to May 3, for its seventy-seventh annual meeting.

The convention consisted of general meetings, symposiums, and divisional meetings. General meetings opened with registration on Monday, together with council meetings and a reception.

Divisional meetings commenced on Tuesday. These were held in the Chemical building of the Ohio State University. Each division of chemistry held meetings throughout the rest of the week at which lectures and discussions of recent developments in their respective fields were held. These divisional meetings were open to those who wished to attend. Definite programs were followed in each division in order that visitors could attend such lectures and discussions as interested them most.

A large number of faculty men from the Minnesota School of Chemistry as well as other chemists in the state attended this convention, and several took part in the programs which were held. In the division of biological chemistry, Dr. R. A. Gortner from the farm campus, discussed research he has done in physico-chemical studies on proteins. Dr. Gortner also gave a discussion of the studies of electro-kinetic potentials in which he was assisted by W. Martin.

Dr. I. M. Kolthoff gave several lectures, including one in the division of chemical education on demonstrations in analytical chemistry, and several joint discussions in the division of analytical chemistry where he was asisted by Dr. Barber and Ernest Sandell. Mr. Kolthoff and Mr. Kameda held a joint discussion on electro-chemistry.

In the division of chemical engineering, Dr. R. E. Montonna discussed studies on distillation in which he had been assisted by John L. Tronson. A discussion of the chemical effect of electrical discharge on gaseous hydrocarbons, was given by Drs. Lind and Glockler in the division of petroleum chemistry.

Twelve instructors from the School of Chemistry attended this meeting. Among those present that did not take part in the program were Drs. Mann, Kirk, Cohen, Reyerson, Smith, Harding, and Geiger. J. E. Tindall of the Minnesota Linseed Oil company and several chemists from Rochester were other Minnesota men present at this meeting.

(Continued on page 274)

Both were emancipators

While Lincoln was freeing the slaves by war, McCormick by his invention of the reaper was freeing the farmers from needless toil.

The telephone today is adding to man's freedom by saving time and effort on a scale unknown in earlier civilizations.

Itself an expression of progress, the telephone offers increasing opportunities to men who look and plan ahead. Workers in the Bell System, whether in technical or business activities, are constantly developing the vision into the fact of better public service.

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"OUR PIONEERING WORK HAS JUST BEGUN"

Around the World With Our Alumni

Architects

'24—I. Woodner Silverman is competing for the Paris prize in Architecture, the winner of which is given a scholarship for study abroad. He has been awarded third and fourth place on two former occasions.

'26—T. Gerald Kronick is another one of the Minnesota graduates who is taking post graduate work at Harvard. "Jerry" is recognized as the foremost architectural student there.

'28—Homer Tatham is with the Insulite company and has recently been appointed technical advisor for their London branch. He sailed for England on Saturday, April 28. Incidently, this trip is also his honeymoon. Best of luck, Homer.

'28—Walter J. Huchthausen is taking graduate work in architecture at Harvard.

'28—John Thomas Grisdale has been awarded honorable mention and a prize of $500 in the competition for the Christopher Columbus Memorial at Havana, Cuba. In this world-wide competition ten architects were selected for the final competition by the jury in Madrid, Spain. Jack was one of the four American architects placing in the preliminaries of this competition.

'28—Kenneth Lewis is associated with Lang, Raugland and Lewis, architects, and has charge of their St. Paul branch at 1965 University Avenue, St. Paul.

'28—Gurdon Jones is a draftsman for McKenzie-Hague Elevator company, Minneapolis. It will be remembered that Gurdon took an active interest in the Arabs.

'28—William McGinnaty is with Holabird and Roche, Chicago architects, as an engineer. His parents are living with him in Chicago at 1724 Roscoe Street.

'28—Roy Thorshov is planning to attend the Fontainbleu School of Fine Arts in France this summer. He will be accompanied by Natan Juran, '29. Fontainbleu, thirty miles from Paris, was a favorite residence of the kings of France and is now noted for the excellent training the school affords architects, painters, sculptors and musicians.

Civils

'14—Luis J. Larson is another man who has recently changed his location, and incidently, his job. He is now research engineer for the A. O. Smith corporation in Milwaukee, Wisconsin, instead of an instructor at the university of Illinois. He may be reached at 920 Shepard avenue, Milwaukee, Wisconsin.

'15—H. S. Loeffler has been promoted to bridge engineer for the Great Northern Railway company. His headquarters are in St. Paul.

'21—C. D. Jensen is acting as assistant professor of civil engineering at Lehigh University. At present he is making a special investigation into the welding methods that are supplanting riveted steel construction.

'24—George V. Guerin has been appointed assistant bridge engineer for the Great Northern Railway company with headquarters in St. Paul.

'24—Reuben W. Gustafson is still with the Great Northern Railway company, but he is now in Seattle instead of St. Paul. His new address has not come through yet, but the news of his promotion to assistant bridge engineer has. Best of luck, Reuben.

'26—Arthur S. Krefting has been promoted from structural draftsman to bridge engineer for the Soo Line railway. 4851 Lyndale avenue north is his Minneapolis address.

'26—Merton A. Dimmick is acting as an instructor at the South Dakota State School of Mines. These civils are versatile fellows, for though Merton graduated a civil engineer he is teaching physics and electrical engineering to the prospective miners of South Dakota.

'27—F. C. Teske, who is employed in the bridge department of the Northern Pacific railway, has been awarded the Lord Strathcona Fellowship in transportation at Yale University.

'27—Lester G. Gehring is still with the boys in the Minnesota State Highway department.

Electricals

'05—Erich J. Schrader, consulting engineer of Reno, Nevada, visited the Twin Cities recently.

'06—Martin Cornelius is one of those few alumni who retain an active interest in the old school after they leave. He wrote in the other day to correct a wrong address in last year's directory, and to make things worth while he sent along the addresses of two other men. We could wish that a few more men would follow his example! Incidently, he is still with the Westinghouse Electric company at Chicago, and is living at 111 West Washington avenue, Chicago, Illinois.

'21—Percival E. Loye is still in Minneapolis, though he has changed his address several times since the last directory was published. He may be reached now at 602 Baker Building.

'22—Arne Enger is now living at 1 Montgomery Street, San Francisco, Cal. He is still with the Westinghouse Electric company.

'23—George E. Swift is a sales engineer for the Electric Machinery Manufacturing company at 53 West Jackson Boulevard, Chicago, Illinois. His present home address is 5124 North Winchester avenue, Chicago.

'24—J. M. Juran is now living at 5113 W. 21st St., Cicero, Illinois. He is still with the Hawthorne branch of the Western Electric company and since he left school his advance in that company has been rapid. After a year in the student course at the Hawthorne plant, he was assigned the task of investigating shop and outside complaints, and from there his next move was to a position in the inspection statistical department. Two years later he captured the position of acting department chief, and in January of this year he was promoted to be head of the quality inspection department. Now he is chief of the inspection results division. In his spare time Joe plays chess, and he is the champion of the Hawthorne works. Some record!

'25—"Bob" Ludlum recently moved to 1412 North Kingsley Drive, Hollywood. His business address still remains the same—for he is still with the Edison Lamp works of the General Electric company in Los Angeles.

'25—Bernard J. Larpenteur with the Dorr company of New York is back in Minneapolis for an indefinite period. He is working on an experiment for his company at the Mines Experiment Station.

'26—Richard W. Jones moved recently from St. Paul to 215 N. Homewood Avenue, Pittsburgh.

'27—L. A. Weom is now working for the Fairbanks Morse branch in St. Paul, having started there the first of the year. Last fall "Al" returned to the campus for some further work after leaving the Illinois Bell Telephone company, but returned to the business world at his first opportunity. He is with the sales division and at present is selling pumps and electrical equipment. All the old gang can reach him at 1751 Capitol Avenue, St. Paul, Minnesota.

'27—Hans Norberg is located with the General Electric company at the Philadelphia branch. When he leaves the test course a few months hence he expects to go into switchgear engineering. He may be reached, for the time being, at 7121 Elmwood avenue, Philadelphia, Pa.

'27—Edward L. Bottemiller is still with the General Electric company in Schenectady and from the letters that he writes he seems to be satisfied. For his own pleasure he has recently purchased a second hand Ford—and maybe, if the gods are kind, we will see him sometime before the summer comes around.

Chemists

'23—Paul M. Paulson is now in charge of the patent department for the Roessler Hasslacher Chemical company at Perth Amboy, N. J.

'25—Norman Bekkedahl is now living at 3945 Connecticut Avenue, Washington, D. C. He is still with the Bureau of Standards at the Capitol.

'26—Wallace E. Jordan, formerly of Two Harbors, is now working for the Western Paint and Varnish company at New Duluth, Minnesota.

'26—Edward F. Sverdrup has been advanced to the position of research chemist for the United States Rubber Reclamation company. There is also a rumor that he will leave the bachelor corps in the very near future.

A History of the Blarney Stone

St. Patrick

By His Irish Majesty for 1929, Lester J. Rowell, M. E. '29

I HAVE often wondered if there can still be any uncertainty in the minds of Minnesota engineers as to the truth of the statement that St. Patrick was one of the world's greatest engineers. It seems unlikely that there should be any such speculation. The custom of honoring the great patron saint annually with becoming rites and ceremonies has been established so long at Minnesota that the present crop of engineers has undoubtedly accepted the tradition as a child accepts Santa Claus. However, if there are any such persons who have accepted the theory on faith, rest assured that our beloved St. Patrick once lived and that it was he who "Pied Pipered" all snakes, lizards, and reptiles out of Ireland into the ocean. As to whether he was a civil, mechanical, or electrical engineer, the good lord only knows.

Personally, the authenticity of St. Pat's past has caused no suspicion whatever in my mind, but I must confess that there is one phase of the Engineers' Day program which did arouse my inquisitive nature. This occurred some four years ago when I was witness to a furious scrap between some engineers and foresters over the Blarney Stone. The intensity of the struggle indicated that they were fighting for something more than an ordinary green rock, and being acquainted with the traditional gridiron battles between Minnesota and Michigan over the "Little Brown Jug," I surmised that this emerald stone must, too, have some traditional legends attached to it. This I found to be the case and since then I've been keeping my ear to the ground to learn as much as I could about the genealogy, if you like, of our Blarney Stone. My enlightenment upon the subject follows:

The difficulty which an archaeologist has in searching out the pedigree of this stone, or the most credulous engineer in putting its powers to test, lies chiefly in the fact that scarcely any two authorities agree as to the identity of the stone. An attempt has been made to prove that the stone was originally brought to Ireland by a Phoenician colony. It had previously been held and treasured many years by the inhabitants of Tyre and Carthage. The strange powers of this stone, namely that of gifting its users with eloquent and persuasive speech, attracted the attention of some Carthaginian adventurers who carried the stone away to Minorca by stealth, and afterward, being driven into Cork harbor, they hid their treasure away in a woods known as the "groves of Blarney," celebrated in song and story, whence it was taken out to be used in rearing the tower of Blarney Castle.

The ruins of the famous old fortress, Blarney Castle, are visited by thousands of tourists each year. This is largely on account of a tradition which has been attached, for some centuries, to one of the stones used in building the castle. The stone is endowed with the property of communicating to the happy tongue that comes in contact with its polished surface the gift of gentle speech, with the soft talk of a "speak-easy" in all its various branches. These powers may be employed in vows or promises as light as air, such as lead the female heart, or elaborate articulations of a more serious nature such as may do for the students' work committee, all summed up and characterized by the mysterious term "Blarney." Poetically speaking—

There is a stone there
That whoever kisses
Oh! he never misses to grow eloquent;
'Tis he may clamber
To a lady's chamber
Or become a member of Parliament.

The village of Blarney is in the south of Ireland, about four miles from Cork.

(Continued on page 276)

His Queen

Engineers' Day, May 11, 1929

Committees

General Arrangements

George Meffert, *Chairman*
W. Gerald Warrington *Secretary*
Curtiss Crippen, *Treasurer*
Donald Burris
Melvin Elmquist
G. R. Higgins
Francis Mullen
Adolph Ringer
Rolland Stoebe
Harold Lieske
Gordon Farel
Donald Kendall
Conroe Hawkinson
Steve Gadler

Broadcasting

Robert Orth, *Chairman*
Millard Garrison
Leslie Grochau
Ransford Fenton
Edward Johnson
Ruben Wald

Brawl

Walter Johnson, *Chairman*
Victor G. Nelson

Program

J. Rex Severson, *Chairman*
Lloyd Kernkamp
Ralph Sprungman
W. W. Ralphe
Ralph Baskerville
George Langenberger
Henry Ogren

Open House

William Martenis, *Chairman*
R. S. Anderson
Donald Bayers
Carl Sweet
A. B. Johnson
William Barstow
John Madden
Charles Bailey
Karl Johnson

Knighting

Elwood Johnson, *Chairman*
Justin E. Schradle
Earl Dominick
M. J. Schumacher
Lewis Rodert
Gordon Conrad
Richard Cady
Charles Hendrickson
Richard Jones

Buttons

William Thompson, *Chairman*
O. R. Lindstrom
George Otterson
Earl Ewald
William Ekeley
Berry Ervin
Raymond Hertel
James Spicola

Publicity

William H. Painter, *Chairman*
Francis J. Fox
W. Cameron Kay
E. E. Edgell
George Dolemen

Program of the Day

Morning

9:00-12:00—All of the laboratories, shops and all departments conduct open house for the visitors and alums. Souvenirs are given out.

11:00—Loyal sons of St. Patrick parade through the campus district, displaying many floats depicting the engineer's view of the campus. The Blarney Stone always rides in the parade on its way to the Knighting ceremony.

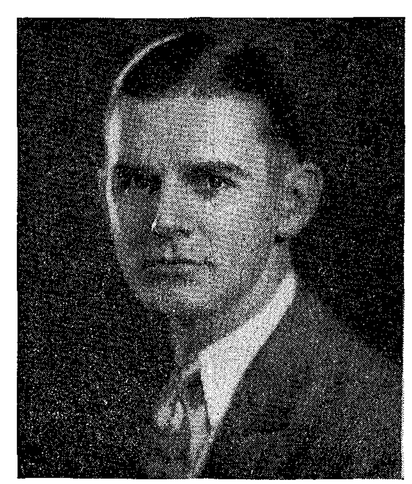
Afternoon

12:30—Senior engineers are knighted on the campus knoll by their royal St. Patrick. Announcement is made of members of Plumb Bob.

2:30—Dansant held in the Main Engineering auditorium. Green Tea is served in the Architectural Library.

9:00—The Brawl! The biggest party of the year. St. Pat and his queen lead the Grand March.

George H. Meffert, *Chairman*



Lester J. Rowell, *St. Pat.*

Margaret Bradbury, *Queen*

Committees

Dansant

Eugene Weber, *Chairman*
Basil Beaver
L. G. Haverland
Ray Englund
R. F. Cunningham
Lloyd Westin

Green Tea

Marjorie Mailand, *Chairman*
Inez Wood
Betty Bass
Loraine Carlson
Faith Patterson
Eleanor Hupp

Finance

R. H. S. Guppy, *Chairman*
Karl Sommermeyer
James Ford
Maurice O'Brian
Howard Truax
Clarence Pappenfus

Posters

Edward Hanson, *Chairman*
Gordon Bestic
Melvin Stenrud
William Doneghy
Louis Miller
Edward Petrick

Alumni

J. L. Warrington, *Chairman*
A. Robert Heller
Wilho Kallio
Bernard Petrok
Donald Kaplan
Roman Soufal

Decorations

Gerhard Peterson, *Chairman*
Hans Wessel
Leonard Melkus
James Brunet
Fred Reinders
Irwin Malakowsky

Parade

Robt. C. Ramsdell, *Chairman*
J. G. Skidmore
George Snodgrass
James Finch
Edgar Carsberg
Walter Buehl
Carl Wilckens
Erwin Hill
Earl Thoureen

Printing

Morris Hauge, *Chairman*
Homer Brown
Harry Markus
Lloyd Knuth
Arvie Ackerman
Noel Jones

Records

Russell Cheney, *Chairman*
Lyle Shellenbarger
Owen Moorhead
Harold Emlein
W. C. Mielke

The Architects Jubilee

By MARJORIE J. MAILAND

IF you see people running up and down stairs in the main engineering building, and if you hear strange noises emanating from the third floor of that building, you may, with no thought of the consequences, blame the Architects, for they are working fast and furiously on their big celebration of the year. It will take place from Wednesday, May 22, to Saturday, May 25, and unless you see the displays you will never believe that so many wonders could be contained in such a small amount of space.

One of the major features of the celebration will be an exhibit of the best work the students have done the past year. (Believe it or not, the architects do work at times!) Milton Melzian, a second Frank Lloyd Wright, will probably display a modernistic skyscraper or an unusually striking country house. You have heard of "Nate" Juran's exceptional renderings? There will be a display of his work. Dudley Bayliss of Jinx Ball fame will have a showing—he is the boy that gets the mentions. There are only a few interior decorators, but where quality counts and quantity is not necessary Jenny Lieb and Ruth Carter can put on a display with the best.

A sketch exhibit will be another feature of interest. You have probably seen various people at various times sitting on the curb wth pencil and pad and if you visit this display you will see their finished work. If the artist was using a brush and pallet, the result will probably be one of the river house-boats, or some scene on the river bank. All through the winter these budding artists work at still life, and the results, typified in green water jugs, copper tea pots and red velvet hangings will be exhibited too.

To top these student exhibits the celebrities of the department are allowing some of their work to be shown. There will be etchings by S. Chatwood Burton, whose fame along this line has gone all over the states. In one of these, you will see a quaint French chateau; in another, a scene in Mexico, the city of gold. A low adobe hut lazily sprawling out over the sand in the intense heat; a slow redskin taking his siesta; a cool seashore with an old fishing schooner swaying easily in the water; any and all of these have been done by Professor Burton, and they may be seen at any time during the exhibit.

Mr. Young and Mr. Arnal excel in water color work, and they will have exhibits at the Jubilee too. Some one has started a rumor that Mr. Arnal has done a special watercolor for this exhibit while in Florida on his last vacation.

R. C. Jones' work has won prizes abroad, and his best sketches will be on display here. The Parthenon shows in one; a charming Italian fountain in a Florentine square in another.

R. T. Jones is a designer of small houses, and of his work there will be a drawing of his most charming Italian house surrounded by trees and bushes.

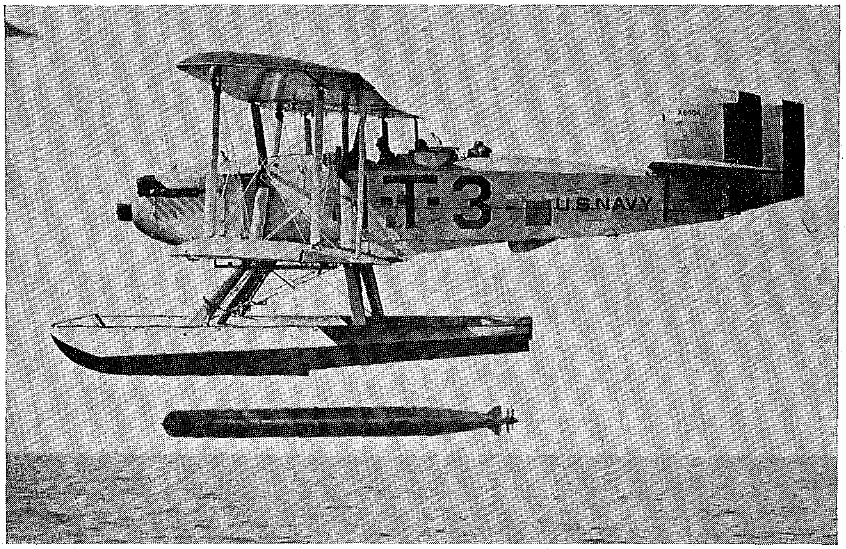
If you are at the Jubilee on Friday afternoon, the Library will be one of the places that you must visit, for tea will be served from three to five o'clock, and all the campus is invited. After walking the halls and taking in all the displays, the tea will be a quiet interlude. The library will be an actual example of the interior decorator's ability, and although we have no guarantee as to Ruth Carter's ability as a cook, the decorations will be absolutely the best ever.

And now we come to the best part of the whole day. At the end of the hall in which the exhibitions are hung, there is a doorway, and it is through this door that you get the first glimpse of the decorations for the Architects' Jubilee Ball. This will take place on Friday evening, May 24, from 9 to 1 a. m. Fabian Redmond and Fred Hakenjos are in charge of the construction of the scenery and decorations of the auditorium. The theme "Under the Sea" sounds all wet, but it won't be like the first Jinx Ball motif. The decorations have all been planned with this theme in view, and great sea monsters, sunken ships, treasure trove, and mermaids all have their part in the final result. Even the Ville D'ys, that glorious city which was sunk beneath the sea for its wickedness will be displayed, and Fred has done some wonderful work on its ruined walls and towers.

Don't forget that the Ball is a costume affair—anything will do, and costumes that can be worn under the sea are recommended as practical. Father Neptune will be in charge and with his ever-youthful wife will lead the festivities. If you will take our advice you will be present, for the Architects have a reputation to live up to.

Progress in the Art of Flying

(Continued from page 249)



DROPPING A TORPEDO FROM THE AIR

A remarkable photograph of an SC type plane in action. The exhaust of the torpedo motor can be seen plainly.

type and made approximately one hundred short flights with it on the shores of Lake Michigan. Chanute found the glider very difficult to manage and he discarded it as dangerous just a month before Lienthal met his death. Chanute built a few gliders of different design, and the last one turned out to be the prototype of the present-day biplane. Some seven successful flights were made with it. While the credit for pointing the way to successful flight goes to Lienthal, Chanute may be said to have pointed out a way to stability in flight.

Before going into the work of the Wright brothers I wish to mention the work of Professor Pierpont Langley. Before beginning his research in aerodynamics in 1887, Langley was already famous in the scientific world as an astronomer. During his work he brought out many important facts relating to the theory of flight. In 1891 after the completion and publication of his "Experiments in Aerodynamics," Langley began the construction of flying machines. He started first by building models and he encountered many difficulties, for most of the models were too heavy to fly. For power he used small steam, compressed air and carbonic acid gas engines. Finally his "Model number 3," which was actually the fourth model constructed lifted thirty per cent of its own weight in a test. "Model number 4" actually flew, but upon test it was found to be unstable. Finally on May 6, and November 28, 1896, Langley's best model, driven by a one horse power steam engine weighing twenty-seven pounds was successfully flown, the best distance obtained being three-quarters of a mile.

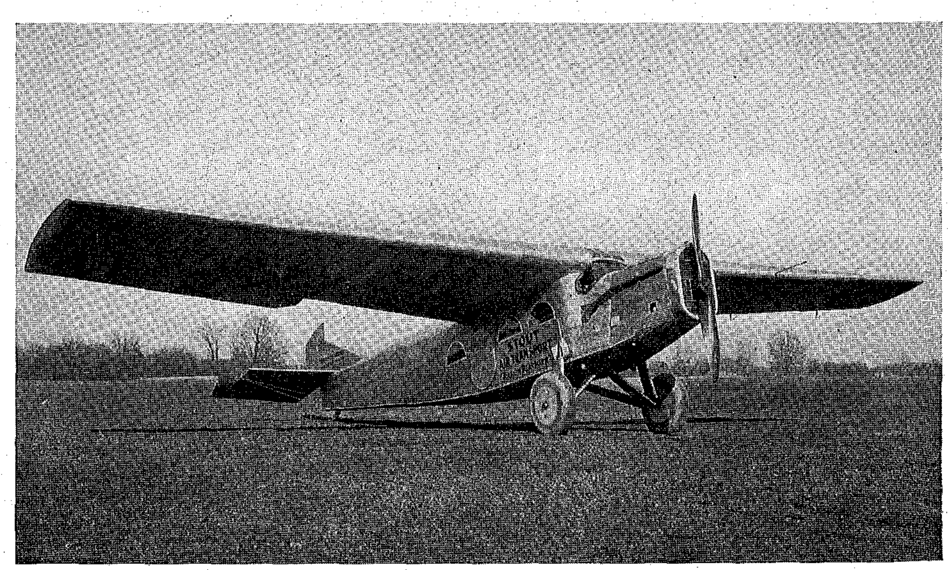
He then constructed a man-carrying plane which was a direct copy of his successful model. The United States Government subsidized him to the extent of $50,000 for this machine, and on October 7, 1903, the machine was tried out. The launching was not a success and it ended its test in the river. Langley was severely criticized and the press was even hostile in its attitude. The public looked upon the matter as conclusive evidence that the machine was a failure, and the brilliant investigator died three years later, broken in heart by the unjust criticism of his efforts. The full story of his attempts is recorded in Grover C. Loening's book, "Monoplanes and Biplanes," and another good reference is "The Romance of the Air" by Charles C. Turner. The data for this talk was taken from these books.

One autumn evening in the year 1878 a father came home with a small toy concealed in his hands. When he reached the room in which his two little sons were playing he released the toy and instead of falling to the floor, it rose into the air and flew across the room and finally struck the ceiling where it fluttered for a moment and then sank to the floor. The toy was made of light materials and did not last long, but the memory of its flight stayed with these boys forever. The plaything was made up of two propellers mounted on vertical axes and driven by rubber bands. This type of machine is called a helicopter. The boys tried to construct larger and larger models, but the larger they were made the worse they flew.

Finally the two brothers grew to manhood and at the death of Otto Lienthal they turned their serious attention to the subject of aeronautics. As you have probably guessed, these two boys were Wilbur and Orville Wright.

They first made an exhaustive study of all the works which had been performed up to their time and decided that there were two schools of experiments. The first was represented by such men as Professor Langley and Sir Hiram Maxim who were experimenting with power flight, and the second was represented by Lienthal, Mouillard, and Chanute with their gliders. The Wright brothers decided to follow the work of

(Continued on page 272)



STOUT ALL METAL AIR TRANSPORT

This type of thick-winged monoplane is the fore-runner of the present trimotor, all metal, passenger and mail carrying plane.

A Bridge Oddity

(Continued from page 252)

struction and all of the diagonals are of eye-bar construction also. We find that the posts are made up of fabricated sections. The floor beams and stringers are supported by these posts. This main truss is supported by a tower on the south bank of the river and a set of columns on the north side. The columns on the north side rest upon a stone pier, this being the only pier in the water.

The main span has been calculated to carry a load of 256½ tons besides its own weight. In the design of the truss special attention was given to its construction in order to eliminate vibration, but because of the fact that the bridge was not designed for present day traffic the vibration is now rather great. The floor of the main channel span is 75 feet above low water level, and is about 55 feet above what is considered high water level by the War Department. The drive-way on the main span is 18 feet wide, and has a 5 foot walk on one side.

Following the main channel span is a span of 120 feet, which is made up of an inverted curve chord Pratt truss. It is of interest to note the various types of construction used in this bridge. At this point a deck span with a truss has been used. By using an inverted truss at this point a light type of construction was obtained which could not be obtained with a plate girder construction. It may be seen that the engineers made use of a number of types of construction in the erection of this bridge. The main features are as follows: the spiral approach, plain truss, inverted truss or deck span, and plate girder construction.

Next we have twenty-one deck spans which are 33 feet in length and 39 inches deep. These spans rest on framed columns which in turn are supported upon small stone piers, or foundations. The columns that support the deck girders have been framed into towers at every odd span. This type of construction was used to make erection work easy, and to render the structure more stable. The bearing plates used on the towers are of a different type of construction than those used on the plain columns. The final section of the north approach is made up of a dirt roadway 172 feet in length. The total length of the bridge is 1,920 feet, or over a third of a mile. In this distance the engineers made an allowance of five inches for expansion and this expansion joint was made at the one pier that is in the water.

As this historical bridge is becoming old and more or less inadequate for the present day traffic conditions, it seems only reasonable that we discuss the possibilities for future development. The demand for a new bridge which is increasing every year is due to the increase in the number of cars that use the bridge. To a person going over this spiral for the first time in an automobile the bridge seems very dangerous and because of this fact it is thought advisable to build a new bridge. No one really knows how dangerous a spiral approach is, but it is true that no serious accident has taken place on this one.

There are three proposed locations for a new bridge. They are: first, on the new Hastings dam; second, a high level bridge up the river from Hastings. and third, a high or low level bridge at the foot of Vermillion street.

As work on the dam has been started it is almost certain that no effort will be made to secure a bridge in connection with the dam. To do this now would require revision of design and extensive dealing with government regulations. It would also require a great expenditure of money for relocation of the highway and the construction of the same. For this reason the location at the dam is omitted.

The second possible location is a high level bridge up the river from Hastings. As the banks on both sides of the river are high at this location a high level bridge could be built, but the cost of such a construction would be geat. Because such a bridge would cross the river at an angle and at a bend in the river, it would be difficult to secure the permission of the War Department.

The proposed location which the Highway Department is now considering is along the center-line of Vermillion street. The plans at the present are to let the approach extend through the business district, although this is the objection overcome by the spiral. There has been considerable discussion about the changing of this approach and no definite conclusion has been reached.

'88—John C. Morris is acting as consulting engineer for the Robertson Resilient Wheel corporation at 110 South Dearborn Street, Chicago, Illinois. He may be reached at 4445 Berkeley avenue in that city.

'18—Oliver S. Hagerman wrote in the other day to say: "I have moved recently with the company, from New York to Chicago. Hereafter I will be at 1802 Cherry Street, Winnicha, Illinois." Hagerman is with the American Light and Traction company.

'20—Harold T. Odegaard is now living at 908 South Main Street, Aberdeen, South Dakota, having moved recently from Portage, Wisconsin. As far as we know, Harold is still with the Chicago, Milwaukee and St. Paul railroad company.

'27—Robert Gibson has left the Pittsburgh shops of the Western Electric company, and in the future may be found teaching the rudiments of Engineering to the boys at Carnegie Tech, in Pittsburgh, Pa.

'27—E. V. Nelson had been working on the Range until recently when he went to Chicago to accept a position with the Inland Steel company.

'28—Robert E. Thelin is still with the Ideal Electric company at Mansfield, Ohio. Apparently Bob likes his work there for he is planning on staying with the company.

Students Seek Jobs

During the past few weeks there has been a great deal of excitement among the seniors of the technical schools on the campus. It has been open season on embryo chemists and engineers. Many of the larger manufacturing plants are looking for new men to receive training and take over the positions that are open only to the most capable men who have survived the struggle of obtaining an education. By the number of men that have been here interviewing seniors for their respective companies it surely proves that the person who said that a man with a college education was not in demand made a great mistake.

Some of the men who have visited at the School of Chemistry in the past few weeks are Dr. Forrester of the Dupont Rayon company, Mr. Marsh of Hercules Powder, Hanson of the Grasseli company, Krause and Evans of the Dupont company, Mr. Coith from Proctor and Gamble, and Messers. Jones and Trumble from the Goodrich Rubber company.

California Institute of Technology has contracted for a new 200-inch telescope.

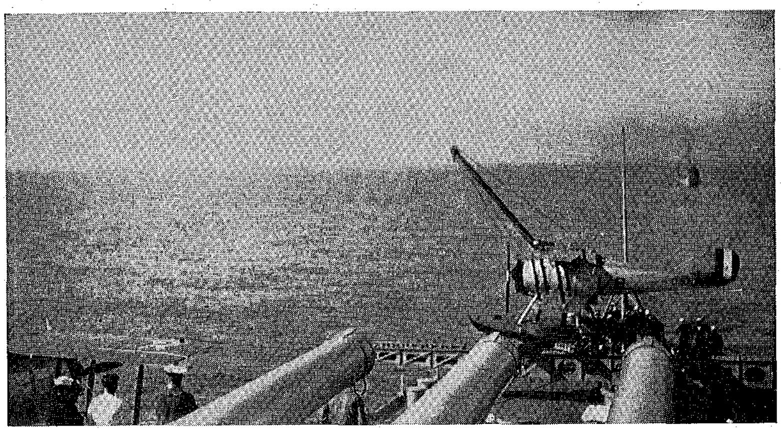
Progress in the Art of Flying

(Continued from page 266)

the second school because power flight, at that time, seemed an extravagant waste and because gliders had made actual flights.

At the start of their experiments, Wilbur Wright said, "The difficulties which obstruct the pathway to success in flying machine construction are of three general classes. First come those which relate to the construction of the sustaining wings, second, those which relate to the generation and application of the power required to drive the machine through the air, and third, those relating to the balancing and steering of the machine after it is actually in the air. Of these difficulties, two are to a certain extent solved." He continues to say that the difficulties of construction and motive power are minor, but that control is the major question. Most of the experimenters did not bother about any means of control but steadied their gliders by shifting their weight. The fact that the Wright brothers appreciated the problem of control is no doubt the reason for their success.

In 1900 they brought their glider to Kitty Hawk, North Carolina. This locality was chosen for the steady wind that continues over the sand dunes day after day, and which would make tests possible. The glider was first flown as a kite, and in these tests it was found that it did not have wing area to lift the weight of a man, so they decided to glide from a hill. The promontory chosen was Kill Devil Hill, a dune four miles south of their workshops.



A modern type of scout plane in use on battleships by the U. S. Navy being hoisted aboard the parent ship.

In 1901 they brought a larger glider to Kitty Hawk and in testing it they learned more about the problems of stability, and at the end of their glider experiments in 1902 they decided to build a power machine. At the end of December, 1903, they made four short flights, the longest of which lasted 59 seconds. These flights and those made at Dayton the following year proved that power flight was possible although they often resulted in more or less serious damage to the plane.

About this time Archdeacon, Bleriot and Ferber took up their work using data collected by the Wright brothers, and on August 22, 1906, Santos Dumant made the first power flight in Europe. With these trial flights, aviation moved from its infancy to the second stage of its growth, and progress since has been rapid.

News from the Technical Campus

(Continued from page 258)

Daniels Talks Here

Dr. Farrington Daniels, 1910, M. S. 1911, professor of chemistry at the University of Wisconsin, recently lectured in the auditorium of the school of chemistry. He spoke on the "Speed of Chemical Reactions," emphasizing the importance of x-ray and other processes for increasing the speed of reactions. The lecture was sponsored by the graduate organization of the School of Chemistry, and followed a dinner given at the Campus Club.

Dr. Daniels is well known in the field of physical chemistry, is an entertaining lecturer. Not surprising then was the decision of the Minnesota Section of the American Chemical Society to hold its April meeting on the same evening, in the same hall.

At the last meeting of the American Institute of Chemical Engineers, officers were elected. New president is Gustave Heinemann, '29. Others elected are: W. Cameron Kay, '30, vice-president; Robert Miller, '29, treasurer; Russell F. Heckman, '30, recording secretary; Donald G. Benson, '30, correspondence secretary.

M. E. Dept. Shows Film

On May 6, 7, and 8 engineers saw three reels of film entitled "Modern Manufacturing with Stable Electric Arc." T. P. Hughes secured the films from the Lincoln Electric Film company, invited all engineers to attend, required attendance of all classes in M. E. '13.

Mr. Hughes decried the scant knowledge which the graduating engineer has about electric arc welding. Said he: "Modern designing problems demand an intimate knowledge of arc welding. Engineers who can figure stresses and strains for riveted joints only, find themselves incapable of handling present day problems in which the older method has been largely replaced by the electric arc." He further urged that future engineers should receive as much training and instruction concerning the strength of welds as has been previously given to rivets.

Lincoln Electric's film demonstrated the applicability of electric arc welding to industry, gave evidence that stronger joints could be secured and that less noise is made.

Miners Hold Banquet

Senior miners were feted by Junior miners at the thirty-first annual banquet of the School of Mines held this year at the Hotel Francis Drake. Myron Landin, M. '30, acting as toastmaster introduced fellow classmate Myron Griswold who well-wished all seniors. Ingolf E. Serigstad of the graduating class responded, gave thanks, and well-wished those left behind.

The "Golden Shell," a tri-motored Fokker plane owned by the Shell Petroleum company, recently left St. Louis for a tour of mid-western cities. Victor J. Azbe, chairman of the St. Louis aeronautical meeting and the "Golden Shell" will stimulate interest in the meeting to be held at St. Louis from May 27 to 30.

The aeronautic division of the American Society of Mechanical Engineers will assemble in St. Louis at that time to see the Gardner Cup Races and a unique airplane show where manufacturers may exhibit without cost. The St. Louis Chamber of Commerce is financing all arrangements. This organization has been especially active in aeronautics.

A History of the Blarney Stone

(Continued from page 263)

Blarney Castle was built about the middle of the fifteenth century. Its walls were eighteen feet thick, and it was, therefore, a notable fortress in those days. In 1602, when the Spanish were exciting the Irish chieftains to harass the English authorities, Cormack McDermot McCarthy held, among other dependencies, this castle. He concluded an armistice with Carew, the Lord President, on condition of surrendering the fort to the English garrison. Day after day his lordship looked for the fulfillment of the compact, while the Irishman kept putting him off with soft speeches and delusive promises, until at length Carew became the laughing stock of Queen Elizabeth's ministers, and the dupe of the Lord of Blarney. Hence, the saying, "None of your Blarney talk." In 1643, Lord Broghill took and held the castle of Blarney for some time. After the restoration of Charles II, Lord Muskerry was created Earl Clancarty, and his estates were restored to him. His son, Donagh, fought for James II, and the castle suffered another siege during the Orange troubles. Soon after that its fortifications and mansions were destroyed, and little of it was left intact except the walls of the large square tower (120 feet high), which contains the celebrated Blarney Stone.

The best informed, perhaps, designate this stone as set in the northern angle of the lofty castle wall, about twenty feet from the top, bearing this inscription: "Cormack MacCarthy fortis me fieri fecit, A. D. 1446." There is no way for a tourist to reach this stone except by being lowered by ropes, from the summit of the wall, at the peril of his life. At one time, however, there were so many adventurous souls who were ready to run the risk, that another stone was picked out by the village wiseacres. This stone was only a few feet below the battlements, and bore the date 1703, with a part of the arms of the family of Jeffreys, into whose hands the castle had passed some years after it fell into ruin. Here it was possible to combine adventure with comparative safety, (that is, with only the peril of arm or limb) as, in order to kiss the substituted stone, it was necessary for the tourist only to crawl through a broken place in the battlement, and induce some friend to hold fast to his legs or feet while he reached the stone with his lips, hanging head downward. Even this did not satisfy the conscience of the head of the Jefferys family, who presently had the stone marked "1703" taken out of its place in the wall, and planted on the apex of one of the turrets, where it could tempt no one to harm.

But, in the course of time, there came to Blarney a maniac, whose one hobby was to find the famous stone. (There is no doubt in my mind but what this man must have been a forester.) As his condition of mind was not recognized at once, he was allowed to go to the summit of the tower. What was the horror of the people when they beheld him climbing to the top of the parapet and executing a wild dance around the marvelous stone. Just when everyone was expecting him to fall and be dashed to pieces, he suddenly seized the stone and dropped it to the ground beneath, where it was broken into three fragments. For a long time thereafter, the Irish guides used to point out these fragments, with the injunction to the visitor to kiss "all the three halves" if he would imbibe any of its mysterious virtues.

News from the Technical Campus

(Continued from page 274)

Chemists Honored

Gust E. Erickson, D. L. Fuller, A. E. Lyden and L. P. Moore, senior chemical engineers, have recently been awarded fellowships in chemistry. These fellowships are generally given only to individuals who have taken at least one year of graduate work.

Mr. Erickson will go to the Massachusetts Institute of Technology where he has been awarded a research assistantship.

Mr. Fuller has received the Goodrich Tire and Rubber Company scholarship at the University of Akron at Akron, Ohio.

Mr. Lyden has been appointed assistant in chemical engineering at the Sheffield Scientific School of Yale university at New Haven, Conn.

Mr. Moore will be connected with the Canadian Institute of Cellulose Research at McGill University, Montreal, Quebec. While working as research assistant he will study for the doctor's degree under Professor Harold Hibbert.

Professor L. S. Ornstein from Holland's famous University of Utrecht traveled to Minneapolis. At Utrecht he is professor of experimental physics, director of the physics laboratory. At Minnesota he will give three lectures, one for the physics department, one for the School of Chemistry, last for the Minnesota section of the American Chemical Society.

Miners Leave for Africa

Lawrence Fetzer, W. J. McLean, and LeRoy Hassenstaf of the School of Mines will soon leave for Africa. On May 6 Miners Fetzer and McLean will entrain for New York, will sail for Brussels on May 11, and then go to Belgian Congo. Mr. Hessenstaf will leave in June for Broke Hills, Rhodesia, Africa. In Africa they may meet Phil Merritt, Don Davis, and William Pettijohn, also from Minnesota.

Anglo-American mining companies operating in South Africa generally import American engineers to survey and analyze prospective sites. Africa contains much gold, many diamonds, also copper, coal, and oil. Germany's Schacht, "Iron Man" of reparations, believes that former German East Africa has resources that could pay the total debt demanded by Allied Powers.

In Africa Minnesota's Miners may *kiboko* belligerent blacks. Kibokos are heavy whips made from rhinoceros hide. They are used by African white men on blackamoors. In Africa an ancient caste system makes it necessary for whites to have many servants. Fetzer, McLean and Hassenstaf will have valets, cooks, major domos, house men, chore boys, and these their assistants.

A. I. E. E. Hears Anderson

On May first the Minnesota Branch of the A.I.E.E. heard G. N. Anderson of the Northwestern Bell Telephone company. Speaker Anderson demonstrated the effect of suppressing higher and lower frequencies in the reproduction of music and voice over transmission lines. He also presented a combined visual and audible demonstration of the effect on transmission of trouble in telephone circuits. Toward the close of his talk, Mr. Anderson explained how cross-talk is produced between telephone circuits, and demonstrated the effect of overloading vacuum tubes upon the transmission of speech and music.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VOLUME IX — MINNEAPOLIS, MINN., JUNE, 1929 — NUMBER 9

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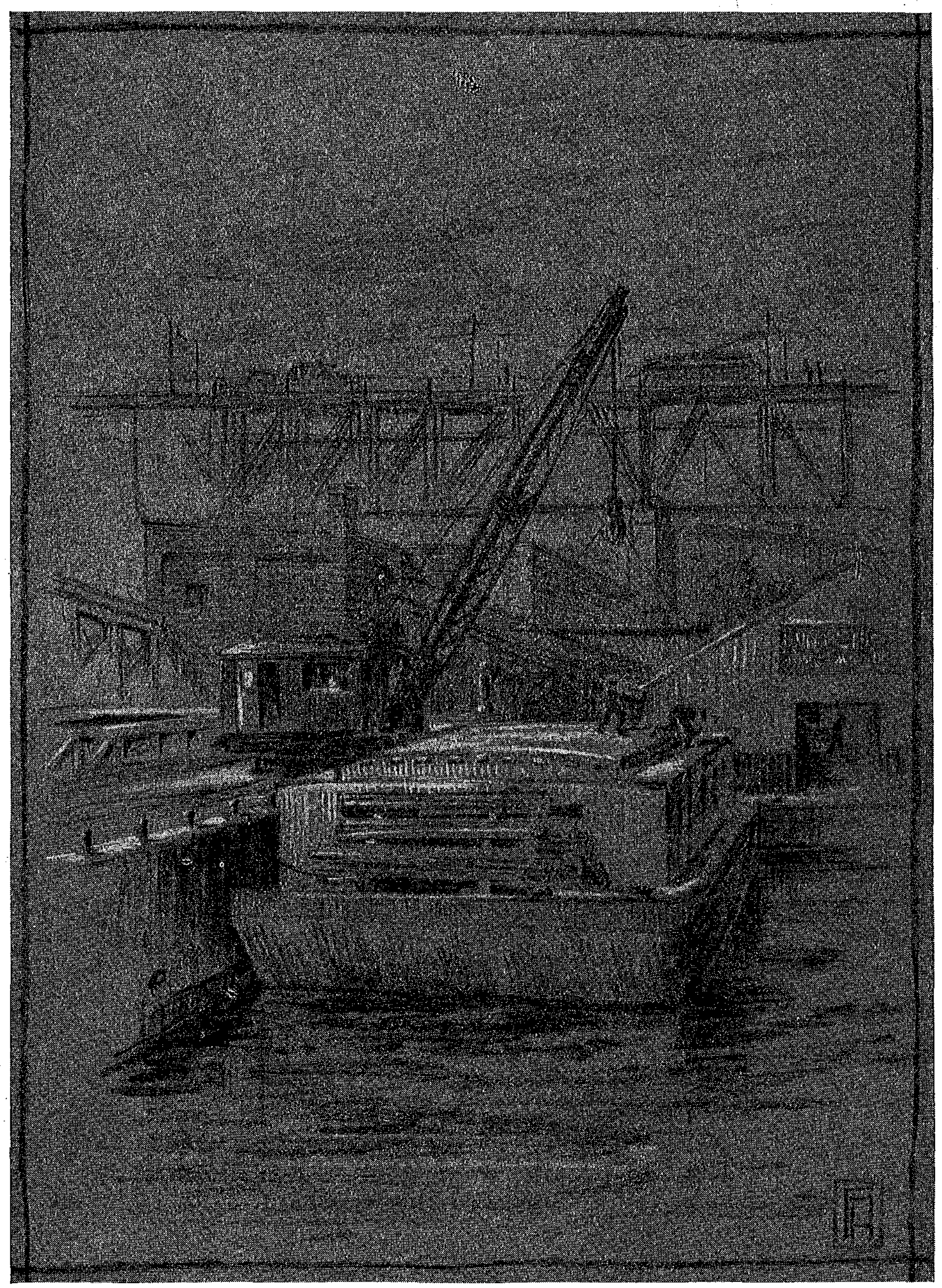


At the Port of Minneapolis

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume IX JUNE 1929 Number 9

Gas-Electric Cars

By H. H. Hanft, E. E. '25
Westinghouse Railway Engineer

IT is only since the war that the gas-electric car for railroad work has come into prominence, but many years have passed since the first gas-electric rail car went into service. It was in 1890 that the Patton Motor Car company built a car powered with a small gasoline engine and with electrical transmission. In 1902 the first extensive application of gasoline driven cars was made by a French company for use in Hungary, their number being supplemented from time to time until there were approximately 70 in operation in 1912. The latest reports indicate that of these there are approximately 50 still in serviceable condition.

