# THE MINNESOTA TECHNO-LOG

Vol. XII OCTOBER, 1931 No. 1

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THE UNIVERSITY OF MINNESOTA

THE MINNESOTA
# TECHNO-LOG
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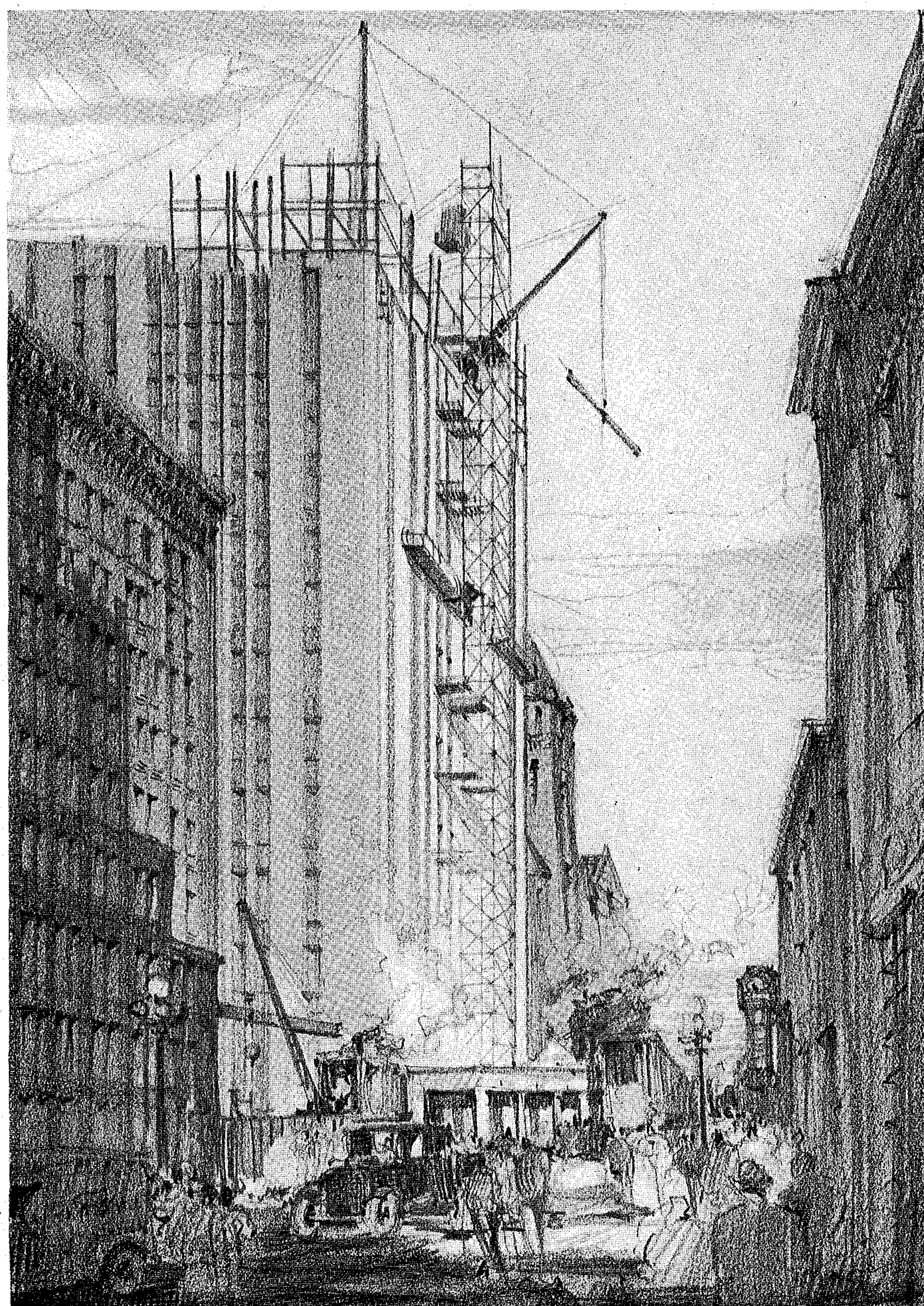

The New Telephone Building
from a Lithograph
by Robert Cerny

THE MINNESOTA TECHNO-LOG
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# the western Engineer Helps Japan Industrialize

By GEORGE GLOCKLER,
Associate Professor of Chemistry

THE rise of Japanese industry since the restoration of 1868 is often spoken of as one of the great modern miracles. A people isolated almost completely for centuries with no contact and intercourse with other nations had lived under a insular mediaevalism. It had developed its own methods of living, commerce, art, and government, tinged only by earlier contacts with its neighbors, the Chinese, who were the first teachers of the Japanese in matters of religion, art, and philosophy. After such intermittent contact the Japanese developed these in the course of their isolation, but they apparently originated little themselves but proved to be masters of adaptation, and in most endeavors it can be seen that they have learned from the Chinese and that they have learned well. As an example, their art, based on Chinese fundamentals, is no doubt on the highest plane and their ability to incorporate beauty into the common things of everyday life is one of their greatest achievements.

This nation led the life of an agricultural race in the middle of the nineteenth century, the main pursuit of the people being the acquisition of life's necessities. Government had developed into a feudal system of Lords who as Shoguns reigned over their principalities and who settled their individual differences by little wars and conflicts as has been the habit with humankind from time immemorial. The spirit of loyalty was developed in this society to the highest plane of perfection. The stories woven about the Samurai's complete devotion to his lord are the most remarkable documents of human character.