Due to war activities and our subsequent entry, gasoline car development slowed down and finally stopped from 1914 to 1920. However, prior to the war the chief obstacles to unqualified success were due to engine designs.

The war brought about marked advances in engine designs. About 1920, with increased operating costs, the railroads reopened the question of gasoline rail cars and a number of lightweight units were constructed. The first of these were simply highway trucks with flanged wheels instead of rubber tired wheels. These were light in weight and construction. Several modifications and improvements followed, but in general, the experience indicated the necessity of more power and heavier car construction.

The next major step was the construction of the Brill model 55 car. This conformed more closely to the ideas of the railroads and was found to be thoroughly practical for light branch line service. The transmission of these cars was of the mechanical type but they helped greatly to bring the gas-electric rail car to its present state of perfection.

The next advances were made when the Electromotive Company applied electrical transmission to a 175 horse-power engine, and the Brill Company appeared with a 250 horse-power engine with electrical transmission. Every one of these cars proved themselves reliable where properly applied.

There has been a decided increase in the use of the electrical transmission on the gasoline driven rail cars in recent years, and this form of transmission has been selected for the large majority of all cars bought within the past two years.

HUGO H. HANFT
Mr. Hanft is seen standing on one of the exterior galleries of the Milan Cathedral.

While as yet the use of the gas-electric car is not practical on main lines, it has proven more satisfactory and more economical than steam locomotives on branch lines. Its operating cost is about one-half that of a steam locomotive. In addition, there are a number of indirect returns which are exceedingly difficult to evaluate, such as reduced right of way maintenance, reduction of attendant facilities, and charges, and improved public relations.

The savings effected by rail car operation are due to saving in crew expense, saving in fuel, reduction of maintenance and attendant charges, and improved availability. The original light weight car often saved its price within the first year and the modern cars usually require less than two years.

The thermal efficiency of the gasoline engine is more than three times that of a steam engine. Statistics show that the thermal efficiency of a steam engine is not over 6 per cent while that of a gasoline engine is 20 per cent. Another advantage that lies with the gasoline electric rail car is that of availability of service. Where the average steam locomotive operates 113 miles per day, the gas engine plant can easily average from three to four times this amount.

There are three types of transmission with the gasoline drive, namely, mechanical, hydraulic and electrical. Of these the electrical form of transmission embodies qualities which render it the most practical for railway propulsion, especially for engine sizes about 125 hp. The essential advantages which make the electrical transmission the most desirable are the smooth flow of power to the wheels regardless of tractive effort or speed, the flexibility of control and application of power, and the absence of rigid or troublesome mechanical connections between the spring mounted engine and the wheels.

With electrical transmission the engine is directly coupled to a simple generator which furnishes power to propulsion motors geared to the axles. An auxiliary generator also driven by the engine furnishes power for exciting the field of the main generator. The control of power is simple, usually being accomplished simply by varying the engine speed, automatic adjustment of the current and voltage being built into the apparatus.

In the electrical system of power transmission as in any other system, the problem of the auxiliaries is troublesome. Pressure air for the brakes must be provided and also cooling air to the radiators. Batteries must be charged and in some cases heat and light providing for trailing cars. It is these auxiliaries which cause a large part of the apparent complication in the self propelled vehicle and yet these auxiliaries must be provided for, whatever system of transmission is employed.

The steam locomotive is not seriously threatened in the near future, but its position will depend upon the rate of progress which its designers can provide. It will be supplanted in a number of places by electrification, because the latter can show economies of operation which cannot be attained by steam or gas-electric engines.

Some Factors Affecting the Strength of Concrete

By JOHN SKIDMORE, C. E. '30

SINCE the invention of portland cement of Aspdin, of Leeds, England, in 1824, concrete has revolutionized structural methods and has come to be one of the most widely used materials in structural work. Although discovered slightly more than a century ago, it was not until fairly recently that any scientific research was done to discover, if possible, what methods of mixing, placing and curing the concrete would lead to desirable results in the way of strength, durability and economy, which are three prime requisites of practically all concrete[1]. This article will deal largely with the results of experiments carried on at the Structural Materials Research Laboratory with the co-operation of Lewis Institute and the Portland Cement Association.

The results of these experiments show that the quantity of mixing water is of vital importance in designing concrete of a given strength; that longer periods of mixing increase the strength of the concrete at a given age; that the presence of moisture after the concrete has set furthers the process of hydration, making the concrete stronger and more nearly water-proof; that concrete cured at 20° F. is only 41 per cent as strong as concrete cured at 70° F.

Concrete is a mixture of portland cement, water and inert materials, put in place in a plastic condition but hardening soon after, due to the chemical reaction which takes place between the water and the cement. Since concrete cannot be tested for quality at the time it is placed, the methods of mixing, placing and curing, and protection during the curing period are of the utmost importance if the finished product is to meet the requirements of the work for which it was intended. The effect of each of the above factors has been determined by exhaustive research and experimentation the results of which make it practicable to design mixtures so that the qualities of the concrete can be calculated with considerable accuracy at the time of placing.

Perhaps the most notable fact brought to light by these experiments was the effect on the concrete of the quantity of mixing water. This discovery, known as the water-cement ratio strength law, may be stated as follows:

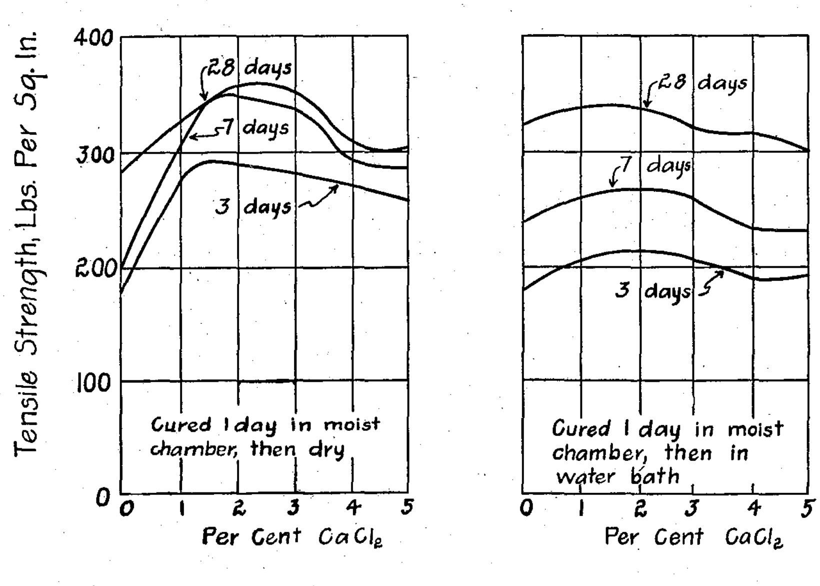
For given materials and methods of manipulation, the strength of concrete is determined solely by the ratio of the volume of cement, so long as the mixture is plastic and workable.

Stated differently, if a definite amount of cement and water are used in a concrete mixture, the strength of the concrete at a given age is fixed, regardless of quantity of aggregates used, provided the mixture when made, was plastic and workable and the aggregates were clean and made up of sound particles. Thus it will be seen that designing a concrete of a given strength consists in selecting the water-cement ratio corresponding to that strength and then finding the combination of aggregates which will give the desired workability when mixed with cement and water in this ratio. The weak point of this law is the term "workable." Each man has his own idea as to when a concrete mixture is workable. The tendency, in any case, would be to facilitate handling and placing by incorporating more water in the mix, thus increasing the ratio of water to cement and causing a corresponding decrease in the strength of the concrete at a given age.

It will be observed that, using equal volumes of cement and water, concrete has a compressive strength of 2,000 pounds per square inch at the end of twenty-eight days, whereas concrete made using only half as much water as cement has a compressive strength of 5,300 pounds per square inch at the end of the same period.

Not only does the water-cement ratio control the compressive strength of concrete but also other desirable qualities, one of which is impermeability. This fact will be more easily appreciated if the cement paste is thought of as a glue which holds the particles of the aggregate together. The greater the density of this glue, the greater the impermeability of the concrete. Impermeable concrete requires non-porous aggregates thoroughly incorporated in a cement paste which is itself impermeable. An impermeable paste is obtained only with a low water-cement ratio; thorough incorporation of the aggregates requires a mixture that is plastic and workable. Therefore a low water cement ratio insures a highly impermeable concrete.

The proper control of the water-cement ratio, however, is only one of the factors to be considered in the production of high quality concrete. To obtain the best results, some standard procedure of mixing, placing, and curing should be adopted, and adhered to as nearly as possible at all times.



Time-Strength Curves of Cement Mortar With Included $CaCl_2$

[1]By *mixing* is meant the mixing together of aggregate (that is, the sand, and gravel or crushed rock) cement, and the water.

By *placing* is meant the deposition of the plastic concrete into forms that hold it in the desired shape until it has solidified.

By *curing* is meant the treatment of the concrete (after it has solidified) to increase its strength by furthering the process of hydration of the cement.

Tests prove that the strength of concrete is increased by longer periods of mixing. The strength increases rapidly for periods of mixing up to about two minutes. Concrete mixed for two minutes is from 20 to 35 per cent stronger than concrete mixed only 15 seconds. Furthermore, tests show that thorough mixing produces more uniform concrete. Test specimens made of concrete mixed 15 seconds showed a variation of individual specimens of about 30 per cent from the average strength while specimens made of concrete mixed two minutes varied less than 10 per cent. Thorough mixing gives increased workability which facilitates the handling and placing of the concrete. Another advantage of thorough mixing is the production of homogeneous concrete, which is necessary if the cement is to be water tight. This quality is of great importance, especially in northern United States where the concrete is exposed to freezing. A porous concrete absorbs water easily and the expansion and contraction of the water when it freezes and melts results in the weathering of the surface and eventual disintegration of the entire mass. Again, concrete that is not homogeneous will be composed of small particles that do not contain the same amounts of cement. Since the porosity of concrete is dependent on the gel or glue that holds the particles together, it follows that the particles containing the greater amount of cement will be more dense because of the greater amount of glue present and the result will be a concrete that consists of alternate dense and porous parts. The porous spots will absorb more moisture than the more dense portions; and since concrete expands when it absorbs water, the porous particles will expand more than the remainder of the concrete, setting up internal stresses which may result in cracking of the concrete.

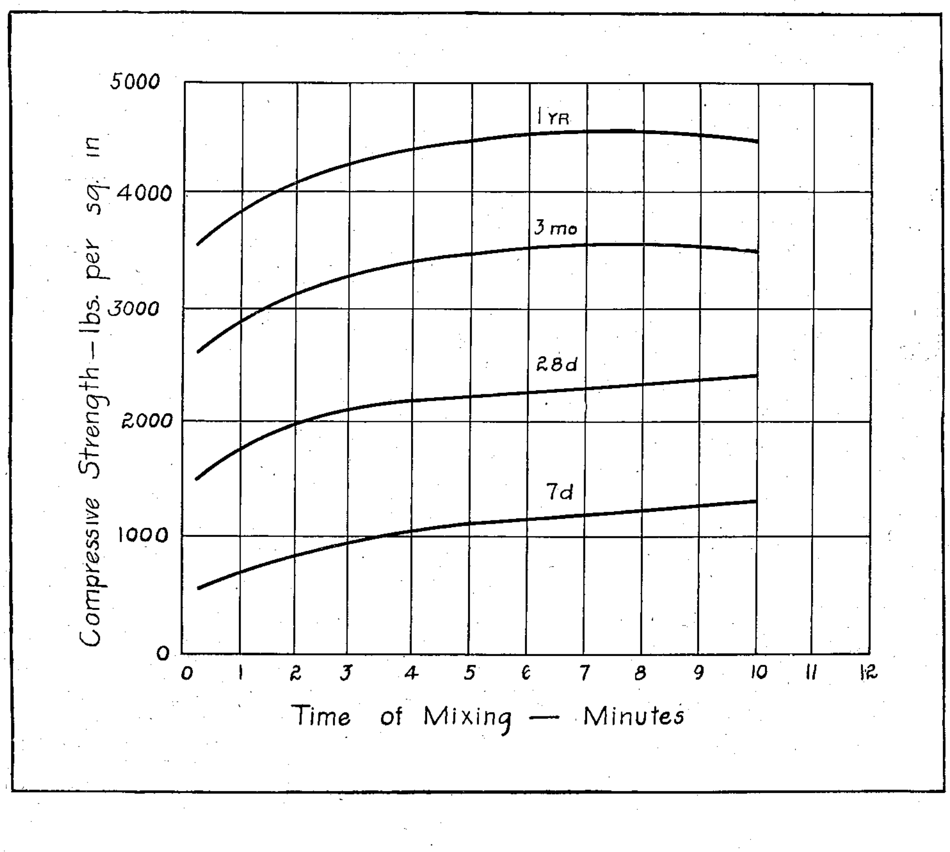
After the concrete has been mixed and placed follows a period during which the concrete is said to be setting. The concrete solidifies in a comparatively short time but the hardness keeps on increasing indefinitely so long as temperature conditions are favorable and moisture is present to complete the hydration. Tests indicate that damp storage of concrete after it has solidified increases compressive strength materially.

If the concrete is allowed to dry out too soon after it has set, only a part of its potential strength will be attained. Furthermore, after concrete has once been dried out, the presence of moisture will not further the process of hydration and therefore the strength of the concrete is increased. The reason for this is that each small particle of concrete is surrounded by a thin layer of highly impermeable cement gel formed by the action of cement and the small amount of water present before the concrete had dried out. Proper curing increases the impermeability of concrete by making more complete the process of hydration. Thus, the production of strong impermeable concrete necessitates curing in the presence of moisture for a period after the concrete has solidified.

The length of the curing period, considering the strength of the concrete alone, should be as long as possible. It is necessary, however, for economic reasons, to make the period as short as possible consistent with obtaining concrete of a given strength. Various methods of curing concrete other than by wetting with water have been tried. The most common method is the use of calcium chloride, both in solution in the mixing water and spread on the surface of the concrete after it has solidified. The latter practice is objectionable, however, because at present, no device has been perfected that will spread the calcium chloride evenly over the surface of the concrete. The calcium chloride acts as a curing agent by absorbing moisture from the air, thus keeping the surface of the concrete moist. If the calcium chloride is not spread evenly over the surface of the concrete, there will be a greater amount in one place than in another; the greater amount of calcium chloride will absorb the greater amount of water; and the concrete immediately underneath will be of greater strength because of the more complete hydration of the cement due to the presence of a greater amount of moisture. The result will be a concrete that is made up of strong and weak portions. Such concrete will not bear up under loads as well as concrete that is homogeneous with respect to strength. It will be noted that even though the concrete was properly proportioned, mixed and placed, the final result is concrete with a segregated internal structure.

Experiments involving the use of calcium chloride in solution in the mixing water were conducted recently by A. S. Levens of the College of Engineering and Architecture, University of Minnesota. Experiments were made with specimens containing up to 5 per cent calcium chloride. Figure 4 shows a part of the results obtained through this experiment. In every case the use of calcium of chloride up to 2 per cent of volume of the current produced concrete of the greatest tensile strength at the end of a given period. Amounts in excess or deficiency of 2 per cent produced concrete with a lower tensile strength. The strongest specimen tested was one that contained 2 per cent calcium chloride cured one day in a moist chamber and then air cured until tested at the end of seven and twenty-eight day periods. Specimens containing no calcium chloride and which were cured in a water bath were stronger than those containing no calcium chloride and which were air cured. In the case of the air cured specimens, the use of more than 2 per cent calcium chloride caused a sharp decrease in the tensile strength of the concrete. The disadvantage of using calcium chloride as an integral part of the mix is that it causes shrinkage of the concrete. When

(Continued on page 289)



The Chemist Turns Inspector

By HOWARD DRAPER, CH. E. '29 *and* L. B. OTIS, CH. E. '29

BATTLE cry around the chemistry building: "Have you got your tickets yet?" "Are you sleeping upper or lower?" No, it was not in anticipation of a football trip—just the senior chemical engineers looking forward to their annual spring inspection spree to Chicago and its environs.

To make a long story short, we embarked on two special Pullmans under the able chaperonage of Doctors Mann, Montonna and Montillon of the Engineering Department, who saw to it that we indulged in nothing but the mildest forms of amusement (craps, poker, etc.). After a short time we learned that Dr. Mann is quite a shark at poker, and after the first night out the wiser boys played bridge.

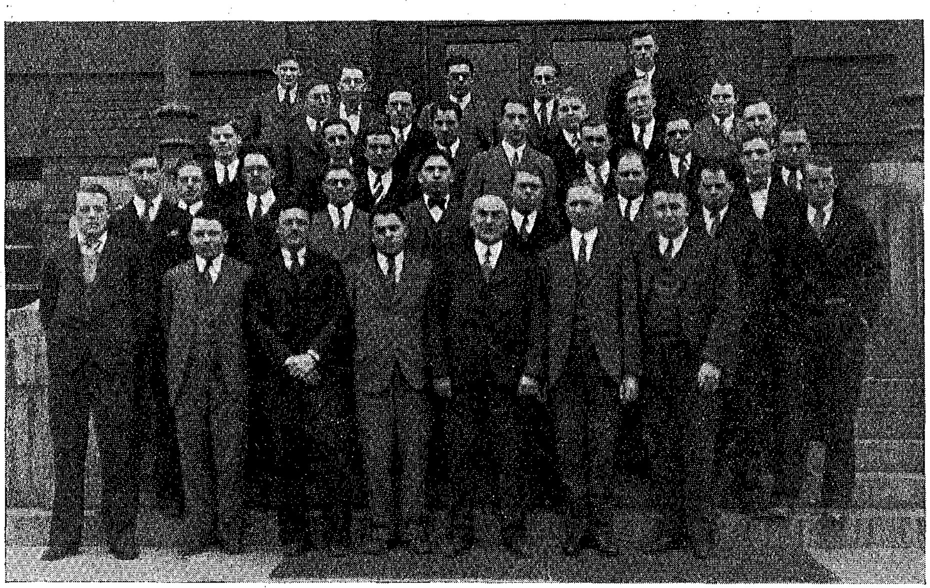
The lads who were up woke those who had had some sleep as the train pulled into Green Bay at six A. M., where we had breakfast, or whatever you might call it, at the depot. We arrived at Appleton at seven-thirty and walked to the hotel, as per the itinerary sketched out by the professors in charge. This itinerary, by the way, gave the plans for the trip in the most minute details.

A bus, furnished by the Kimberly-Clark Paper Co. took us the three miles to their plant, which is north of Appleton on the Fox River. We were initiated into sight seeing by being shown the intricacies of paper-making. This company manufactures it from wood-pulp by a chemical and mechanical process. The company gave us a very good lunch gratis, but some of the boys were a bit bashful about the free-lunch proposition, since they were too young to appreciate the free lunches accompanying beer in the saloon days.

We then saw paper made from rags at the Fox River Paper company, located in the city of Appleton on the Fox River. This plant is the haven of the old rags sold to the junk-man. However, these same old rags go to produce a very fine grade of paper. Our respect for the plant grew as we were presented with a generous sample of fine bond paper. Different trade-marks in the water-markings are one of the features of Fox River Paper.

The evening train bore us into Milwaukee, and we took the Wisconsin by storm. They knew we were coming, but we managed to surprise them anyhow and disorganize their forces. However, rooms were eventually secured. A burlesque show across the street from the hotel did not add to the moral uplift of the boys, and a few succumbed, while others used the telephones in their rooms to good advantage to get in touch with various female acquaintances, and the more successful socialized. The remainder made arrangements for future evenings. However, some of them took the trip seriously and wrote up the first instalment of the report on the trip.

Next morning found "Doc" Mann clucking around trying to gather his chicks together. After a careful census of noses disclosed that all were present, we took one of Milwaukee's fancy double-jointed streetcars by storm and proceeded merrily (to the consternation of the conductor) for Pfeister-Vogel Leather Company. As a kindly note of warning, we would suggest that anyone taking a pleasure trip avoid approaching the vicinity of a tannery, as it is upsetting to say the least. The deleterious odors thereof do not tend to make a hasty breakfast more digestible—at least, not in the writer's case.



THE 1929 CHEMICAL ENGINEERING CLASS

Our olfactory nerve was somewhat mollified by our visit to the perfumed atmosphere of the Palmolive Soap company, where, much to our disgust and chagrin, Palmolive soap was made *without* dye, as we had supposed. For the enlightenment of those who did not see it, we may mention that the color is due to the natural color imparted to the soap by palm and olive oil. Here, too, we received samples of soap, shaving cream and powder, which were welcomed by the more forgetful men.

After gulping down a hasty lunch, we then enjoyed a street-car ride to the United States Glue plant. Products of this plant are gelatine, glue and fertilizer, but after our initiation at the tannery, the glue factory seemed mild in comparison. That night, the waitress in the restaurant brought us Jell-o for dessert. We haven't forgiven her yet. To the best of our knowledge, thirty-three dishes went back untasted.

* * *

Another session of Milwaukee night life.

* * *

The next morning was spent in a manner quite similar to our first in Milwaukee and we arrived at the plant of the Pittsburg Plate Glass company. However, do not be misled by the name—this plant manufactures paints, varnishes and lacquers. The more experimental boys bore resemblances to barber poles by the time we left.

We next visited the Milwaukee coke and gas plant, where the complex material, coal, is transformed into coke and gas. Being in the gashouse district, some of the boys partook of veal stew. After the first orders of stew were served, the remainder changed their orders to roast beef as the stew bore too much of a resemblance to the raw material used in the glue factory.

After lunch, a short boat ride in the good ship Sally was taken to Jones Island, the location of the Milwaukee sewage disposal plant, where we saw the process of purifying sewage and the separation of the solid material from the water, which came off in a form suitable for drinking purposes. The solid material was converted into the fertilizer known under the trade name of "Milorganite" (Mil for Milwaukee, "org" for organic and "nite" for nitrogen).

We left Milwaukee with the pleasant memories of a tannery, glue factory and a sewage disposal plant. We arrived in Chicago that night and most of us were ready to call it a day, and turned in at the Atlantic Hotel. The next day being Sunday, we partially caught up with our sleep. Not satisfied with the routine specified in the travelogue, some of us inspected the field museum, while others visited Lincoln Park and its zoo. For some reason or other, none of our band were mistaken for the monkeys, even though they did eat peanuts.

The next morning we traveled on the Illinois Central Blue Island Express to Kensington, to visit the famous Sherwin-Williams Paint company. On our arrival there, one of our important members, none other than "Borox" was found missing. However, he finally arrived, amidst much cheering, having caught the next train. At this plant we saw them making the red dye used in printing government postage stamps, and also that on the "Lucky Strike" cigarette package.

The Universal Portland Cement company at Buffington was the next to receive the numerous foolish questions with which we distracted our guides. At this plant we received our second free lunch, and found that our appetites had improved appreciably since the Kimberly-Clark free lunch. After lunch, dressed similar to the motorist of 1905 or thereabouts, in linen dusters and caps, we walked through the plant. We then returned to Chicago via bus and continued our social activities. To keep up its reputation, Chicago had a killing for us—a woman being shot by revenue agents.

The next morning we visited the Argo Corn Products Refining company to see them manufacture starch and syrup. The Western Electric company followed — Western Electric being the birthplace of modern telephones and equipment as well as television.

We returned again to the Atlantic Hotel and resumed extra-curricular activities along the great White Way.

The next morning we assembled at the Standard Oil company in Whiting, Indiana. During our sprint over the 720 acres covered by this plant behind a long-legged guide who made Nurmi seem a snail, we remembered "Doc" Mann's cautions to the effect that he didn't care to see any of us lagging more than a mile behind the rest, as he couldn't see any farther than that. However, there was no chance of anybody getting a mile behind "Doc" Mann, because he brought up the rear a mile behind everyone else. After this we did not hear much more about a bet which was made earlier in the trip between him and Fred Hovde as to whom had the best endurance.

The rest of the day was occupied in inspecting the Grasselli Chemical company and the U. S. Lead Refining company. In the latter plant considerable quantities of silver and gold were recovered from the crude lead. We were permitted to view $500,000 worth of silver in a vault. We were amazed at the safety enjoyed by this company at such a close proximity to Chicago. However, we were informed that anyone maliciously entering this plant might be greatly shocked at what he found there—high voltage wire protection.

The next morning we packed up and left for the Illinois Steel company at South Chicago. After seeing tons of molten steel being tossed around by cranes as easily as one would handle a glass of water, we continued our journey to Joliet, where we saw steel wire drawn down to small sizes and then woven into wire fences. Our next visit was Ottawa, where we remained over night and visited the National Plate Glass company the next morning.

The last plant to receive our attention was the Western Clock Company, home of the famous Westclox line.

If one alarm clock at 7:30 A. M. seems noisy, one should hear a thousand ringing in the testing room all the time. These clocks woke us up to the fact that our trip was practically over. In celebration of this event, Dr. Mann treated us all to a street-car ride to the station. The train pulled in and we piled on; of course, there were those who didn't know when they'd had enough and those who went to bed. With the appearance of the Foshay tower in the dim horizon, we realized that a red-letter day in our life—the spring inspection trip—had come to an end.

Some Factors Affecting the Strength of Concrete

(Continued from page 287)

used in excess of two per cent, calcium chloride causes shrinkage.

For this reason, calcium chloride should not be used in winter construction work to lower the freezing point of the concrete or as a substitute for heating the water and aggregate and protecting the concrete after it is in place as the resulting shrinkage and cracking will involve far more serious results than would be justified in the economy resulting from not heating the constituents of the mix and protecting the concrete after it has been placed. The effect of the temperature on the rate of hardening of the concrete is shown very clearly by the accompanying graph. The strength of concrete cured at 70° F. for twenty-eight days was taken as the basis and all other specimens were figured on a percentage basis. Thus, at twenty-two days, concrete aired at a temperature of 90° F. was about 10 per cent stronger than concrete cured at 70° F. for the same length of time. Concrete cured at 50° F. for twenty-eight days was only 82 per cent as strong while that cured at 20° F. was only 41 per cent as strong as the concrete cured at 70° F.

The ultimate possible strength attainable by concrete is dependent on the conditions at the time of mixing, placing, and curing; that is, the aggregate, the water-cement ratio, time of mixing, method of placing, length of curing period, and method of curing.

News from the Technical Campus

Arabs Initiate Thirteen

At the last meeting of the Arabs, technical schools dramatic organization, initiation ceremonies were held, and officers for the coming year were elected.

Thirteen undergraduates promised to uphold the traditions of the organization, and pledged themselves to secrecy and service. Those to receive pins were: Edwin L. Ager, Richard Bennion, James Dennerly, Gilbert Green, Robert Heller, Charles Hubley, Carl Ave Lallemont, O. Reginald Lindström, C. W. MacMullen, J. P. Shirley, Clifford Stephens, and Raymond Trueman.

Francis J. Fox was chosen president of the organization for the season of 1929-30. Mr. Fox has been active on the Minnesota Techno-Log for the past three years. In collaboration with Robert J. Ginnaty, he wrote Enginferno, the production offered by the Arabs during the present season (Techno-Log, May, 1929). Other officers elected are: J. P. Shirley, vice-president; J. Rex Severson, treasurer, and Francis Gorman, secretary.

Following a banquet at the Pagoda, a short resume of the season's activities was given by Donald Felthouse, retiring president. Mr. Felthouse pointed out that the present season was one of the most successful in Arabs history. Said he further: "The organization may justly claim as its greatest achievement the formation of friendships. Friendships that have been welded in the fire of mutual sacrifice to withstand the separation of future years."

A.S.C.E. Committee Meets

Ora M. Leland, Dean of the College of Engineering and Architecture, Dean of the school of Chemistry, journeyed to New York. There assembled the committee on student affairs recently appointed by Anson Marston, president of the American Society of Civil Engineers.

Other members of new committee: Engineer-chairman H. P. Hammond, professor at Brooklyn Polytechnical Institute; Engineer G. H. Fenkell of Detroit; Engineer George L. Lucas of New York; Engineer Charles W. Sherman of Boston.

Student chapters of the American Society of Civil Engineers number ninety-five, have total enrollment of over 5,000 prospective engineers. At Minnesota 125 undergraduates display A.S.C.E. pins; sponsor educational films — "Power," "Conowingo"; hold occasional smokers.

Precocious Professors Play Pranks

On the occasion of the marriage of J. E. Larson, instructor in mechanical engineering, prankish professors played pranks. Profiting by the absence of Mr. Larson, his colleagues bedecked his office with gay streamers, old shoes, rice, and other humorous decorations usually considered appropriate.

Mr. Larson had left for Hastings, Minn., where his marriage to Miss Ada Locker was solemnized. Following the ceremony, Mr. and Mrs. Larson motored to Brainerd, then to Gull Lake and will spend the rest of their honeymoon at Itasca Park.

Navy to Select Grads for Flight Training

Naval officers during the month will select twenty University graduates for aeronautical training in the United States Naval Reserve and the Marine Reserve.

The individuals chosen will take a ground school course at the University and the Naval Reserve Armory beginning with the fall term. After completing this successfully, they will be sent for a month's training to the United States Naval Aviation Base at Great Lakes, Illinois, and later to Pensacola, Florida, where they will receive a minimum of 200 hours of flight instruction.

Upon completion of the course, students will be given an examination and commissions in either the naval reserve or the marine corps reserve.

A. C. S. To Meet in Minneapolis

The American Chemical society will hold its annual Fall meeting in Minneapolis from September 9 to 13. Dr. Samuel C. Lind, director of the School of Chemistry at the University, is chairman of the executive committee in charge of general arrangements.

It is believed that over 2,000 chemists from the United States and foreign countries will attend the meeting. The American Chemical Society has a membership of approximately 17,000, is the largest independent scientific organization in the United States.

Dr. Irving Langmuir, president of the society, will deliver the principal address of the meeting. Dr. Langmuir recently spoke in Minneapolis as a guest of the School of Chemistry (Minnesota Techno-Log, April, 1929).

The committee members from the University include Professor R. E. Kirk, secretary; Professor R. E. Montonna, treasurer; C. H. Bailey, R. A. Gartner, George Glocker, W. M. Lauer, C. A. Mann, Charles Rosenblum, L. H. Ryerson, and M. C. Sneed.

Beck Gets Law Honor

Miss Eva L. Beck, secretary to Deans of the College of Engineering from 1910 to 1921 recently received the degree of bachelor of laws at Minnesota college.

Miss Beck was awarded a prize of $100 upon graduation for attaining the highest scholastic average in the senior class. She plans to enter legal work sometime during the fall.

Techno-Log Announces New Officers

J. P. Shirley and J. Lamont Warrington Are Elected to Head Magazine Next Year.

J. P. Shirley and J. Lamont Warrington have been elected to the positions of managing editor and business manager, respectively, of the TECHNO-LOG for the coming year.

Mr. Shirley, who will succeed J. Robert Ginnaty as managing editor, held the position of news editor on the TECHNO-LOG staff during the past year and was active in the last production of the Arabs. He was elected vice-president of the Arabs at the recent spring election.

Succeeding W. Gerald Warrington as business manager is his brother, J. Lamont Warrington, who, during the past year, has held the position of business associate on the TECHNO-LOG staff.

Mr. Warrington, who is a senior electrical engineer, has been active in campus affairs for the past two years. He took one of the lead roles in "Enginferno," the most recent production of the Arabs, and was active on committees for Engineers Day and the 1929 Electrical Engineering party.

At the annual TECHNO-LOG banquet in May, he was awarded a silver TECHNO-LOG key for meritorious service on the publication staff.

Mr. Warrington is a member of Synton and Kappa Eta Kappa fraternities.

Those Honored

Many technical students are included in the annual announcement of prizes, awards and elections to scholastic fraternities

Architectural Awards

The Moorman Prize was won by Dudley C. Bayliss.

The Magney and Tusler prizes were awarded to James A. Brunet, Erling W. Nelson.

The American Institute of Architects prizes were awarded to Frederick M. Hakenjos and Leland R. Amundson.

The School of Architecture prizes were won by Gerhard C. Peterson, Melvin C. Stenrud.

The Scarab medal in Architecture was won by Edward W. Hanson.

The Alpha Alpha Gamma prize was awarded to R. C. Gherny.

The American institute of Architects medal was awarded to Frederick M. Hakenjos.

The William A. French prizes in interior decoration were awarded to Eugine Undine and Ruth Carter.

Alpha Chi Sigma Prize

The Alpha Chi Sigma prize, awarded each year to the male sophomore in the school of Chemistry having the highest scholastic average at the end of the winter quarter, was won by Donald G. Gernes.

Pi Delta Epsilon

Engineers elected to Pi Delta Epsilon, honorary journalistic fraternity are Francis J. Fox, J. Wesley Gray, and W. Gerald Warrington.

Chi Epsilon

New members initiated during the past year in Chi Epsilon, honorary Civil Engineering fraternity are: James B. Janson, Robert N. Lohn, Rex S. Anderson, Harolt T. Clausen, Raymond E. Hertel, George H. Meffert, Lyell R. Shellenbarger, Rolland W. Stoebe, Eugene W. Weber.

Alpha Delta Sigma

Wesley Gray and Robert E. Stewart were elected to Alpha Delta Sigma, honorary advertising fraternity.

Tau Beta Pi

Tau Beta Pi, all engineering honorary fraternity, elected the following men during the past years: seniors, Leland R. Amundson, Lester F. Borchardt, Donald C. Felthous, Maurice C. Fetzer, David W. Glaser, John Gunnarson, Fred L. Hovde, Maoling Liu, Chester L. Nelson, Theodore A. Perry, Otto J. Pfeifer, Nordahl T. Rykken, Richard E. Daschner, Grant L. Waits, Peter Warhol; juniors, Rex S. Anderson, Bruce R. Colby, Byrnon R. Colby, Charles T. Hendrickson, Raymond E. Hertel, William Cameron Kay, Clarence A. Kutz, J. Theodore Lundquist, John H. Roe, Lyell R. Shellenbarger, Raymond Sheppard, Melvin C. Stenrud, Bruce V. Wallace.

Iota Sigma Pi

Iota Sigma Pi, honorary chemical sorority, has elected the following members during the past year: Keren E. Gilmore, Margaret Jump, Sister Remberta Westkemper, Sister Urban.

Phi Lambda Upsilon

New members elected to Phi Lambda Upsilon, honorary chemical society, are: E. C. Bayfield, J. L. Beal, W. R. Brown, C. D. Byrkit, J. W. Read, E. M. Van Duzee, Stanley M. Jackson, John R. McDonnell, Frederick C. Beyer, Donald G. Gernes.

The Sigma Xi Prize

This prize, which is awarded to undergraduates who have shown special skill in the field of research, was won by Maurice G. Fetzer.

A. S. C. E. Prizes

The northwestern section of the American Society of Civil Engineers offers prizes annually to the members of the student chapter submitting the best papers. These were won by Willard W. Fryhofer, Fred C. Frederickson, Lyell R. Shellenbarger, Grant J. Waits.

Eta Kappa Nu

Elections to Eta Kappa Nu, honorary electrical engineering fraternity included Lester F. Borchardt, William Devoy, Raymond Freeman, Maoling Liu, John Millunchick, Lloyd Oman, William Painter, Erling Saxhaug, James Specht, Frederick W. Suhr, Irwin Vignes, Glen Williams, Homer Brown, Roy Comstock, Ransford Fenton, Charles Hendrickson, Vernon Norman, John Roe, George Shortley, Karl Sommermeyer.

Pi Tau Sigma

Pi Tau Sigma, honorary society in the department of mechanical engineering elected the following men: Melvin P. Fedders, Manford P. Hanson, W. E. Reed, Howard D. Geise, Richard Guppy, Hugo V. Kajola, William A. Reichow, Adolph G. Ringer, Ray Sheppard.

Bookstore Board

Engineers who have been elected to serve on the Bookstore Board for the coming year are Leonard Melkus, Architecture; Clinton MacMullen, Chemistry; James Bailey, Electrical; Roland Stoebe, Civil; and Ralph Baskerville, Mechanical.

All University Council

The following men have been elected to represent the technical colleges on the all university council: Hubert Tierney, School of Chemistry; Lyle Christensen, School of Mines; and Francis Mullen, Engineering and Architecture.

Tau Sigma Delta

Tau Sigma Delta, national honorary fraternity in architecture elected the following men: Leland R. Amundson, Frederick M. Hakenjos, Glyne W. Shifflet, James A. Brunet, Gerhard C. Peterson.

The Shelvin Fellowships

Edward C. Truesdale, B.A. Carleton College, 1922, M.A. Harvard, 1927.

The DuPont Fellowship in

DuPont Fellowship

The DuPont fellowship in Chemistry was awarded this year to Elmore H. Northy.

Plumb Bob

Plumb Bob is an organization of senior men in the technical colleges who have assisted in the promotion of the general welfare of the university. The following men have been elected: Realto Cherne, Raymond C. Freeman, J. Robert Ginnaty, Frederick M. Hakenjos, Fred L. Hovde, Lawrence E. Johnson, Leon A. Mears, William H. Painter, Harold W. Rehfeld, Nordahl T. Rykken, Louis M. Schaller, Stanton P. Wallin.

Grey Friars

Frederick Hovde has been elected to Grey Friars, a senior men's honorary organization.

Iron Wedge

Harold Rehfeld and Louis M. Schaller have been elected to Iron Wedge, a senior honorary society.

Silver Spur

Silver Spur, a junior men's organization, has elected Curtis Crippen and William Painter to its membership.

The Phi Lambda Upsilon Prize

The Phi Lambda Upsilon prize, awarded each year to that male student majoring in agricultural biochemistry, was awarded this year to Donald C. Gernes.

The Chemistry Faculty Prize

Awarded to that student who maintains the highest average in the work of the sophomore and junior years and the first two quarters of the senior year, it was won this year by Arvind E. Lynden.

Board of Publications

W. Gerald Warrington, business manager of the Techno-Log during the past year, has been elected to represent the College of Engineering and Architecture, the School of Chemistry, and the School of Mines on the board in control of student publications for the next year.

The Minnesota Techno-Log

UNIVERSITY *of* MINNESOTA

Again—Speech!

AGAIN the cry is speech, speech, speech.

We are told that we have courses in speech right in our own University. But it has been rumored that the present courses are poorly conducted, inadequate, and fail in their major purpose. In order to ascertain the truth or falsity of this rumor an examination was made of the course in public speaking attended by engineers, and known as Speech 35.

It was found that there are some twenty individuals in the class, meetings are scheduled three times each week, are held twice some weeks, once other weeks. Up to mid-quarters each man made two talks. On the first of these he was required to give a resume of his life's history. One student forced himself to the front of the room. Said he, "My name is Jomatz." He mumbled, shook his head and his knees and collapsed as he reached his chair. On his second and last venture little improvement was shown.

In fact, students are even required to purchase text books,—full of information on "personality," how to "hold the audience" and such colorful admonitions as "Be Yourself," and the "chief thing to remember about the head . . . use it."

Significance: Proficiency in public speaking, when not innate, can be obtained only through practice. Despite the most earnest attempts of an instructor, it is impossible to give adequate practice to each man when some twenty individuals are clamoring for self-expression. It is useless to urge a speaker "to be natural" when the prospect of a speaker's platform is more terrifying to him than dry land to a fish.

Suggestion: That small classes be originated. That attendance be demanded of every engineer for at least one quarter during his undergraduate years. That practice in large dosages be administered to every man three times each week.

$1,000

WE are often so busy that we do not have time to read even the technical journals and literature of our own industry or our own jobs.

The result is that today hundreds of executives are busily making mistakes and overlooking constructive ideas because they are denying their minds and their businesses the benefit of the experience and stimulus of other men's ideas and findings.

This train of thought comes as the result of an experience of a New York executive last year. This man called in a well-known business counsel to advise with him on a certain problem in his business. The "expert" told him a story of another executive in a similar line who had worked out successfully this particular problem. That was all.

The bill was $1,000 and it was paid cheerfully, for it unquestionably pointed the right course.

That executive does not know that the story he paid $1,000 to hear was told in a business magazine that lay unopened on his desk even while he was talking with the "expert." And he probably never will discover it, for he is "too busy to read."

Two Seas

THERE are two seas in Palestine.

One is fresh, and fish are in it. Splashes of green adorn its banks. Trees spread their branches over it, and stretch out their thirsty roots to sip of its healing waters.

Along its shores the children play, as children played when The Master was there. He loved it. He could look across its silver surface when He spoke His parables. And on a rolling plain not far away He fed five thousand people.

The river Jordan makes this sea with sparkling water from the hills. So it laughs in the sunshine. And men build their houses near to it, and birds their nests; and every kind of life is happier because it is there.

The river Jordan flows on south into another sea.

Here is no splash of fish, no fluttering leaf, no song of birds, no children's laughter. Travelers choose another route, unless on urgent business. The air hangs heavy above its waters, and neither man nor beast nor fowl will drink.

What makes this mighty difference in these neighbor seas?

Not the river Jordan. It empties the same good water into both. Not the soil in which they lie; not the country 'round about.

This is the difference. The Sea of Galilee receives but does not keep the Jordan. For every drop that flows into it another drop flows out. The giving and receiving go on in equal measure.

The other sea is shrewder, hoarding its income jealously. It will not be tempted into any generous impulse. Every drop it gets, it keeps.

The Sea of Galilee gives and lives. This other sea gives nothing. It is named The Dead.

There are two kinds of people in the world.

There are two seas in Palestine.

—Bruce Barton.

Your Ideas and Opinions

READERS, we welcome your opinions on engineering things of general interest, and about things on the Minnesota campus. This is your publication—broadcast your ideas to the whole student body here. Maybe you have something up your sleeve; if so let us and the rest of the Techno-Log readers hear about it. Drop into the office or write us a letter, but don't let your ideas slide off into oblivion.

THE 1929 ALUMNI DIRECTORY
of the
Technical Colleges *of the* University *of* Minnesota

ABBREVIATIONS

Courses

A, Architecture; AE, Architectural Engineering; I, Interior Decoration; C, Civil Engineering; E, Electrical Engineering; M, Mechanical Engineering; G, General Engineering; Ch, Chemistry; Ch. E., Chemical Engineering; E. M., Engineer of Mines; E. M. (Geol.), Engineer of Mines in Geology; Met. E., Metallurgical Engineer.

Advanced Degrees

CE, Civil Engineer; EE, Electrical Engineer; ME, Mechanical Engineer; MS, Master of Science; MS (Arch), Master of Science in Architecture; MS(CE), Master of Science in Civil Engineering; MS(EE), Master of Science in Electrical Engineering; MS(ME), Master of Science in Mechanical Engineering; Ch.E., Chemical Engineer.

*Deceased

CHRONOLOGICAL DIRECTORY
College of Engineering and Architecture

FROM 1875 to 1896 inclusive, the first degrees awarded for the regular four-year courses were Bachelor of Civil Engineering (1875), Bachelor of Architecture (1877), Bachelor of Mechanical Engineering (1878), and Bachelor of Electrical Engineering (1891). In this period, also, a few professional advanced degrees were given, as Civil Engineer in 1888, Mechanical Engineer in 1894, and Electrical Engineer in 1896.

From 1897 to 1911 inclusive, the degrees of Civil Engineer, Electrical Engineer, and Mechanical Engineer were regularly awarded at the close of the four-year courses, and a few were given in 1912 and 1913. In 1908, however, five-year courses were established and at the end of the first four years, the degree of Bachelor of Science in Engineering was awarded for each of the three courses, civil, electrical, and mechanical, and also for a general course in engineering, which last had begun in 1900. Upon completion of the fifth year's work the professional degrees, Civil Engineer, Electrical Engineer, and Mechanical Engineer were given, the first being awarded in 1913.

In 1921, the first degree became Bachelor of Science in Civil Engineering, Electrical Engineering, or Mechanical Engineering. The degree of Bachelor of Science in Architecture was established in 1916. The general engineering course was discontinued in 1923. The new requirements for the professional degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer were adopted in 1921 and these degrees were placed in the Graduate School.

In 1928, the form of the Bachelor's degree in this college was changed to the original one used prior to 1878, namely, Bachelor of Architecture, Bachelor of Civil Engineering, etc., and this form was used in June, 1928, and thereafter. Similar action was taken in the School of Chemistry.

New Courses were established as follows: Agricultural Engineering in 1926; and Aeronautical Engineering and Landscape Architecture in 1928.

1875

Bachelor of Civil Engineering

*Leonard, Henry C. (B. S. 1878)
Rank, Samuel A. (B. S. 1875)
*Stewart, Clark

1876

Bachelor of Civil Engineering

*Gillette, Lewis S. (B. S. 1877, C. E. 1898)
*Hendrickson, Eugene A.
Thayer, Charles E.

1877

Bachelor of Architecture

*Pardee, Walter S.

1878

Bachelor of Mechanical Engineering

Bushnell, Charles S.

1879

Bachelor of Civil Engineering

*Dawley, William S.
*Furber, Pierce P., Sr.

1883

Bachelor of Civil Engineering

Peters, William G.
*Smith, Louis O.

Certificate in Civil Engineering

Holcomb, Alexander M.

Bachelor of Mechanical Engineering

Barr, John H. (M. S. 1888)

1884

Bachelor of Civil Engineering

Hoag, William R. (C. E. 1888)
*Loy, George J.
*Matthews, Irving W.

1885

Bachelor of Civil Engineering

*Fitzgerald, Patrick T.
Reed, Albert I.

Bachelor of Mechanical Engineering

Bushnell, Elbert E.

1886

Bachelor of Architecture

*Woodmansee, Charles C.

1887

Bachelor of Mechanical Engineering

Crane, Fremont (B. S. 1886, C. E. 1898)

Bachelor of Mechanical Engineering

Andrews, George C.

1888

Bachelor of Civil Engineering

Andersen, Christian

Bachelor of Mechanical Engineering

Loe, Eric H.
Morris, John O. (M. E. 1903)

ADVANCED DEGREES

Civil Engineer

Hoag, William R. (B. C. E. 1884)

Master of Science

Barr, John H. (B. M. E. 1883)

1889

Bachelor of Civil Engineering

Coe, Clarence S.

1890

Bachelor of Civil Engineering

Burt, John L.
Dann, Wilbur W.
*Gilman, Fred H.
Greenwood, Williston
Hayden, John F.
Higgins, John T. (M. D. 1894)
*Hoyt, William H. (C. E. 1898)
*Smith, William C.
Trask, Birney E. (C. E. 1894)

Bachelor of Mechanical Engineering

Gerry, Martin H., Jr. (B. E. E. 1891)
Nelson, Thorwald E.
Woodward, Herbert M.

1891

Bachelor of Civil Engineering

Chowen, Walter A.
Douglass, Fred L. (C. E. 1899)

Bachelor of Electrical Engineering

Gerry, Martin H., Jr. (B. M. E. 1890)
Huhn, George P.

Bachelor of Mechanical Engineering

Aslakson, Baxter M.

1892

Bachelor of Architecture

Goodkind, Leo
Plowman, George T.

Bachelor of Civil Engineering

Hankenson, John J.
Higgins, Elvin L.

Bachelor of Electrical Engineering

Burch, Edward P. (E. E. 1898)
Burtis, William H.
Gray, William I. (E. E. 1898)
Howard, Monroe S.

Bachelor of Mechanical Engineering

Felton, Ralph P.
Gill, James H. (M. E. 1894)

1893

Bachelor of Architecture

Morse, George
Washburn, Delos C.

Bachelor of Civil Engineering

*Anderson, Ole J.
*Batchelder, Frank L.
*Erf, John W.
Hoyt, Hiram P.
Mann, Fred M. (C. E. 1898)

Bachelor of Electrical Engineering

Chase, Arthur W.
Dewey, William H.
Guthrie, John D. (M. D. 1897)
Morse, George H. (E. E. 1911)
Reidhead, Frank E. (E. E. 1898)
Springer, Franklin W. (E. E. 1898)

Bachelor of Mechanical Engineering

Anderson, Ole A. (M. E. 1908)
Avery, Henry B. (M. E. 1898)
Couper, George B. (M. E. 1902)

1894

Bachelor of Civil Engineering

*Cunningham, Andrew O.
Gilman, James B.
Johnson, Noah
Weeks, William C.

Bachelor of Electrical Engineering

Chalmers, Charles H. (E. E. 1903)

Bachelor of Mechanical Engineering

*Bray, George E. (M. E. 1904)

ADVANCED DEGREES

Civil Engineer

Trask, Birney E. (B. C. E. 1890)

Mechanical Engineer

Gill, James H. (B. M. E. 1892)

1895

Bachelor of Civil Engineering

Bohland, John A.
*Casseday, George A.
Chapman, Leslie H.
Shenehon, Francis C. (C. E. 1900)

Bachelor of Electrical Engineering

Adams, George F.
*Bishman, Adam E.
Eddy, Horace T. (E. E. 1896)
Ford, Robert E. (E. E. 1903)
Rounds, Fred M.
*Tanner, Harry L.
Von Schlegell, Frederick

Bachelor of Mechanical Engineering

Shepherd, Burchard P.
*Tilderquist, William M.
Weaver, Albert C.

1896

Bachelor of Civil Engineering

*Beyer, Adam C.
Burch, Albert M.
*Jones, C. Paul
Long, Fred W. (C. E. 1898)

Bachelor of Electrical Engineering

Erikson, Henry A. (Ph. D. 1908)
Magnuson, Carl E. (M. S. 1897, E. E. 1905)
*Wheeler, Herbert M.

Bachelor of Mechanical Engineering

Hastings, Clive
Hilferty, Charles D.
*Hugo, Victor
Lang, James S. (E. E. 1897, M. E. 1899)

Bachelor of Science (in Engineering)

Hickok, Jessie E. S. (M. S. 1904)

ADVANCED DEGREE

Electrical Engineer

Eddy, Horace T. (B. E. E. 1895)

1897

Civil Engineer

*Hewett, Frank M.
Lee, Engbret A.
Walker, Frank B.
Woodman, Howard H.

Electrical Engineer

Abbott, Arthur L.
Chestnut, George L.
Hibbard, Truman
Lang, James S. (B. M. E. 1896, M. E. 1899)
Markhus, Olaf G. F.
Miller, William L.
Myers, Mortimer

Mechanical Engineer

Blake, Robert P.
Craig, Robert E.
Cross, Charles H.
Lonie, James H.
Savage, Edward S.
Silliman, Henry D.

ADVANCED DEGREE

Master of Science

Magnuson, C. E. (B. E. E. 1896, E. E. 1905)

1898

Civil Engineer

Glass, Clifton A.
Taylor, Edward W. D.

Electrical Engineer

*Dahl, Hans F. M.
Gilchrist, Charles C.
McKellip, Frank W.
Wagner, Adolph W.

Mechanical Engineer

O'Brien, John E.
Willson, Manton F.
Wright, Roydon V.
Zeleny, Frank

ADVANCED DEGREES

Civil Engineer

Crane, Fremont (B. S. 1886, B. C. E. 1887)
*Gillette, Lewis S. (B. C. E. 1876, B. S. 1877)
Hoyt, William H. (B. C. E. 1890)
Long, Fred W. (B. C. E. 1896)
Mann, Fred M. (B. C. E. 1893)

Electrical Engineer

Burch, Edward P. (B. E. E. 1892)
Gray, William I. (B. E. E. 1892)
Reidhead, Frank E. (B. E. E. 1893)
Springer, Franklin W. (B. E. E. 1893)

Mechanical Engineer

Avery, Henry B. (B. M. E. 1893)

1899

Civil Engineer

Anderson, John G.

Electrical Engineer

Artz, Emmanuel A. (B. S. 1897)
Graling, Verney
Hildebrandt, Henry A.
Huntoon, Milton B.
MacKusick, Elwood M.
Pratt, Arthur K.

Mechanical Engineer

Bayless, Harry C.
Richardson, Wilbur P.
Wennerlund, Elias C.

ADVANCED DEGREES

Civil Engineer

Douglas, Fred L. (B. C. E. 1891)

Electrical Engineer

Huntoon, Milton B.

Mechanical Engineer

Lang, James S. (B. M. E. 1896, E. E. 1897)

1900

Civil Engineer

Grime, Edwin N.
*Prendergast, Paul S.
Whitman, Edward A.

Electrical Engineer

Dow, James C.
*Johnson, Frank E.
Kinsell, William L.
Parkhurst, Harleigh
Shumway, Ernest J.
Stussy, William T.
Thaler, James A.
Thompson, Roy E.
*Tracy, Fred G.
Wiltgen, Edward

Mechanical Engineer

Ashbaugh, Lewis E. (C. E. 1907)
Daniel, T. Lester
*Higgins, Charles C.
Johnston, William W.
Newhall, William B.

ADVANCED DEGREE

Civil Engineer

Shenehon, Francis C. (B. C. E. 1895)

1901

Civil Engineer

Everington, James W.
Gunstad, Paul I.
Klemer, Frank H.
McKittrick, James
Quense, John H. (M. E. 1902)
Strate, Thomas H.

Electrical Engineer

Anderson, Martin E.
Blake, Henry B.
Danner, Jake
Houlton, Amos D.
Houts, Guy J.
Reque, Styrk G.
Tullar, Chas. E.

Mechanical Engineer

Robertson, Philip W.
Wilson, Eliel F. (E. E. 1902)

Bachelor of Science (in Engineering)

Groat, Ben. F. (L. L. B. 1908, L. L. M. 1911)

1902

Civil Engineer

Allee, David A.
Beaulieu, Richard L.
Hallan, Christian
Houston, George S.
*Knowlton, Warren C.
Lambert, Fred T.
McClelland, Claude L.
Shepley, Charles R.
Weston, William S.

Electrical Engineer

Burns, Harvey L.
French, Edwin L.
McPherson, William B.
Nilson, Wilhelm
Spence, William J.
Wilson, Eliel F. (M. E. 1901)

Mechanical Engineer

Acomb, William E.
Bean, William L.
Cook, Robertson
Grimshaw, William E.
Herrick, Carl A.
Quense, John H. (E. E. 1901)
Ramstad, Edward C.
Stone, Melvin O.
*Sudheimer, Edwin L.
Taylor, Ralph G.

Bachelor of Science (in Engineering)

Graham, Eugene C.

ADVANCED DEGREES

Mechanical Engineer

Couper, George B. (B. M. E. 1893)
Quense, John (C. E. 1901)

1903

Civil Engineer

Barlow, Harry E.
Bennett, Walter J.
Beyer, Theodore A.
Carr, Harvey C.
Davison, Joseph H.
Grow, Harry A.
Madden, Francis
*Novig, Ole S.
Oltman, Charles A.
Prendergast, Arthur A.
Robbins, Orison B.
Smith, Leighton H.
Smith, Paul S. (B. S. 1901)
Stewart, Clarence H.

Electrical Engineer

Benedict, George F.
Dibble, Barry
Eberhardt, Otto I.
Erickson, Carl G.
Ireland, Roy R. (B. S. 1901)
Laird, Lee R.
*Miller, Lucius W.
Page, Mark L.
Rask, Louis G.
Rosok, Ingwald A.
Schumacher, John H.
Vincent, Jay C.

Mechanical Engineer

Hughes, Frank C.
Kjosness, Ingram G.
Williams, Edward H.

Bachelor of Science (in Engineering)

Crounse, Avery F.
Whitney, Alfred C.

ADVANCED DEGREES

Electrical Engineer

Chalmers, Charles H. (B. E. E. 1894)
Ford, Robert E. (B. E. E. 1895)

Mechanical Engineer

Morris, John O. (B. M. E. 1888)

1904

Civil Engineer

Bouge, Nathan H.
Downing, Frank E.
Fernald, Frank O.
*Holland, Jay C.
Nelson, Nels B.
Rothi, Paul

Electrical Engineer

Bouman, Bernhard M.
Cheney, Edward J.
Crabbe, George
Goodwin, Victor E.
*Helms, Frank C.
Howatt, John
Morton, Harry G.
Otto, Frederick A.
*Rosok, Peter A. M.
Taplin, Robert B.
Tomlinson, L. C.
Wicks, John

Mechanical Engineer

Fager, Simon R.
Otto, Robert W.
Stanton, Raymond E.
Davis, Gilbert N.

Bachelor of Science (in Engineering)

Collins, Stewart G.

ADVANCED DEGREES

Mechanical Engineer

*Bray, George E. (B. M. E. 1894)

Master of Science

Hickok, Jessie E. S. (B. S. 1896)

1905

Civil Engineer

Bisbee, Elmer
Brockway, Royden R.
Burke, Roy L.
Cutler, Alvin S.
Feyder, William H.
Finley, Joseph E.
Gillette, George L.
Hopeman, Albert M.
Jensen, John A.
Johnson, Nels
King, Wesley E.
McMillan, Franklin R.
Mattison, Oliver
*Mueller, Henry J.
Nelson, Oscar B.
Smith, Donald T.

Electrical Engineer

Adams, William C.
Anderson, Emil
Billau, Louis S.
Boman, Carl E.
Coleman, Frank D.
Davis, Charles A.
Ely, Irving R.
Frankoviz, John J.
Gibson, Charles B.
Jackson, Earl D.
Jones, Raymond L.
Kochendorfer, Milton J.
LeBlond, Edmond J.
LeTourneau, Edward H.
Lundquist, Reuben A.
Morris, Robert
Ryan, William T.
Simmon, Karl A., Jr.
*Smith, Clinton B.
Wood, John W.

Mechanical Engineer

Andrews, George L.
Bates, Albert H.
Clipfell, Carroll D.
Cutter, Francis C.
Gerrish, Harry E.
Harris, Sigmund
Johnson, Austin G.
*Johnson, Ernest P.
Lewis, Edward B.
*Pancratz, Alexander J.
Rydeen, Francis G. A.
Sperry, Leonard B. (E. E. 1908)
Tuck, George A.

Bachelor of Science (in Engineering)

Gregg, Treshame D. (C. E. 1906)

ADVANCED DEGREE

Electrical Engineer

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

1906

Civil Engineer

Adams, Elmer E.
Alrick, Bannona G.
Alsop, Ernest B.
Bowen, Fred P.
Childs, Hervey B.
Childs, John C.
Hanauer, Monroe H.
Hayward, George I.
Malloy, Charles J.
*Murphy, John G.
Norelius, Lewis M.
Reed, Arthur L.
Wiesner, Frederick E.

Electrical Engineer

Albrecht, George M.
Bunce, Paul F.
Calmeyer, John P.
Cohen, Nathan
Cooper, Leo H.
Cornelius, Martin
Dunn, Andrew P.
Englin, Charles F.
Finchy, Jacob O.
Glascock, Henry H.
*Gunther, Albert N.
Haeberle, Elmer H.
Hoff, Christopher
Hokanson, Clarence E.
Hubbard, Robert T.
Lang, Charles A.
Mowry, Harry W.
Payne, Harold G.
Roepke, Otto B.
*Schow, Harry A.
Schwedes, Walter F.
Shuck, Gordon R.
Stenger, Laurence A. (M. S. 1916)
Stone, Harris G.
Ungerman, Carl M.
Weber, Erwin L. F. (M. E. 1908)
Wiggins, Gerald G.
Zimmer, William A.

Mechanical Engineer

Armstrong, Thomas S.
Crawford, Wallace T.
Garber, Gabriel E.
Loye, Benjamin W.
*Matteson, Frank E.
Ringsred, Arthur C.
Rose, Norman W.

Bachelor of Science (in Engineering)

Swensen, Karl P. (M. S. 1907)

ADVANCED DEGREE

Civil Engineer

Gregg, Tresham D. (B. S. Eng. 1905)

1907

Civil Engineer

Batson, Charles D.
Blomquist, Hjalmer F.
Cram, Clyde M.
*Dougherty, Joe
Dunham, John A.
Grant, James A.
Green, Fred H.
Haverson, Henry D.
Hawley, Harry G.
Hobart, Walter B.
Huston, David B.
Jones, Lewis A.
Kelly, Earl W.
Swenson, Charles A. (L. L. B. 1910)
Tondell, Mandel G.
VanCleve, Horatio P.
Yager, Louis

Electrical Engineer

Alton, Herbert D.
Andrus, Raymond J.
Baer, Louis E.
Countryman, Peter F.
Eddy, Lynne W.
Fairchild, Albert R.
Kerns, Ralph W.
Norcross, Arthur F.
Pearce, John H.
Rezab, John J.
Schow, William P.
Smith, Byron E.
Smithson, John E.
Sternberg, Carl
Uzzell, George W.
Woehler, William L.

Mechanical Engineer

Bell, Maurice D.
Bjorge, Oscar B.
*Brown, Oliver L.
Buhl, Paul S.
Burwell, Loring D.
Fee, E. Franklin
Gessert, George R.
Gilman, Nicholas A.
Krag, Walter C.
Meany, James M.
Nekola, John W.
Rawson, Ralph H.
Spring, Willis W.
*Stacy, Elmer N.
Stephenson, Oliver H.
Tubby, Oliver G.
Wagner, Otto H.

ADVANCED DEGREES

Civil Engineer

Ashbaugh, Lewis E. (B. S. in Eng. 1900)

Master of Science

Swensen, Karl P. (B. S. in Eng. 1906)

1908

Civil Engineer

Ash, James W.
Bergoust, Oscar J.
Borrowman, LeRoy F.
Brenchley, Harry E.
Comstock, John W.
Dallimore, Arthur N.
Doeltz, William F., Jr.
Dougan, Henry K.
Fleming, Douglas R.
Furber, Pierce P., Jr.
Gage, Hugh N.
Hustad, Andrew P.
Knowlton, Herbert H.
Krauch, William L.
Lang, Fred C.
Longfellow, Dwight W.
McCall, Harry J.
McCree, Andrew A.
Mowery, Clarence W.
Norelius, Lewis M.
Okes, Day I.
Olson, Melvin S.
Quinn, John I.
Robertson, Charles N.
Schlattman, Edward C.
Walker, George W.
Widell, Gustaf F.
Willis, Roy
Woodrich, Oscar F.

Electrical Engineer

Anderson, Frank A.
Bachrach, Alfred
Brown, George J.
Carter, Robert J. S.
Casberg, James W.
Currie, Neill, Jr.
Frahm, Alfred R.
Hoppin, Glenn H.
*Hovelson, Henry
Kauffman, Roy
King, Alfred B.
McAfee, Allan L.
Pancratz, Frank J.
Peterson, Clarence A.
Prentice, Robert S.
Schildt, William F. H.
Schoepf, Alfred W.
Scobie, Francis G.
Sperry, Leonard B. (M. E. 1905)
Sturtevant, Percy G.
Svendsen, George P.
Swanstrom, Frank N.
Sweningsen, Oliver
Weibeler, William M.
Zimmerman, Louis P.

Mechanical Engineer

Anderson, Ole A.
Bingham, Stanley E.
Councilman, Halstad P. (B. S. Eng. 1909)
Cox, Richard F.
Estep, Harvey C.
Fleming, Frank R. (E. E. 1909)
*Frary, Hobart D. (M. S. 1909)
Harwood, Stanley G.
Hetherton, Percival
Morris, Thomas C.
Norelius, Emil F.
Norton, Clyde W. (M. E. 1909)
Peterson, George T.
Priedeman, George W.
Walsh, James (E. E. 1909)
Weber, Erwin L. F. (E. E. 1906)

Bachelor of Science (in Engineering)

Clarke, Charles P. (C. E. 1909)
Fruen, Arthur B. (C. E. 1909)
King, Robert N.
McKeehan, Louis W. (M. S. '09, Ph. D. '11)
Rowe, Harry B.
Schmid, Robert J.

1909

Civil Engineer

Childs, James A.
Ellison, Jay T.
Ellsberg, N. W.
Esser, Frank F.
Fiske, F. William, Jr.
Houston, Cecil C.
Hubbard, Fred A.
Hubbard, Henry A.
Ingberg, Simon
Jaques, Robert
King, Lawrence W.
Mitchell, John B.
Nelson, Edward S.
Okes, Sidney R.
Paul, Frederick T.
Sheffield, Fred W.
Shepard, George M.
Siverts, Samuel A., Jr.
Torrance, Ell

Electrical Engineer

Beckjord, Walter C.
Brockway, Alvah E.
Cobban, Rollo J.
Converse, Clovis M.
Davies, Ralph M.
Fitts, Joel A.
Fleming, Frank R. (M. E. 1908)
Gadsby, Lester H.
Grant, Fred R.
Harris, Clayton
*Hitzker, Albert J.
Hopkins, Mark L.
Hornibrook, James W.
Japs, Bernard G.
Johnson, Herman R.
Kristy, George A.
Lindelef, Charles G.
McKenzie, Lauren F.
Murrish, Frederic E.
Poore, Orson B.
Robison, Archer R.
Stillman, Marcus H.
Todd, Milo E.
Turner, Leslie E.
Vita, Theodore
Walling, Benjamin B.
Walsh, James (M. E. 1908)
Williams, Fred M. (B. A. 1905)

Mechanical Engineer

Beery, Charles B.
*Bieri, John B.
Birnberg, Zingel C. J.
Buck, Frederick W.
Buhl, John E.
Forfar, Donald M.
Holmgren, Charles E.
Kircher, Frank J.
Kircher, George A.
Knopp, William R.
Lambert, Edwin M.
Mark, Walter J.
Morris, John E.
Moyer, Malcolm B.
Nemec, Frank L.
Shippam, Willis
Souba, William H.
Starrett, Howard M.
Udell, Carl D.
Williams, Wilbur S.
Wright, Harris H.

Bachelor of Science (in Engineering)

Curtiss, Lindsley B.
Councilman, Halstad P. (M. E. 1908)
Norton, Clyde W. (M. E. 1908)

ADVANCED DEGREES

Civil Engineer

Anderson, Ole A. (B. S. M. E. 1893)
Clarke, Chas. P. (B. S. Eng. 1908)
Fruen, Arthur B. (B. S. Eng. 1908)

Master of Science

*Frary, Hobart D. (M. E. 1908)
McKeehan, L. W. (B. S. Eng. '08, Ph. D. '11)

1910

Civil Engineer

Adams, Benjamin W.
Asleson, Hans
Bolme, Ole M.
Boyum, Benjamin C.
Brownell, Otto E.
Chapman, Burton L.
Dahlquist, Philip L.
Ekman, Claes T.
Garen, George M.
Godward, Alfred C.
Jevne, George W.
Leach, Edward W.
Meyer, Carl F.
Motl, Charles L.
Nason, George L.
Olson, Arthur O.
Overholt, Harley G.
Sawyer, Emerson D.
Sommerfeld, Adolph A.
Timperley, William D.

Electrical Engineer

Anderson, Oscar P.
Anderson, Oscar V.
Beck, Vernon S.
Conley, Wilfred E.
Dahlstrom, Raymond E.
Finke, Walter J.
*Hagstrom, Herbert E.
Hansen, Christian
Hustad, Byron P.
Jesperson, Clarence M.
Johnson, Leonard T.
Josephson, Eliot B.
Landeen, Arvid G.
Nelson, Carl H.
Phelps, Ray R.
Powles, James W.
Reid, Harry A.
Skytte, Ernest E.

Mechanical Engineer

*Atkinson, William B.
Comb, Fred R.
Cook, Harry C.
DuToit, George A., Jr.
Fleming, Laurence T.
Frear, Jenness B.
Kaplan, Eugene V.
Martin, Wallace H.
Meixner, Bernard A.
Moyer, Amos F.
Nichols, Browning, Jr.
Pease, Maynard W.
Wesbrook, Donald M.

Bachelor of Science (in Engineering)

Salisbury, Willis R.

1911

Civil Engineer

Ainslie, Arthur F.
Arnesen, Herbert P.
Boerner, Francis C.
Cottingham, William P.
Croft, Ernest B.
Elfstrum, Axel E.
Enger, Edward H.
Fieldman, David P.
Hodnett, Ralph M.
Hoffman, Michael J.
Johnson, Carl A.
Kvitrud, Ingvald
Maney, George A.
Mark, Reuben A.
Mattison, George C.
Methven, Clyde L.
Miller, Erwin J.
Orbeck, Martin J.
Roth, Lewis M.
Siverson, Sigvel J.
Smith, Sydney H.
Swedberg, M. Roy
Walby, Arthur C.

Electrical Engineer

Ashworth, Roy H.
Blossom, George W.
Burrows, Robert P.
Butterworth, Allan C.
Chapman, Arthur G.
Demarest, Charles S.
Drinkall, Leon R.
Emerson, Lynn A.
Forsberg, William P.
Fredrickson, Harry B.
Hansen, Maurice J.
James, Henry C., Jr.
Johnson, Edward J.
Jones, Watkin W.
Lyford, Dartt H.
McCoy, Ira C.
McQuillin, Raymond E.
Markuson, Oscar S.
Mittag, Albert H.
Nebel, Walter H.
O'Brien, Raymond J.
Pengilly, Joseph H.
Riegel, Louis F.
Shepard, Donald D.
Soulek, Joseph H.
*Stinson, Will V.
Walker, William A.
Wilson, Glenn W.

Mechanical Engineer

Barnum, Marvin C.
Bishop, Ira L.
Farnam, Julian P.
Kasper, Walter F.
Larson, Martin S.
Olstad, Oscar A.
Oram, Robert C.
Owens, Leo E.
Sneve, Jack S.
Woodman, Joseph C.

Bachelor of Science in Science and Technology

Hoffman, Ralph M.
Klopsteg, Paul E. (M. A. 1913, Ph. D. 1916)

ADVANCED DEGREE

Electrical Engineer

Morse, George H. (B. E. E. 1893)

1912

Civil Engineer

Adams, John W., Jr.
Curtis, Thomas H.
Flygare, August L.
Hosfield, Raleigh W.
West, Robert W.

Bachelor of Science in Engineering (Civil)

Anderson, Harvey B. (C. E. 1913)
*Bailey, William H. (C. E. 1913)
Bingen, William J. (C. E. 1913)
Cummings, Elmer F. (C. E. 1913)
Diamond, Grover W.
Giertsen, Marcus O. (C. E. 1913)
Haberle, Edward L. (C. E. 1913)
Jorgens, Charles R. Danevin (C. E. 1913)
Kapphahn, Raymond J. (C. E. 1913)

Bachelor of Science in Engineering (Civil)

King, Forest V. (C. E. 1913)
Kriz, Joseph J. (C. E. 1913)
Pagenhart, Clarence C.
Pease, Raymond A. (C. E. 1913)
Peterson, Barney J. (C. E. 1913)
Ryan, Loiel S. (C. E. 1913)
South, Willard A. (C. E. 1913)
Souther, Morton E. (C. E. 1913)
Swenson, Hjalmer S. (C. E. 1913)
Torgerson, Irving E. (C. E. 1913)
Wangaard, Oscar H. (C. E. 1913)
Welin, Arthur G. (C. E. 1913)
Wolff, Henry E. (C. E. 1913)

Electrical Engineer

Anderson, Arthur R.
Bill, Earl McM.
Dorrance, Albert P.
*Purves, Leland E.
Streich, Harry C.
Young, Charles N.

Bachelor of Science in Engineering (Electrical)

*Avis, Samuel L. (E. E. 1913)
Benham, Claude F. (E. E. 1913)
Brewster, William E. (E. E. 1913)
Daum, H. Arno
Hedenstrom, Ernest A.
Herrmann, Raymond R. (E. E. 1913)
Hillman, Charles K.
Hoorn, Frederick W. (E. E. 1914)
Hovden, Conrad D. (E. E. 1913)
Knapp, Lester H.
Mathes, Robert C. (E. E. 1913)
Merriell, Elmer W. (E. E. 1913)
*Nelson, George A. (E. E. 1913)
Pardee, Charles A. (E. E. 1913)
Ringstrom, Ivan G. (E. E. 1913)
Swenson, Theodore J. M.
Thuras, Albert L. (E. E. 1913)
Towle, Neal C. (E. E. 1913)

Mechanical Engineer

Boyce, Leonard F.
Brown, William P.
*Johnson, Frank
Markoe, James C. P.
Thompson, Herbert L.

Bachelor of Science in Engineering (Mechanical)

Chapin, Harold S. (M. E. 1913)
Clark, William G. (M. E. 1913)
Crane, Eugene C. (M. E. 1913)
Crawford, Allen S.
Dinsmore, Arthur T. (M. E. 1913)
Donaldson, Frank A.
Hirleman, Clark W. (M. E. 1913)
Mikesh, Martin A. (M. E. 1913)
Morton, Harold S. (M. E. 1913)

Bachelor of Science in Engineering (Mechanical)

Rand, Lars (M. E. 1913)
Ruemmele, Albert E. (M. E. 1913)

Bachelor of Science in Science and Technology

Johnson, Paul A. (Lawrence)

1913

Bachelor of Science in Engineering (Civil)

Bergquist, John E.
Bradley, Byron H. (C. E. 1914)
Chilton, Edward G. (C. E. 1914)
Curtis, Benjamin J. (C. E. 1914)
Hewett, Maurice W. (C. E. 1914)
Koepke, Walter E. (C. E. 1914)
Kruse, Helmer V. (C. E. 1914)
Lovering, Harry D. (C. E. 1914)
Montgomery, Albertus
Morse, George A. (C. E. 1914)
Quiggle, Arthur W. (C. E. 1914)
Rolfe, West A.
Thurston, Harold H. (C. E. 1914)
Webster, Donald W. (C. E. 1914)
Wilk, Benjamin (C. E. 1914)

Electrical Engineer

White, Charles W.

Bachelor of Science in Engineering (Electrical)

Dewars, Allen G. (E. E. 1914)
Dow, Clarence A. (E. E. 1914)
Everett, William R. (E. E. 1915)
Goebel, Rudolph C. (E. E. 1914)
Goetsenberger, Ralph L. (E. E. 1914)
Haines, Allen K.
Irwin, Vincent H. (E. E. 1914)
Lagaard, Alexander S. T. (E. E. 1914)
Mahoney, William L. (E. E. 1914)
Miller, Hollis DeW.
Ramm, Theodore D.
Taylor, Lyman D. (E. E. 1916)
*Wilcox, Leslie W.

Bachelor of Science in Engineering (Mechanical)

Buenger, Albert (M. E. 1914)
Critchett, Edward F. (M. E. 1914)
McCartney, Floyd A.
Ovestrud, Melvin (M. E. 1914)
*Robertson, Soren M.
Sausen, Bert R.

ADVANCED DEGREES

Civil Engineer

Anderson, Harvey B. (B. S. Eng. 1912)
*Bailey, William H. (B. S. Eng. 1912)
Bingen, Wm. J. (B. S. Eng. 1912)
Cummings, Elmer F. (B. S. Eng. 1912)
Giertsen, Marcus O. (B. S. Eng. 1912)
Haberle, Edward L. (B. S. Eng. 1912)
Jorgens, Charles R. D. (B. S. Eng. 1912)
Kapphahn, Raymond J. (B. S. Eng. 1912)
King, Forest V. (B. S. Eng. 1912)
Kriz, Joseph J. (B. S. Eng. 1912)
Pease, Raymond A. (B. S. Eng. 1912)
Peterson, Barney J. (B. S. Eng. 1912)
Ryan, Loiel S. (B. S. Eng. 1912)
South, Willard A. (B. S. Eng. 1912)
Souther, Morton E. (B. S. Eng. 1912)
Swenson, H. Seymour (B. S. Eng. 1912)
Torgerson, Irving E. (B. S. Eng. 1912)
Wangaard, Oscar H. (B. S. Eng. 1912)
Welin, Arthur G. (B. S. Eng. 1912)
Wolff, Henry E. (B. S. Eng. 1912)

Electrical Engineer

*Avis, Samuel L. (B. S. Eng. 1912)
Benham, Claude F. (B. S. Eng. 1912)
Brewster, Wm. E. (B. S. Eng. 1912)
Herrmann, Raymond R. (B. S. Eng. 1912)
Hovden, Conrad D. (B. S. Eng. 1912)
Mathes, Robert C. (B. S. Eng. 1912)
Merriell, Elmer W. (B. S. Eng. 1912)
*Nelson, George A. (B. S. Eng. 1912)
Pardee, Charles A. (B. S. Eng. 1912)
Ringstrom, Ivan G. (B. S. Eng. 1912)
Thuras, Albert L. (B. S. Eng. 1912)
Towle, Neal C. (B. S. Eng. 1912)

Mechanical Engineer

Chapin, Harold S. (B. S. Eng. 1912)
Clark, Wm. G. (B. S. Eng. 1912)
Crane, Eugene C. (B. S. Eng. 1912)
Dinsmore, Arthur T. (B. S. Eng. 1912)
Hirleman, Clark W. (B. S. Eng. 1912)
Mikesh, Martin A. (B. S. Eng. 1912)
Morton, Harold S. (B. S. Eng. 1912)
Rand, Lars (B. S. Eng. 1912)
Ruemmele, Albert E. (B. S. Eng. 1912)

1914

Civil Engineer

Larson, Albin

Bachelor of Science in Engineering (Civil)

Brenchley, Walter C. (C. E. 1915)
Burnett, Harold V.
Dimond, Harvey G.
Doolittle, William Y.
Ekberg, Carl E. (C. E. 1915)
Hustad, John C. (C. E. 1915)
Johnson, Edgar W. (C. E. 1915)
Lagaard, Maurice B. (C. E. 1915)
Larson, Louis (C. E. 1915)
Mitchell, Lester M. (C. E. 1915)
Nordstrom, Carl T.
Ott, Leonard E. (C. E. 1915)
Price, John R.
Rankin, Renville S.
Rockwell, Harvard S.
Sears, Dow I.
Weatherill, Cedric S. (C. E. 1915)
Weigel, Howard N. (C. E. 1915)

Bachelor of Science in Engineering (Electrical)

Adler, Eugene H. (E. E. 1915)
Bisek, Peter P.
Chapman, Wendell P.
Dunham, Roy O. (E. E. 1915)
Elliott, A. Douglass (E. E. 1915)
Fallon, Eugene L. (E. E. 1915)
*Garney, Walter S. (E. E. 1916)
*Gunnarson, Carl A.
Harris, Harold R. (E. E. 1915)
Jackson, Otto E. (E. E. 1915)
Johnson, Carl J. (E. E. 1915)
Johnson, Elmer W. (E. E. 1915)
Jones, George R. (E. E. 1915)
Layden, Arthur L.
Loeffler, Henry S. (E. E. 1915)
Mertz, Karl J.
Meyer, Herbert W.
Peterson, Andrew M.
Putz, John H. (E. E. 1915)
Robertson, Burton J. (E. E. 1915)
Schroeder, Carl W. (E. E. 1915)
Tallmadge, Everett S. (E. E. 1915)
Wentz, Walter W. (E. E. 1915)
Wilcox, Hugh B. (M. S. 1916)
*Wuest, Karl F. (E. E. 1915)

Bachelor of Science in Engineering (Mechanical)

Colvin, James A. (M. E. 1915)
Dorr, William R.
Gemmel, John H. (M. E. 1915, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (M. E. 1915, B. S. 1918, M. B. 1919, M. D. 1920)
Hartney, James L. (M. E. 1915)
Hubbell, Arthur C. (M. E. 1915)
Kopper, Edward, Jr. (M. E. 1916)
Mayer, Harris J. (M. E. 1915)
Peoples, John S.
Peterson, Albert L. (M. E. 1915)
Rockwood, Fletcher (M. E. 1915)
Snow, Clarence J. (M. E. 1915)
Thayer, Paul W. (M. E. 1915)

ADVANCED DEGREES

Civil Engineer

Bradley, Byron H. (B. S. Eng. 1913)
Chilton, Edward G. (B. S. Eng. 1913)
Curtis, Benjamin J. (B. S. Eng. 1913)
Hewett, Maurice W. (B. S. Eng. 1913)
Koepke, Walter E. (B. S. Eng. 1913)
Kruse, Helmer V. (B. S. Eng. 1913)
Lovering, Harry D. (B. S. Eng. 1913)
Morse, George A. (B. S. Eng. 1913)
Quiggle, Arthur W. (B. S. Eng. 1913)
Thurston, Harold H. (B. S. Eng. 1913)
Webster, Donald W. (B. S. Eng. 1913)
Wilk, Benjamin (B. S. Eng. 1913)

Electrical Engineer

Dewars, Allen G. (B. S. Eng. 1913)
Dow, Clarence A. (B. S. Eng. 1913)
Goebel, Rudolph C. (B. S. Eng. 1913)
Goetzenberger, Ralph L. (B. S. Eng. 1913)
Hoorn, Frederick W. (B. S. Eng. 1912)
Irwin, Vincent H. (B. S. Eng. 1913)
Lagaard, Alexander S. T. (B. S. Eng. 1913)
Mahoney, William L. (B. S. Eng. 1913)

Mechanical Engineer

Buenger, Albert (B. S. Eng. 1913)
Critchett, Edward F. (B. S. Eng. 1913)
Ovestrud, Melvin (B. S. Eng. 1913)

1915

Civil Engineer

Cottingham, George, Jr.

Bachelor of Science in Engineering (Civil)

Aasland, Christopher
Anderson, George T.
Christianson, Hilmar B.
Croswell, Thomas L.
Cuddy, William A. (C. E. 1916)
Dorsey, John G.
Handshu, C. E.
*Haynes, Stanley H. (B. S. 1917)
Helmick, Dan S.
Johnson, Alexander B.
Jones, Idris V.
Jones, Ivor V.
Knight, Ralph J.
Laurence, Philip L. (Johnson)
Leonard, Thomas K. (C. E. 1916)
McKay, Earle D. (C. E. 1916)
Oustad, Olaf L.
Pratt, Benjamin A.
Rufsvold, Olav M. (C. E. 1916)
Scott, Elmer C. (C. E. 1916)
Skurdalsvold, Peter (C. E. 1916)
Swenson, Oscar E. (C. E. 1916)
West, John C.
Wild, Carl D. (C. E. 1916)
Withee, Warren

Bachelor of Science in Engineering (Electrical)

Anderson, Joseph W.
Eggers, Henry C. T. (E. E. 1916)
*Garvey, Walter S. (E. E. 1916)
Hjermstad, Harry M. (Webster)
*Houghtaling, Elting W. (E. E. 1916, B. S. 1916)
Jones, Robert A. (E. E. 1916)
Lawrence, Scott W. (E. E. 1916)
Lutz, Richard E.
Olaison, Clifford E. (E. E. 1916)
Skagerberg, Rutcher (E. E. 1916)

Bachelor of Science in Engineering (Electrical)

Thompson, Harry T. (E. E. 1916)
Turner, Roy H. (E. E. 1916)
Wilcox, Halsey H.

Bachelor of Science in Engineering (Mechanical)

Boyles, Ralph R. (M. E. 1916)
Crosby, Milton E.
Giltinan, David M. (M. E. 1916)
Holmberg, Abner W. (M. E. 1916)
Kerns, Clinton B.
Orr, George M.
Roberts, Earl H. (M. E. 1916)
Skon, Herman W. (M. E. 1916)
Tupper, Charles E.
Wolff, William S. (M. E. 1916)

ADVANCED DEGREES

Civil Engineer

Brenchley, Walter C. (B. S. Eng. 1914)
Ekberg, Carl E. (B. S. Eng. 1914)
Hustad, John C. (B. S. Eng. 1914)
Johnson, Edgar W. (B. S. Eng. 1914)
Lagaard, Maurice B. (B. S. Eng. 1914)
Larson, Louis J. (B. S. Eng. 1914)
Mitchell, Lester M. (B. S. Eng. 1914)
Ott, Leonard E. (B. S. Eng. 1914)
Weatherill, Cedric S. (B. S. Eng. 1914)
Weigel, Howard N. (B. S. Eng. 1914)

Electrical Engineer

Adler, Eugene H. (B. S. Eng. 1914)
Dunham, Roy O. (B. S. Eng. 1914)
Elliott, A. Douglass (B. S. Eng. 1914)
Everett, William R. (B. S. Eng. 1913)
Fallon, Eugene L. (B. S. Eng. 1914)
Harris, Harold R. (B. S. Eng. 1914)
Jackson, Otto E. (B. S. Eng. 1914)
Johnson, Carl J. (B. S. Eng. 1914)
Johnson, Elmer W. (B. S. Eng. 1914)
Jones, George R. (B. S. Eng. 1914)
Loeffler, Henry S. (B. S. Eng. 1914)
Putz, John H. (B. S. Eng. 1914)
Robertson, Burton J. (B. S. Eng. 1914)
Schroeder, Carl W. (B. S. Eng. 1914)
Tallmadge, Everett S. (B. S. Eng. 1914)
*Wuest, Karl F. (B. S. Eng. 1914)

Mechanical Engineer

Colvin, James A. (B. S. Eng. 1914)
Gemmell, John H. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hartney, James L. (B. S. Eng. 1914)
Hubbell, Arthur C. (B. S. Eng. 1914)
Mayer, Harris J. (B. S. Eng. 1914)
Peterson, Albert L. (B. S. Eng. 1914)
Rockwood, Fletcher (B. S. Eng. 1914)
Snow, Clarence J. (B. S. Eng. 1914)
Thayer, Paul Wm. (B. S. Eng. 1914)

1916

Bachelor of Science in Architecture

*Albee, Pierce
Heath, Donald C.
Liebenberg, Jacob J.
Tannehill, Louis Wm.

Bachelor of Science in Engineering (Civil)

Askew, Thomas A., Jr.
Biskup, William F.
Bruce, Hjalmer N. (C. E. 1917)
Carlson, Anders J. (C. E. 1917)
Doell, Chas. E. (C. E. 1917)
Ellingson, Elmer
Grow, Robert W.
Hendrickson, Norman E.
*Johnston, Ralph E. (C. E. 1917)
Kivley, Warren O.
Knauss, Archibald C. (C. E. 1917)
Larson, Carl
Lux, Arthur E.
McCullough, Bruce M.
Nortner, Sylvester E.
Pan, Wen P.
Peterson, Harold L. (C. E. 1917)
Peterson, William W.
Watson, Fred O.
Weinke, Ernest H. (C. E. 1917)
Williams, Charles A.

Bachelor of Science in Engineering (Electrical)

Abbott. Amos H. (E. E. 1917)
Anderson, Frank L.
Arenson,Timothy G.
Bleecher, George W.
Blomberg, Evar H. (E. E. 1917)
Brown, Louis M.
Burt, Fred R.
Butterworth, Russell I. (E. E. 1917)
Covell, Russell O.
Croswell, Daniel R.
Dow, William G. (E. E. 1917)
Edelman, Philip (E. E. 1917)
Ellefson, Selmer
Fastenau, Karl DeV.
Gannett, Danforth K. (E. E. 1917)
Hult, George A.
Irwin, Frank H. (E. E. 1917)
Loye, Donald P. (E. E. 1917)
Russell, Carl A.
Schulz, Elton A.
Simons, Walter W.
Tallmadge, Hiram (E. E. 1917)
Teberg, Ernest J. (E. E. 1917)
Thompson, Jesse L. (E. E. 1917)
Turnquist, Axel A. (E. E. 1917)

Bachelor of Science in Engineering (Mechanical)

Corser, John
Dresser, Harry S.
Johnson, Ira L. (M. E. 1917)
*Mason, Arthur P.
Miller, William C.
Moody, Chester S. (M. E. 1917)
Ritchie, John R. (M. E. 1917)
Smart, George A.
Stone, Charles W. (M. E. 1917, M. S. 1919)

ADVANCED DEGREES

Civil Engineer

Cuddy, William A. (B. S. Eng. 1915)
Leonard, Thomas K. (B. S. Eng. 1915)
McKay, Earle D. (B. S. Eng. 1915)
Rufsvold, Olav M. (B. S. Eng. 1916)
Scott, Elmer (B. S. Eng. 1915)
Skurdalsvold, Peter (B. S. Eng. 1915)
Swenson, Oscar E. (B. S. Eng. 1915)
Wild, Carl D. (B. S. Eng. 1915)

Electrical Engineer

Eggers, Henry C. T. (B. S. Eng. 1915)
*Garvey, Walter S. (B. S. Eng. 1915)
*Houghtaling Elting W. (B. S. Eng. 1915, B. S. 1916)
Jones, Robert A. (B. S. Eng. 1915)
Lawrence, Scott (B. S. Eng. 1915)
Olaison, Clifford E. (B. S. Eng. 1915)
Scott, Walter L. (B. S. Eng. 1915)
Skagerberg, Rutcher (B. S. Eng. 1915)
Taylor, Lyman D. (B. S. Eng. 1913)
Thompson, Harry T. (B. S. Eng. 1915)
Turner, Roy H. (B. S. Eng. 1915)
Wentz, Walter W. (B. S. Eng. 1915)

Mechanical Engineer

Boyles, Ralph R. (B. S. Eng. 1915)
Giltinan, David M. (B. S. Eng. 1915)
Holmberg, Abner W. (B. S. Eng. 1915)
Kopper, Edward, Jr. (B. S. Eng. 1914)
Roberts, Earl H. (B. S. Eng. 1915)
Skon, Herman W. (B. S. Eng. 1915)
Wolff, William S. (B. S. Eng. 1915)
Wong, Jee K. (B. S. Armour Institute)

Master of Science

Stenger, Lawrence A. (E. E. 1906)
Wilcox, Hugh B. (E. E. 1914)

1917

Bachelor of Science in Architecture

Brown, Floyd W.
Buckhout, Donald H.
Gilman, Howard B.
Kreinkamp, Linton H.
Mixer, Walter R.
Poulsen, George F.
Prudden, George H., Jr.
Riedesel, George M.

Bachelor of Science in Engineering (Civil)

Boyce, Ellsworth R.
Brataas, Mark G.
Douglass, Addison H. (C. E. 1920)
Fossen, George
Linden, Henning
Luplow, Walter D.
Luxford, Ronald F.
Rader, Clarence McK. (C. E. 1917)
Rickman, Herman W.
Tryon, Philip D.
Wolfangle, Raymond J.

Bachelor of Science in Engineering (Electrical)

Becker, Ward E.
Boyum, Irvin L.
Carlson, Chauncy M.
Dunlap, Lemuel J.
*Ebert, Solomon B.
Eckenbeck, Evertt E.
Jacobs, Arthur R.
Juvrud, Edwin C.
Lilly, Clarence W.
Malmstrom, Axel L.
*McKibbin, Ray (E. E. 1918)
*Melby, Einar C.
Scott, Willard W.
Swenson, George W. (E. E. 1921)
Thomas, William A.
Wheeler, Herbert H.
Williams, Frederick J.
Willis, Benjamin S.

Bachelor of Science in Engineering (Mechanical)

Andersen, Edward I. (M. E. 1919)
Boehnlein, Charles (M. E. 1919)
Bros, Ernest T.
Brown, Homer L.
Carlson, Arvid P.
Ek, Gustav A.
Eustis, Irving N. (M. E. 1918)
Gerlach, Arthur C.
Guggisberg, Charles F.
Hektner, Joel
Holmstine, Arthur G.
Hvoslef, Frederik W. (M. S. 1919)
Jones, Edwin F.
Knutson, Harry
Larson, Victor F.
Murray, John H.
Nelson, Otis S.
Romero, Cirilo L. P. Y. (M. E. 1918)
Rosenbloom, Abraham E.
Swenson, Clarence Q. (M. E. 1920)
Taylor, Duane L.

ADVANCED DEGREES

Civil Engineer

Bruce, Hjalmar N. (B. S. Eng. 1916)
Carlson, Anders J. (B. S. Eng. 1916)
Doell, Charles E. (B. S. Eng. 1916)
*Johnston, Ralph E. (B. S. Eng. 1916)
Knauss, Archibald C. (B. S. Eng. 1916)
Peterson, Harold L. (B. S. Eng. 1916)
Rader, Clarence McK. (B. S. Eng. 1917)
Weinke, Ernest (B. S. Eng. 1916)

Electrical Engineer

Abbott, Amos H. (B. S. Eng. 1916)
Blomberg, Evar H. (B. S. Eng. 1916)
Butterworth, Russell I. (B. S. Eng. 1916)
Dow, William G. (B. S. Eng. 1916)
Edelman, Philip (B. S. Eng. 1916)
Gannett, Danforth K. (B. S. Eng. 1916)
Irwin, Frank H. (B. S. Eng. 1916)
Loye, Donald P. (B. S. Eng. 1916)
Mori, Nathaniel R. (B. S. Eng. 1915, University of Washington)
Tallmadge, Hiram (B. S. Eng. 1916)
Teberg, Ernest J. (B. S. Eng. 1916)
Thompson, Jesse L. (B. S. Eng. 1916)
Turnquiest, Axel A. (B. S. Eng. 1916)

Mechanical Engineer

Johnson, Ira L. (B. S. Eng. 1916)
Moody, Chester S. (B. S. Eng. 1916)
Ritchie, John R. (B. S. Eng. 1916)
Stone, Charles W. (B. S. Eng. 1916, M. S. 1919)

1918

Bachelor of Science in Architecture

Forsberg, Enock E.
Kaplan, Seeman
King, Harvey M.
Moorman, Albert J.

Bachelor of Science in Engineering (Civil)

Battles, Leon E.
*Chamberlain, Herbert D.
Deutsch, Richard E.
Eliassen, Sigurd
*Gould, Reed D.
Konstantinopoulos, Nicholas (Konstants)
Nickerson, Neal C.
Smith, Cedric B. (B. A. 1914)
Smolensky, Martinian G.

Bachelor of Science in Engineering (Electrical)

Brooke, Harold L.
Gibbs, Clayton T.
Hartig, Henry E.
Hotchkiss, Fred W.
Levin, Jake M.
Ross, Russell H.
Schlenk, Hugo, Jr.
Smith, Donald C.
Smith, Hugh A.
Talbot, Thomas F.

Bachelor of Science in Engineering (Mechanical)

Abrahamson, Howard B.
Anderson, Hilder A.
Bierman, George H. (M. E. 1919)
Francis, Paul E.
Greenberg, Morris
Hagerman, Oliver S.
Kivley, Ray C.
Muller, Carl C.

Bachelor of Science in Engineering

Peterson, Harold R.
Putman, George W.

ADVANCED DEGREES

Electrical Engineer

*McKibben, Ray (B. S. Eng. 1917)

Mechanical Engineer

Eustis, Irving N. (B. S. Eng. 1917)
Romero, Cirilo L. P. Y. (B. S. Eng. 1917)

1919

Bachelor of Science in Architecture

Buenger, Edgar
Deane, George B.
Deneen, David J.
Emery, George C.
Fraser, George
Hamilton, Jefferson M.
Hammett, Ralph W.
Schwartz, John S.
Wright, Stewart V.

Bachelor of Science in Engineering (Civil)

Coe, Edward H.
Elstad, Rudolph T.
Hawlick, Henry I.
Rosenthal, Oscar L.
Sushan, Harry M.

Bachelor of Science in Engineering (Electrical)

Christensen, Edgar W.
Cotton, Ernest H.
Drinkall, John F.
Duncan, George R.
Grimes, David
Hartman, Walter K.
Heinemann, John R.
Jordan, Frank W.
Klass, Frederick
Langland, Harold S.
Lee, Oscar C.
Marshall, Donald E.
Nelson, Gustav A.
Olson, Richard H.
Peterson, Albert E.
Peterson, Arthur P.
Petrich, Alfred C.
Pierson, Joe W.
Reeve, Charles H.
Sander, Theodore, Jr.
Swanson, Edwin W.

Bachelor of Science in Engineering (Mechanical)

Baker, Arthur W.
Bros, Raymond J. (M. E. 1920)
Cosh, Richard A.
Dowd, Archie J.
Elliot, Harry C.
Foltz, Ross M.
Hartzberg, Edward M.
Moffat, George N. (M. E. 1920)
Pavek, William J. (M. E. 1920)
Williams, Arthur H.
Wunderlich, Milton S. (M. E. 1920)

Bachelor of Science in Engineering

Briggs, Hiram K.
Gee, Harry J.
Kapphahn, Ernest H.
Kroeze, Herbert A.
Lewis, Carroll E.
Lilly, Eugene

ADVANCED DEGREES

Mechanical Engineer

Andersen, Edward I. (B. S. Eng. 1917)
Bierman, George H. (B. S. Eng. 1918)
Boehnlein, Charles (B. S. Eng. 1917)
Hvoslef, Fredrik W. (B. S. M. E. 1917)

Master of Science

Stone, Charles W. (B. S. Eng. 1916, M. E. 1917)

1920

Bachelor of Science in Architecture

Anderson, Milton J.
Kleinschmidt, Florian A.
Korslund, Harry J.
Lin, Shu M.
Loye, Edwin M.
Lyon, Glenn H.
Raugland, Arnold I.

Bachelor of Science in Engineering (Civil)

Alexander, George D.
Beneke, Walter E.
Berg, Karl A. E.
Bernt, Hans E.
Bleifuss, Donald J.
Dever, Francis A.
Fitzgerald, William J.
Friar, Floyd M.
Gilbert, Roy
Gould, Edward S.
Hanke, Carl C.
Hansen, Carlos C.
Holm, Edwin R.
Johnson, Byron F.
Larson, Amandus C.
Lebeck, Carl E.
Lende, Henry M.
Malmberg, Victor A.
Nelson, Donald O.
Neville, Earle L.
Pless, Arnold G. M.
Purdy, Irving B.
Seemann, Ernest W.
Sherwood, Edward B.
Staehle, Gilbert C. (M. S. Eng. 1922)

Bachelor of Science in Engineering (Electrical)

Aske, Irving E.
Bauer, Ruben B.
Carlson, Victor H.
Ellsworth, Charles D.
Engquist, Victor E.
Goss, Harold R.
Groth, Arthur W.
Hunt, Gates E.
Janzen, William H.
Jules, Harold A.
Kingsley, Norman W.
Knowles, Everett H.
Kruse, Orlin O.
Larson, Walter J.
Lee, Walter J.
Lockwood, Raymond A.
McKenzie, Leonard F.
Mayer, Albert F.
Miller, George W.
Mitchell, Alexander C.
Molskness, Nels S.
Nelson, Clarence L.
Noel, Clay W.
Peterson, Peter I.
Peterson, Richard M.
Peterson, Vance C.
Price, Clarence R.
Siegmann, Chester W.
Strothman, Russell A.
Triem, Ralph H.
Waldron, Ralph E.
Westberg, Russell E.

Bachelor of Science in Engineering (Mechanical)

Anderson, Helmer N.
Ball, Hampton B.
Cerney, Glen C.
Curry, Esra B. (M. E. 1921)
Czock, Jacob H.
Egilsrud, Fridtjof S.
Fortune, Harry G.
Gerow, Theron G.
Hayes, Edward J. (M. E. 1921)
Joachim, William F. (M. E. 1921)
Merrill, Lewis E. (M. E. 1921)
Odegaard, Harold T.
Powell, Knox A.
*Reasoner, Clayton M. (M. E. 1921)
Rhame, Paul W. (M. E. 1921)
Shellenberger, Hiram R.
Tuve, George L. (M. E. 1921)
Wallfred, John E.
Waterous, Fred A.
William, Myrl J.

Bachelor of Science in Engineering

Didriksen, Philip H.
Hanrahan, Edmund C.
Harris, Nathan
Madsen, Olav
Moore, Clarence F.
Swenson, Gustav A.
Vallacher, Theodore L.
Wyly, Lawrence T.

ADVANCED DEGREES

Civil Engineer

Douglass, Addison H. (B. S. 1917)

Mechanical Engineer

Bros, Raymond J. (B. S. 1919)
Moffat, George N. (B. S. 1919)
Pavek, William J. (B. S. 1919)
Swenson, Clarence Q. (B. S. 1917)
Wunderlich, Milton S. (B. S. 1919)

1921

Bachelor of Science in Architecture

Anderson, Milton L.
Dahl, George L.
Damberg, Rheuben P.
Gewalt, Carl H.
Larson, Edwin
Melander, Albin R.
*Thorshov, Olaf
Wills, Arthur D.

Bachelor of Science in Civil Engineering

Barber, Harold A.
Carpenter, Hugh W.
Christilaw, George M.
Daly, Richard T., Jr.
Dehn, Eltor A.
Del Plaine, Carlos W. (C. E. 1922)
Enke, Fred A.
Grochau, Earl H.
Hallady, Leslie L.
Hanson, Edwin L.
Henry, Burt C.
Jensen, Cyril D.
Johnson, Alphonse N.
Johnson, Carl S.
McCubrey, Everett J.
Mackintosh, William S.
Muessel, Robert W.
Simmonds, Richard R.
Sverdrup, Leif J.
Weis, Wallace D.
Werdenhoff, James H.

Bachelor of Science in Electrical Engineering

Anderson, Edward S.
Austin, Paul D.
Barger, Harold L.
Barnes, Dean M.
Beardmore, Albert E.
Berg, Samuel A. (B. A. 1921) (E. E. 1922)
Briggs, William G.
Carlson, Carl P.
Colson, Lauren G.
Donahoe, Robert E.
Hammerstrom, Aleck A.
Hayward, Laurence W.
Hougan, Sander
Johnson, Edgar F.
Johnston, Charles K.
Larson, Ludvig C. (E. E. 1923)
Loye, Percival E.
McKibben, Lloyd S.
McVean, Norman S.
Maine, Basil C.
Manderfeld, Emanuel C.
Mangney, Elmer J.
Miller, Andrew L.
Nelson, Richard L.
Palmer, Roy A.
Pearson, Charles W.
Peterson, Harold W.
Podosin, John
Satori, Roy H.
Shuirman, Gabe
Stanius, Godfrey
Sweet, Ray R.
Wahlquist, Hugo W.
Wessale, George
Wilson, Paul R.

Bachelor of Science in Mechanical Engineering

Arneson, Lloyd O.
Elmer, Lloyd A.
Farmer, John W.
Forsberg, Elmer J. (M. E. 1922)
Gjesdahl, Maurice S.
Hamlin, Lehan H.
Johnson, Carl A. (M. E. 1922)
Lewis, George R.
Luce, Alexander W. (M. E. 1923)
Reuter, Peter T.
Roy, Milo C.
Umbehocker, Frank
Vaule, Sven A.
von Rohr, Herbert H.

Bachelor of Science in Engineering

Beeman, Harry J.
Carlton, Richard P.
Cowin, Clifford C.
Dills, Lyle A.
Godwin, Kenneth A.
Jacobson, Howard C.
Liddle, Ralph W.
McLean, Milton D.
McMeekin, Glenn D.
Martin, Curtis R.
Noble, John F.
Papenthien, Roy O.
Young, Joseph E.

ADVANCED DEGREES

Electrical Engineer

Swenson, George W. (B. S. Eng. 1917)

Mechanical Engineer

Curry, Ezra B. (B. S. Eng. 1920)
Hayes, Edward J. (B. S. Eng. 1920)
Joachim, William F. (B. S. Eng. 1920)
Merrill, Lewis E. (B. S. Eng. 1920)
*Reasoner, Clayton M. (B. S. Eng. 1920)
Rhame, Paul W. (B. S. Eng. 1920)
Tuve, George L. (B. S. Eng. 1920)

1922

Bachelor of Science in Architecture

Bakken, Laurence H.
Croft, Edna K.
Damberg, Paul S.
Dawson, John W.
Gerlach, Henry C.
Graf, Donald T.
Hahn, Stanley W.
Haines, Howard N.
Kreinkamp, Herbert A.
Little, Alice V.
Moorman, Frank S.
Smit, Catherine
Stewart, George A.
Willner, William E.

Bachelor of Science in Civil Engineering

Anderson, Nels S.
Andrus, Harry J.
Bailey, George R.
Berdan, Hubert J.
Chernus, Maurice
Cook, Walter K.
Cray, Seymour R. (C. E. 1923)
Erickson, Edwin C. O.
Espenett, Edward L.
Feder, Max
Fraser, Carlisle G.
Frost, Herbert J.
Greenberg, Jack
Hortskotte, Arthur E.
Johnson, Ellsworth
Keeler, Jasper F.
Kelley, William
Levens, Alexander S. (M. S. in C. E. 1924) (C. E. 1927)
Lund, Earl H. (C. E. 1923)
Markson, Christian O.
Mattson, Dewey F.
Morrison, John E.
Newberry, Lester W.
Ost, Roland E.
Palda, Chas. H.
Palmer, Howard B.
Paulson, Thorwald S.
Peterson, Neander E.
Pinska, Lawrence F.
Reardon, John M.
Rosenthal, Paul
Silverman, Emil M.
Slade, Loring
Soshnik, Edward J.
Stoutland, Oliver A.
Swanson, Clifford L.
Tarbell, William P.
Teberg, Lawrence E.
Thompson, Claudius A.
Tierney, Festus P.
White, Arden D.
Wilson, Charles A.
Wood, Victor R.

Bachelor of Science in Electrical Engineering

Aultfather, David H.
Bergstrom, Marlow B.
Bisbee, Bertin A.
Bjonerud, Earl S.
Bochus, Gerald H.
Bosshardt, Wilmert C.
Carlson, Richard E.
Cooley, Gilbert
Dahl, Hjalmer A.
Downie, John M.
Drost, Henry F.
Dunnum, Orney E.
Ellestad, Irwin M.
Enger, Arne
Fiske, Harold C.
Forbes, Henry C.
Hagelin, Lawrence W.
Heidelberger, Roy J.
Hendrickson, Arnold B.
King, John E.
Linhoff, Carl H.
McEachin, John
McMillen, James S.
Magnuson, John E.
Mentzer, Clarence A.
Merritt, Alva W.
Mintz, Nathaniel
Nielsen, Walter M.
Nordlien, Berger W.
Olson, Arnim G.
Oscarson, Gerhard L.
Pangburn, Carroll G.
Plank, Howard G.
Ransom, Glen B.
Rome, Robert C.
Rood, Arnold E.
Sannicolo, Joseph F.
Selander, Karl W.
Sorensen, John E.
Steffens, Robert A.
Tuve, Merle A.
Wickman, Martin F.
Willard, Arthur C.
Williams, Percival H.
Wilson, Abner W.

Bachelor of Science in Mechanical Engineering

Aure, Roy
Bros, Chester W. (M. S. in M. E. 1924)
Carlson, Ernest F.
Clark, John S.
Curtis, Verne F.
Eddy, Clarence
Fahland, Frank, Jr.
Hemsey, Clayton E.
Hilgedick, Ralph V.
Hoffman, Richard H.
Holmsten, Victor T.
Katter, Calvin K.
Katter, Reuben L.
Kelsey, Howard C.
Kleinschmidt, Armin R.
Kumm, Arthur W.
Mikesh, Edward S.
Nordenson, Arnold
Nordstrom, Ernest A.
Olmstead, Charles F. (M. E. 1923)
Peters, Walter C.
*Rood, Olaf T. (M. E. 1923)
Rosendahl, Harold R.

Bachelor of Science in Engineering

Adams, Edward H.
Brown, Harry
Capstick, Donald
Dock, Chester
Forssell, William
Hayes, Harold
Meili, Rudolph E., Jr.
Olson, Clarence

ADVANCED DEGREES

Civil Engineer

Del Plaine, Carlos W.

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921, B. A. 1921)

Mechanical Engineer

Forsberg, Elmer J. (B. S. Eng. 1921)
Johnson, Carl A. (B. S. Eng. 1921)

Master of Science in Engineering

Stehle, Gilbert C. (B. S. 1920)

1923

Bachelor of Science in Architecture

Backstrom, W. A.
Holien, Edward O.
Johnson, Elving L.
Markuson, Miner J.
Nielsen, Eunice V.
Sime, Theodore L.
Strom, Arthur
Walquist, John A.

Bachelor of Science in Architectural Engineering

Luedeman, Clarence H.
Sutherland, Samuel J.

Bachelor of Science in Civil Engineering

Aasland, Arne
Abramson, Harry W.
Aldrich, Louis W.
Aslakson, Carl I.
Berg, Swan P.
Bergford, Lester M.
Bergford, Rolf E.
Buhr, Leo
Christlieb, Frank B.
Cribbs, Harry E.
Curry, Byron K.
Darrell, James E.

Bachelor of Science in Civil Engineering

DeFreece, Paul R.	Nelson, Elmer A.
Dindorf, Edward C.	Nelson, Glenn
Flindt, Richard H.	Odquist, Carl
Hill, Hibbert M.	Olson, Elmer J. E.
Hiner, Walter G.	Peck, Lloyd A.
Hosmer, Orville H.	Sauer, Arthur A.
Johnson, Albert W.	Schaller, George C.
Johnson, Nels	Schlenk, John J.
Judd, Maurice D.	Sclarow, Abraham M.
Kotz, Walter E.	Spencer, Raymond D.
Lazarus, Morris W.	Stephens, Clifford S.
Leonard, Aubrey C.	Swanson, Paul H.
Maiser, Walter L.	Tennstrom, Carl H.
Manger, Henry J.	Thompson, Everett
Meskal, George A.	Villaume, Walter F.
Mitchell, Lloyd S.	Zimmerman, Arthur C.

Bachelor of Science in Electrical Engineering

Babcock, Vernon M.	McCullough, Robert T.
Bouquet, Otto T.	Meserve, Ralph H.
Braden, Rene A.	Moreno, Gerardo
(M. S. 1925)	Nash, Russell O.
Bumgardner, Louis T.	Newman, John M.
Burrill, Charles M.	Nordvall, Glenn W.
Case, Gerald F.	Olin, Henry A.
Clausen, Elmer W.	Olson, Roy H.
Dunnavan, Ralph B.	Pause, Harold A.
Elwood, Daniel H.	Pulver, Richard F.
Engstrom, Elmer W.	Rath, Harvey C.
Fairbanks, George W.	Reeve, Howard E.
Feeney, Wayne I.	Russell, Winfred W.
Fischer, Harold W.	Ryan, Robert M.
Friedman, Edwin A.	Sampson, Clifford L.
Goldberg, Maurice G.	(M. S. 1925)
Grettum, LeRoy Atwood	Schottler, George J.
Hargraves, Robert A.	Schweiso, Clifford C.
Hawkins, Harvey C.	Scott, Herbert L.
Heidelberger, Otto F.	Sickel, Edwin C.
(M. S. 1925)	Swift, George E.
Helwig, William F.	Thorne, Donald E.
Johnson, Gustaf A.	Trask, Alfred S.
Johnson, James P.	Ward, Alvin C.
Kannenberg, Walter F.	Wellisch, Walton
(M. S. 1925)	Wiggins, John B.
Kearney, Adrian A.	Williams, Roy N.
Koch, Karl L.	Wills, David C.
Lambie, Horace H.	Wilson, Frank W.
Lieberman, Henry	Zimmerschied, Clarence R.
Lundquist, John V.	

Bachelor of Science in Mechanical Engineering

Acker, Sidney H.	*Keiser, Karl W.
Amidon, Lee L.	(M. S. in M. E. 1924)
Ascher, Raymond C.	Kuhlman, Rudolph H.
Bachmann, Graydon A.	Larson, Glen M.
Bergsland, Grant C.	Lindelien, Engen
Bros, Bernard M.	Marshall, Chester R.
Brossard, Edward V.	Messer, Harold D.
Copeland, Floyd E.	Parkin, Orrin G.
Cross, Roland E.	Peckham, Harold E.
Eige, Elmer H.	Ransom, Ralph W.
Gilstad, Arthur	Sear, Arthur W.
Halden, Herbert O.	Swanson, Philip G.
Hibbard, Shelden S.	Waby, Delton T.

ADVANCED DEGREES

Civil Engineer

Cray, Seymour E.	(C. E. 1922)
Lund, Earl H.	(C. E. 1922)

Electrical Engineer

Larson, Conrad L.	(B. S. E. E. 1922)

Mechanical Engineer

Luce, Alexander W.	(B. S. M. E. 1921)
Olmstead, Charles F.	(B. S. M. E. 1922)
*Rood, Olaf T.	(B. S. M. E. 1922)

1924

Bachelor of Science in Architecture

Backstrom, Emil F.	Kraft, Edwin W.
Barnum, Charles R.	Magoon, Herbert A.
Bonsall, Wallace C.	Nelson, Mark L.
Hawkins, Edward W.	Nystrom, Paul E.
Hinman, Charles H.	Rosenberg, Rahil A.
Johnson, Anton A.	Silverman, Isadore W.

Bachelor of Science in Architectural Engineering

Person, Otto C.	Tvedt, Lawrence A.
Root, Frank R.	

Bachelor of Science in Civil Engineering

Bachelder, William H.	Bevan, R. Louis
Bauer, Roscoe W.	Braddock, Edward
Bergquist, Edwin T.	Brody, Mace F.
Bergquist, Philip L.	Bullis, Everard J.
Bestor, George C.	Chapin, S. Caryl
Dedic, Richard J.	McCrady, Archie R.
Erickson, Carl E.	Nelson, Martin E.
Garzon, Julian R.	Normann, Rolf A.
Gillard, Herbert W.	Olson, C. Milford
Grant, Elberth R.	Parker, Robert M.
Guerin, George V., Jr.	Peterson, Lloyd L. H.
Guesmer, George O.	Powell, Louis H.
Gustafson, Reuben W.	Ranger, Donald R.
Hankins, Nathaniel R.	Roos, Frank T. W.
Harrington, Marzy V.	Somero, Waino M.
Hayden, Claude E.	Sprehn, George H.
Herberg, Sanford	Stoddart, Hugh A.
Holder, Laurance E.	Stoner, Clifford M.
Johnson, Raymond V.	Tews, Arthur W.
Kaufman, Morris B.	Thompson, Theodore S.
Larson, Peter L.	Velz, Clarence J.
Liese, Herbert W.	Wilson, Walter E.
Lund, Roy V.	

Bachelor of Science in Electrical Engineering

Anderson, Emil G.	Little, LeRoy C.
Anderson, Fayette C.	McConnell, E. S.
Anderson, Matthew A.	McGregor, F. A.
Appleman, Frank C.	McLeland, Lyle K.
Arstad, Leonard O.	Mabbott, Leonard E.
Carlson, Warren E.	Mangney, Hilding O.
Cass, Hoyt R.	Marcroft, Harold C.
Cassidy, Walter J.	Marshman, Irving C.
Dahl, Harold W.	Mathes, Richard E.
Diment, J. Morton	Mayer, Joseph S.
Dunlap, George M.	Miller, Archibald T.
Eckberg, Curtis R.	Miller, William J.
Frazee, Leonard M.	Monsen, Manley A. B.
Furber, John R.	Monseth, Ingwald T.
Garthus, Ira B.	Morton, Lysle W.
Greene, Alfred B.	Nee, Harold E.
Greene, Chauncey L.	Nelson, Edgar M.
Greiner, Harry S.	Pelley, Lloyd L.
Grettum, Walter A.	Schilling, Theodore F.
Harrington, Russell A.	Schow, Garfield G.
Hecht, Henry W.	Sheekman, Harvey Z.
Heggen, Reuben	Skarolid, Charles T.
Holbeck, John I.	Stimart, Elwood L.
Huseby, Gisle E.	Strege, Henry W.
Jacobson, Frank H.	Swift, Donald C.
Johnson, Iver W.	Taplin, George C.
Juran, Joseph M.	Teal, Clarence W.
Kapple, Frederick R.	Trcka, Benjamin C.
Kator, Jozef J.	Tunell, Robert H.
Kline, Frank W.	Tyvand, James A.
Krause, Fred E.	Waligoski, Adam A.
Lampher, Murray N.	Warren, Laurence C.
Lauritzen, Carl W.	Weber, Hanard P.
Lebeck, Torarin E.	Wolfe, George E.
Lewis, John G.	

Bachelor of Science in Mechanical Engineering

Anderson, Joseph A.	Moore, John H.
Berry, George F.	Morris, Frank A.
Blodgett, Charles R.	(M. S. M. E. 1925)
Borst, Wellington L.	Nelson, Edward K.
Boyd, Paul M.	Nelson, Einer
Collis, Norman S.	*Olien, Hamlet C.
Dale, Dallas W.	Olson, Arthur L.
Darmody, William J.	Peterson, Arthur S.
Earl, Donald F.	Rathburn, George A.
(M. S. M. E. 1925)	Ross, Kenneth R.
Engh, Harris S.	Rosseau, Clifton C.
Erskine, Robert K.	Saltwick, Andrew
Estabrooks, Clyde F.	Sartell, Page M.
Grobel, Lloyd P.	Sebo, Arthur O.
Hiers, Charles R.	Sesseng, Gunnar
Holmstine, Ralph D.	Simms, Charles G.
Kiesner, Frank C.	Staehle, Haswell E.
Koehler, Edwin F.	Stauffacher, Edward L.
Langford, George, Jr.	Thomas, W. Alan
Langman, Harley R.	Tuttle, Stanley B.
Logue, John F.	Wagner, John W.
Mehandru, Behari L.	Willson, Stuart V.
Montgomery, Ralph M.	Woolman, Harry D.

ADVANCED DEGREES

Master of Science in Civil Engineering

Levens, Alexander S.	(B. S. C. E. 1922)

Master of Science in Mechanical Engineering

Bros, Chester W.	(B. S. M. E. 1922)
*Keiser, Karl W.	(B. S. M. E. 1923)

1925

Bachelor of Science in Architecture

Bross, Peter P.	Lumm, Allan G.
Erickson, Clarence P.	Molander, Edwin W.
Freeberg, George	Olson, Edwin E.
Kendall, Walter A.	Peterson, Everett L.
Lantz, Reuben S.	Rigg, Alwin E.

Bachelor of Science in Architectural Engineering

Brimeyer, Ferdinand J.	Pesek, Cyril P.
Elmburg, LeRoy M.	Vaudreuil, Lionel H.
Grisson, Aubrey H.	Rankin, Dean W.
Larson, Emil L.	Wicklund, Paul E.

Bachelor of Science in Interior Decoration

Cote, Rhoda H.	Slocumb, Mary G.
MacGregor, Helen J.	Smith, Verna G.
Parker, Helen R.	

Bachelor of Science in Civil Engineering

Auxer, William L.	Kroll, Arthur J.
Banovetz, John A.	LaBonte, Anton E.
Bartholomew, Neal W.	Larson, Fred H.
Beese, Harold U.	Lushene, Joseph P.
Berg, Thorsten H.	McAndrews, Harry N.
Bertossi, Clarence F.	Macgowen, Irvin S.
Bird, Harold E.	Mark, Max B.
Blue, Clarence W.	Moore, Norman R.
Bonner, Donald E.	Morris, Russell F.
Brose, William C.	Nelson, Edwin W.
Burns, Dwight T.	Nelson, George A.
Carlbom, Leonard H.	Nichol, Frank E.
Cornell, George M.	Nordstrom, Milton E.
Craig, Hamilton S.	Nutting, Horace W.
Donahue, Stephen	O'Brien, Thomas E.
Dungay, Herbert F.	Olson, Kenneth M.
Duval, Arndt J.	Olson, Vernon H.
Elers, Baldwin C.	Peterson, Clarence R.
Frantz, Willard F.	Peterson, Harold C. E.
Fulton, Edwin G.	Prichard, Charles E.
Galanter, Samuel S.	Quinn, Edward I.
Gerdes, Carl H.	Quinn, Ursula R.
Gobeli, Arthur W.	Schmidt, Roland L.
Haima, Mark	Skrukrud, Odean M.
Hansen, Arthur A.	Sullivan, Frederick V.
Hartman, Philip F.	Swanberg, John H.
Hendricks, Clifford L.	Thompson, Clarence W.
Hendrickson, C. Edward	Waldor, N. T.
Imsande, Fred L. C.	Ward, John, Jr.
Jones, Harold W.	Wold, Milton C.
Knudsen, Esther M.	Youngquist, Eder B.

Bachelor of Science in Electrical Engineering

Albrecht, Ernest G.	Ludlum, Robert V.
Albrecht, Karl J.	Lund, Jeffery L.
Anderson, Arthur P.	McClung, Karl R.
Benson, Ikel C.	McCully, James P.
(M. S. E. E. 1927)	McEwen, Alexander D.
Boe, Lester L.	Malmgren, Richard V.
Borchert, Oscar H.	Meagher, Joseph E.
Bordeau, Sanford P.	Nelson, Carl C.
Brossard, Henry F.	Nelson, Clarence H.
Burlingame, Robert E.	Nickerson, Edward
Cameron, Harry D.	Nierling, Grant C.
Childs, Morris P.	Parsons, Sidney A.
Christensen, Arthur L.	Peterson, Lewis E.
Cosandey, Charles J.	Postma, John
Countryman, M. Alden	Reed, Henry R.
Cousins, Van M.	(M. S. E. E. 1927)
Edwards, Richard G.	Richardson, Philip E.
Ellis, Carl E.	Robertson, Kenefick
Franzen, Roy O.	Schenckloth, Harry H.
Gilman, Gaylord	Schuck, Roy D.
Hammer, Harold E.	Shavor, George J.
Hanft, Hugo H.	Smith, Harold D.
Heins, Harold H.	Solomonson, Lawrence D.
Hill, Edward L.	Steinert, Emil
Holmes, Raymond H.	Taylor, Richard G.
Hussey, Norman W.	Thomas, Richard L.
Jacobsen, Arthur C.	Thomson, Andrew
Johnson, Enan C.	Thyberg, Clarence W.
Johnson, Robertson B.	Tunell, Clement R.
Kauppinen, Heino	Untinen, August L.
Keller, Raymond W.	Upton, Albert P.
Knoll, Franklin O.	Westigard, Glenn A.
(B. S. C. E. 1922)	Wieland, Willard W.
(St. Thomas)	Winslow, Harry J.
Koch, Winfield R.	Wurzbach, Henry A.
Lewis, Berkeley R., Jr.	

Bachelor of Science in Mechanical Engineering

Algren, Axel B.	Jacobi, Alfred J.
Backstrom, Russell E.	Jacobson, Reuben A.
(M. S. M. E. 1927)	Jenkins, Clifford H.
Beseler, Herman F.	Ludvigsen, Elliot L.
Bjerre, Folmar I.	Lundquist, C. D. Vernon
Boss, Ronald W.	Martino, Anthony D.
Caswell, Thomas B.	Mills, Hartzel
Donnelly, William H.	Pendergast, Webster G.
Eggleston, Smith	Peterson, Laurence L.
Erskine, Lawrence F.	Robinson, Parke D.
Forseth, George O.	Souba, John I.
French, William O.	Stevens, Everett B.
Heath, Arthur C., Jr.	Whitten, Robert C.
Hoisveen, Leonard F.	Wilson, Roy A.
Holmes, Roland W.	

ADVANCED DEGREES

Master of Science in Architecture

Dayu, Doon (B. S. 1924)

Master of Science in Electrical Engineering

Braden, Rene A. (B. S. E. E. 1923)
Heidelberger, Otto F. (B. S. E. E. 1923)
Kannenberg, Walter F. (B. S. E. E. 1923)
Sampson, Clifford L. (B. S. E. E. 1923)

Master of Science in Mechanical Engineering

Earl, Donald E. (B. S. M. E. 1924)
Morrill, Raleigh D. (B. S. M. E. 1909, E. E. 1922, Maine)
Morris, Frank A. (B. S. M. E. 1924)

1926

Bachelor of Science in Architecture

Frenzel, Herman
Kronick, T. Gerald
Lighter, Clyde W.
Naslund, Gustave A.
Potter, Robert P.
Stageberg, Oswald C. R.

Bachelor of Science in Architectural Engineering

Kranzfelder, Robert H.
Rasey, Raymond F.
Redin, R. Kenneth

Bachelor of Science in Interior Decoration

Ehrenberg, Muriel L.
Guesmer, Marie W.
Snyder, Dorothy E.

Bachelor of Science in Civil Engineering

Balkin, Samuel W.
Bolstad, Roswell C.
Breeden, James R.
Bunnell, Charles W.
Comfort, Thomas H.
Cooper, R. Conrad
Croswell, Leslie D.
Deegan, Raymond C.
Drdla, Robert L.
Fenton, Paul C.
Flaaten, Percy H.
Foster, Kenneth W.
Gould, Edward C.
Haakensen, N. Theodore
Halbkat, Frankun J.
Hoffman, John R.
Jakkula, Arne A. (M. S. C. E. 1927)
Johnson, Clifford S.
Johnson, James R.
Johnson, Raymond A.
Juell, Barton
Kelly, Raymond R.
Krefting, Arthur S.
Lewin, Sherman W.
Liese, Carl R.
Lindstedt, Philip C. A.
Lipchick, Alex A.
Lorens, Edward R.
Lund, Clarence V.
Manson, Philip G.
Meyerdick, Clarence E.
Nasvik, Adolph C.
Neubauer, Loren W.
Nyvall, Clifton S.
Ohman, Uno G.
Peterson, Garvin E.
Sandberg, Clifford H.
Schulz, Alex A.
Young, Edward F.
Young, Truman P.

Bachelor of Science in Electrical Engineering

Ageton, Edwin O., Jr.
Anderson, Lowell W.
Ayshford, Loren C.
Barron, John H.
Berghs, Charles J.
Bergman, Hilder W.
Beveridge, Robert A.
Bullard, Henry M.
Carman, Willard J.
Christen, Ray L.
Coon, Lawrence C.
Dahl, Merle G.
Deinema, George R.
Deterling, Edward A.
Dimmick, Merton A.
Etem, Victor
Faulkner, Louis L.
Feldman, Carl B. H.
Ferguson, Kenneth R.
Fiene, Marcus
Forsmark, Ulrik E.
Gaalaas, George L.
Gemmell, Robert W.
Getchell, Earl
Graf, Alois W.
Gross, Leon A.
Haedecke, August D.
Hafstad, Lawrence R.
Hammond, Joseph A.
Hargrave, William A.
Hart, Maurice W.
Hartley, Lowell J.
Hilgedick, Winfred C.
Holcomb, Harry S.
Hummel, Carl
Irons, George R.
Jensen, Otto L. (B. A.)
Joesting, Frederick D.
Johnson, Clarence A.
Johnson, Welton V.
Jones, Richard W.
Kelly, William J.
Larsen, Einar H.
Lee, Albert A.
LeVesconte, Lester B.
Levy, Max L.
Lindquist, Oliver J.
Lostrom, Herbert W.
Lyberg, Verele C.
Lynskey, Joseph P.
Mackay, Donald H.
Mahachek, Ross
Mann, Alvin K.
Meader, Glenn S.
Mindrum, Arthur I.
Murdoch, George B.
Nelson, Paul B.
Nelson, Robert B. D.
Nimmer, Walter B.
Orning, Harold
Parry, John E.
Quine, William M.
Rhoades, Herbert E.
Robinson, Lawrence T.
Salstrom, Paul S.
Schroeder, Clarence A.
Schweppe, Walter A.
Scott, Franklin B.
Sjoberg, Roy H.
Slaggie, Eucharius L.
Tholstrup, Henry L.
Tighe, James S.
Walters, Robert P.
Wenrich, James R.
Wentz, Edward C.
Williams, William R.

Bachelor of Science in Mechanical Engineering

Anderson, Wesley J.
Bancroft, Henry K.
Beek, Hiram D.
Bennett, John C. (M. S. M. E.)
Bohannon, George W.
Burt, Paul R.
Cole, Ernest C.
Comfort, Clifford E.
Corbett, Theodore R.
Dewaji, Gunaker
DuBois, N. Warren
Fornfeist, Carl H.
Grant, Russell S.
Hanna, Cyril C.
Hass, Paul O.
Kleinfeld, Leonard S.
Letson, Donald E.
Lundgren, Carl W.
Maney, James E.
Mork, George W.
Norrbom, Oscar E.
Nordenson, Willard H.
O'Donnell, Lawrence
Pierce, Walter H.
Pike, Jay B. (M. S. M. E. 1927)
Roberts, Norman A.
Rollin, Harold E.
Slaby, Louis J.
Tucker, Carl W.

ADVANCED DEGREES

Civil Engineer

Coe, Edward H. (B. S. C. E. 1919)
Luxford, Ronald F. (C. E. 1917, M. S. 1925, Wisconsin)

Master of Science in Civil Engineering

Nichol, Frank E. (B. S. C. E. 1925)

1927

Bachelor of Science in Architecture

Anderson, Lawrence B.
Backstrom, K. A. W.
Broderick, Vere H.
Cameron, Lester W.
Close, Winston A.
Eaton, Paul Frederick
Edwards, William H.
Flegal, Ai Claude
Gustafson, Robert F.
Havens, Paul Maynard
Castner, Arthur Henry
Kilpatrick, Porter Warren
McCan, Realino Vincent
Melius, Arnold A.

Bachelor of Science in Architectural Engineering

Bull, Alvah Stanley
Davidson, Henry A.
Gilfillan, Donald Wm.
Nelson, Neal N.
Nyquist, Roy L.
Park, James Injun
Sorenson, Russell L.
Stolte, Sidney L.

Bachelor of Science in Interior Decoration

Cameron, Grace
Wilkinson, Gladness B.
Grafslund, Geneva Louise

Bachelor of Science in Civil Engineering

Bolnick, Harry Wm.
Borne, Floyd O.
Borrowman, John Keeley
Brattlof, Clifford
Briggs, Luerd E.
Brohaugh, Gustave C.
Campbell, Douglas M.
Carlson, Elmer W.
Christianson, Elmer John
Clark, Kenneth Miles
Crowell, Sidney Howe
Engler, Myer
Edlund, Ray Clinton
Gehring, Lester George
Hagman, Walter Fred
Hoving, John E.
How, Francis Waldo
Johnsen, Kenneth A.
Johnson, Laurence Victor
Castner, Roy W.
Lande, Clarence C.
Luethi, Carl Francis
Loucks, Roger Brown
Lundsten, Frank Rueben
Lund, Stanley D.
Marcroft, John Clifford
Morris, George Edward
Murray, Harold E.
Norman, Henry Robert
Pajari, Tauno
Paulson, Joseph Bernard
Pearson, Einar Otto
Pearson, Harold Theodore
Peterson, Frederick G.
Platzer, George John
Pohl, Loren Frank
Preus, Christian K.
Riedesel, Russell Irving
Rosing, Donald Clay
Ruth, Fred Louis
Santelman, Ralph Henry
Sperling, Abe J.
Teske, Frederick Carl
Turrittin, Hugh Lonsdale
Wentz, Clarence Arthur
Witt, Edward John
Youngquist, C. Vernon
Zuckman, George J.

Bachelor of Science in Electrical Engineering

Anders, Milton F.
Anderson, Henry Alvin
Asphalt, Filip Johanson
Bailey, Stuart Lawrence
Barton, James Parker
Beach, George
Berglund, Erick Bernard
Berkner, Lloyd Biel
Byer, Randall R.
Bezek, Albert
Bonner, Arthur Lee
Bottemiller, Edward L.
Boyce, Harold J.
Brandt, Clifford Alois
Brayden, Giles William
Brightfelt, John Charles
Buccowich, Paul
Burmeister, Charles H.
Clark, Charles Stevens
DuBois, John Harry
Edgar, Robert Ferguson
Farmer, Herbert Fred
Gibson, Robert
Heimer, Amos Kingsley
Hortberg, Reynold Olof
Hovey, Bertram Kelsey
Johnson, Gustave F.
Lange, George M.
Lee, Albert Christian
Lee, Paul Raymond
Leider, Albert E.
Lewis, Lloyd W.
McDonnell, Lawrence P.
McKesson, Lewis James
Miller, William S. E.
Moore, Gordon B.
Moosbrugger, Frank John
Moses, Marlowe Grant
Nelson, Clarence Enoch
Nergaard, Leon Severin
Nielsen, Andres H.
Nolan, George Charles
Norberg, Hans A.
Ofelt, George R.
Osburn, Roy Wesley
Peters, Charles Max
Pilger, Clarence L.
Prehn, Victor Nicholas
Rauscher, Paul Frank
Redding, James A.
Ringstrom, George H.
Robinson, Richard Burton
Rogers, H. Barrett
Scholz, Edmund Henry
Schultz, Albert W.
Schulze, LeRoy Edward
Smith, Jerome Conrad
Speer, Paul B.
Sunblad, Everts William
Swanson, Carl Everett
Thompson, Niles J.
Volkenant, Gordon W.
Wald, Joseph Harold
Ward, Stanley A.
Weber, Clyde
Weeks, Leonard H.
Wehlitz, Hubert Frank
Weom, Laurel Allan
Whiteley, Howard Orville
Witts, Seth Newton
Woloshin, Boris

Bachelor of Science in Mechanical Engineering

Akins, Clifford Miller
Bliven, Paul
Boyce, Norman Elliott
Bros, Kenneth Donald
Carlson, Clifton Conrade
Chapman, Wilbur J.
Coates, Joseph Edwin
Cook, Lyle M.
Dacanay, Lino P.
Dixon, Donald Kenneth
Evans, Ralph B.
Giessel, Paul Albin
Hall, John Whitmore
Hutchinson, Edwin T.
Irons, Roy Cecil
Isaacson, Arthur M.
Lamon, Harold Joseph
Little, Fred Wellington
Loo, Yuson
Lowther, Wilfred Wesley
McNeill, Lyle D.
MacDonald, George A.
Mongren, Richard Vern
Munger, Maurice
Parten, Carl Darius
Richardson, Ralph Arthur
Roberts, Dimon Albert
Schneider, Frank Mahlon
Spehr, Peter Eldon
Spencer, John Boyd
Trexler, Richard Rollo
Tubbesing, Norman F.
Vye, George Parks

ADVANCED DEGREES

Civil Engineer

Levens, Alexander Sander (B. S. C. E. 1922, M. S. C. E. 1924)

Master of Science in Civil Engineering

Jakkula, Arne Arthur (B. S. C. E. 1926)

Master of Science in Electrical Engineering

Benson, Ikel (B. S. E. E. 1925)
Reed, Henry Rouse (B. S. E. E. 1925)

Master of Science in Mechanical Engineering

Pike, Jay Becker (B. S. M. E. 1926)

1928

Bachelors of Architecture

Carjola, Chester L.
Church, Bruce R.
Ekman, Harold
Grossman, Frederic R.
Holien, Gilman C.
Huchthausen, Walter J.
Jones, Paul W.
Rakov, Avner
Thorshov, Roy N.
Witt, Edward H.

Bachelors of Architectural Engineering

Affleck, Dean H.
Davidson, John E.
Jerabek, Daniel A.
Jones, Gurdon W.
Loo, Pang Chieh
McGinnity, William J.
Meyers, Clare F.
Pearson, George O.
Ramey, John M.
Roston, Rees E.

Bachelors of Interior Decoration

Berman, Florence C.
von Sien, Ruth E.

Bachelors of Civil Engineering

Amidon, Roger E.
Beaudin, Lawrence A.
Benson, Mons H.
Bergford, John F.
Bolton, John M.
Daly, Frank A.
Dreveskracht, Wallace W.
Engstrom, LeRoy
Erickson, Hugo G.
Erickson, Lloyd R.
Ferguson, George E.
Frank, Carl W.
Gard, Donald L.
Goldberg, Hymen
Gustafson, J. Melvin
Johnson, Ralph P.
Knox, Charles E.
Kopp, David C.
Kopplin, Charles D.
Kreger, Lynn S.
Lexau, Ole H.
McDanield, Laren A.
McNally, Lee D.
Maturi, Rudolph
Meyeron, Ben
Normann, Olav. K.
Olson, Clarence C.
Parker, Clyde H.
Prior, Charles H.
Rinell, Eric A.
Ringwood, James B.
Rydeen, James P.
Schroepfer, George J.
Silliman, Paul D.
Tauber, Joseph H.
Tebo, Frank A.
Thwing, George Jr.
Vorisek, Jerry J.
Wielde, John A.

Bachelors of Electrical Engineering

Ackermann, Robert W.
Anderson, Elwood C.
Barnes, James C.
Benesovitz, Abe
Braaten, Arthur M.
Brown, Glendon C.
Burris, Arthur P.
Christopherson, Arnold J.
Clousing, Lawrence A.
Compton, Milton E.
Cook, J. Marvin
Cooper, Jack I.
Corliss, Charles V.
Dahl, Paul E.
Elmburg, John C. W.
Engquist, Emil B.
Fisher, George L.
Fogelholm, Edward G.
Frankovich, John J.
Fredrickson, Edwin W.
Froberg, Harold E.
Furber, Richard D.
Grimm, Raymond E.
Gustafson, Thor A.
Hamilton, Sam R.
Harwick, Henry C.
Hawkins, George C.
Heywood, George L.
Holt, Gunnard T.
Holt, Leo G.
Hoover, Lloyd H.
Jarchow, Theodore L.
Johnson, Douglas O.
Johnson, Sheldon F.

Bachelors of Electrical Engineering

- Klammer, Kalmer K.
- Koerner, Allen M.
- Kotchevar, Joseph F.
- Kriechbaum, John P.
- Krieger, Keith M.
- Kritzer, Louis W.
- Larson, Seymour R.
- Lende, Willard H.
- Lee, Alfred H.
- McCrea, John A.
- *McIntire, Elmer E.
- Neill, Clarence L.
- Nogueria, Frederico P.
- Ohman, Leo S.
- Peterson, Randall J.
- Peterson, Valgar N.
- Riddell, Donald J.
- Schvone, Anthony P.
- Schliep, Carl J.
- Seeger, Franklin H.
- Sharpless, William M.
- Sheire, James B.
- Smeby, Lynne C.
- Soderholm, Lauren V.
- Stevens, Donald T.
- Stevens, Bruce E.
- Stuart, Donald M.
- Swanson, Carl E.
- Sweeney, Frank C.
- Thelin, Ruben E.
- Towey, James M.
- Young, Clifford L.

Bachelors of Mechanical Engineering

- Angell, Glenn H.
- Arko, Frank W.
- Barthelemy, Carl R.
- Blackmore, Frank E.
- Blackshaw, Joe L.
- Bowers, Raymond
- Boyce, John
- Burke, James J.
- Dunning, Robert M.
- Elliott, Merle B.
- Fritzberg, L. Hilding
- Gustafson, Hugo F.
- Hathaway, Herbert F.
- Hemenway, Edward L., Jr.
- Japs, Wilbur H.
- Knutson, Melvin I.
- Kusnerek, Clement J.
- Larson, Werner L.
- Libby, Calvin R.
- Lundquist, Wilton G. C.
- McGladrey, Lyle L.
- Mayhugh, Benjamin F.
- Miller, Marvel P.
- Nelson, Arthur
- Osrowske, Arthur B.
- Pettersen, Wilber E.
- Roberts, Henry M.
- Robertson, Haney M.
- Spotts, Herbert J.
- Von Stocker, Selmer G.
- Wood, Leslie L.

ADVANCED DEGREES

Master of Science in Civil Engineering

- McKay, Earle Douglas (B. S. 1915, C. E. 1916)

Master of Science in Electrical Engineering

- Bailey, Stuart Lawrence (B. S. E. E. 1927)
- Feldman, Carl Brandt (B. S. E. E. 1927)
- Fiene, Marcus Ernest (B. S. E. E. 1926)
- Schweppe, Walter August (B. S. E. E. 1926)
- Tholstrup, Henry Leo (B. S. E. E. 1926)

Electrical Engineer

- Kannenberg, Walter Frederick (B. S. 1923, M. S. 1925)

School of Chemistry

THE first degree was that of Chemical Engineer, granted in 1897, at the close of the regular four-year course. In 1902, the present degree of Bachelor of Science in Chemistry was conferred and has continued except for the two years, 1905 and 1906, when the degree was Analytical Chemist. For the course in chemical engineering, the corresponding degree of Bachelor of Science in Chemical Engineering was used.

In 1912, the degree of Chemical Engineer was granted at the close of the four-year course, as had been the custom for several years in the College of Engineering and Architecture, but in 1913 the new plan in that college was followed in the School of Chemistry as far as chemical engineering was concerned, and the degree of Chemical Engineer was granted at the end of the fifth year's work after the Bachelor of Science in Chemical Engineering had been obtained for the four-year course.

The present plan of conferring the professional degree of Chemical Engineer as a graduate degree based upon graduate study, experience, and a thesis was established in 1923.

In 1928 the form of the Bachelor's degree was changed to Bachelor of Chemistry and Bachelor of Chemical Engineering, taking effect in June, 1928. Similar action was taken at the same time by the College of Engineering and Architecture.

1897

Chemical Engineer

- *Chapin, Lewis P.
- Hamilton, Herbert C.
- Linton, James H.
- Webber, Frederick W.

1902

Bachelor of Science in Chemistry

- Benner, Raymond C.
- *Lando, Maximillian N.
- Rice, Edgar W.

1903

Bachelor of Science in Chemistry

- Bakke, Oliver M.

1904

Bachelor of Science

- Grout, Frank F.
- Gutsche, Edward J.
- Hopkins, Joseph I.
- Rose, Anton R.

1905

Analytical Chemist

- Borrowman, George L.
- Dahlberg, Arnold V.
- Frary, Francis C. (M. S. 1906, Ph. D. 1912)
- Jackson, Myron B.
- Longworth, Fred J.
- Pennock, Edward M.
- Poore, Charles D.

1906

Analytical Chemist

- Bernhagen, Lewis O.

Master of Arts in Chemistry

- Wilhoit, Albert D. (B. A. 1905, Macalester)

Master of Science in Chemistry

- Frary, Francis C. (A. C. 1905, Ph. D. 1912)

1907

Bachelor of Science in Chemistry

- Doran, James M.
- Halvorson, John O.
- Kennedy, William W.
- Manuel, Earle V.
- Von Kuster, Edith I. (Mrs. W. Johnson)

Bachelor of Science in Chemical Engineering

- Davies, Edwin T.

1908

Bachelor of Science in Chemistry

- Anderson, Edward X. (M. S. 1909)
- Badger, Walter L. (B. A. 1907, M. S. 1909)
- *Cressy, Charles R. (M. S. 1913)
- Lowe, John M.
- McBride, Russell S.
- Porter, Allen H.
- Whited, Oric O.

1909

Bachelor of Science in Chemistry

- Bacon, Charles B.
- Dresser, Eva L. (Alves)
- Kueffner, Otto K.
- Selvig, Walter
- Sterling, Faith (Sterling)
- Walker, George W.

Bachelor of Science in Chemical Engineering

- Barnaby, William E.
- Morey, George W.
- Roehrich, Victor H. (M. S. 1910)

Bachelor of Science in Chemistry

- Anderson, Edward X. (B. S. 1908)
- Badger, Walter L. (B. A. 1907, B. S. 1908)

1910

Bachelor of Science in Chemical Engineering

- Bicknell, Henry R.
- Daniels, Farrington (M. S. 1911)
- De Witt, Joseph Henri
- Dietrichson, Gerhard
- Finke, Wilbur W. M.
- *Peterson, Andrew P. (M. S. 1911)
- *Smith, Carolyn H.
- *Stone, George H.
- Taylor, Carl A.
- Tronson, Carl A.
- Woolett, Guy H. (M. S. 1916, Ph. D. 1918)

Bachelor of Science in Chemical Engineering

- Dahlberg, Henry W.
- Gutsche, Frank Carl
- Smith, Sheldon H.

Master of Arts in Chemistry

- Nye, Lillian L. (B. A. 1909)

Master of Science in Chemistry

- Pitchford, G. Leonard (B. S. 1907, Nebraska)
- Roehrich, Victor H. (B. S. 1909)

1911

Bachelor of Science in Chemistry

- Cantwell, William F.
- Halvorson, Henry A.
- Hartnett, John G.
- Hennessy, Hugh J.
- Johnson, Einer (M. S. 1912)
- Leavenworth, Francis M.
- McMiller, Paul R.
- Olson, Arthur O.
- Pettijohn, Earl (M. S. 1912, Ph. D. 1918)
- Stoppel, Ernest A.

Bachelor of Science in Chemical Engineering

- Baker, Russell E.
- *Bolton, John B.
- Callaway, Roy S.

Master of Science in Chemistry

- Bell, Grace M. (B. A. 1909)
- Daniels, Farrington (B. S. 1910)

Master of Science in Chemistry

- Kepner, Ben-Hur (B. A. 1910)
- Peterson, Andrew P. (B. A. 1910)
- Poppe, Frederick W. (B. A. 1910, Lawrence)

1912

Bachelor of Science in Chemistry

- Brinton, Paul H. M.-P. (M. S. 1913, Ph.D. 1916)
- Daniels, Elmer A. (M. S. 1913, Ph.D. 1917)
- Hoffman, Henry J. (M. S. 1914)
- Karatz, Lucian
- *McLeod, John R.
- Mitchell, Ralph W.
- Nesse, Charles O.
- Parkin, Guy G. (M. S. 1913)
- Robinson, Rhea B.
- Rockwood, Ralph H.
- Schmidt, George H.
- *Spriestersbach, David O. (M. S. 1915)
- Wanless, Lynn A.

Bachelor of Science in Chemical Engineering

- Edwards, Junius D. (Ch. E. 1913)
- Goldstein, Milton M. (Ch. E. 1913)
- Harshaw, John R.

Chemical Engineer

- Brunkow, Herbert E.
- Martin, Edmund W.

Master of Science in Chemistry

- Johnson, Einer (B. S. 1911)
- Pettijohn, Earl (B. S. 1911, Ph. D. 1918)

Doctor of Philosophy

- Frary, Francis C. (A. C. 1905, M. S. 1906)

1913

Bachelor of Science in Chemistry

- Felion, Arthur J.
- Mastin, Marion G.
- Miller, Ralph H.
- O'Connell, Thomas C. (M. S. 1914)
- Otterstein, Earl F.
- Sutter, Hedwig M. (Mrs. R. Wilson)
- Taylor, Cyril Stead
- Yngve, Victor

Bachelor of Science in Chemical Engineering

- Anderson, Fredolf T. (Ch. E. 1914)
- Katz-Nelson, William
- Kern, Herbert A. (Ch. E. 1914)
- Peterson, Henry (Ch. E. 1914)
- Porter, Ralph E. (Ch. E. 1914)

Chemical Engineer

Edwards, Junius D. (B. S. 1912)
Goldstein, Milton M. (B. S. 1912)

Master of Arts in Chemistry

Beck, Maud G. (B. A. 1905)
Skartvedt, Peter M. (B. A. 1906, St. Olaf)

Master of Science in Chemistry

Brinton, Paul H. M.-P. (B. S. 1912, Ph.D. 1916)
Cressy, Charles R. (B. S. 1908)
Daniels, Elmer A. (B. S. 1912)
Parkin, Guy G. (B. S. 1912)

Doctor of Philosophy

Cohen, Lillian (B. S. 1900, M. S. 1901)

1914

Bachelor of Science in Chemistry

Gauger, A. W. Merton, Howard V.
Juvrud, Ingvald O. Tibbling, Ernest F.

Chemical Engineer

Anderson, Fredolf T. (B. S. 1913)
Bierman, Harry C. (B. S. 1914)
Kern, Herbert A. (B. S. 1913)
May, Darwin R. (B. S. 1914, Ch. E. 1915)
Peterson, Henry (B. S. 1913)
Porter, Ralph E. (B. S. 1913)
Tinkham, Willis M. (B. S. 1914)

Bachelor of Science in Chemistry

Bray, Mark W. (B. A. 1912, Lawrence)
Hoffmann, Henry J. (B. S. 1912)
Kokatnur, Vaman R. (B. A. 1912, Bombay, India, Ph. D., 1916)
Yngve, Victor (B. S. 1913)

Doctor of Philosophy

Brown, Harold H.
(B. A. 1909, M. A. 1910, Syracuse)

1915

Bachelor of Science in Chemistry

Fegan, Elmer T. (M. S. 1916)
Olsen, Leslie R.
Ringstrom, Hugo (M. S. 1917)
Toncheff, Stanil

Bachelor of Science in Chemical Engineering

Morse, Guilford A. (Ch. E. 1915)

Master of Science in Chemistry

Nietz, Adolph (B. A. 1913)
*Spriestersbach, David O. (B. S. 1912)
Ziegler, Mildred R. (B. A. 1914)

Doctor of Philosophy

Temple, Sterling N.
(Ph. D. 1905, M. A. 1906, Hamline)

1916

Bachelor of Science in Chemistry

Dunningham, Merton
Souther, Benjamin L.
Morrow, Leon W.

Bachelor of Science in Chemical Engineering

Bell, Alexander D. (Ch. E. 1917)

Master of Science in Chemistry

Fegan, Elmer T. (B. S. 1915)
May, Darwin (B. S. Ch. Eng. '14, Ch. E. '15)
Newman, Allen T. (B. S. 1912, Nebraska)
Stenger, Lawrence A. (B. S. E. E. 1906)
Woolett, Guy H. (B. S. 1910, Ph. D. 1918)

Doctor of Philosophy

Brinton, Paul H. M.-P. (B. S. 1912, M. S. 1913)
Kokatnur, Vaman R.
(B. S. 1912, Bombay, M. S. 1914)

1917

Bachelor of Science in Chemistry

Corson, Benjamin I. Marr, Horace S.
Durham, Samuel W. Marshall, Olive W.
*Eckman, Lawrence R. Owens, Jay C.
*Egge, Walter Rask, Olaf S.
Markus, Benjamin

Bachelor of Science in Chemical Engineering

Burningham, Foster A. (Ch. E. 1918) Luft, Oscar W.
Strong, Frank D.
Domovsky, Aaron Washburn, Frederick M.
Higburg, William Widell, Gideon
Kuentzel, Ward E.

Chemical Engineer

Bell, Alexander D. (B. S. 1916)

Master of Science in Chemistry

Barrows, Vera (B. A. 1906)
Cade, Arthur R.
(B. S. Worcester Polytechnic Inst. 1915)
Joyce, Floyd E. (B. S. 1912, Iowa)
Lauer, Walter M.
(B. S. 1913, Ursinus College, Ph. D. 1924)
Ringstrom, Hugo (B. S. 1914, B. S. 1915)
Seyfried, Lillian M. (B. A. 1915)

Doctor of Philosophy

Daniels, Elmer A. (B. S. 1912, M. S. 1913)

1918

Bachelor of Science in Chemistry

Joselowitz, Goodwin Nelson, Harry G.
Kesselman, Leo Pan, Wen Ping

Bachelor of Science in Chemical Engineering

Donauer, Max (Ch. E. 1925)
Hogness, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 1919)
Kessel, Herbert (Ch. E. 1919)
Neilson, Chris

Chemical Engineer

Burningham, Foster A. (B. S. 1917)

Master of Science in Chemistry

Schultz, Peter D. (B. A. 1914, Bethel College)

Doctor of Philisophy

Pettijohn, Earl
(B. A. 1906, B. S. 1911, M. S. 1912)
Sternberg, Woldemar M.
(B. S. 1908, Petrograd, Russia)
Woollett, Guy H. (B. S. 1910, M. S. 1916)

1919

Bachelor of Science in Chemistry

Beckel, Arthur C. Heck, Frank J.
Brooks, Leslie C. Thorson, Stuart J.
Engstrom, Leslie G.

Bachelor of Science in Chemical Engineering

Fischer, Earl B. (Ch. E. 1923)
Greenlaw, Charles E.
Hawkey, Harold K. (Ch. E. 1919)
Koch, Arthur
Reu, Albrecht H. (Ch. E. 1920)
Winslow, Raymond (Ch. E. 1920)

Chemical Engineer

Hogness, Thorfin R. (B. S. 1918)
Hawkey, Harold K. (B. S. 1919)
Johnson, Donald Lee (B. S. 1918)

1920

Bachelor of Science in Chemistry

Hoff, John E.
Korfhage, Roy F.
Matthews, Glenn E. (M. S. 1921)
Moe, Claude P.
Pippel, Herbert A.

Bachelor of Science in Chemical Engineering

Anderson, Minton M. (Ch. E. 1921)
Busch, John S.
Fieger, Ernest A. (Ch. E. 1921)
Hammer, George E.
Jones, Ernest J. (Ch. E. 1921)
Kracek, Frank C. (Ph. D. 1924)
Mitchell, Donald F. (Ch. E. 1921)
Parrett, Arthur N. (Ch. E. 1921)
Pearson, Elmer A. (Ch. E. 1921)
Reck, Robert C. (Ch. E. 1921)
Sternberg, Heime A. (Ch. E. 1921)
Stoppel, Arthur E. (Ch. E. 1921, Ph. D. 1924)
Wallfred, Carl L. (Ch. E. 1921)
Weber, Ludwig J. (Ch. E. 1921, Ph. D. 1924)

Chemical Engineer

Reu, Albrecht H. (B. S. 1919)
Winslow, Raymond M. (B. S. 1919)

Master of Science in Chemistry

Morse, Minerva (B. A. 1915, Ph. D. 1925)
Plummer, Clayton E.
(B. C. E. 1914, Michigan)

1921

Bachelor of Science in Chemistry

Corl, Cady S. Riley, Philip J.
Epstein, Hymen (M. S. 1924)
Kryger, Edward R. Seymour, Merrill W.
Nygard, Edwin M. Westerberg, Carl G.

Bachelor of Science in Chemical Engineering

Aronovsky, Samuel I. (Ch. E. 1922)
Boxell, Morris L.
Cornell, Reuben W. (Ch. E. 1922)
Lee, Melville R. (Ch. E. 1922)
Leerskov, Gerhard W.
Nicholson, Harry G.
Peterson, Marshall A. (Ch. E. 1922)
Ramsey, Selmer
Riddington, Frederick W. (Ch. E. 1922)
Roberts, Wesley J. (Ch. E. 1922)
Ruchhoft, Clarence
Schermer, Oscar C. (Ch. E. 1922)
Swart, Richard H.

Chemical Engineer

Anderson, Minton M. (B. S. 1920)
Fieger, Ernest A. (B. S. 1920)
Jones, Ernest J. (B. S. 1920)
Mitchell, Donald F. (B. S. 1920)
Nicholson, Harry G. (B. S. 1921)
Parrett, Arthur N. (B. S. 1920)
Pearson, Elmer A. (B. S. 1920)
Reck, Robert C. (B. S. 1921)
Sternberg, Heime A. (B. S. 1920)
Stoppel, Arthur E. (B. S. 1920, Ph. D. 1924)
Wallfred, Carl L. (B. S. 1920)
Weber, Ludwig J. (B. S. 1920, Ph. D. 1924)

Master of Science in Chemistry

Hauge, Sigfred M. (B. A. 1918, St. Olaf)
Hovland, Clifton R. (B. A. 1919, St. Olaf)
Kohlhase, Arthur H.
(B. S. 1919, Hamline, Ph. D. 1924)
Matthews, Glenn E. (B. S. 1920)

1922

Bachelor of Science in Chemistry

Darling, Stephen F. (M. S. 1924)
Ellestad, Reuben (M. S. 1924)
Hammond, Kathryn D. (Mrs. K. E. Kelley)
Sullivan, Betty
Tappan, Ruth W. (Mrs. Joseph Dowling)

Bachelor of Science in Chemical Engineering

Barrett, Joseph O. (Ch. E. 1923)
Busch, William A.
Cassel, Norman S. (Ch. E. 1923)
Chadbourne, L. Rodney (Ch. E. 1923)
Halvorson, Halvor O. (Ch. E. 1923)
Langseth, Axel O. (Ch. E. 1923)
Livermore, Harvey J.
Luger, Karl E.
Manuel, Douglas R.
Morin, William T. (Ch. E. 1923)
Morken, Carl H.

Bachelor of Science in Chemical Engineering

Schwartz, Marcel M.
Stone, Leslie F. (Ch. E. 1923)
Wyman, LeRoy L. (Ch. E. 1923)

Chemical Engineer

Aronovsky, Samuel I. (B. S. 1921)
Cornell, Reuben W. (B. S. 1921)
Lee, Melville R. (B. S. 1921)
Peterson, Marshall A. (B. S. 1921)
Riddington, Frederick W. (B. S. 1921)
Roberts, Wesley J. (B. S. 1921)
Schermer, Oscar C. (B. S. 1921)

Master of Science in Chemistry

Fulermer, Jervis M.
(B. S. 1920, Washington State College)
Harris, Elmin E. (B. S. 1921, Hamline)
Heisig, Lucille Krantz (B. A. 1919)

Doctor of Philosophy

Hartshorn, Elden B. (B. S. 1912, Dartmouth)

1923

Bachelor of Science in Chemistry

Kampa, Edmund Webster, Cora H.

Bachelor of Science in Chemical Engineering

Bostwick, Ross D.
Bruce, G. Norman
Eck, Lester J. (M. S. 1924)
Edgar, Donald E. (M. S. 1925)
Firth, Charles V.
Frederickson, Hubert M.
Hatch, Lloyd
McMillen, Elliott L. (M. S. 1927)
Paulson, Paul M. (M. S. 1924)
Peterson, Clifford E.
Rademacher, Richard L. (M. S. 1924)
Sorenson, Ben. E. (M. S. 1924, Ph. D. 1927)
Thordarson, William (M. S. 1924)
White, Robert H. (M. S. 1924)

Chemical Engineer

Barrett, Joseph O. (B. S. 1922)
Cassel, Norman S. (B. S. 1922)

Chemical Engineer

Chadbourne, L. Rodney (B. S. 1922)
Halvorson, Halvor O. (B. S. 1922)
Langseth, Axel O. (B. S. 1922)
Morin, William T. (B. S. 1922)
Stone, Leslie F. (B. S. 1922, Ph.D. 1927)
Wyman, LeRoy L. (B. S. 1922)

Master of Science in Chemistry

Anderson, Winslow S. (B. S. 1921, Bates College)
Bakken, Adolph C. (B. A. 1919, St. Olaf)
Pagel, Herbert A. (B. A. 1922)

Bachelor of Science in Chemical Engineering

Ernst, Robert C.
(B. S. 1921, N. C. State College)
Kester, Ernest B. (B. A. 1922)

Doctor of Philosophy

Levine, Arthur (B. A. 1916, Augustana College)

1924

Bachelor of Science in Chemistry

Fredrickson, Edna M. Ludwig, Llewellyn G.
Humphrey, Gertrude J.

Bachelor of Science in Chemical Engineering

Bache, Edmund
Dahlen, Miles A.
Fuhrman, Alvin O.
Glenn, Harry W.
Krantz, Rudolph W. (B. A. 1923, M. S. 1925)
Lavine, Irvin
Luft, Hans L. (M. S. 1924)
Paul, Karl F.
Roque, Feliciano T.
Zima, Albert G.

Master of Science in Chemistry

Bauer, Esther E. (B. A. 1921)
Darling, Stephen F. (B. S. 1922)
Dobrovolny, Frank J.
(B. A. 1920, Dakota Wesleyan)
Ellestad, Reuben B. (B. S. 1922)
Elmquist, Ruth E. (B. A. 1921)
Riley, Philip J. (B. S. 1921)

Master of Science in Chemical Engineering

Eck, Lester J. (B. S. 1923)
Hartkemeier, Leonard (B. S. 1921, Louisville)
Luft, Hans L. (B. S. 1924)
Nelson, Ernest W. (B. A. 1920)
Paulson, Paul M. (B. S. 1923)
Rademacher, Richard L. (B. S. 1923)
Sorenson, Ben E. (B. S. 1923, Ph. D. 1927)
Thordarson, William (B. S. 1923)
White, Robert H. (B. S. 1923)

Doctor of Philosophy

Fuson, Reynold C.
(B. A. 1920, Montana, M. A. 1921, Calif.)
Kohlhase, Arthur H.
(B. S. 1919, Hamline, M. S. 1921)
Kracek, Frank C. (B. S. 1920)
Lauer, Walter M.
(B. A. 1913, Ursinus College, M. S. 1917)
Sarver, Landon E. (B. A. 1915,
Randolph Macon, M. A. 1919, Lafayette)
Stoppel, Arthur E. (B. S. 1920, Ch. E. 1921)
Weber, Ludwig J. (B. S. 1920, Ch. E. 1921)

1925

Bachelor of Science in Chemistry

Anderson, Alvin P. Gillman, Hyam
Ayers, Ellsworth B. Hamm, Homer A.
Brinker, Howard C. Vievering, William A.
Galvez, Nicolas L.

Bachelor of Science in Chemical Engineering

Bekkedahl, Norman P. McKee, John B.
Coult, Lyman H. (M. S. 1926)
Covell, Paul L. Reiter, Alfred A.
Edmunds, Alvin M. Scandling, Joseph E.
Jewett, Ernest E. Sprung, Murray M.
(M. S. 1926) Stier, Ruth I.
Johnson, Lester L. (Mrs. Cecil Mayo)
(M. S. 1927) Zeidlik, William J.
Johnston, Charles L. (M. S. 1926)

Chemical Engineer

Donauer, Max (B. S. 1918)

Master of Science in Chemistry

Chaney, Albert L.
(B. A. 1920, Washington Missionary College)
Freche, Hertha R. (B. A. 1919)
Underhill, Editha (B. A. 1916, Vassar)

Master of Science in Chemical Engineering

Edgar, Donald E. (B. S. 1923)
Krantz, Rudolph W. (B. A. 1923, B. S. 1924)

Doctor of Philosophy

Morse, Minerva (B. A. 1915, M. S. 1920)

1926

Bachelor of Science in Chemistry

DeVaney, Grace M. Thompson, Warren L.
Dysterheft, George A. Weetman, Bruce
Johnson, Waldo C.

Bachelor of Science in Chemical Engineering

Bunger, Harold A. Schlafge, William H.
Haugsrud, Parmalee S. (M. S. 1927)
Jerabek, Henry S. Shirk, Loren H.
Kobe, Kenneth A. (M. S. 1926)
Kugler, Joseph H. Smith, Allen S.
Lewenstein, Abraham Sverdrup, Edward F.
Murray, Robert (M. S. 1927)
Reiter, Alfred A. Tronson, John L.
(M. S. 1926) Rauen, Theodore
Rogers, Marvin Jordan, Wallace E.

Master of Science in Chemical Engineering

Jewett, Ernest E. (B. S. 1925)
Kameda, Tohru (1925, Tokio Technical School)
McKee, John B. (B. S. 1925)
Pagnucco, John W. (B. A. '23 U. of Minn.;
M. S. '26)
Reiter, Alfred A. (B. S. 1926)
Shirk, Loren H. (B. S. 1926)
Tindall, Jesse E. (B. A. 1919, Denver)
Zeidlik, William J. (B. S. 1925)

Doctor of Philosophy

Barber, Hervey H. (B. A. 1918)
Dobrovolny, Frank J.
(A. B. 1920 Dakota Wesleyan; M. S. 1924)
Morris, Vlon N. (B. S. 1922; M. S. 1924, Purdue)
Swearingen, Lloyd E.
(B. S. 1920; M. S. 1921, Oklahoma)

1927

Bachelor of Science in Chemistry

Anderson, Edgar G. Lux, Lester
Dumke, Walter H.

Bachelor of Science in Chemical Engineering

Arnold, Jerome H. Languth, Karl H.
Beal, John L. Maehl, Kenneth A.
Bercovitz, Henry Moffat, Harold A.
Cornell, L. Wallace Murray, Robert C.
Elston, Arthur A. Ohlweiler, William
Gerlicher, Harold W. Wheeler, Roger B.
Holst, James E.

Master of Science in Chemistry

Kilburn, Elsie I. (B. A. 1924)
Lampert, Kenneth C. (B. S. '25)
Lohman, Anne L. (B. A. 1922)
Wernlund, Christian J. (Ph. B. 1913, Hamline;
M. S. 1916, Northwestern)
Willman, August (B. A. Rude College)

Master of Science in Chemical Engineering

Johnson, Lester L. (B. S. '25)
McMillen, Elliot L. (B S. 1923)
Schlafge, William H. (B. S. '26, M. S. '27)
Sverdrup, Edward F. (B. S. '26)

Doctor of Philosophy

Crawford, H. Marjorie
(B. A. '20, Miami; M. S. '22, Iowa)
Edgar, Donald E. ('23 B. S., '27 Ph. D.)
Pagel, Herbert A. (B. A. '22; M. S. '23)
Sly, Caryl (B. S. '23; M. S. '24, Nebraska)
Sorenson, Ben E. (B. S. '23, M. S. '24)
Stone, Leslie F. (B. S. '22, ChE. '24)
Whitney, Robert B. (B. A. '24)

1928

Bachelor of Science in Chemistry

Blosjo, Herbert Helmer Robinson, Helen M.
Goldberg, Will Mordecai Silverman, Reuben
Hansen, Theodore Bruce Sandell, Ernest B.
Hargrove, Lorin Donald Wells, Percy Albert
Knutson, Reuben W.

Bachelor of Science in Chemical Engineering

Kurtz, Kerwin K. Jallings, Kenneth R.
Fawcett, Robert B. Merrill, Grant S.
Foker, Leslie Warren Seestrom, Hjalmer E.
Gehrenbeck, Gilbert B. Stodola, Frank Harold
Gerlicher, Robert A. Swenson, George W.
Hella, Roy Paul Van Duzee, Edward M.

Master of Science in Chemistry

Bull, Henry B. (B. S. '27 U. of So. Carolina)

Master of Science in Chemical Engineering

Buzzell, Maurice E. (B. A. '26 Macalester Col.)
Kobe, Kenneth Albert (B. S. '26 U. of Minn.)
Tronson, John Laurence (B. S. '26 U. of Minn.)
Rohrman, Frederick A.
(B. S. '26 Oregon Agri. Col.)

Doctor of Philosophy

Beard, Ralph Finney (B. S. '17)
Dahlen, Miles A. (B. S. '24)
Brewer, Ralph Emmett (B. A. '17; M. S. '20)

School of Mines and Metallurgy

IN 1887 the General Faculty of the University recommended that the Board of Regents establish a "College of Mines and Metallurgy."

The "School of Mines and Metallurgy" was formally opened in January, 1892, with William R. Appleby in charge. Near the end of that year a reorganization was effected whereby the School of Mines and Metallurgy was temporarily affiliated with the College of Mechanic Arts, to form the College of Engineering, Metallurgy and Mechanic Arts. This organization continued until 1897. In March of that year the dissolution of the School of Mines from the Engineering College took place and from then on the school was known as "The School of Mines" until the present year when the name was changed to the "School of Mines and Metallurgy."

From 1894 to 1897 inclusive, the school granted to its graduates the respective degrees of Bachelor of Mining Engineering and Metallurgy. The year 1897 marked the beginning of the granting of the degree of Engineer of Mines and Metallurgical Engineer. Those men who had previously received the bachelor degrees were given, upon presentation of a satisfactory thesis, engineers' degrees.

In 1911 a new course leading to the Degree of Engineer of Mines in Geology was established.

Beginning with the year 1927-1928 a student in the School of Mines and Metallurgy may work toward a degree recently established, that of Engineer of Mines in Petroleum, bringing the total number of degrees granted by the School of Mines and Metallurgy to four, namely, Engineer of Mines, Metallurgical Engineer, Engineer of Mines in Geology, and Engineer of Mines in Petroleum.

1894

Engineer of Mines

Christianson, Peter

1895

Engineer of Mines

Wilkinson, Charles D.

1896

Engineer of Mines

May, Albert E. Tanner, Wallace N.

1897

Engineer of Mines

Becker, George Wales, Roland T.
Mills, Eugene C.

1898

Engineer of Mines

Brackenbury, Cyril Walker, Clinton L.
McIntosh, Joseph B.

1899

Engineer of Mines

Bass, William C. Warren, Frank M.
Peterson, Andrew Y.

1900

Engineer of Mines

Campbell, William L. McCarthy, Edward P.
Chandler, Eugene D. Teague, Harold W.
Egleston, Olver J. Toll, Rensselaer H.
Hunt, Walter E.

1901

Engineer of Mines

Burgess, Thomas O. Smith, Hoval A.
Clapp, W. Howard Taresh, John
Gholz, Arthur L.

Metallurgical Engineer

Sanderson, Henry S. Smith, Elmo V.

1903

Engineer of Mines

Cohen, Samuel W. Smith, Franklin W.
Field, Edward M. Sowle, Lawrence K.
Flynn, John G. Truesdale, William H. (M. S.)
Hoard, Harold J. Whiteley, Eugene E.
Holden, Henry H. Winther, Arno
Rait, Donald M.

1904

Engineer of Mines

Bowman, Frank A. Kingston, Merton S.
Devereux, Francis C. McCarty, Andrew L.
Hale, William H. Merritt, Lucien
Houlton, Lewis K. Shouts, Sydney L.
Keene, Amor F.

Metallurgical Engineer

Brosius, Harold I.

1905

Engineer of Mines

Angst, Harry H. Loye, Henry E.
Boyd, Robert R. Lytzen, Walter W.
Cadwell, W. Chauncey McKay, Henry S.
Calhoun, Allan B. Merriam, Robert S.
Curry, Duncan E. Minder, Emil G.
Field, Thorold F. Schrader, Erick J.
Gulick, Hervey Ziesemer, Ralph A.
Keller, Orrin E. M.

1906

Engineer of Mines

Brandt, John Neustadt, Berthold R.
Clement, Lester L. O'Connor, Edward S.
Harrington, Guy P. Rawson, Horace C.
Howes, Frank T. Rose, William A.
Kurtzman, Paul S. Wallace, George W.
Moenke, William F. Wheeler, Walter H.
Morgan, Charles

1907

Engineer of Mines

Bassett, Robert H. Probst, Elmer A.
Cowin, James Roed, Olaf
Gillan, Silas L. Smith, Edgar W.
Jackson, Charles F. *Steele, Charles W.
McRae, Randolph J. Swensen, Karl P.
Oberg, Anton C. Wiest, Michael A.
Olund, Henning E. Ziesemer, Harry M.
Parker, Walter H.

1908

Engineer of Mines

Boyle, Patrick J. Kennedy, John J.
Cullyford, James A. Knickerbocker, A. K.
Deichen, William A. Locke, Alfred M.
Edwards, Frank R. Olmstead, John S.
Goodwin, William R. Peterson, Joseph S.
Grimes, John A. Strong, John L.
Hoass, Ole G.

1909

Engineer of Mines

Cole, Willard A. Hoyt, Samuel L.
Crowley, Jay Rood, Lynn
Gavin, Lawrence T. Santo, Julius H.
Grant, Roy C. Taylor, Harold G.
Hognason, Geo. B. Williams, Homer A.

1910

Engineer of Mines

Bischoff, Harry R. Holler, Frederick W.
Conkey, Charles R. Johnson, Algot F.
Devereux, Lawrence Jones, Philo E.
Duncan, Kenneth J. Larson, Clarence L.
Farnam, Henry E. Leonard, Forest M.
Fritzberg, Ernest A. McKenzie, James R.
Giltinan, George M. Moody, Revillo G.
Goodrich, Norman P. Newell, John R.
Harmon, Benjamin G. Ostrand, Peter M.
Heath, Clarence L. Stewart, G. Gordon
Heidel, C. Sumner Strane, Archie J.
Herring, William E. Swanson, Axel H.

1911

Engineer of Mines

Abbott, Theodore S. Elliott, Jay R.
Anderson, Joseph Fixen, Victor L.
Anderson, Walter C. Jahn, William F.
Bailey, Paul T. Kingsley, Neil S.
Baker, Emory P. Lindholm, Milton S.
Beck, Charles S. Rahilly, Harold J.
Borgeson, Anshelm C. Tetlie, John R.
Burgess, Robert J. Walker, E. Harold
Crouse, Charles S. Walters, Charles W.
Drake, George M. Wehr, Arthur J.
Ekloff, Victor E. Whitson, Lloyd R.

Metallurgical Engineer

McCullough, Ervin W.

1912

Engineer of Mines

Bjorge, Guy N. Hagstrom, Leonard J.
Coventry, Edward D. Harrington, George L.
Dickson, Robert H. Hewitt, Ezra A.
Knox, La Fayette Perry, Joe B.
Kremer, Edward G. Prouty, Roswell W.
Lea, John Quinn, Max F.
Lewis, John W. Stevens, Howard E.
McAdams, Howard R. Taylor, William L.
Martin, Lynn Wallinder, Arthur
O'Brien, J. Charles Walter, Rollie B.
Olson, Walter S. Woodis, Clark N.

1913

Engineer of Mines

Coady, Leo J. Ladd, Greeley
Ely, Robert H. Michie, Roy G.
Fosness, Arthur W. Nissen, Arvid (M. S.)
Hammond, Arthur H. Ofsthun, Norman
Hanson, J. Bernard Walker, Chas. A.
Hondrum, Olaf

1914

Engineer of Mines

Anderson, Arthur P. Quinlan, Howard
Bierman, Alfred C. Ravicz, Louis G.
Eidemiller, Howard N. Robertson, John H.
Larson, Ernest L. Wasson, Harold J.
Potter, Orrin W.

1915

Engineer of Mines

Butler, William V. Neerland, Herman
Christenson, Alfred Ramsing, Fred C.
Coller, Walter A. Sanchez, Richard M.
Collins, Leon T. Urquhart, George K.
Haugen, Albert C. Wade, Henry H.
Heilig, Louis S. Williams, Paul S.
Kerr, Charles D.

1916

Engineer of Mines

Aronson, Sam. Lee, Oscar
Craig, John J. McDermid, Archie J.
Davies, Fred A. McHardy, Roy H.
Dovre, Adolph Nord, Harry H.

Metallurgical Engineer

Krogh, Alvin T.

1917

Engineer of Mines

Anderson, Edwin H. Ernster, Omer F. (M. S.)
Buresch, Charles E. Fearing, Edward J.
Dennis, Richard C. Harmon, Sydney
Dopp, J. Lawrence Levorsen, A. Irving
Elson, Richard H. Woodruff, John J.

Metallurgical Engineer

Peterson, Paul A.

Engineer of Mines in Geology

Coryell, Lewis S. Sweetman, Edwin A.
Hubbard, W. Earle Wallace, Carleton S.
Kwong, Yih Kun

1918

Engineer of Mines

Armstrong, Harold K. Jerrard, Walther L.
Cowin, Percy G. Moga, John A.
Hsieh, Chung

Metallurgical Engineer

Allard, Raymond W. Dowdell, Ralph L. (M. S.)

Engineer of Mines in Geology

Foley, Lyndon L. Ingersoll, Guy E.
Gannett, Roger W. Quinn, Howard E.

1919

Engineer of Mines

Frellsen, Sidney A. Goldberg, Samuel B.
Goldberg, Bert Mellem, Walter R.

Metallurgical Engineer

Pan, Wen Ping

Engineer of Mines in Geology

Hosted, Joseph O.

1920

Engineer of Mines

Ainsworth, Robert E. Johnson, Axel L.
Arnold, Lewis E. Kersten, Erwin H.
Bailey, A. K., Jr. Mark, Israel
Clark, Fred E. Nichols, Clifford R.
Donaghue, Abner J. Peterson, Clarence D.
Edwin, John Raiter, Clifford R.
Frank, Harry O.

Engineer of Mines in Geology

Copeland, Wm. A. Wheeler, James D.

1921

Engineer of Mines

Butler, Roy G. Johnston, Kenneth A.
Chadbourn, Charles H. Sebenius, Carl H.
Frank, Elden Sponberg, Edwin C.
Gandrud, Bennie W. Zanger, Eugene

Metallurgical Engineer

Hamernik, Frank J. Wenger, Frank B.
Dawson, Loren W. West, Herbert S.
Nichols, William J.

Engineer of Mines in Geology

Carlson, Edwin N. Walz, C. M.
Davies, Herman F.

1922

Engineer of Mines

Adams, E. Maurice Johnson, Ralph C.
Anderson, Oscar B. Kilp, Raymond G.
Barker, Clifton T. Lin, Sze Chen
Barr, J. Carroll Lovering, Thomas S. M. S., Ph. D.
Chang, Chen Ping McKenzie, Frederick R.
Echebarria, Luis de U. Moga, Gregory M.
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Hansen, Mayer G. Thoeni, Victor T.
Hoffman, Louis Wilson, J. Byron
Hope, Lawrence I.

Metallurgical Engineer

Johnsen, Trygve

Engineer of Mines in Geology

Patton, Richard C.

1923

Engineer of Mines

Anderson, Alfred T. Levy, Julian H.
Brawley, John N. Lundquist, O. William
Brenner, Walter W. Pabst, Henry A.
Calhoun, Robert A. Ridgway, Robert H.
Chang, Chi Russell, Charles B.
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Hezzelwood, George Vivian, Edgar W.
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Kwong, Shou Kun Wrbitzky, Harry M.

Metallurgical Engineer

Mooney, Frank E. Queneau, Roland B.
Persons, Robert W. Scheid, Adolph J.

Engineer of Mines in Geology

Clay, J. Withers Kegler, Vern L.
Conhaim, Howard J. LaTendresse, H. E.
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Foss, Adolph L. Middleton, John L.
Friedl, Arthur J. Wilcox, Fred H.
Griswold, Willis R. Wolfer, Donald H.
Henkel, Howard

1924

Engineer of Mines

Ballord, John A. Larsen, Raymond M.
Brunner, Donald G. Lee, Clarence O.
Case, Leslie M. Moe, Cecil J.
Huang, Ta Heng *Olson, Stanley G.
Hutchinson, Bernard C. Oscarson, Philip E.
Jensen, Willard C. Sung, Kuo Hsiang

Metallurgical Engineer

Curran, Francis J. Forsyth, Arthur C.

Engineer of Mines in Geology

Graeber, Clyde P. Nelimark, John H.
Knutson, Clarence J. Stewart, James L.

1925

Engineer of Mines

Haley, A. J. Mann, Victor I.
Hennen, E. H. Sherman, Howard P.
Kamb, Hugo R. Trulander, William
Kendrick, W. L.

Metallurgical Engineer

Johnson, George A. Runke, D. H.
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Engineer of Mines in Geology

Olson, Walter S.

1926

Engineer of Mines

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Metallurgical Engineer

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Engineer of Mines in Geology

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1927

Engineer of Mines

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Metallurgical Engineer

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Engineer of Mines in Geology

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1928

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Hedlund, Wilber

Metallurgical Engineer

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214 Julian St., Waukegan, Ill.
BERGLUND, ERICK B. '27 E
Westinghouse Mfg. Co., East Pittsburg, Pa.
BERGMAN, HILDER W. '26 E
3445 Wisconsin Avenue, Berwyn, Ill.
BERGOUST, OSCAR J. '08 C
BERQUIST, EDWIN T. '24 C
2030 London Rd., Duluth, Minn.
Arkansas Highway Dept., Hope, Ark.
BERGQUIST, JOHN E. '13 C
1210 W. California, Urbana, Illinois.
BERGQUIST, PHILIP L. '24 C
Wood Conversion Co., Cloquet, Minn.

BERGSLAND, GRANT C. '23 M
403 West Avenue S., La Crosse, Wis.
BERGSTROM, MARLOW B. '22 E
517 Security Bldg., Elec. Engr.
J. E. Sumpter Co.
BERKNER, LLOYD V. '27 E
418 Hurley-Wright Bldg., Airways Div.,
Dept. of Commerce, Wash., D. C.
Asst. Radio Engr.
BERMAN, FLORENCE '28 ID
644 Elwood Ave. N., Minneapolis, Minn.
BERNT, HANS E. '20 C
210 S. LaSalle St., Chicago, Ill.
Field Engr., Universal Portland Cement Co.
BERRY, GEORGE F. '24 M
623 E. 4th St., Duluth, Minn.
BERTOSSI, CLARENCE F. '25 C
1019 First Ave. S., Fargo, N. D.
N. P. Ry.
BESELER, HERMAN F. '25 M
665 19th Ave. N. E., Minneapolis, Minn.
Carter Mayhew Mfg. Co.
BESTOR, GEORGE C. '24 C
818 Univ. Ave. S. E., Mpls. Standard Oil Co.
BEVAN, R. LOUIS '24 C
10th Ave. S. E. and River, Minneapolis, Minn.
City Engr. Bridge Dept.
BEVERIDGE, ROBERT A. '26 E
1122 Ewing St., Fort Wayne, Ind.,
Gen'l Elec. Co.
Motor Specialist.
*BEYER, ADAM C. '96 C
BEYER, RANDALL R. '27 E
Northern States Power Co., Minneapolis, Minn.
BEYER, THEODORE A. '03 C
405 Kearns Bldg., Salt Lake City, Utah.
Vice President, James J. Burke & Co., Inc.
BEZEK, ALBERT J. '27 E
*BIERI, JOHN B. '09 M
BIERMAN, GEORGE H. '18 M '19 ME
White Motor Co., Cleveland, Ohio.
842 E. 79th St., Cleveland, Ohio.
General Foreman.
BILL, EARL M. '12 E
Schenectady, New York
General Electric Co.,
Ry. & Tr. Eng. Dept.
BILLAU, LEWIS S. '05 E
Baltimore, Maryland.
Baltimore and Ohio Ry.
Asst. Elec. Eng.
BINGEN, WILLIAM J. '12 C '13 CE
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Salesman.
BINGHAM, STANLEY E. '08 M
881 St. Clair St., St. Paul, Minn.
BIRD, HAROLD E. '25 C
St. Paul, Minn.
Minn. State Highway Dept.
BIRNBERG, ZINGEL C. J. '09 M
Youngstown, Ohio.
Carnegie Steel Co.
Machine Designer.
BISBEE, BERTIN A. '22 E
1451 Capitol Ave., St. Paul, Minn.
Minn. Products Coke Co.
BISBEE, ELMER '05 C
Masonic Club, Palace Hotel,
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BISEK, PETER P. '14 E
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*BISHMAN, ADAM E. '95 E
BISHOP, IRA L. '11 M
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General Supt.
BISKUP, WILLIAM F. '16 C
2091 Princeton Ave., St. Paul, Minn.
Minneapolis Steel and Machinery Co.
BJERRE, FOLMAR I. '25 M
1009 Statler Bldg., Boston, Mass.
Dist. Engr., N. England States, Mathews Conveyor Co.
BJONERUD, EARL S. '22 E
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San Francisco, Calif.
BJORGE, OSCAR B. '07 M
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Secy and Gen. Mgr., Clyde Equipment Co.

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Oliver Bldg., Pittsburgh, Pa.
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BLUE, CLARENCE W. '25 C
W. D. Lovell Co.
Minneapolis, Minn.
BOCKUS, GERALD H. '22 E
New Ulm Grocery Co., New Ulm, Minn.
Asst. Mgr.
BOE, LESTER L. '25 E
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BORROWMAN, LEROY F. '08 C
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BORST, WELLINGTON L. '24 M
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Donovan Construction Co.
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BOSS, RONALD W. '25 M
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BRATTLOF, CLIFFORD
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Engr. Drftsm., N. Y. Central R. R., Grand Cent. Terminal.
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BRAYDEN, GILES W. '27 E
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William Bros Boiler & Mfg. Co.
BROS, CHESTER W. '22 M
Minneapolis, Minn.
William Bros Boiler & Mfg. Co.
BROS, ERNEST T. '17 M
Minneapolis, Minn.
William Bros Boiler & Mfg. Co.
BROS, RAYMOND J. '19 M '20 ME
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Wm. Bros Boiler & Mfg. Co.
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With I. M. Miller, Architect.
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BROSSARD, HENRY F. '25 E
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Assoc. Arch., A. R. Van Dyck, Architects.
BROWN, GEORGE J. '08 E
27 New Parliament Bldg., Winnipeg, Man., Can.
BROWN, GLENDON '28 E
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
BROWN, HARRY E. '22 G
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BROWN, HOMER L. '17 M
Aurora, Ill.
C. B. & Q. R. R.
BROWN, LOUIS M. '16 E
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Westinghouse Elec. & Mfg. Co.
*BROWN, OLIVER L. '07 M
BROWN, WILLIAM P. '12 M
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Brown Bros. Welding Co.
BROWNELL, EDWARD '26 C
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N. S. P. Co.
BROWNELL, OTTO E. '10 C
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Div. of Sanitation, Minn. Dept. of Health.
BRUCE, HJALMER N. '16 C '17 CE
3431 11th Ave. S., Minneapolis.
A. M. Chesher Printing Co.
BUCCOWICH, PAUL '27 E
BUCK, FREDERICK W. '09 M
Duluth, Minn.
Stryker Manley & Buck, Real Estate and Mortgage Loans.
BUCKHOUT, DONALD H. '17 A
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Carl H. Ruch, Genl. Contractor.
Estimator, Engr., Draftsman, etc.
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360 Robert St., St. Paul, Minn.
C. H. Johnston, Arch., Mechanical Engineer.
BUENGER, EDGAR '19 A
Rochester, Minnesota.
BUHL, JOHN E. '09 M
Turner Const. Co., 244 Madison Ave., New York.
BUHL, PAUL S. '07 M
532 W. Evergreen Ave., Youngstown, O.
Eng., Republic Iron & Steel Co.
BUHR, LEO '23 C
Bruce, Wis. N. S. P. Co.
BULL, ALVAH STANLEY '27 AE
c-o The Insulite Co., 7-219 General Motors Bldg., Detroit, Mich.
BULLARD, HENRY M. '26 C
1314 Wood St., Wilkinsburg, Pa.
Westinghouse Elec. and Mfg. Co.
BULLIS, EVERARD J. '24 C
808 Metro. Life Bldg., Woodrich Const. Co., Minneapolis, Minn.
BUMGARDNER, LOUIS T. '23 E
312 Hackney Bldg., St. Paul, Minn.
L. A. Bumgardner Co.
BUNCE, PAUL F. '06 E
Omaha, Nebraska.
N. W. Bell Tel. Co., Div. Supt. of Traffic.
BUNNELL, CHARLES W. '26 C
Nashville, Tenn.
Div. of Bridges, Tenn. State Highway Dept.
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Manager in charge of field construction,
R. R. Engr. M. N. & S. & M. A. & C R R Co., Minneapolis, Minnesota.
BURCH, EDWARD P. '92 E, '98 EE
Mpls., Anoka, & C. R. R. Co., Receiver.
BURKE, JAMES J. '28 M
Edison Building, Chicago, Ill.
BURKE, ROY L. '05 C
515 Sellwood Bldg., Duluth, Minn.
Bowe and Burker.
BURLINGAME, ROBERT E. '25 E
15 S. Fifth Street, Minneapolis, Minn.
Electrical Section, N. S. P. Co.
BURMEISTER, CHARLES '27 E
Redwood Falls, Minn.
Redwood Falls Light & Power Co.
BURNETT, H. V. '14 C
526 McKnight Bldg., Minneapolis, Minn.
BURNS, DWIGHT T. '25 C
728 Ave. F, Fort Madison, Iowa.
BURNS, HARVEY L. '02 E
149 Fulton St., New York, N. Y.
Methods & Planning Engr.,
Installation Dept., Western Elec. Co.
BURRILL, CHARLES M. '23 E
Schenectady, N. Y.
Radio Engr. Dept., Gen. Elec.
BURRIS, ARTHUR '28 E
Westinghouse Elec. & Mfg. Co.,
Pittsburgh, Pa.
BURROWS, ROBERT P. '11 E
680 Folsom St., San Francisco, Calif.
Asst. Mgr., Sunbeam Lamp Div.,
Nat'l. Lamp Works at G. E. Co.
BURT, FRED R. '16 E
East Pittsburgh, Pa.
Gen. Engr., Westinghouse Elec. and Mfg. Co.
BURT, JOHN L. '90 C
Guadalajara, Jalisco, Mexico.
Owner of sugar estate.
BURT, PAUL R. '26 M
Minneapolis, Minn.
Northwestern Bell Telephone Co.
BURTIS, WILLIAM H. '92 E
Armour, S. Dakota.
Public Utility System.
BURWELL, LORING D. '07 M
Minnetonka Mills (via Hopkins), Minnesota.
BUSHNELL, CHARLES S. '78 M
4120 59th Ave. S. W., Seattle, Wash.
BUSHNELL, ELBERT E. '85 M
331½ S. Spring St., Los Angeles, Calif.
Mfg. Typewriter Supplies.
BUTTERWORTH, ALLAN C. '11 E
Hurley, Wis.
Montreal Mining Co.
BUTTERWORTH, RUSSELL I. '16 E '17 EE
Bristol, Tenn., Gen. Supt., Tenn. Central Service Co.
CALMEYER, JOHN P. '06 E
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307 W. 107th St., New York, N. Y.
CAMERON, HARRY D. '25 E
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CAMERON, LESTER W. '27 A
CAMPBELL, DOUGLAS M. '27 C
40 Squadron 5 S, Naval Aviator, Naval Air Station, Hampton Roads, Va.
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CARLSON, C. PHILIP '21 E
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CARLSON, CHAUNCY M. '17 E
Albert Lea, Minn.
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Interstate Power Co.
CARLSON, CLIFTON C. '27 M
CARLSON, ELNER W. '27 C
CARLSON, ERNEST F. '22 M
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High Bridge Steam Plant, N. S. P. Co.
CARLSON, RICHARD E. '22 E
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Western Electric Co.
CARLSON, VICTOR H. '20 E
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CASS, HOYT R. '24 E
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FISKE, FREDERICK W. '09 C
Engr., George Grant Construction Co.
904 New York Bldg., St. Paul, Minn.
FISKE, HAROLD C. '22 E
La Salle Hotel, Chicago.
Chic. Dist. Repr., James R. Kearney Corp'n.
FITTS, JOEL A. '09 E
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FITZGERALD, WILLIAM J. '20 C
601 Metropolitan Bank Bldg., Minneapolis, Minn.
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Land and Cattle Business.
FLEMING, FRANK R. '08 ME '09 EE
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Valuation Engineer, N. P. Ry.
FLEMING, LAURENCE T. '10 M
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Prod. Dept., Public Service Co., Chicago, Ill.
FOLTZ, ROSS M. '19 M
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Obenberger Forge Co.
General Manager.
FORBES, HENRY C. '22 E
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Westinghouse Elec. & Mfg. Co.
Radio Engineer.
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FORSMARK, ULRIK E. '26 E
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FORSSELL, WILLIAM O. '22 G
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FRANK, CARL '28 C
Otto Randolph Corporation, Fort Madison, Iowa.
FRANKOVITZ, JOHN J. '05 E
Fergus Falls, Minn.
Frankovitz Hardware Company.
FRANKOVITZ, JOHN J. '28 E
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FRANTZ, WILLARD F. '25 C
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GRANT, FRED R. '09 E
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GRIME, EDWIN N. '00 C
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Engr., Water Service.
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17 No. Minn. Str.
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HAHN, STANLEY W. '22 A
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Project Manager.
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HANDSCHU, C. E. '15 C
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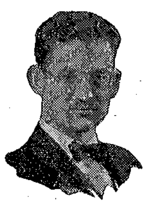

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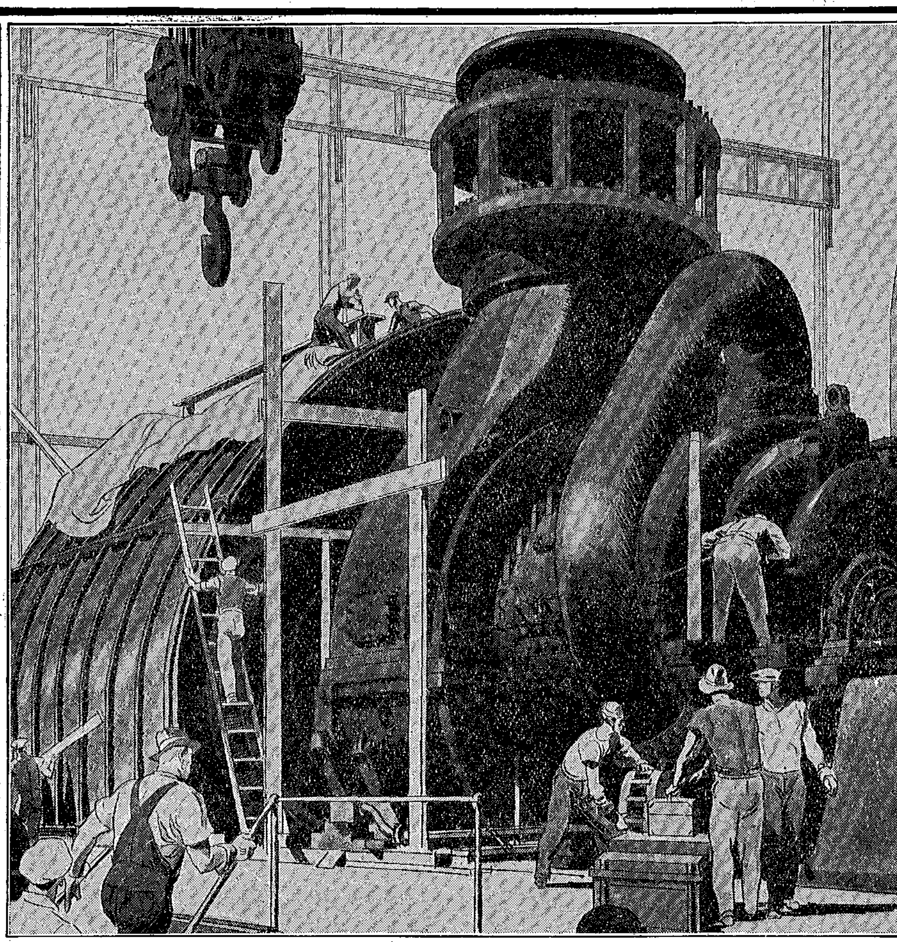

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DAYTON
Harris, Clayton '09 E

DES MOINES
Ash, J. Wesley '08 C
Bakken, Lawrence H. '22 A
Bernt, Hans E. 20 C
Kingsley, Norman W. '20 E
Reeve, Howard E. '23 E
Rome, Robert C. '22 E

DUBUQUE
Madden, Francis '03 C
Peterson, Lloyd L. '24 C

FORT MADISON
Burns, Dwight T. '25 C
Frank, Carl '28 C

HUMBOLT
Christen, Ray L. '26 E

INDEPENDENCE
Dunlap, Geo. M. '24 E

JANESVILLE
Wild, Carl D. '15 C, '16 CE

MARSHALLTOWN
Weatherill, Cedric '14 C, '15 CE

OTTUMWA
Triem, Ralph H. '20 E

REDFIELD
Olson, Arthur O. '10 C

SIOUX CITY
Arzt, Emmanuel A. '97 E, '99 EE
Christianson, Hilmer B. '15 C
Donauer, Max '18 ChE
Mitchell, Lloyd S. '23 C
Ward, John, Jr. '25 C

WATERLOO
Nordenson, Willard '26 M
Stanius, Godfrey '21 E

WAVERLY
McMeekin, Glenn D. '21 G

KANSAS

ARKANSAS
Werdenhoff, James H. '21 C

ATCHISON
Hastings, Clive '96 M

ELDORADO
Ayers, Ellsworth B. '25 Ch

FT. LEAVENWORTH
Grow, Robert W. '16 C

KANSAS CITY
Langman, Harley R. '24 M

MANHATTAN
Graham, Eugene C. '02 B

PITTSBERG
Woodman, Howard H. '97 C

WICHITA
Schultz, Peter D. '18 Ch
Stauffacher, Edward L. '24 M

KENTUCKY

ASHLAND
Porter, Ralph E. '13 ChE

BARBOURVILLE
Dyer, Walter S. '25 OCh

DUBLIN
Donahue, Stephen '25 C

LOUISVILLE
Ernst, Robert C. '23 ChE
Haines, Howard N. '22 A
King, Harvey '18 A

So. Louisville
Wright, Stewart V. '19 A
Paducah
Knapp, Lester '12 E

LONG ISLAND

Long Island City
Plumber, Clayton '20 Ch

LOUISIANA

Baton Rouge
Fieger, Ernest A. '20 ChE
Hammond
Gewalt, Carl H. '21 A
Marreno
Fleming, Douglas R. '08 C
Merraro
Mills, Hartzell '25 M
Schlenk, Hugo '18 E
New Orleans
Bell, Grace M. '11 Ch

MARYLAND

Annapolis
Seymour, M. W. '21 Ch
Winslow, Harry J. '25 E
Baltimore
Billau, Lewis S. '05 E
Peterson, Arthur P. '19 E
Rask, Olaf S. '17 Ch
Schmidt, George H. '12 Ch
Takoma Park
Jones, Lewis A. '07 C
Roepke, Otto B. '06 E

MASSACHUSETTS

Amherst
Markuson, Miner J. '23 A
Boston
Bjerre, Folmar I. '25 M
Damberg, Paul S. '22 A
Damberg, Rheuben P. '21A
Dietrichson, Gerhard '10 Ch
Emery, George C. '19 A
Ferguson, Kenneth '26 C
Groat, Benjamin '08 LLB, '11 LLM, '01G
Lang, James S. '96 M, '97 EE, '99 ME
McVean, Norman S. '21 E
Morrow, Leon W. '16 Ch
Nebel, Walter H. '11 E
Paulsen, Thorwald '22 C
Payne, Harold G. '06 E
Reuter, Peter T. '21 M
Wald, Jos. H. '27 E
Walker, Frank B. '97 C
Webster, Harry M. '15 E
Woodward, Herbert M. '90 M
Cambridge
Arnold, Jerome H. '27 ChE
Darling, Stephen F. '22 Ch
Dietrichson, Gerhard '10 Ch
Ellestad, Reuben B. '22 Ch
Fawcett, Robt. B. '28 ChE
Huchthausen, Walter '28 A
Nygard, Edwin M. '21 Ch
Plowman, George T. '92 A
Sprung, Murray M. '25 ChE, '28 PhD
Whitney, R. B. '27 PhD
Chicopee Falls
Berglund, Erick '27 E
Burton, James P. '27 E
Forbes, Henry C. '22 E
Tholstrup, Henry L. '26 E, MS '28
East Walpole
Brown, Harold H. '10, '14 PhD
Franklin
Tomlinson, L. C. '04 E
Northampton
Morse, Minerva '20 Ch
Norwood
Brown, Harold H. '09 Ch
Korslund, Harry J. '20 A
Pittsfield
Currie, Neill, Jr. '08 E
Goodwin, Victor E. '04 E
Springfield
Jones, Ivor Vaughan '15 C
Walpole
Forssell, William O. '22 G
Winthrop
Haakenson, N. Theodore '26 C

MICHIGAN

Ann Arbor
Badger, W. L. '08 Ch
Barnum, Charles R. '24 A
Dow, William G. '16 E, '17 EE
Orbeck, Martin J. '11 C
Rogers, Marvin '26 ChE
Berrien Springs
Chaney, Albert L. '25 Ch
Dearborn
Hoppin, Glenn H. '08 E
Detroit
Ascher, Raymond C. '23 M
Babcock, Vernon M. '23 E
Bailey, Stuart L. '27 E, MS '28
Brooke, Harold L. '18 E
Bull, Alvah Stanley '27 A
Dale, Dallas W. '24 M
Dedic, Richard J. '24 C
Elliot, Harry C. '19 M
Grisson, Aubrey '25 AE
Gutsche, Edward J. '04 Ch
Hamilton, Herbert C. '97 ChE
Huntoon, Milton B. '99 E
Loye, Benjamin W. '06 M
Lundquist, Reuben A. '05 E
Malmstrom, Axel L. '17 E
Mitchell, L. Morris '14 C, '15 CE
Nelson, Elmer A. '23 C
Rand, Lars '12 M, '13 ME
Riddington, Fred W. '22 ChE
Shepard, Donald D. '11 E
Staehle, Haswell E. '24 M
Swart, Richard H. '21 ChE
Walker, Geo. W. '09 Ch
Webster, Cora H. '23 Ch
Wennerlund, Elias C. '99 M
Wilk, Benjamin '13 C, '14 CE
Flint
Anderson, Joseph A. '24 M
Lamon, Harold J. '27 M
Murray, John H. '17 M
Rhame, Paul W. '20 M
Shuirman, Gabe '21 E
Simms, Charles G. '24 M
Wagner, John W. '24 M
Grand Rapids
Benson, Mons '28 C
Lyon, Glenn H. '20 A
Mahoney, William L. '13 E, '14 EE
Murray, H. E. '27 C
Nelson, Edwin W. '25 C
Tallmadge, Hiram '16 E, '17 EE
Ironwood
Holmberg, Abner W. '15 M, 16'ME
Sears, Dow I. '14 C
Jackson
Briggs, William G. '21 E
Kalamazoo
Ludvigsen, Elliot L. '25 M
Manominee
Peterson, Lewis E. '25 E
Midland
Edmunds, Alvin M. '25 ChE
Elston, Arthur A. '27 ChE
Muskegon
Olsen, Arthur O. '10 C
Pontiac
Pike, Jay R. '26 M, ME '27
Sault St. Marie
Fenton, Paul C. '26 C
South Haven
Smith, Sidney H. '11 C
Three Rivers
Chapin, S. Caryl '24 C

MINNESOTA

Alberta
Schlattman, Edward C. '08 C
Albert Lea
Carlson, Chauncy M. '17 E
Dock, Chester '22 G
Pless, Arnold '20 C
Sorenson, Russell L. '27 AE
Annandale
Seegar, Franklin H. '28 E
Anoka
Reed, Arthur L. '06 C
Thurston, Harold H. '13 C, '14 CE
Atwater
Swenson, Charles '07 C, '10 LLB
Austin
Angell, Glenn H. '28 M
Murray, Robt. C. '26 ChE
Barnum
Wood, Victor R. '22 C
Bellingham
Strege, Henry '24 E
Belle Plaine
Groth, A. W. '28 E
Bloomingham
Scott, Elmer C. '15 C, '16 CE
Bowlus
Johnson, Ralph '28 C
Brainerd
Anders, Milton '27 E
Croswell, Leslie D. '26 C
Davison, Joseph H. '03 C
Hallady, Leslie L. '21 C
Lewis, Lloyd '27 E
Jones, Harold W. '25 C
Breckenridge
Brataas, Mark '17 C
Holmgren, Charles E. '09 M
Buhl
Anderson, Ole A. '93 M, '08 ME
O'Donnell, Lawrence '26 M
Woehler, William L. '07 E
Carlton
Nickerson, Neal C. '18 C
Chippewa Falls
Ranger, Donald R. '24 C
Chisholm
Anderson, George T. '15 C
Arko, Frank W. '28 M
Elstad, Rudolph T. '19 C
Hammerstrom, Aleck A. '21 E
Maturi, Rudolph '28 C
Olson, Elmer J. '23 C
Cloquet
Backstrom, Russell E. '25 M
Bergquist, Philip L. '24 C
Glenn, Harry W. '24 ChE
Schlenk, John J. '23 C
Stuart, Don N. '28 E
Cokato
Peterson, Richard M. '20 E
Coleraine
Battles, Leon E. '18 C
Delano
Brunkow, Herbert E. '12 ChE
Detroit Lakes
Hvoslef, Frederick W. '17 M, '19 MS
Duluth
Anderson, Milton J. '20 A
Bergford, Lester M. '23 C
Bergquist, Edwin T. '24 C
Berry, George F. '24 M
Bishop, Ira L. '11 M
Blackshaw, Joe L. '28 M
Buck, Frederick W. '09 M
Burke, Ray L. '05 C
Butterworth, Allan C. '11 E
Cosandy, Chas. '25 E
Dinsmore, Arthur T. '12 M, '13 ME
Dorsey, John G. '15 C, '16 CE
Ellefson, Selmer '16 E
Fee, E. Franklin '07 M
Flaaten, Percy H. '26 C
Gustafson, T. '28 E
Hart, Maurice W. '26 E
Hemenway, Ed. L. '28 M
Hibbard, Sheldon S. '23 M
Hoff, John E. '20 Ch
Holbeck, John I. '24 E
Holmes, Raymond H. '25 E
Hustad, Byron P. '10 E
Jaques, Robert '09 C
Johnson, Austin G. '05 M
Johnson, Donald L. '18 Ch E
Kapphahn, R. J. '12 C, '13 CE
Kelly, Earl W. '07 C
Knutson, Harry '17 M
Kransfelder, Robt. H. '26 AE
Kusnierek, Clenet J. '28 M
Larson, Victor F. '17 M
Lostrom, Herbert W. '26 E
McEachin, John L. '22 E
McKay, Earle D. '15 C, '16 CE, MS '23
Martino, Anthony '25 M
Melander, Albin R. '21 A
Nelson, Edward K. '24 M
Nelson, Einer '24 M
Olin, Henry A. '23 E
Osrouske, Arthur B. '28 M
Peterson, George T. '08 M
Pulver, Richard F. '23 E
Quinn, John '08 C
Ringsred, Arthur C. '06 M
Roberts, Henry M. '28 M
Rose, Norman W. '06 M
Ross, Kenneth R. '24 M
Ross, Russell H. '18 E
Roy, Milo C. '21 M
Saltwick, Andrew '24 M
Schwedes, Walter F. '06 E
Simmonds, Richard R. '21 C
Sneve, Jack S. '11 M
Spotts, Herbert J. '28 M
Spring, Willis W. '07 M
Tennstrom, Carl H. '23 C
Tondell, Mandell '07 C
Turnquist, Axel A. '16 E, '17 EE
Wilde, John A. '28 C
Williams, Roy N. '23 E
Wilson, Walter E. '24 C
East Grand Forks
Dahlberg, A. V. '05 AC
Elk River
Balton, John M. '28 C
Longfellow, Dwight W. '08 C
Normann, Rolf A. '24 C
Washburn, Delos C. '93 A
Ely
Kauppinen, Heino '25 E
Pearson, Elmer A. '20 ChE
Eveleth
Nastlund, Gustave A. '26 A
Ohman, Leo S. '28 E
Fairmont
Coult, Lyman H. '25 ChE
Curtis, Thomas H. '12 C
Eustis, Irving N. '17 M, '18 ME
Kasper, Walter '11 M
Krafft, Edwin A. '24 A
Starrett, Howard M. '09 M
Faribault
Brossard, Henry '25 E
Crawford, Wallace '06 M
Klemer, Frank H. '01 C
McKellip, Frank W. '98 E
Federal Dam
Poore, Orson B. '09 E
Fergus Falls
Christopherson, Arnold '28 E
Frankoviz, John J. '05 E
Gard, Donald '28 C
Hallan, Christian '02 C
Young, Jos. E. '21 G
Ft. Snelling
Linden, Henning '17 E
Frazee
Chilton, Edward G. '13 C, '14 CE
Gaylord
Deterling, Edward W. '26 E
Hecht, Henry W. '24 E
Glencoe
Hankenson, John J. '92 C
Glenwood
Krieger, Keith M. '28 E
Thorson, Stuart J. '19 Ch
Graceville
Hartnett, John G. '11 Ch
Grand Meadow
Grimm, Raymond E. '28 E
Granite Falls
Lende, Henry M. '20 C
Knutson, R. W. '28 Ch
Grove City
Nelson, Richard L. '21 E
Hackensack
Frederickson, Edna '24 Ch
Halstad
Forseth, George O. '25 M
Hastings
Christenson, Elmer '27 C
Manger, Henry J. '23 C
Hibbing
Benesovitz, A. '28 E
Blomberg, Evar H. '16 E, '17 EE
Friedman, Edwin A. '23 E
Little, Fred W. '27 M
Markus, Benjamin '17 Ch
Pan, Wen P. '16 C, '18 Ch
Reeve, Charles H. '19 E
Scott, Franklin B. '26 E
Stewart, Clarence H. '03 C
Homer
Ramslen, A. M. '29 Ch
Hopkins
Anderson, Harvey B. '12 C, '13 CE
Norman, Allan K. '28 C
Humbolt
Baer, Louis E. '07 E
Hutchinson
Higgins, Elvin L. '92 C
International Falls
Anderson, Ed. S. '21 E
Busch, John S. '20 ChE
Cantwell, Wm. F. '11 Ch
Hass, Paul O. '26 M
Wilson, Roy A. '25 M

KEEWATIN
Bingen, William J. '12 C, '13 CE
Leach, Edward W. '10 C
LAKE CITY
Christilaw, George '21 C
Hayden, Claude '24 C
Martin, Curtis R. '31 G
Tews, Arthur W. '24 C
LE ROY
Meyers, Clare '28 AE
LESUEUR
Cromell, Sidney '27 C
Odquist, Carl '23 C
LITCHFIELD
Erickson, Hugo '28 C
Gehring, Lester G. '27 C
LITTLE FALLS
Donahoe, Robert E. '21 E, '22 EE
Grettum, Walter '24 E
Merritt, Alva W. '22 E
Ryan, Loiel S. '12 C, '13 CE
LONG LAKE
Kelley, William '22 C
MADISON
Corliss, C. V. '28 E
MANKATO
Gerlach, W. D. '26 A
Kleinschmidt, Armin R. '22 M
Mabbott, Leonard E. '24 E
Neilson, Chris '18 ChE
MAPLE PLAIN
Compton, Milton '28 E
MAPLETON
Borchert, Oscar H. '25 E
MARSHALL
Neill, Clarence L. '28 E
MAYNARD
Johnson, Alexander B. '95 C
MENDOTA
Braddock, Edward '24 C
MINNEAPOLIS
Abbott, Amos H. '16 E, '17 EE
Aasland, Arne '23 C
Adams, Edward H. '22 G
Adams, John W. '12 C
Affleck, Dean H. '28 AE
Ageton, Edwin O. '26 E
Alexander, George D. '20 C
Algren, Axel B. '25 M
Alrick, Bannona G. '06 C
Anderson, Clifford H. '26 C
Anderson, Edgar G.
Anderson, Emil '05 E
Anderson, Frank L. '16 E
Anderson, Helmer N. '20 M
Anderson, Hilder A. '18 M
Anderson, John G. '99 C
Anderson, Joseph W. '15 E
Anderson, Matthew '24 E
Anderson, Nels S. '22 C
Andrus, Raymond J. '07 E
Arstad, Leonard O. '24 E
Asfalt, Filip J. '27 E
Aske, Irving E. '20 E
Asleson, Hans '10 C
Austin, Paul D. '21 E
Bachelder, William H. '24 C
Backstrom, Kenneth A. '27 A
Backstrom, Wilburg A. '23 A
Balkin, Samuel W. '26 C
Bancroft, Henry K. '26 M
Barber, Hervey H. '26 PhD
Barger, Harold L. '21 E
Barnes, James C. '28 E
Barnum, Marvin C. '11 M
Beal, John L. '27 ChE
Beck, Bernon S. '10 E
Beck, Maud G. '13 Ch
Beery, Charles B. '09 M
Bell, Maurice D. '07 M
Benson, Ikel C. '25 E, EE '27
Berg, Swan P. '23 C
Berg, Thorsten H. '25 C
Bergford, Rolf E. '23 C
Bergstrom, Marlow B. '22 E
Berman, Florence '28 ID
Beseler, Herman F. '25 M
Bestor, George C. '24 C
Bevan, R. Louis '24 C
Bind, Harold E. '25 C
Biskup, William F. '16 C
Bleecker, George W. '16 E
Blue, Clarence W. '25 C
Boehnlein, Charles '17 M, '19 ME
Boerner, Francis C. '11 C
Bordeau, Sanford P. '25 E
Bouquet, Otto T. '23 E
Boyum, Irvin '17 E
Braddock, Edward '24 C
Bradley, Byron H. '13 C, '14 CE
Brenchley, Harry E. '08 C
Brooks, Leslie C. '19 Ch
Bros, Bernard M. '23 M
Bros, Chester W. '22 M
Bros, Ernest T. '17 M
Bros, Raymond J. '19 M, '20 ME
Brossard, Ed. '23 M
Brown, Floyd W. '17 A
Brownell, Otto E. '10 C
Bruce, G. Norman '23 Ch
Bruce, Hjalmar N. '16 C, '17 CE
Bullis, Everard J. '24 C
Bunger, Harold A. '26 ChE
Burch, Albert M. '96 C
Burch, Edward P. '92 E, '98 EE
Burlingame, Robert E. '25 E
Burnett, H. V. '14 C
Burt, Paul R. '26 M
Burtis, Wm. '92 E
Busch, William A. '22 ChE
Cade, Arthur R. '17 Ch
Calloway, R. S. '11 ChE
Capstick, Donald W. '22 G
Carlbom, Leonard H. '25 C
Carr, Harvey '03 C
Carter, Robert J. '08 E
Caswell, Thomas B. '25 M
Cayola, Chester L. '28 A
Cerney, Glen C. '20 M
Chalmers, Charles H. '94 E, '03 EE
Chernus, Maurice '22 C
Childs, James A. '09 C
Christensen, Arthur L. '25 E
Clark, John S. D. '22 M
Clarke, Charles P. '08 C, '09 CE
Close, Winston '27 A
Cohen, Lillian '00 Ch
Collins, Stewart G. '04 G
Colvin, James A. '14 M, '15 ME
Comb, Fred R. '10 M
Cooley, Gilbert '22 E
Cooper, Leo H. '06 E
Cooper, R. Conrad '26 C
Corbett, Theodore R. '26 M
Corl, Cady S. '21 ChE
Cornell, L. Wallace '27 ChE
Corser, John '16 M
Covell, Paul L. '25 ChE
Crane, Eugene C. '12 M, '13 ME
Critchett, Edward F. '13 M, '14 ME
Croft, Edna K. (Miss) '22 A
Croft, Ernest B. '11 C
Crounse, Avery F. '03 G
Cutler, Alvin S. '05 C
Dahlstrom, Raymond E. '10 E
Davies, Edwin T. '07 ChE
Davies, Ralph M. '09 E
Dawson, John W. '22 A
Deane, George B. '19 A
Deinema, George R. '26 E
Del Plaine, Carlos W. '21 C, '22 CE
Deneen, Davis J. '19 A
Diment, J. Morton '24 E
Doell, Charles E. '16 C, '17 CE
Donaldson, Frank A. '12 M
Doolittle, William Y. '14 C
Dorrance, Albert P. '12 E
Douglass, Addison H. '17 C, '20 CE
Dresser, Harry S. '16 M
Dreveskracht, Wallace '28 C
Drinkall, Leon R. '19 E
DuToit, George A. '10 M
Dunnigan, Merton A. '16 Ch
Eck, Lester J. '23 Ch
Edgar, Robert F. '27 E
Eggers, Henry C. T. '15 E, '16 EE
Ehrenberg, Muriel L. (Miss) '26 ID
Ek, Gustaf A. '17 M
Ekman, Claes T. '10 C
Elliott, A. Douglass '14 E, '15 EE
Ellsworth, Charles D. '20 E
Elsberg, Nels W. '09 C
Enger, Edward H. '11 C
Engstrom, L. G. '19 Ch
Erickson, Clarence P. '25 A
Erickson, Edwin C. O. '22 C
Erickson, Henry A. '96 E
Erickson, Lloyd '28 C
Erskine, Robert K. '24 M
Estabrooks, Clyde F. '24 M
Everett, William R. '13 E, '15 EE
Fager, Simon R. '04 M
Farmer, John W. '21 M
Farnam, Julian P. '11 M
Fegan, Elmer T. '15 Ch, '16 Ch
Felion, E. T. '13 Ch
Firth, Charles V. '23 ChE
Fischer, Earl B. '19 ChE
Fischer, Harold W. '28 E
Fiske, Harold C. '22 E
Fitzgerald, William J. '20 C
Flindt, Richard H. '23 C
Foker, Leslie W. '28 ChE
Ford, Robert E. '95 E, '03 EE
Forfar, Donald M. '09 M
Forsberg, Enock E. '18 A
Fossen, George '17 C
Foster, Kenneth W. '26 C
Frantz, Willard F. '25 C
Fredrickson, Edwin '28 E
Freeberg, George '25 A
Froberg, Harold '28 E
Fruen, Arthur B. '08 G, '09 CE
Furber, J. Roscoe '24 E
Furber, Richard '28 E
Garber, Gabriel E. '06 M
Garthus, Ira B. '24 E
Garzon, Julian R. '24 C
Gee, Harry J. '19 G
Gemmell, John H. '14 M, '15 ME
Gerlach, W. D. '26 A
Gerrish, Harry E. '05 M
Gillete, George L. '05 C
Gilman, James B. '94 C
Godward, Alfred C. '10 C
Goldberg, Hyman '28 C
Goldstein, Milton M. '12 ChE
Goetzenberger, Ralph L. '13 E, '14 EE
Grout, Frank F. '04 Ch
Gould, Edward S. '20 C
Gray, William I. '92 E, '98 EE
Greene, Al. '24 E
Green, Chauncy L. '24 E
Greiner, Harry S. '24 E
Guesmer, Geo. O. '24 C
Guesmer, Marie W. (Miss) '26 ID
Guggisberg, Charles F. '17 M
Hagelin, Lawrence W. '22 E
Halvorson, Halvor O. '22 ChE
Hammer, George F. '20 ChE
Hammer, Harold E. '25 E
Hammond, Laurence D. '14 M, '15 ME, '19 MB, '20 MD
Hankins, Nathaniel R. '24 C
Hansen, Christian, Jr. '10 E
Harrington, Russell A. '24 E
Harris, Nathan '20 G
Harris, Sigmund '05 M
Hartig, Henry E. '18 E
Hartzberg, Edward M. '19 M
Haugsrud, Parmalee S. '26 ChE
Hawkey, Harold K. '19 ChE
Hawkins, Harvey C. '23 E
Hawkins, G. C. '28 E
Hayden, John F. '90 C
Heath, Donald C. '16 A
Heidelberger, Otto F. '23 E, '24 MS
Heidelberger, Roy J. '22 E
Helmick, Dan S. '15 C
Herberg, Sanford '24 C
Herrick, Carl A. '02 M
Herrmann, Raymond R. '12 E, '13 EE
Hibbard, Truman '97 E
Hickok, Mrs. Harvey (Miss Jesse E. Stevens) '96 G, '04 MS
Hildebrandt, H. A. '99 E
Hill, Edward L. '25 E
Hill, Hibbert M. '23 C
Hirleman, Clark W. '12 M, '13 ME
Hobart, Walter B. '07 C
Hoffman, John R. '26 C
Holcomb, Harry S. '26 E
Hoover, Lloyd '28 E
Hopkins, Joseph I. '04 Ch
Hopkins, Mark L. '09 E
Hotchkiss, Fred W. '18 E
Houlton, Amos D. '01 E
Houston, George S. '02 C
Huhn, George P. '91 E
Hustad, Andrew P. '09 C
Hustad, John C. '14 C, '15 CE
Hutchinson, Edwin T. '27 M
Jackson, Otto E. '14 E, '15 EE
Jacobsen, Arthur C. '25 E
Jacobson, Frank H. '24 E
Jacobson, Howard C. '21 G
Jacobson, Reuben A. '25 M
Jakkula, Arne A. '26 C
Jallings, K. R. '28 Ch
Jarchon, Theo. '28 E
Jensen, John A. '05 C
Jerabek, Henry S. '26 ChE
Johnson, Alphonse N. '21 C
Johnson, Clifford S. '26 C
Johnson, Edgar W. '14 C, '15 CE
Johnson, Elmer W. '14 E, '15 EE, '23 ME
Johnson, Enan C. '25 E
Johnson, Gustave F. '27 E
Johnson, Ira L. '16 M, '17 ME
Johnson, James R. '26 C
Johnson, Robertson B. '25 E
Johnston, Charles K. '21 E
Jones, George R. '14 E, '15 EE
Kameda, Tohru '26 ACh
Kampa, Edmund P. '23 Ch
Kaplan, Seeman '18 A
Kapple, Frederick R. '24 E
Kapplin, C. Donald '28 C
Karatz, Lucian '12 Ch
Katter, Reuben L. '22 M
Keeler, Jasper F. '22 C
Kelly, Wm. J. '26 E
Kennedy, W. W. '07 Ch
Kinsell, William L. '00 E
Kline, Frank W. '24 E
Knoll, Franklin O. '25 E
Knudson, Melvin I. '28 M
Kobe, Kenneth A. '26 ChE
Kotz, Walter E. '23 C
Krefting, Arthur S. '26 C
Kritzer, Louis M. '28 E
Kronick, T. Gerald '26 A
Kumm, Arthur W. '22 M
Kvitrud, Ingwald '11 C
Lagaard, Alex S. '13 E, '14 EE
Lambert, Edwin M. '09 M
Lang, Charles A. '06 E
Lang, Fred C. '08 C
Langland, Harold S. '19 E
Languth, Karl H. '27 ChE
Larson, Amandus C. '20 C
Larson, Carl '16 C
Lauer, Walter M. '24 PhD
Lebeck, Carl E. '20 C
Lee, Melville R. '21 ChE
Lee, Oscar C. '19 E
Leerskov, Gerhard W. '21 ChE
Leonard, Thomas K. '15 C, '16 CE
Levens, Alexander S. '22 C
Levin, Jake M. '18 E
Lewin, Sherman W. '26 C
Lewis, Berkeley R. '25 E
Lewis, George R. '21 M
Libby, Calvin R. '28 M
Lieberman, Harry '28 E
Liese, Carl '26 C
Lighter, Clyde W. '26 A
Lindstedt, Philip G. '26 C
Lipchick, Alex A. '26 C
Lobeck, Torarin '24 E
Lowe, John M. '08 Ch
Lowther, Wilfred W. '27 M
Loye, Percival E. '21 E, '22 EE
Ludwig, Llewellyn G. '24 Ch
Lund, Clarence V. '26 C
Lund, Roy V. '24 C
Lund, Stanley D. '27 C
Lundgren, Carl W. '26 M
Lundquist, C. Vernon '25 M
Lundquist, Wilton '28 M
Lutz, Richard E. '15 E
Lux, Lester L. '27 Ch
Lyberg, Verele C. '26 E
McCartney, Floyd A. '13 M
McClung, Karl '25 E
McCullough, Bruce M. '16 C
McGladrey, Lyle '28 M
McKenzie, Leonard F. '20 E
McLeland, Lyle K. '24 E
McNally, Lee '28 C
MacGregor, Helen '25 ID
Magney, Hilding O. '24 E
Mann, Alvin K. '26 E
Mann, Fred M. '93 C, '98 CE
Markoe, James C. '12 M
Marshall, Chester R. '23 M
Marshall, Olive Wadleigh '17 Ch
Mattison, Oliver '05 C
Mayer, Harris J. '14 M, '15 ME
Meader, Glenn S. '26 E
Meili, Rudolph E. '22 G
Mentzer, Clarence A. '22 E
Merrill, Lewis E. '20 M, '21 ME

Minneapolis
Meyer, Herbert W. '14 E
Miller, Marvel P. '28 M
Mindrum, Arthur I. '26 E
Mitchell, Donald F. '20 ChE
Mixer, Walter R. '17 A
Molskness, Nels S. '20 E
Moore, Clarence '20 G
Morris, Frank A. '24 M
Moore, Gordon B. '27 E
Mork, George W. '26 M
Morse, George '93 A
Morton, Harold S. '12 M, '13 ME
Morton, Harry G. '04 E
Mowery, Clarence W. '08 C
Moyer, A. F. '10 M
Nash, Russell O. '23 E
Nason, George L. '10 C
Nelson, Arthur '28 M
Nelson, Clarence E. '27 E
Nelson, Clarence H. '25 E
Nelson, Clarence L. '20 E
Nelson, Gustaf A. '19 E
Nelson, Harry G. '18 Ch
Nelson, Nels B. '04 C
Nelson, Oscar B. '05 C
Nelson, Richard L. '21 E
Nelson, Robert B. '26 E
Nemer, Frank L. '09 M
Neubauer, Loren W. '26 C
Newhall, William B. '00 M
Nicholson, Edward '25 E
Nielson, Eunice V. '23 A
Noble, John F. '21 G
Nordenson, Arnold '22 M
Nordlien, Berger W. '22 E
Nordstrom, Milton E. '25 C
Nordvall, Glenn '23 E
Norrbom, Oscar '26 M
Nyvall, Clifton S. '26 C
Olmstead, Charles '22 M, '23 ME
Olsen, Leslie R. '15 Ch
Olsen, Melvin S. '08 C
Olson, Arthur O. '11 Ch
Olson, Edwin E. '25 A
Oram, Robert C. '11 M
Orning, Harold '26 E
Orr, George M. '15 M
Osburn, Roy W. '27 E
Otterstein, Earl F. '13 Ch
Otto, Robert W. '04 M
Parker, Clyde '28 C
Parker, Helen R. '25 ID
Parker, Robert M. '24 C
Parry, John E. '26 E
Paul, Frederick T. '09 C
Pelley, Lloyd L. '24 E
Pendergast, Webster G. '25 M
Pennock, Edward M. '05 AC
Person, Otto C. '24 AE
Pesek, Cyril P. '25 AE
Peterson, Everett L. '25 A
Peterson, Harold W. '21 E
Peterson, Henry '13 ChE
Platzer, Geo. J. '27 C
Powell, Louis H. '24 C
Pratt, B. A. '15 C
Prendergast, Arthur '03 C
Prichard, Charles E. '25 C
Priedeman, George W. '08 M
Quiggle, Arthur W. '13 C, '14 CE
Quinn, Edward I. '25 C
Rademacher, Richard L. '23 ChE
Rakov, Abner '28 A
Ramey, John M. '28 AE
Rasey, Raymond R. '26 C
Raugland, Arnold I. '20 A
Reid, Harry A. '10 E
Reidhead, Frank E. '93 E, '98 EE
Rhoades, Herbert E. '26 E
Riley, Philip J. '21 Ch
Rinell, Eric '28 C
Ritchie, John R. '16 M, '17 ME
Rockwell, Harvard S. '14 C
Robertson, B. J. '14 E, '15 EE
Robertson, Haney H. '28 M
Robinson, H. Marjorie '28 Ch
Robinson, Parke D. '25 M
Robinson, Rhea B. '12 Ch
Rollin, Harold '26 M
Roos, Frank T. '24 C
Rosenberg, Rahil A. '24 A
Rosendahl, Harold R. '22 M
Rosey, Raymond R. '26 C
Ryan, Robert M. '23 E
Ryan, W. T. '05 E
Salisbury, Willis R. '10 G
Sandell, Ernest B. '28 Ch
Sarver, Landon A. '15 BA, '19 MA, '24 PhD
Scandling, Joseph E. '25 ChE
Schaller, George C. '23 C
Schavone, Anthony P. '28 E
Schermer, Oscar C. '21 ChE
Schilling, Theodore '24 E
Schlafge, Wm. H. '26 ChE, '27 KE
Schlenk, John J. '23 C
Schow, Garfield G. '24 E
Schultz, Albert W. '27 E
Schwartz, John S. '19 A
Schweiso, Clifford C. '23 E
Scott, Herbert L. '23 E
Sebo, Arthur O. '24 M
Seeman, Ernest '20 C
Seyfried, Lillian M. '17 Ch
(Mrs. W. H. Hunter))
Shavor, George J. '25 E
Shenehon, Francis '95 C, '00 CE
Shepley, Charles R. '02 C
Shippam, Willis '09 M
Siegmann, Chester W. '20 E
Silverman, Emil '22 C
Silverman, Isadore W. '24 A
Silverman, R. R. '28 Ch
Siverson, Sigvel J. '11 C
Siverts, Samuel A. '09 C
Sjoberg, Roy H. '26 E
Skurdalsvold, P. '15 C, '16 CE
Smeby, Lynne C. '28 E
Smith, Harold D. '25 E
Snyder, Dorothy E. '26 M
Soshnik, Edward J. '22 C
South, W. A. '12 C, '13 CE
Springer, F. W. '93 E, '98 EE
Stephens, Clifford '23 C
Stephenson, Oliver H. '07 M
Sternberg, Carl '07 E
Stodola, Frank H. '28 ChE
Stolte, Sidney L. '27 AE
Stone, Charles W. '16 M, '17 ME, '19 MS
Stoppel, Arthur E. '20 ChE
Sullivan, Betty '22 Ch
Sundblad, Everts W. '27 E
Svendsen, George P. '08 E
Swanberg, John H. '25 C
Swanson, Edwin W. '19 E
Swanson, Paul H. '23 C
Swanson, Philip G. '23 M
Swanstrom, Frank N. '08 E
Swedberg, M. Roy '11 C
Sweet, Ray R. '21 E
Swenson, George '17 E, '21 EE
Swenson, Gustav A. '20 G
Swenson, H. Seymour '12 C, '13 CE
Taplin, George C. '24 E
Tebo, Frank '28 C
Thorshov, Roy N. '28 A
Tindall, Jesse E. '25 ChE
Tinkham, Willis M. '14 ChE
Thayer, Charles E. '76 C
Thayer, Paul W. '14 M, '15 ME
Tholstrup, Henry L. '26 E
Thomas, Richard L. '25 E
Thomson, Andrew '25 E
Thorshov, Olaf '21 A
Thyberg, Clarence W. '25 E
Tighe, James S. '26 E
Timperley, William D. '10 C
Todd, Milo E. '09 E
Torrance, Ell '09 C
Trask, Alfred S. '23 E
Trask, Birney E. '90 C, '94 CE
Trcka, Benj. C. '24 E
Tronson, John L. '26 ChE
Tryon, Philip D. '17 C
Tupper, Charles E. '15 M
Turner, Roy H. '15 E, '16 EE
Underhill, Editha '16 BA, '25 MS
Ungerman, Carl M. '06 E
Untinen, August L. '25 E
Upton, Albert '25 E
Vaule, Sven A. '21 M
Vincent, Jay C. '03 E
Von Stucker, Selmar '28 M
Walby, Arthur C. '11 C
Walker, George W. '08 C
Wallfred, Carl L. '20 ChE
Walling, Benjamin B. '09 E
Walquist, John A. '23 A
Wangaard, Oscar H. '12 C, '13 CE
Wanless, Lynn A. '12 Ch
Watson, Fred G. '16 C
Webber, Fredrick W. '97 ChE
Weeks, Leonard H. '27 E
Weigel, Howard N. '14 C, '15 CE
Wentz, Walter W. '14 E, '16 EE
Werdenhoff, James H. '21 C
Westerberg, Carl George '21 Ch
Westigard, Glenn A. '25 E
White, Robert H. '23 ChE
Whited, Oric O. '08 Ch
Whitney, Alfred C. '03 G
Wilcox, Hugh B. '14 E, '16 MS
Wilhoit, Albert D. '06 Ch
Wilkinson, Gladness B. ID '27
Williams, Charles A. '16 C
Williams, Roy N. '23 E
Willson, Stuart V. '24 M
Wilson, Eliel '01 M, '02 E
Woodrick, Oscar '08 C
Woolett, Guy H. '10 Ch
Young, Edward F. '26 C
Ziegler, Mildred R. '15 Ch
Zima, Albert G. '24 ChE

Montevideo
Scott, Lawrence '15 E, '16 EE

Montgomery
Soulek, Joseph H. '11 E

Moorhead
Hopeman, Albert M '05 C

Moose Lake
Handschu, C. E. '15 C

Mora
Hanna, Cyril C. '26 M

Newport
Knight, Ralph J. '15 C

New Ulm
Bockus, Gerald H. '22 E
Haeberle, Elmer H. '06 E
Robertson, Charles N. '08 C

North Hibbing
Lundquist, John V. '23 E

Oak Terrace
Lorens, Ed R. '26 C
Rathburn, George A. '24 M

Olivia
Kircher, Frank J. '09 M
Kircher, Geo. A. '09 M
McAubrey, Everett J. '21 C

Owatonna
Aultfather, David '22 E
Hosfield, Raleigh '12 C
Souba, John I. '25 M
Sweeney, Frank C. '28 E

Peterson
Boyum, Benjamin C. '10 C

Pine City
Nutting, Horace W. '25 C

Pine River
DuBois, N. Warren '26 M
Peterson, Volgar '28 E

Plainview
Askew, Thomas A. '16 C

Proctor
Bohannon, George W. '26 M
Maney, James E. '26 M

Raymond
Haima, Mark '25 C

Red Wing
Cook, Harry C. '10 M
Cornell, Reuben W. '21 ChE
Deegan, Raymond '26 C
Josephson, Eliot B. '10 E

Red Wood Falls
Clipfell, Carroll D. '05 M

Robbinsdale
Busch, Wm. '20 ChE

Rochester
Boyce, Ellsworth R. '17 C
Bross, Peter P. '25 A
Buenger, Edgar '19 A
Heck, Frank J. '19 Ch, '24 MS
Holst, James E. '27 ChE
Leonard, Aubrey C. '23 C
Pagenhart, Clarence C. '12 C

Rushford
Engh, Harris S. '24 M

Sauk Rapids
Ramsay, Selmer '21 ChE

St. Cloud
Jorgens, C. R. D. '12 C, '13 CE
Swenson, Gustav A. '20 G
Wickman, Martin F. '22 E

St. James
Slaby, Louis J. '26 M
West, John C. '15 C

St. Paul
Abrahamson, Howard B. '17 M
Albrecht, Ernest G. '25 EE
Amidon, Roger '28 C
Anderson, M. M. '20 ChE
Andrews, George L. '05 M
Arnesen, Herbert P. '11 C
Aronovsky, Samuel Isaac '21 ChE
Aure, Roy '22 M
Backe, Edmund '24 ChE
Baker, Russel E. '11 ChE
Banovetz, John A. '25 C
Barlou, Harry E. '03 C
Barrett, Joseph O. '22 ChE
Barthelemy, Carl R. '28 M
Bartow, Harry E. '03 C
Blandin, Lawrence '28 C
Beek, Hiram D. '26 M
Bell, Alexander D. '16 Ch, '17 ChE
Bennett, John C. '26 M
Bingham, Stanley E. '08 M
Bird, Harold E. '25 C
Bisbee, Bertin A. '22 E
Bliven, Paul '27 M
Bohland, John A. '15 C
Borst, Wellington L. '24 M
Boss, Ronald W. '25 M
Bourne, Floyd '27 C
Bowers, Raymond J. '28 M
Boyles, Ralph R. '15 M, '16 ME
Brandt, Clifford A. '27 E
Brockway, Royden R. '05 C
Brohaugh, Gustave C. '27 C
Buenger, Albert '13 M, '14 ME
Bumgardner, Louis T. '23 E
Calmeyer, John P. '06 E
Carlson, Arvid P. '17 M
Carlson, Ernest '22 M
Carlton, Richard P. '21 G
Chapman, Leslie H. '95 C
Chapman, Wilbur J. '27 M
Christlieb, Frank B. '23 C
Collis, N. Stuart '24 M
Comfort, Clifford E. '26 M
Comfort, Thomas H. '26 C
Cornell, George M. '25 C
Cowin, Clifford C. '21 G
Crawford, Allen S. '12 M
Cummings, Elmer '12 C, '13 CE
Curry, Ezra Benham '20 M, '21 ME
Damberg, Paul '22 A
Darrell, James E. P. '23 C
Daum, H. Arne '12 E
Davidson, John E. '28 AE
Davis, Gilbert M. '04 M
Dehn, Eltor '21 C
Deutsche, Richard E. '18 C
Dewars, Allen G. '13 E, '14 EE
DeWitt, Joseph H. '10 Ch
Diamond, Grover W. '12 C
Dills, Lyle A. '21 G
Dimond, Harvey G. '14 C
Dougan, Henry K. '08 C
Dungay, Herbert F. '25 C
Dunnavan, Ralph B. '23 E
Dunning, Robt. M. '28 M
Duvall, Arndt J. '25 C
Dysterheft, George A. '26 Ch
Eggleston, Smith '25 M
Egilsrud, F. S. '20 M
Ellison, Jay '09 C
Engstrom, LeRoy '28 C
Engquist, Victor E. '20 E
Erskine, Lawrence '25 M
Felion, Elmer T. '13 Ch
Feyder, William H. '05 C
Finley, Joseph E. '05 C
Fiske, Frederick W. '09 C
Finke, W. M. '10 Ch
Fleming, Frank R. '08 M, '09 EE
Flygare, August L. '12 C
Forsberg, Elmer J. '21 M, '22 ME
Francis, Paul E. '18 M
Fraser, Carlisle G. '22 C
Fraser, George '19 A
Frenzel, Herman '26 A
Fuhrman, Alvin O. '24 ChE
Gage, Hugh N. '08 C
Garen, George M. '10 C
Gehrenbeck, G. B. '28 ChE
Gessert, George R. '07 M
Giertsen, Marcus O. '12 C, '13 CE
Gilstad, Arthur '23 M
Goebel, Rudolph C. '13 E, '14 EE
Goldberg, Maurice '23 E
Goldberg, W. M. '28 Ch
Goodkind, Leo '92 A
Greenberg, Morris '18 M
Grime, Edwin M. '00 C
Guerin, George V. '24 C
Gustafson, J. M. '28 C
Gustafson, Reuben W. '24 C
Haberle, Edward '12 C, '13 CE

St. Paul
Halvorson, Henry A. '11 Ch
Hamilton, Sam '28 E
Hansen, Carlos C. '20 C
Harris, Harold R. '14 E, '15 EE
Hatch, Lloyd '23 ChE
Hayes, Edward J. '20 M
Hedenstrom, Ernest A. '12 E
Hendricks, Clifford '25 C
Hendrickson, C. Edward '25 C
Hendrickson, Norman '16 C
Hennessy, Hugh J. '11 Ch
Hewett, Maurice W. '13 C, '14 CE
Hiner, Walter G. '23 C
Hoff, Christopher '06 E
Hoffman, Henry J. '12 Ch
Hoffman, Michael J. '11 C
Hoisveen, Leonard '25 M
Holder, Laurence E. '24 C
Hosmer, Orville H. '23 C
Hovden, Conrad D. '12 E, '13 EE
Hoving, John E. '27 C
How, Francis W. '27 C
Irons, George '26 E
Jackson, Earl D. '05 E
Jenkins, Clifford H. '25 M
Johnson, Carl A. '21 M, '22 ME
Johnson, Einer '11 Ch
Johnson, Laurence V. '27 C
Johnson, Nels '23C
Johnson, Waldo C. '26 Ch
Jones, Edwin F. '17 M
Jones, Gordon '28 AE
Joyce, Floyd E. '17 Ch
Judd, Maurice '23 C
Kapp, David '28 C
Katter, Calvin K. '22 M
Kennedy, Wm. W. '07 Ch
King, Lawrence W. '09 C
King, Wesley '05 C
Klass, Frederick '19 E
Koch, Arthur Louis '19 ChE
Koch, Karl L. '23 E
Kochendorfer, Milton J. '05 E
Kopper, Edward '14 M, '16 ME
Krauch, William '08 C
Kryger, Edward R. '21 Ch
Kugler, Joseph H. '26 ChE
LaBonte, Anton '25 C
Larson, Albin '14 C
Larson, Martin S. '11 M
LeBlond, Edmond J. '05 E
Levy, Max L. '26 E
Lewis, Edward B. '05 M
Liebenberg, Jacob J. '16 A
Liese, Herbert W. '24 C
Lighter, Clyde W. '26 A
Lilly, Clarence W. '17 E
Lilly, Eugene '19 G
Lindquist, Oliver J. '26 E
Livermore, Harry J. '22 ChE
Loeffler, Henry S. '14 E, '15 EE
Logue, John F. '24 M
Lovering, Harry D. '13 C, '14 CE
Luft, H. L. '24 ChE
Luft, Oscar W. '17 Ch
Lux, Albert '28 OrgCh
Lux, Arthur E. '16 E
Lux, Lester L. '27 Ch
McCree, Andrew A. '08 C
McCubrey, Everett J. '21 C
McDanield, L. A. '28 C
McMiller, Paul R. '11 Ch
McPherson, William B. '02 E
Macgowan, Irvin '25 C
Mackintosh, William S. '21 C
Maehl, Kenneth A. '27 Ch
Mangney, Elmer J. '21 E
Malloy, Charles J. '06 C
Manson, Philip W. '26 C
Markson, Christian O. '22 C
Mattson, Dewey F. '22 C
Mayer, Albert F. '20 E
Mayer, Joseph S. '24 E
Mayeron, Ben '28 C
Mayhugh, Ben F. '28 M
Meixner, Bernard A. '10 M
Merrill, Grant S. '28 ChE
Mertz, Karl J. '14 E
Meserve, Ralph H. '23 E
Meskal, George '23 C
Methven, Clyde '11 C
Mikesh, Edward S. '22 M
Miller, Erwin J. '11 C
Miller, George W. '20 E
Miller, William C. '16 M
Miller, William J. '24 E
Mitchell, John B. '09 C
Moore, John H. '24 M
Moorman, Albert J. '18 A
Moorman, Frank S. '22 A
Motl, Charles L. '10 C
Muller, Carl C. '18 M
Nelson, Edward S. '09 C
Nelson, Mark L. '24 A
Neville, Earle L. '20 C
Nordstrom, Carl T. '14 C
Norton, Clyde W. '08 M, '09 ME
Nye, Lillian L. '10 Ch
Okes, Day I. '08 C
Okes, Sidney R. '09 C
Olson, Clarence '28C
Olson, Clarence E. '22 G
Oltman, Charles A. '03 C
Ott, Leonard E. '15 C
Owens, Leo E. '11 M
Palda, Charles H. '22 C
Parkin, Guy G. '12 Ch, '13 Ch
Pause, Harold A. '23 E
Peckham, Harold E. '23 M
Peters, Walter C. '22 M
Peterson, A. M. '14 E
Peterson, Harold C. E. '25 C
Peterson, Marshall A. '21 ChE
Pinska, Lawrence F. '22 C
Pohl, Loren F. '27 C
Poulsen, George F. '17 A
Powles, James W. '01 E
Quinn, Ursula R. '25 C
Rauen, Theodore '26 ChE
Reardon, John M. '22 C
Redin, R. K. '26 AE
Rigg, Alvin E. '25 A
Ringstrom, Ivan G. '12 BS, '13 EE
Rockwood, Ralph H. '12 Ch
Roe, Chas. P. '29 CH
Roe, Harry B. '08 E
Roehrich, Victor '09 ChE
Roth, Lewis M. '11 C
Rufsvold, Olav M. '15 C, '16 CE
Santelman, Ralph H. '27 C
Schroepfer, Geo. '28 C
Shepard, George M. '09 C
Sickel, Edwin C. '23 E
Skagerberg, Rutcher '15 E, '16 EE
Skon, Herman W. '15 M, '16 ME
Slade, Loring '22 C
Smith, Sheldon H. '10 ChE
Snow, Clarence J. '14 M, '16 ME
Souther, M. Edwin '12 C, '13 CE
Speer, Paul B. '27 E
Stanton, Raymond E. '04 M
Stevens, Everett B. '25 M
Stewart, George A. (Garnet) '22 A
Streich, Harry C. '12 E
Swenson, Theodore J. M. '12 E
Swift, Donald C. '24 E
Tallmadge, Everett S. '14 E, '15 EE
Tauber, Jos. '28 C
Teberg, Lawrence E. '22 C
Teske, Frederick C., Jr. '27 C
Thomas, William A. '17 E
Thompson, Claudius '22 C
Thompson, Niles J. '27 E
Thompson, Theodore S. '24 C
Toncheff, Stanil T. '15 Ch
Vievering, Wm. A. '25 Ch
Villaume, Walter F. '23 C
Waldor, Ted N. '25 C
Waldron, Ralph E. '20 E
Walters, Robert P. '26 E
Waterous, Fred A. '20 M
Webster, Donald W. '13C, '14 CE
Weinke, Ernest '16 C, '17 CE
Welin, Arthur G. '12 C, '13 CE
Wellisch, Walton '23 E
Weom, Laurel A. '27E
Whitman, Edward A. '00 C
Williams, Fred J. '17 E
Willis, Roy '08 C
Winslow, Raymond M. '19 ChE
Witt, Edward J. '28 A
Witt, Edward J. '27 C
Wolf, Milton C. '25 C
Wolfangle, Raymond J. '17 C
Wolff, William S. '15 M, '16 ME
Woolman, Harry D. '24 M
Wunderlick, Milton S. '19 M, '20 ME
Wurzbach, Henry A. '25 E
Yager, Louis '07 C

Silver Lake
Jerabeck, Dan '28 AE

Slayton
Price, John R. '14 C

Sleepy Eye
Hansen, T. '28 Ch

Staples
Ainslie, Arthur F. '11 C

Stevenson
Quine, William M. '26 E

Stillwater
Englin, Charles F. '06 E
Ovestrud, Melvin '13 M, '14 ME
Schuck, Roy D. '25 E
Tierney, Festus P. '22 C

St. Peter
Skartvedt, Peter M. '06 Ch, '13 Ch

Taylors Falls
Rydeen, James '28 C

Tracy
Peterson, Garvin E. '26 C

Twin Valley
Croswell, Daniel R. '16 E
Croswell, Thomas L. '15 C
Nilson, Wilhelm '02 E

Two Harbors
Jordan, Wallace E. '26 ChE

Tyler
Johnson, Anton A. '24 A

Virginia
Barrows, Vera '17 Ch
Riddell, John D. '28 E
Sannicolo, Joseph F. '22 E
Whitten, Robert C. '25 M

Waconia
Wessale, George '21 E

Wadena
Hayden, Claude E. '24 C
Imsande, Fred '25 C

Wahkon
Friar, Floyd M. '20 C

Waseca
Johnson, Edgar F. '21 E
Zimmerman, Louis P. '08 E

Washtucna
Bouge, Nathan H. '04 C

Willmar
Beese, Harold U. '25 C
Bergquist, Philip L. '24 C
Peterson, Randall '28 E

Winona
French, William O. '25 M
Gerlicher, H. W. '27 ChE
Grettum, Leroy A. '23 E
McAndrews, Harry '25 C
Miller, Archibald T. '24 E
Miller, William L. '97 E

Winthrop
Haakenson, N. Theodore '26 C
Malmberg, Victor A. '20 C

MISSISSIPPI

Jackson
Kroeze, Herbert A. '19 G

Laurel
Nee, Harold E. '24 E

Springfield
Cote, Rhoda (Mrs. J. P. Barton) '25 ID

University P. O.
Woolett, Guy H. '10 Ch

MISSOURI

Gasconade
Chapman, Burton L. '10 C

Jefferson Barracks
Russell, Carl A. '16 E
Sullivan, Frederic V. '25 C

Jefferson City
Espenett, Edward L. '22 C
Sverdrup, Leif J. '21 C

Kansas City
Didriksen, Phillip '20 E
Glass, Clifton A. '98 C
Koehler, Edwin F. '24 M
Swanson, Clifford L. '22 C
Luedeman, Clarence H. '23 AE
Tibbling, Ernest F. '14 Ch
Wright, Harris H. '09 M

Knob Lick
Rydeen, Francis G. '05 M

Marshall
Pettijohn, Earl '11 Ch, '12 Ch, '19 PhD

Mt. Grove
Hummell, Carl A. '26 E

New London
Glascock, Henry H. '06 E

St. Joseph
Grant, Elberth R. '24 C

St. Louis
Erickson, Carl G. '03 E
Haines, Allen K. '13 E
Johnson, Noah '94 C
Krantz, Rudolph W. '24 ChE, '25 MS
McCann, Realino V. '27 A
Olson, Richard H. '19 E
Oscarson, Gerhard L. '22 E

Troy
Ball, Hampton B. '20 M

Willow Springs
McDanield, Loran '28 C

MONTANA

Billings
Berg, Karl A. E. '20 C
Coleman, Frank D. '05 E

Bozeman
Thaler, James A. '00 E

Bridger
Coon, Lawrence C. '26 E

Butte
Jordan, Frank W. '19 E
Pratt, Arthur C. '99 E
Rolfe, West A. '13 C
Stussy, William '00 E

Deerlodge
Baker, Arthur W. '19 M

Glasgow
Joselowitz, G. '18 Ch

Glendive
Adams, Benjamin W. '10 C

Great Falls
Dow, James C. '00 E
Hougan, Sander '21 E
Jufrud, Ingvald O. '14 Ch
Sheire, James B. '28 E

Harve
Haverson, Henry D. '07 C

Helena
Kivley, Warren O. '16 C

Miles City
Aasland, Christopher '15 C

NEBRASKA

Lincoln
Japs, Barney '09 E
Pagel, H. Armin '23 Ch

Omaha
Bunce, Paul F. '06 E
Christensen, Edgar W. '19 E
Eddy, Horace T. '95 E, '96 EE
Ellestad, Irwin M. '22 E
Johnson, Gustav A. '23 E
Johnson, James P. '23 E
Lund, Earl H. '22 C, '23 CE
Sampson, Cliff. L. '23 E, '25 EE
Schneckloth, Harry H. '25 E
Skarolid, Charles J. '24 E
Teal, Clarence W. '24 E
Vorisek, Jerry '28 C
Wallfred, John E. '20 M
Weibler, William M. '08 E
Wilcox, Halsey H. '15 E
Wilson, Paul R. '21 E
Zimmer, William A. '06 E

New Duluth
Jordan, Wallace E. '26 ChE

NEW HAMPSHIRE

Berlin
Burningham, F. A. '17 ChE

Hanover
Hartshorn, Elden B. '22 PhD

NEW JERSEY

Bloomfield
Widell, E. Gideon '17 ChE

Camden
Corson, Benjamin I. '17 Ch

Carteret
Kerns, Clinton B. '15 M

Cliffwood
Sharpless, Wm. M. '28 E

Harrison
Anderson, Oscar P. '10 E
Wyman, I. R. '22 Ch

Irvington
Prehn, Victor N. '27 E

Kearney
Dowd, Archie J. '19 M
Mikesh, Martin A. '12 M, '13 ME
Franzen, Roy O. '25 E
Pangburn, Carroll '22 E
Peterson, Vance C. '20 E
Steffens, Robt. A. '22 E
Waligoski, A. Arnold '24 E

Kenvil
Paul, Karl F. '24 ChE

Monmouth
Hoorn, Frederick W. '12 E, '14 EE

MONTCLAIR
Cassel, Norman S. '22 ChE
NEW BRUNSWICK
Von Kuster, Edith I. '07 Ch
(Mrs. W. Johnson Kenyon)
NEWARK
Frederickson, Harry B. '11 E
Fritzberg, Hilding L. '28 M
Koepke, Walter E. '13 C, '14 CE
Rose, Anton R. '04 Ch
NUTLEY
Johnson, Welton V. '26 E
PARLIN
Edgar, Donald E., '27 PhD, '23 ChE
PERTH AMBOY
Johnson, Lester L. '25 ChE
Johnston, Charles L. '25 ChE
Kohlhase, Arthur H. '21 Ch
Paulson, Paul M. '23 ChE
Temple, Sterling N. '05 PhB
Wernlund, Chris '27 PhD
PHILLIPSBURG
Etem, Victor '26 E
NEW BRUNSWICK
Moore, Norman '25 C

NEW MEXICO

ALBUQUERQUE
Larson, Fred '25 C

NEW YORK

ATTICA
Anderson, Ed I. '17 M, '19 ME
BAY SHORE
McCullough, Robert T. '23 E
BROOKLYN
Daly, Richard T. '21 C
Ely, Irving R. '05 E
McKee, John B.
Stoppel, Ernest A. '11 Ch
Sushan, Harry M. '19 C
BUFFALO
Bakken, Adolph C. '23 Ch
Bercovitz, Henry '27 ChE
Czock, Jacob H. '20 M
Johnson, Carl S. '21 C
Jules, Harold A. '20 E
Kelsey, Howard C. '22 M
Kiesner, Frank C. '24 M
Luft, O. W. V. D. '17 Ch
Schildt, William F. '08 E
Sverdrup, Edward F. '26 ChE
Swanson, Oscar E. '15 C, '16 CE
CHENANGO FORKS
Harshaw, John R. '12 Ch
FULTON
Korfhage, Roy F. '20 Ch
ITHACA
Barr, John H. '83 M, '88 MS
JERSEY CITY
Mikesh, Martin A. '12 M, '13 ME
LONG ISLAND CITY
Boyd, Paul M. '24 M
Wagner, Otto H. '07 M
MT. VERNON
Hiers, Charles R. '24 M
Loye, Edwin M. '20 A
NEW BRIGHTEN, STATEN ISLAND
Grimes, David '19 E
Marshall, Donald E. '19 E
NEW YORK CITY
Abbott, Arthur L. '97 E
Backstrom, Emil F. '24 A
Bauer, Ruben B. '20 E
Berg, Samuel A. '21 BA, '21 E, '22 EE
Bierman, Harry C. '14 ChE
Bolme, Ole N. '10 C
Bonner, Arthur L. '27 E
Boman, Carl E. '05 E
Bosshardt, Willmert C. '22 E
Bouman, Bernard M. '04 E
Braden, Rene A. '23 E, '25 MS
Brattlof, Clifford '27 C
Brayden, Giles W. '27E
Buhl, John E. '09 M
Burns, Harvey L. '02 E
Case, Gerald F. '23 E
Cheney, Edward J. '04 E
Cousins, Van Meter '25 E
Covell, Russell O. '16 E
Crabbe, George N. '04 E
Craig, Robert '97 M
Dahl, Harold W. '24 E
Demarest, Charles S. '11 E
Dewey, William H. '93 E
Eckberg, Curtis '17 E
Elmer, Lloyd A. '21 M
Feldman, Carl B. H. '26 E, '28 MS
Gannett, Danforth '16 E, '17 EE
Gerlach, Henry C. '22 A
Gilman, Howard B. '17 A
Gregg, Freshame D. '05 G, '06 CE
Hagerman, Oliver S. '18 M
Hahn, Stanley W. '22 A
Heins, Harold '25 E
Hilferty, Charles D. '96 M
Hokanson, Clarence E. '06 E
Holien, Edward O. '23 A
Houts, Guy J. '01 E
Hubbard, Henry A. '09 E
Ireland, Ray R. '03 E
Johnson, John E. '11 E
Kannenberg, Walter '23E, '25 MS, EE '28
Keller, Raymond W. '25 E
King, Alfred B. '08 E
Koerner, W. M. '28 E
Kokatnur, Vaman R. '14 Ch
Kuhlman, Rudolph H. '23 M
Laird, Lee R. '03 E
Landeen, Arvid G. '10 E
LeTourneau, Edward H. '05 E
Lockwood, Raymond '20 E
Loye, Donald P. '16 E, '17 EE
Luger, Karl E. '22 ChE
Magoon, Herbert A. '24 A
Manderfeld, Emanuel '21 E
Markuson, Oscar S. '11 E
Mathes, Robert C. '12 E, '13 EE
Mitchell, Alexander C. '20 E
Moe, Claude P. '20 Ch
Morris, John E. '09 M
Mowry, Harry W. '06 E
Myers, Mortimer '97 E
Norcross, Arthur F. '07 E
Olstad, Oscar A. '11 M
Otto, Frederick A. '04 E
Robertson, Phillip W. '01 M
Sander, Theodore, Jr. '19 E
Schottler, George J. '23 E
Schroeder, Carl W. '14 E, '15 EE
Simons, Walter W. '16 E
Smith, Donald C. '18 E
Strothman, Russell A. '20 E
Swenson, Clarence Q. '17 M, '20 ME
Swenson, Karl P. '06 G, '07 MS
Taylor, Duane L. '17 M
Thordarson, Wm. '23 ChE
Thorne, Donald '23 E
Thuros, Albert L. '12 E, '13 EE
Tullar, Charles E. '01 E
Tunell, Robert H. '24 E
Wahlquist, Hugo W. '21 E
Wentz, Walter W. '14 E, '16 EE
Wheeler, Herbert H. '17 E
Wiggins, Gerald G. '06 E
Willner, William E. '22 A
Wright, Roydon V. '98 M
Zimmerschied, Clarence R. '23 E
NIAGARA
French, Edwin L. '02 E
Graling, Verney '99 E
NIAGARA FALLS
Benner, Raymond C. '02 Ch
Dobrovolny, Frank J. '24 Ch
NORWICH
Moris, Russel F. '25 C
POUGHKEEPSIE
Crawford, Marjorie '27 PhD
Mann, Alvin K. '26 E
RIVERHEAD
Braaten, Arthur '28 E
ROCHESTER
Matthews, Glenn E. '20 Ch
Nietz, Adolph '15 Ch
Savage, Edward S. '97 M
SCHENECTADY
Allee, David A. '02 C
Anderson, Lowell W. '26 E
Beardmore, Albert '21 E
Bill, Earl M. '12 E
Boe, Lester L. '25 E
Bottemiller, Edward L. '27 E
Burrill, Charles M. '23 E
Downie, John M. '22 E
Dunham, Roy O. '14 E, '15 EE
Engstrom, Elmer W. '23 E
Fallon, Eugene L. '14 E, '15 EE
Fiene, Marcus '26 E, MS EE '28
Forsberg, Peter W. '11 E
Frazee, Leonard M. '24 E
Grant, Fred R. '09 E
Grobel, Lloyd P. '24 M
Haedecke, August D. '26 E
Hargrave, William A. '26 E
Hargraves, Robert A. '23 E
Hartley, Lowell J. '26 E
Hathaway, Herbert F. '28 M
Heinemann, John R. '19 E
Larson, Seymour R. '28 E
Larson, Werner L. '28 M
Lee, Alfred H. '28 E
McCully, James '25 E
Marshman, Irving H. '24 E
Mittag, Albert H. '11 E
Murdock, George B. '26 E
Nergaard, Leon S. '27 E
Nierling, Grant C. '25 E
Parsons, Sidney A. '25 E
Rask, Louis G. '03 E
Robinson, Laurence T. '26 E
Sjoberg, Roy H. '26 E
Soderholm, Lauren V. '28 E
Tunnell, Clement R. '25 E
Warren, Laurence C. '24 E
Wiltgen, Edward '00 E
Woodman, Joseph C. '11 M
SYRACUSE
Jones, Robert A. '15 E, '16 EE
Linhoff, Carl H. '22 E
McKee, John B. '25 ChE
Morris, Thomas C. '08 M
Moyer, Malcolm B. '09 M
UTICA
Sternberg, Woldemar M. '18 PhD
WEST NEW YORK
Velz, Clarence '24 C
WHITE PLAINS
Adams, George F. '95 E
YONKERS
Rice, Edgar W. '02 Ch

NORTH CAROLINA

CANTON
Peterson, Clifford E. '23 Ch
DURHAM
Nielsen, Walter M. '22 E
GREENSBORO
Little, Alice V. '22 A
RALEIGH
Halvorson, John Oliver '07 Ch

NORTH DAKOTA

BISMARCK
Moses, Marlowe '27 E
COLUMBUS
Swenson, Geo. W. '28 Ch
CROSBY
Rosseau, Clifton C. '24 M
ELKTON
Kelly, William J. '26 E
FARGO
Beckel, Arthur C. '19 Ch
Bertossi, Clarence F. '25 C
Grafsland, Geneva '27 I
Jones, Paul W. '28 A
Juvrud, Edwin C. '17 E
Peterson, Albert L. '14 BS, '15 M
Sheffield, Fred W. '09 C
Stoutland, Oliver A. '22 C
Tarbell, William P. '22 C
Sunde, Conrad J. '26 OCh
von Sien, Ruth '28 ID
GRAND FORKS
Anderson, Edward X. '08 Ch
DeVaney, Grace M. '26 Ch
Gauger, A. W. '14 Ch
Harris, Elwin E. '22 Ch
Lavine, Irvin '24 ChE
Schulz, Elton A. '16 E
JAMESTOWN
McCall, Harry J. '08 C
MINOT
Huston, David B. '07 C
Molander, Edwin '25 A
Peterson, William W. '16 C
Williams, William R. '26 E
STANLEY
McGregor, Frazer A. '24 E
VELVA
Gerow, Theron G. '20 M
WILLISTON
Jackson, Myron B. '05 A. C.
WYNDMER
Miller, Andrew L. 21 E

OHIO

AKRON
Gerlicher, R. A '28 ChE
Gustafson, Hugo F. '28 M
Morris, Vlon N. '26 PhD
Pettersen, Wilber E. '28 M
Tronson, John L. '26 ChE, '28 MS
CANTON
Hektner, Joel '17 M
Lang, George M. '27 E
Letson, Donald E. '26 M
CINCINNATI
Holt, Gunnard T. '28 E
Young, Truman P. '26 C
CLEVELAND
Arneson, Lloyd O. '21 M
Bierman, George H. '18 M, '19 ME
Brewster, William E. '12 E, '13 EE
Briggs, Hiram K. '19 G
Conley, Wilfred E. '10 E
Cowin, Clifford Cecil '21 G
Drinkall, John F. '19 E
Estep, Harvey C. '08 M
Hinman, Charles H. '24 A
Johnson, Leonard T. '10 E
Larson, Walter J. '20 E
Lee, Albert A. '26 E
Lund, Jeffery L. '25 E
Maiser, Walter S. '23 C
Marr, Horace S. '17 Ch
Nelson, Edgar M. '24 E
Ransom, Glen B. '22 E
Taylor, Lyman D. '13 E, '16 EE
Yngve, Victor '13 Ch, '14 MS
CLEVELAND HEIGHTS
Merriell, Elmer W. '12 E, '13 EE
COLUMBUS
Curtis, Verne '22 M
Krag, Walter G. '07 M
Moffat, George N. '19 M, '20 ME
Youngquist, Eder B. '25 C
DAYTON
Roberts, Dimon A. '27 M
Slaggie, Eucharius '26 E
IVORYDALE
Hamlin, Lehan H. '21 M
Jewett, Ernest E. '25 ChE
Pagnucco, John W. '23 Ch
Seestrom, Hjalmer E. '28 ChE
Shirk, Loren H. '26 ChE
LAKEWOOD
Richardson, Wilbur P. '99 M
LIMA
Cutter, Francis C. '06 M
MANSFIELD
Gaalaas, George L. '26 E
Kotchevar, Jos. F. '28 E
Langseth, Axel O. '22 ChE
Lee, Paul R. '27 E
Morken, Carl H. '22 ChE
Schliep, Carl J. '28 E
Thelin, Ruben E. '28 E
Wieland, Willard '25 E
MARION
Barron, John H. '26 E
Brose, William C. '25 C
NOVELTY
Madsen, Olav '20 G
SPRINGFIELD
Moore, Norman R. '25 C
TOLEDO
Buckhout, Donald H. '17 A
Donauer, Max '18 B. S. (Ch E)
Feeney, Wayne '23 E
Nyquist, Roy A. '27 AE
YOUNGSTOWN
Birnberg, Zingel C. '09 M
Buhl, Paul S. '07 M
Elmburg, LeRoy '25 AE
Ramm, Theodore D. '13 E
Van Cleve, Horatio P. '07C

OKLAHOMA

BARTLESVILLE
Lee, Walter J. '20 E
FAIRFAX
Gobeli, Arthur W. '25 C
NORMAN
Swearingen, Lloyd E. '26 PhD
OKLAHOMA CITY
Ellingson, Elmer '16 C
Montgomery, Albertus '19C
PONCA CITY
Nelson, Ernest W. '20BA, '24 ChE
TULSA
Beck, Vernon S. '10 E
Olaison, Clifford '15 E, '16 EE
Thompson, Warren L. '26 Ch

OREGON

BURNS
Horstkotte, Arthur E. '22 C
CORVALLIS
Martin, W. H. '10 M
HARRISBURG
McAfee, Allan L. '08 E
HOOD RIVER
Smithson, John E. '07 E
KLAMATH FALLS
Paulson, Jos. B. '27 C
MERRILL
Bogue, Nathan H. '04 C
MEDFORD
Brockway, Alvah E. '09 E
Wood, John W. '05 E
ONTARIO
Countryman, Peter F. '07 E
PORTLAND
Andersen, Christian '88 C
Anderson, Frank A. '08 E
Bjorge, Oscar B. '07 M
Cobban, Rollo J. '09 E
Cook, Robertson '02 M
Couper, George B. '93 M, '02 ME
Curtiss, Faith (Sterling) '09 Ch
Doeltz, William F., Jr. '08 C
Hubbard, Fred A. '09 C
Johnson, Ivar W. '24 E
Meany, James M. '07 M
Morton, Lyle W. '24 E
Nelson, Donald O. '20 C
Nichol, Frank E. '25 C
Rawson, Ralph H. '07 M
Rockwood, Fletcher '14 E, '15 M
Shepherd, Burchard P. '95 M
Stoddart, Hugh A. '24 C
VERNONIA
Knauss, Archibald C. '16 C, '17 CE

PENNSYLVANIA

ALLENTOWN
Reque, Styrk G. '01 E
BELVIEW
Smith, Cedric B. '14 BA, '18 C
BETHLEHEM
Anderson, Fayette C. '24 E
Gjesdahl, Maurice S. '21 M
Jensen, Cyril D. '21 C
BRADFORD
Leavenworth, Francis M. '11 Ch
BRYN MAWR
Jones, Ivor V. '15 C
DONORA
O'Connell, Thomas C. '13 Ch
DORNMONT
Morrison, John E. '22 C
EAST PITTSBURGH
Bullard, Henry M. '26 C
Burt, Fred R. '16 E
Brown, Louis M. '16 E
Farmer, Herbert F. '27 E
Gibson, Charles B. '05 E
Gibson, Robert '27 E
Goss, Harold R. '20 E
Hanft, Hugh '25 E
Jones, Richard '26 E
Kaplan, Eugene V. '10 M
McEwen, Alexander '25 E
May, Darwin R. '14 ChE
Monseth, Ingwald T. '24 E
Nelson, Carl C. '25 E
Schweppe, Walter A. '26 E, '28 MS
ERIE
Cass, Hoyt R. '24 E
Parsons, Sidney A. '25 E
Rath, Harvey C. '23 E
Sturtevant, Percy G. '08 E
ESSINGTON
Powell, Knox A. '20 M
GALLITZIN
Dever, Francis A. '22 C
HARRISBURG
Morse, George H. '93 E, '11 EE
LANDISBURG
Gerlach, Arthur C. '17 M
LESTER
Burwell, Loring D. '07 M
NEW CASTLE
Taylor, Carl A. '10 Ch
NEW KENSINGTON
Edwards, Junius D. '12 ChE
Frary, Francis C. '05AC
Heath, Arthur C. '25 M
Pippel, Herbert A. '20 Ch
Taylor, Cyril S. '13 Ch
Weber, Ludwig J. '20 ChE
PALMERTON
McMillen, E. L. '23 ChE, '27 MS
PHILADELPHIA
Childs, John C. '06 C
Cross, Roland E. '23 M
Dunnum, Orney E. '22 E
Fairchild, Albert R. '07 E
Hunt, Gates E. '20 E
Irwin, Vincent H. '13 E, '14 EE
Lowe, John M. '08 Ch
Manuel, Douglas R. '22 ChE
Nelson, Carl H. '10 E
O'Brien, Raymond J. '11 E
Pearson, Charles W. '21 E
Peterson, Harold L. '16 C, '17 CE
Roberts, Wesley J. '21 ChE
Sartell, Page M. '24 M
Sime, Theodore L. '23 A
Von Rohr, Herbert H. '21 M
Young, Charles N. '12 E
PITTSBURGH
Blackmore, Frank E. '28 M
Bleifuss, Donald '20 C
Burris, Arthur '28 E
Dahl, Hjalmer A. '22 E
Gemmell, Robert W. '26 E
Joesting, Frederick D. '26 E
Le Vesconte, L. B. '18 E
McCrea, John A. '28 E
Rosenthal, Oscar '19 C
Satori, Roy H. '21 E
Selvig, Walter A. '09 Ch
Souther, Benjamin L. '16 Ch
Swanson, Carl E. '28 E
Towle, Neal C. '12 E, '13 EE
Willard, Arthur C. '22 E
POTTSTOWN
Williams, Edward H. '03 M
SCRANTON
Eberhardt, Otto E. '03 E
SHARON
Dahl, Paul '28 E
Hovey, Betram K. '27 E
Steinert, Emil '25 E
Wentz, Edward C. '26 E
STATE COLLEGE
Nortner, Sylvester E. '16 C
McConnell, Edmond S. '24 E
WILKINSBURG
Enger, Arne '22 E
Johnson, Douglas O. '28 E
Johnson, Sheldon '28 E
Koch, Winfield '25 E
Wilson, Abner W. '22 E
WILLIAMSPORT
Briggs, Luard E. '27 C
WILMERDING
Anderson, Wesley J. '26 M
Holmes, Roland W. '25 M

RHODE ISLAND

PROVIDENCE
Tappan, Ruth W. '22 Ch
(Mrs. Joseph Dowling)
ROCKY POINT
McKesson, Lewis J. '27 E
WEST BARRINGTON
Lewis, John G. '24 E

SOUTH DAKOTA

ABERDEEN
Odegaard, Harold T. '20 M
BROOKINGS
Mark, Reuben A. '11 C
Mark, Walter J. '09 M
Reed, Henry R. '25 E, EE '27
HOT SPRINGS
Adler, Eugene H. '14 E, '15 EE
LIGHT CAP
Blake, Henry B. '01 E
MITCHELL
Miller, Ralph Harrison '13 Ch
RAPID CITY
Dimmick, Merton A. '26 C
Heywood, Geo. L. '28 E
SIOUX FALLS
Boyce, Leonard F. '12 M
Countryman, M. Alden '25 M
Hult, George A. '16 E
Ransom, Ralph W. '23 M
Robertson, Kenefick '25 E
Tucker, Carl W. '26 M
TIMBER LAKE
Thwing, Geo. '28C
WATERTOWN
Brown, Harry E. '22 G

SOUTH CAROLINA

CHARLESTON
James Grant '07 C

TENNESSEE

BRISTOL
Butterworth, Russell I. '16 E, '17 EE
CHATTANOOGA
Irwin, Frank H. '16 E, '17 EE
Knox, Chas. '28 C
Withee, Warren '15 C
COPPERHILL
Longworth, Fred James '05 A. C.
MEMPHIS
Nichols, Browning, Jr. '10 M
Slocumb, Mary G. '25 ID
(Mrs. Lawrence Tvedt)
Tvedt, Lawrence A. '24 AE
NASHVILLE
Bunnell, Chas. W. '26 C
Hansen, Arthur A. '25 C
Schultz, Alex A. '26 C

TEXAS

AMARILLO
Bolnuk, Harry W. '27
Wannamaker, Homer '26 C
AUSTIN
Ferguson, Geo. '28 C
Helwig, Wm. F. '23 E
BEAUMONT
Bernhagen, Lewis O. '06 A. C.
BROWNSVILLE
Sherwood, Edward B. '20 C
DALLAS
Chestnut, Geo. L. '97 E
Dahl, George '21 B. S. (Arch)
Fernald, Frank O. '04 C
Hilgedick, Winfred '26 E
Magnuson, John E. '22 E
Rounds, Fred M. '95 E
Smith, Donald T. '05 C
FT. WORTH
Zeidlick, Wm. J. '25 ChE
HARLINGEN
Henry, Burt C. '21 C
HOUSTON
Downing, Frank E. '04 C
Crane, Fremont '86 BS, '87 BCE, '98 CE
LUBBOCK
Tuve, Geo. S. '20 M, '21 ME
Klemschmidt, Floren A. '20 A
MT. PLEASANT
Bakke, Oliver M. '03 Ch
NEW BEAUNFELS
Robison, Archer R. '09 E
ODESSA
Fortune, Harry G. '20 M
PAMPA
Wolfe, George E. '24 E
PORT ARTHUR
Ast, Roland E. '22C

UTAH

SALT LAKE CITY
Ashworth, Roy H. '11 E
Beyer, Theodore A. '03 C
Jones, Watkin W. '11 E
Ringwood, James B. '28 C

VERMONT

ST. JOHNSBURY
Stillman, Marcus H. '09 E

VIRGINIA

FORT HUMPHREY
Luplow, Walter D. '17 C
HAMPTON ROADS
Campbell, Douglas M. '27 C
Joachim, Wm. F. '20 M, '21 ME
HOPEWELL
Smith, Allen S. '26 ChE
JACKSONVILLE
Furber, Pierce P., Jr. '08 C
NEWPORT
Holmstine, Arthur G. '17 M
ROANOKE
Fahland, Frank, Jr. '22 M

WASHINGTON

CENTRALIA
Smith, Leighton '03 C
EASTON
Pearson, Harold T. '27 C
EVERETT
Beaulieu, Richard L. '02 C
KELSO
Phelps, Ray R. '10 E
LONGVIEW
Hetherton, Percival '08 M
Smith, Hugh A. '18 E
NORTHPORT
Wells, Percy '28 Ch
NO. YAKIMA
Gilman, Nicholas A. '07 M
OROVILLE
Norelius, Emil F. '08 M
Norelius, Lewis M. '06 C
PARK WATER
Blake, Robt. P. '97 M
PASCA
Acker, Sidney H. '23 M
PUGET SOUND
Benedict, Geo. F. '03 E
PULLMAN
Levine, Arthur '23 PhD
SEATTLE
Bennett, Walter J. '03 C
Bowen, Fred P. '06 C
Bushnell, Chas. S. '78 M
Curtiss, Lindsley B. '09 G
Durham, Samuel W. '17 Ch
Gillman, Hyam '25 Ch
Grimshaw, William E. '02 M
Guthrie, J. De Mott '93 E
Hayward, George I. '06 C
Hillman, Chas. K. '12 E
Hoffman, Ralph M. '11 Sc. & Tech.
James, Henry C. '11 E
Linton, James H. '97 ChE
Lumm, Gordon '25 A
McKenzie, Lauren F. '09 E
Magnusson, Carl F. '96 E, '97 MS, '05 EE
Markhus, Olaf G. F. '97 E
Pearce, John Henry '07 E
Petrick, Alfred C. '19 C
Quense, John '01 C, '02 ME
Ringstrom, Hugo '15 Ch, '17Ch
Schow, William P. '07 E
Shuck, Gordon R. '06 E
Silliman, Henry D. '97 M
Steinberg, Carl '07 E
Weber, Erwin L. F. '06 E, '08 ME
Wesbrook, Donald McD. '10 M
Westberg, Russell E. '20 E
SPOKANE
Adams, Elmer E. '06 CE
Alton, Herbert D. '07 E
Bostwick, Ross D. '23 ChE
Wiesner, Frederick E. '06 C
TACOMA
Peters, William G. '83 C

WEST VIRGINIA

CHARLESTON
Giltinan, David M. '15 M, '16 ME
Kester, E. B. '22 Ch, '23 MS
FAIRMONT
Schoepf, Alfred W. '08 E
HUNTINGTON
Cornell, Geo. '25
MORGANTOWN
Amidon, Lee L. '23 M
Gill, James H. '92 M, '94 ME
QUANTICO
Strong, Frank D. '17 ChE
WHEELING
Root, Frank R. '24 AE

WISCONSIN

APPLETON
Lewenstein, Abraham '26 ChE
Poppe, Frederick W. '11 Ch
BELOIT
Cole, Ernest C. '26 M
Tuttle, Stanley B. '24 M
BRUCE
Brownell, Edward '26 C
Buhr, Leo '23 C
CHATEK
Weston, Wm. S. '02 C
CHIPPEWA FALLS
Berdan, Hubert J. '22 C
Gray, Seymour R. '22 C, '23 CE
Vaudreuil, Lionel '25 AE
EAU CLAIRE
Bergford, John '28 C
Cotton, Ernest H. '19 E
Dow, Clarence A. '13 E, '14 EE
Fairbanks, Geo. W. '23 E

EAU CLAIRE
Frahm, Alfred R. '08 E
Holm, Edwin R. '20 C
McMillan, James S. '22 E
Meyer, Claire F. '10 C
Monsen, Manley A. B. '24 E
FOND DU LAC
Nimmer, Walter B. '26 E
GRANTSBURG
Nelson, Martin E. '24 C
GREEN BAY
Hartney, James L. '14 M, '15 ME
HURLEY
Ost, Roland E. '22 C
KIMBERLY
Lande, Clarence C. '27 C
LA CROSSE
Bergsland, Grant C. '23 M
Nordstrom, Ernest A. '22 M
MADISON
Bray, Mark W. '14 Ch
Daniels, Farrington '10 Ch
Hubbard, Robert T. '06 E
Knudsen, Esther M. '25 C
Larson, Ludvig C. '21 E, '23 EE
Luxford, Ronald F. '17 C
Nystrom, Paul E. '24A
Reiter, Alfred A. '25 ChE
Turrittin, Hugh L. '27 C
MANITOWOC
Olson, Arthur L. '24 M
MARINETTE
Hornibrook, James W. '09 E
MENOMONIE
Mitchell, Ralph W. '12 Ch
MILWAUKEE
Albrecht, George M. '06 E
Bauer, Roscoe W. '24 C
Brimeyer, Ferdinand J. '25 AE
Brown, Glendon '28 E
Chapin, Harold S. '12 M, '13 ME
Clark, Fred '27E
Cooke, J. M. '28 E
Epstein, Hymen '21 Ch
Hansen, Maurice J. '11 E
Hemsey, Clayton E. '22 M
Johnson, Elving L. '23 E
Johnson, Herman R. '09 E
Kendall, Walter '25 A
Larson, Louis J. '14C, '15 CE
Lundsten, Frank R. '27 C
Mahachek, Ross F. '26 E
Moffat, Harold A. '27 ChE
Newman, John M. '23 E
Norman, Henry R. '27 C
Ohman, George U. '26 C
Papenthien, Roy O. '21 G
Peterson, Laurence L. '25 M
Peterson, Peter I. '20 E
Potter, Robert P. '26 A
Preus, Christian K. '27 C
Price, Clarence R. '20 E
Reed, Albert I. '85 C
Roberts, Earl H. '15 M, '16 ME
Roberts, Norman A. '26 M
Schulze, LeRoy E. '27E
Sesseng, Gunnar '24 M
Skrukrud, Odean M. '25 C
Sutherland, Samuel J. '23 AE
Thomas, W. Alan '24 M
Tyvand, James A. '24 E
Williams, Wilbur S. '09 M
NEENAH
Erickson, Edwin C. O. "22 C
Palmer, Howard B. '22 C
OCONOMOWAC
Plank, Howard G. '22 E
RACINE
Rood, Arnold E. '22 E
SHELL LAKE
Cameron, Harry D. '25 E
SPOONER
Putz, John H. '14 BS, '15 EE
STEVENS POINT
Hammond, Kathryn D. (Kelley) '22 Ch
SUPERIOR
Scobie, Francis G. '08 E
WAUSAU
Mills, Hartzell '25 M
WAUWATOSA
Cross, Chas. H. '97 M
WEST ALLIS
Foltz, Ross Melton '19 M
Smart, George A. '16 M
WEST SALEM
Sprehn, George H. '24 C

WYOMING

CASPER
Fulton, Edw. G. '25 C
SHELL
Rosing, Donald C. '27 C
SHERIDAN
Pearson, Geo. '28 AE
YELLOWSTONE PARK
Lindelef, Charles '09 E

AFRICA

NORTHERN RHODESIA
Powell, Louis H.

ALASKA

ALASKA
Aslakson, Carl I. '23 C
VALDEZ
Smith, Byron E. '07 E

CANADA

EDMONTON
Morris, Robert '05 E
FT. FRANCES, ONT.
Hoss, Paul O. '26 M
Laurence, Paul A. '12 G
MACOUN, SASK.
Towey, James M. '28 E
MONTREAL
Adams, Wm. C. '05 C
Beyer, Randell '27 E
Spence, William J. '02 E
PORT ARTHUR
Souba, William H. '09 M
PORT COLBURN
Kepner, Ben-Hur '11 Ch
ST. CATHARINES
Noel, Clay W. '20 E
TEDFORD MINE, QUEBEC
Johnson, Ray V.
TORONTO
Anderson, Oscar V. '10 E
WEYBURN, SASK.
Casberg, James W. '08 E
WINNIPEG
Borrowman, Leroy F. '08 C
Brown, Geo. J. '08 E
Schumacher, John H. '03 E

CHINA

PEKING
Lin, Shu Ming '20 A
Loo, Pank Chuk '28 AE
TIENTSIN
Eliassen, Sigurd '18 C

CUBA

HAVANA
Romero, Cirilo L. '17 M, '18 ME
GUANTANAMO BAY
Marcroft, Harold C. '24 E
Marcroft, John '27 C

ENGLAND

FELSTEAD, ESSEX
Tronson, Carl A. '10 Ch

HAWAII

FT. KAMEHAMEHA
Solomonson, L. D. '25 E
FORT SHAFTER, HONOLULU
Scott, Willard W. '17 E
HONOLULU
Nelson, Geo. A. '25 C
SCHOFIELD BARRACKS
Coe, Edward H. '19 C
Parkhurst, Harleigh '00 E

INDIA

BENGAL
Dewaji, Gunaker '26 M
BOMBAY
Shellenberger, Hiram R. '20 M

MEXICO

ALBUQUERQUE
Luce, Alex. W. '21 M, '23 ME
GUADALAJARA
Burt, John L. '90 C

PHILIPPINE ISLANDS

BAY, LAGUNA
Galvez, Nicolas L. '25 Ch
CAVITE
Cox, Richard F. '08 M
MALABON, RIZAL
Roque, Feliciano T. '24 ChE
SAN JUAN
Mattison, Geo. C. '11 C

SOUTH AMERICA

Brazil

RIO DE JANEIRO
Thompson, Herbert L. '12 M
Nogueira, Frederic P. '28 E

Chile

CHUQUICAMATA, CHILE
Carlson, C. Philip '21 E
Knowles, Everett H. '20 E
TOCOPILLA
Carlson, Victor H. '20 E
Maine, Basil '21 E

Venezuela

MARACAIBO
Gerdes, Carl H. '25 B. S. (C. E.)

TURKEY

CONSTANTINOPLE
Fulmer, Jervis M. '22 Ch

School of Mines and Metallurgy

ALABAMA

BESSEMER
Morgan, Charles '06 E.M.
BIRMINGHAM
Cowin, Percy G. '18 E.M.
TUSCALOOSA
Gandrud, Bennie W. '21 E.M.
UNIVERSITY
Lee, Oscar '16 E.M.

ARIZONA

AJO
Olmstead, John S. '08 E.M.
Sodoma, Joseph L. '25 Met. E.
BISBEE
Smith, Franklin W. '03 E.M.
Ziesemer, Harry M. '07 E.M.
CALUMET
Rait, Donald M. '03 E.M.
CASA GRANDE
Chandler, Eugene D. '00 E.M.
CLARKSDALE
Ekloff, Victor E. '11 E.M.
INSPIRATION
Donaghue, Abner J. '20 E.M.
JEROME
Bloom, John R. '27 E. M. Geol.
Hansen, Mayer G. '22 E.M.
Hondrum, Olaf '13 E.M.
MIAMI
McDermid, Archie J. '16 E.M.
Robertson, John H. '14 E.M.
MORENCI
Beck, Charles S. '11 E.M.
Becker, George '97 E.M.
RAY
Aanes, Ole O. '27 E.M.
Hewitt, Ezra '12 E.M.
Truesdale, Wm. H. '03 E.M.
WARREN
Brace, H. L. '28 E.M.
Lindholm, Milton S. '11 E.M.
Smith, Hoval A. '01 E.M.
Whiteley, Eugene E. '03 E.M.

CALIFORNIA

BELLFLOWER
Bowman, Frank A. '04 E.M.
BERKELEY
Bjorge, Guy N. '12 E.M.
BEVERLY HILLS
Boyd, Robert R. '05 E.M.
GLENDALE
Gillan, Silas L. '07 E.M.
Hunt, Walter E. '00 E.M.
GRAFTON
Crowley, Jay '09 E.M.
LODI
Cullyford, James A. '08 E.M.
LONG BEACH
Wallace, C. S. '17 E.M.
Ziesemer, Ralph A. '05 E.M.
LOS ANGELES
Ainsworth, Robert E. '20 E.M.
Armstrong, Harold K. '18 E.M.
Arnold, Lewis E. '20 E.M.
Bass, William C. '99 E.M.
Clark, Fred E. '20 E.M.
Collins, Leon T. '15 E.M.
Friedl, A. '23 E.M.Geol.
Gulick, Hervey '05 E.M.
Henkel, Howard L. '23 E.M.
Jerrard, Walther L. '18 E.M.
Lea, John '12 E.M.
McIntosh, Joseph B. '98 E.M.
Ofsthun, Norman '13 E.M.
Olund, Henning E. '07 E.M.
Patton, Richard C. '22 E.M.
Smith, E. W. '07 E.M.
OAKLAND
Walker, Clinton L. '98 E.M.
Wallace, George W. '06 E.M.
OCEAN PARK
Curry, Duncan E. '05 E.M.
PASADENA
Clapp, W. Howard '01 E.M.
PORTERVILLE
Perry, Joe B. '12 E.M.
RIO OSO
Taresh, John '01 E.M.
RIVERSIDE
Prouty, Roswell W. '12 E.M.
SACRAMENTO
Mills, Eugene C. '97 E.M.
SAN BERNARDINO
Stewart, G. G. '10 E.M.
SAN DIEGO
Holden, Henry H. '03 Met.E.
Kersten, Erwin H. '20 E.M.
SIERRA CITY
Lytzen, W. W. '05 E.M.
SUTTER CREEK
Nichols, Clifford R. '20 E.M.
YANKE, JIMS
Bailey, Paul T. '11 E.M.

COLORADO

DEER TRAIL
Woodis, Clark N. '12 E.M.
DENVER
Sanderson, Henry S. '01 Met.E.
GILMAN
Brunner, Donald G. '24 E.M.
Tousley, R. M. '28 E.M.Geol.
SMUGGLER
Peterson, Joseph S. '08 E.M.

DISTRICT OF COLUMBIA

WASHINGTON
Dowdell, Ralph L. '18 Met. E.
Erdmann, Charles E. '23 E.M.
Grimes, John A. '08 E.M.
Harrington, Guy P. '06 E.M.
Hoass, Ole G. '08 E.M.
Leonard, Forest M. '10 E.M.
Lovering, Thos. S. '22 E.M.Geol.
Rawson, H. C. '06 E.M.
Ridgeway, Robert H. '23 E.M.

IDAHO

CONDA
O'Brien, J. Charles '12 E.M.
WALLACE
Merriam, Robert S. '05 E.M.
Shonts, Sydney L. '04 E.M.

ILLINOIS

CHICAGO
Baker, Emory P. '11 E.M.
Bodal, Emil K. '26 E.M.
Coolidge, Marshall H. '27 E.M.
Deringer, Paul J. '27 Met.E.
Hamernik, F. J. '21 Met.E.
Harmon, Benjamin G. '10 E.M.
Hutchinson, Bernard C. '24 E.M.
Johnson, Alfred M. '26 E.M.
Keller, Orin '05 E.M.

CHICAGO
Lundquist, O. W. '23 E.M.
McKenzie, James R. '10 E.M.
Nelson, Evald V. '27 E. M.
Newell, J. R. '10 E.M.
Smith, Elmo V. '01 Met.E.
Thoeni, Victor T. '22 E.M.
Wasson, Harold J. '14 E.M.
Winter, Harry '25 Met.E.
CHICAGO HEIGHTS
Scheid, Adolph J. '23 Met.E.
LASALLE
Holler, Frederick W. '10 E.M.
Neustadt, Berthold R. '06 E.M.
PEORIA
Wrbitzky, Harry M. '23 E.M.

INDIANA

GARY
Mooney, Frank E. '23 Met.E.
LAFAYETTE
Gow, James T. '27 Met.E.
VINCENNES
Adams, E. Maurice '22 E.M.

IOWA

AMES
Clement, Lester L. '06 E.M.
SIOUX CITY
Hoard, Harold J. '03 E.M.
WATERLOO
Locke, Alfred M. '08 E.M.

KANSAS

FORT RILEY
Wehr, Arthur J. '11 E.M.
WICHITA
Carlson, Edwin N. '21 E.M.

KENTUCKY

LEXINGTON
Crouse, Charles S. '11 E.M.
MEXICO
Johnston, Kenneth A. '21 E.M.

MARYLAND

EDGEWOOD ARSENAL
Nissen, Arvid '13 E.M.

MASSACHUSETTS

BROOKLINE
May, Albert E. '96 E.M.

MICHIGAN

CRYSTAL FALLS
Anderson, Edwin H. '17 E.M.
Christenson, Alfred '15 E.M.
DETROIT
Bodal, Emil K. '26 E.M.
HOUGHTON
Hamernik, Frank J. '21 Met.E.
RAMSAY
Eidemiller, Howard N. '14 E.M.
Foss, Adolph L. '23 E.M.

MINNESOTA

CHISHOLM
Borgeson, Anshelm C. '11 E.M.
Chang, Chi '23 E.M.
Duncan, K. J. '10 E.M.
Nord, Harry H. '16 E.M.
CROSBY
Fearing, Edward J. '17 E.M.
Mellem, Walter R. '19 E.M.
Thellin, Herbert E. '23 E.M.
DEERWOOD
Wenger, Frank B. '21 Met.E.
DETROIT
Teague, Harold W. '00 E.M.
DULUTH
Anundsen, Erling A. '28 E.M.
Dawson, L. W. '23 Met.E.
Farnam, Henry E. '10 E.M.
Field, Thorold F. '05 E.M.
Frank, Elden '21 E.M.
Gavin, Lawrence T. '09 E.M.
Gustafson, Arnold A. '22 E.M.
Jeffers, Gordon B. '23 E.M.
Oberg, Anton C. '07 E.M.
Peterson, Andrew Y. '99 E.M.
Peterson, Paul A. '17 Met.E.
Stevens, Howard E. '12 E.M.
Strane, A. J. '10 E.M.
Strong, John L. '08 E.M.
EASTON
Herring, William E. '10 E.M.
ELCOR
Anderson, Alfred T. '23 E.M.
Moe, Cecil J. '24 E.M.
ELK RIVER
Houlton, Lewis K. '04 E.M.
Johnson, Ralph C. '22 E.M.
ELY
Santo, Julius H. '09 E.M.
EVELETH
Boyle, Patrick J. '08 E.M.
Ely, Robert H. '13 E.M.
Johnson, Axel L. '20 E.M.
Kerr, Charles D. '15 E.M.
Kingston, Merton S. '04 E.M.
Moyle, Robert M. '27 E.M.
FARIBAULT
Gallagher, Luke J. '23 E.M.
GLENWOOD
Martin, Lynn '12 E.M.
HANSKA
Haugen, Albert C. '15 E.M.
HIBBING
Anderson, Walter C. '11 E.M.
Bassett, Robert H. '07 E.M.
Brandt, John '06 E.M.
Kurtzman, Paul S. '06 E.M.
Loye, Henry E. '05 E.M.
Sponberg, E. C. '21 E.M.
Taylor, William L. '12 E.M.
Vivian, Edgar W. '23 E.M.
IRONTON
Angst, Harry H. '05 E.M.
Deichen, William A. '08 E.M.
Plut, Frank J. '22 E.M.
LAKEFIELD
Buresch, Charles E. '17 E.M.
MINNEAPOLIS
Allard, Raymond W. '18 Met.E.
Ballord, John A. '24 E.M.
Chadbourn, Charles H. '21 E.M.
Christianson, Peter '94 E.M.
Cole, Willard A. '09 E.M.
Conkey, Charles R. '10 E.M.
Cowin, James '07 E.M.
Craig, John J. '16 E.M.
Devereux, Lawrence '10 E.M.
Durfee, John C. '27 Met.E.
Elliott, Jay R. '11 E.M.
Erck, E. H. '28 E.M.
Field, Edward M. '03 E.M.
Fixen, V. L. '11 E.M.
Forsyth, A. C. '24 Met.E.
Field, Edward M. '03 E.M.
Frellsen, Sidney A. '19 E.M.
Kilp, Raymond G. '22 E.M.
Kingsley, Neil S. '11 E.M.
Kremer, Edward G. '12 E.M.
Ladd, Greeley '13 E.M.
McHardy, Roy H. '16 E.M.
McKenzie, F. R. '22 E.M.
Mark, Israel '20 E.M.
Merritt, Lucien '04 E.M.
Moody, Revillo G. '10 E.M.
Potter, Orrin W. '14 E.M.
Roed, Olaf '07 E.M
Runke, Donald H. '25 Met.E.
Searles, John '23 E.M.
Sung, Kuo Hsiang '24 E.M.
Taylor, Harold G. '09 E.M.
Trengrove, S. A. '28 E.M.
Trulander, Wm. '25 E.M.
Wade, Henry H. '15 E.M.
Wheeler, Walter H. '06 E.M.
Wiest, Michael A. '07 E.M.
Wilson, J. Byron '22 E.M.
MINNEOTA
Hognason, George B. '09 E.M.
MONTEVIDEO
Michie, Roy G. '13 E.M.
NORTH HIBBING
Anderson, Oscar B. '22 E.M.
OLIVIA
Winter, William M. '23 E.M.
ST. PAUL
Abbott, Theodore S. '11 E.M.
Brawley, John N. '23 E.M.
Coller, Walter A. '15 E.M.
Drake, George M. '11 E.M.
Goldberg, Bert '19 E.M.
Harmon, Sydney '17 E.M.
Howes, Frank T. '06 E.M.
Johnson, Trygve '22 Met.E.
Lilly, Richard J. '23 E.M. (Geol.)
McAdams, H. R. '12 E.M.
Moga, John A. '18 E.M.
Neerland, Herman '15 E.M.
Olson, Walter S. '12 E.M.
Quinlan, Howard '14 E.M.
Raiter, Clifford R. '20 E.M.
Rood, Lynn '09 E.M.
Sjolinder, A. '23 E.M.
West, Herbert S. '21 Met.E.
Williams, Homer A. '09 E.M.
Wolfer, Donald H. '23 E.M.
SLAYTON
Minder, Emil G. '05 E.M.
SPRING VALLEY
Kendrick, William L. '25 E.M.
VIRGINIA
Erickson, Arthur C. '23 E.M.
Nelimark, John H. '24 E.M.
Sweetman, Edwin A. '17 E.M.
WILLMAR
Coventry, Edward D. '12 E.M.

MISSOURI

IRON MT.
Edwin, John '20 E.M.
ROLLA
DeVaney, Fred D. '23 E.M.
Gow, Alexander M. '23 E.M.
ST. LOUIS
Boeger, H. S. '28 Met.E.

MONTANA

ANACONDA
Jensen, Willard C. '24 E.M.
Ramsing, Fred C. '15 E.M.
BILLINGS
Davies, Fred A. '16 E.M.
Davies, Herman F. '21 E.M.Geol.
Stewart, James L. '24 E.M.
Walsh, R. P. '28 E.M.Geol.
BUTTE
Brenner, Walter W. '23 E.M.
Coady, Leo J. '13 E.M.
Haley, A. J. '25 E.M.
Rahilly, Harold J. '11 E.M.
Sherman, Howard P. '25 E.M.
Studer, Ralph J. '26 E.M.
Tanner, Wallace N. '96 E.M.
FAIRVIEW
Frank, Harry O. '20 E.M.
HELENA
Heidel, C. Sumner '10 E.M.
PHILLIPSBURG
Fritzberg, Ernest A. '10 E.M.

NEBRASKA

CRETE
Hawlick, Hartley H. '23 E.M.

NEVADA

COMSTOCK
Winther, Arno '03 E.M.
GOLDFIELD
Wilkinson, Charles D. '95 E.M.
GOLD HILL
Goodrich, Norman P. '10 E.M.
Tetlie, John R. '11 E.M.
KIMBERLY
Finberg, M. J. '28 Met.E.
LAS VEGAS
Toll, Rensselaer '00 E.M.
RENO
Schrader, Erick J. '05 E.M.
VIRGINIA CITY
Burgess, Robert J. '11 E.M.

NEW JERSEY

PHILLIPSBURG
Persons, R. W. '23 Met.E.

NEW MEXICO

HURLEY
Knox, LaFayette '21 E.M.
SANTA FE
McCarty, Andrew L. '04 E.M.
VALEDON
Dickson, Robert H. '12 E.M.

NEW YORK

ALBANY
Dinmore, Harry C. '23 E.M.
NEW YORK CITY
Butler, Roy G. '21 E.M.
Dennis, Richard C. '17 E.M
Hennen, Edward H. '25 E.M.
Keene, Amor F. '04 E.M.
Kennedy, John J. '08 E.M.
Larpenteur, Bernard J. '25 Met.E.
McRae, Randolph J. '07 E.M.
Persons, Robert W. '23 Met.E.
Queneau, Roland B. '23 Met.E.
Ravicz, Louis G. '14 E.M.
Swenson, Karl P. '07 E.M.
Walters, Charles W. '11 E.M.
NEW ROCHELLE
Wales, Roland T. '97 E.M.
NIAGARA FALLS
Woodruff, John J. '17 E.M.
PAINTED POST
Case, Leslie M. '24 E.M.
SCHENECTADY
Hoyt, Samuel L. '09 E.M.

NORTH DAKOTA

MANDAN
Olson, Walter S. '25 E.M.Geol.
Sylvester, Robert E. '27 E.M.

OHIO

CLEVELAND
Jerabek, Theophil E. '27 Met.E.
Rose, William A. '06 E.M.
Sowle, Lawrence K. '03 E.M.
LORAIN
Wiley, R. E. '26 Met.E.
MANSFIELD
Boreen, Milden S. '26 Met.E.
MARION
Johnson, Ralph L. '26 Met.E.
MASSILLON
Hebling, J. A. '28 Met.E.
MIDDLETOWN
Johnson, W. S. '28 Met.E.

OKLAHOMA

CARDIN
Winther, Arno '03 E.M.
MUSKOGEE
Larson, Clarence L. '10 E.M.
OKLAHOMA CITY
Edwards, Frank R. '08 E.M.
OKMULGEE
Levorsen, A. Irving '17 E.M.
PONCA CITY
Knutson, Clarence J. '24 E.M.
SEMINOLE
Walter, Rollie B. '12 E.M.
TULSA
Conhaim, Howard J. '23 E.M.
Elson, William H. '17 E.M.
Foley, Lyndon L. '18 E.M.Geol.
Giltinan, George M. '10 E.M.
Kamb, Hugo R. '25 E.M.Geol.
Williams, Paul S. '15 E.M.

OREGON

LINNTON
Larson, Ernest L. '14 E.M.
PORTLAND
Anderson, Joseph H. '11 E.M.

PENNSYLVANIA

BETHLEHEM
Huck, George M. '26 Met.E.
Johnson, George A. '25 Met.E.
Russell, Charles B. '23 E.M.
EAST PITTSBURGH
Krogh, Alvin T. '16 Met.E.
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Wilcox, Fred H. '23 E.M.
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FORT WORTH
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WINK
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WASHINGTON

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KELSO
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MONTESANO
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PULLMAN
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LaTendresse, H. E. '23 E.M.Geol.

Portuguese West Africa

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Middleton, John L. '23 E.M.

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Manitoba

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HAILEYBURY
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Heath, Clarence L. '10 E.M.
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Jackson, C. F. '07 E.M.

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Honduras

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SAN JUANCITO
Zanger, Eugene '21 E.M.

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Huang, Ta Heng '24 E.M.
MUKDEN, MANCHURIA
Hsieh, Chung '18 E.M.
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SHANGHAI
Kwong, Yih Kun '17 E.M.

CUBA

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Brackenbury, Cyril '98 E.M.

INDIA

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MEXICO

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McKay, Henry S. '05 E.M.
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Pixler, Everett T. '27 E.M. (Geol.)
RANQUAQUA
Hedlund, Wilmer '28 E.M.
COLOMBIA
Arnold, Lowell W. '27 E.M.
Olson, Walter S. '25 E.M. (Geol.)
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Probst, Elmer A. '07 E.M.
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QUIRIVILCA, VIA TRUJILLO
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Echebarria, Luis de U. '22 E.M.

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University of Minnesota

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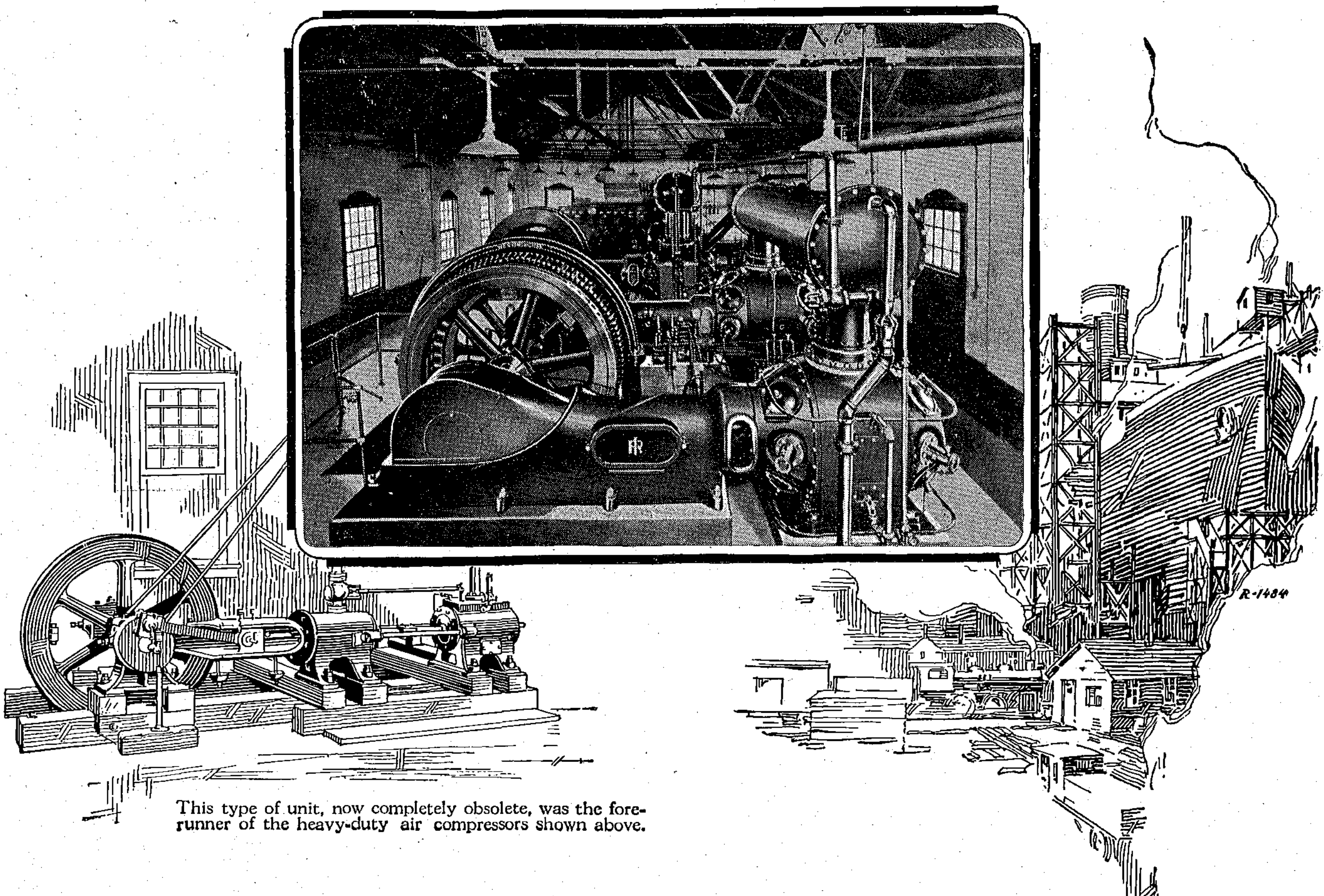

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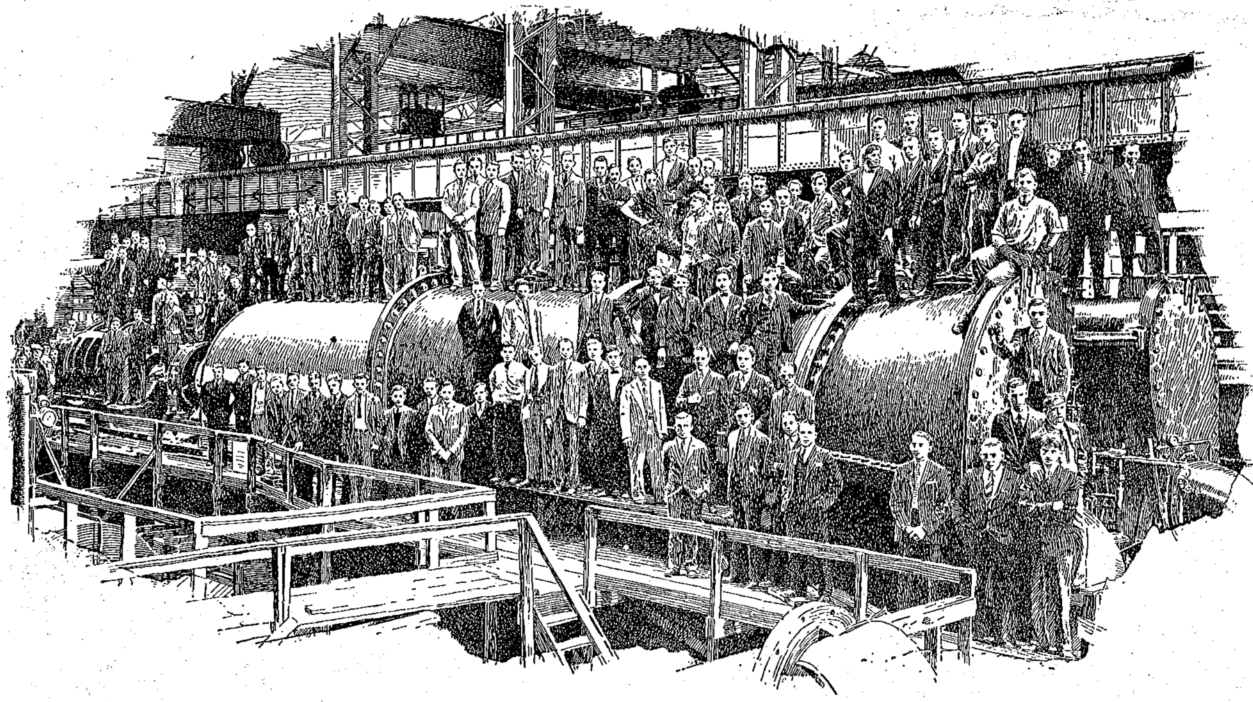

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