The Japanese family is based on the idea of obedience and even worship of parents by their children. It is seen that the Japanese have developed truly remarkable principles of conduct and relations in human affairs.

Industrialism as practiced by Western nations was completely unknown in this society. But in the short span of 50 years the Japanese attained third rank as a maritime power; they changed from an isolated nation to an industrial and commercial people. It truly appears as a miracle, when the slow and painful process of the progress of the Western industrial nations is considered who needed several hundred years to make this same change. How is this tremendous stride, this phenomenal progress to be understood? The nations of Europe and America had a very large and real part in the development of Japanese industry and commerce and the Japanese showed themselves most apt and enthusiastic pupils. There is of course no question but that educated Japanese gladly acknowledge the debt they owe the other nations and they show their appreciation in many and various ways. They know that the hundreds and thousands of foreign engineers who spent many years in Japan erecting plants and running them, until the Japanese personnel was trained to take them over, was one of the greatest factors in the success of the modern industrialization of their country. The courtesy and regard shown the foreign experts are always most remarkable and sincere, and the engineer or businessman who has had dealings with educated Japanese knows from his own experience that they are the most polite people on earth.

> *Japan started a program of modernizing her economic and political institutions something over half a century ago. The westernization of Japan started with this program.*
>
> *Since 1910 the movement has been given much impetus by outside factors, chief among them the World War. American engineers and American machinery and building materials have played a large part in westernizing Japan during this period.*
>
> *Mr. Glockler spent the years from 1916 to 1921 in Japan, during which time his connection with a company importing American machinery gave him ample opportunity to observe the American engineers at work.*
>
> —EDITOR.

The fact that most of the modern industries in Japan have been started by western nations is perhaps lost sight of by the people of these countries themselves. The western engineer has had a great deal to do with this pioneer work but of course his success was only possible because the Japanese people proved themselves so willing to change their mode of life in many fundamental aspects. The result was indeed remarkable.

Since the period of modernization is by no means closed it is possible to find the most modern methods of industry being adopted and yet the time honored ways of centuries are still the habit of the people. For example the methods of rice production are the ways the Japanese farmer has learned from his ancestors. It is naturally a wonder why such an important undertaking as farming has not been modernized to any extent. However, the method of cultivation of rice in small fields is necessary on account of the lack of suitable land and the process of irrigation makes the use of mechanical devices quite difficult. Most likely any other people under the same circumstances would have developed their agricultural methods along very similar lines.

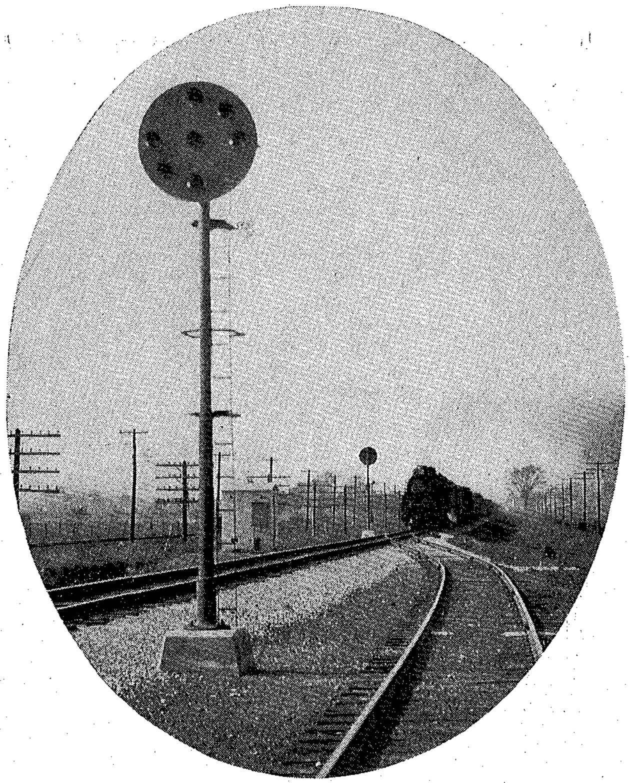
On the other hand, the transportation system of Japan has been developed in a remarkable manner and the railways cover the islands to such an extent that it is possible to reach all the important cities by rail as in any other modern country. The system is patterned after the railroads of western countries and is quite modern in every

(*Continued on page 22*)

# modern

# Railway Sigr

***Where will a railroad career lead a graduate engineer? E. R. Hamilton, E '28, offers a survey of the rapidly developing railroad signaling field. Mr. Hamilton is now associate editor of Railway Signaling.***



A POSITION-LIGHT SIDING SIGNAL IN THE CENTRALIZED TRAFFIC CONTROL TERRITORY OF THE PENNSYLVANIA

WHEN Horace Greeley made his stirring appeal to the young men of America, the call of our railroads to the engineering graduates of the time was an invitation to share in one of the greatest romances in America's history—the growth of a great transportation system. But what of today? What does a railroad career offer, now, to an engineer?

These are questions—questions that many an engineer has pondered over at some time or other in his undergraduate days. Questions that not a few engineers wish they had pondered over before they acted. As this is being written, thousands of senior engineering students are interviewing representatives of industry and making decisions that determine to a very great extent their future happiness. Perhaps some of these students, reading this, will find something that will enable them to choose—or accept—more wisely.

Veteran railroaders will tell you that railroading gets in your blood, that there is something about it that holds you. Notwithstanding the fact that this something is often nothing more nor less than physical or mental inertia, nevertheless one must acknowledge the fact that the railroads are today attracting a great many college men.

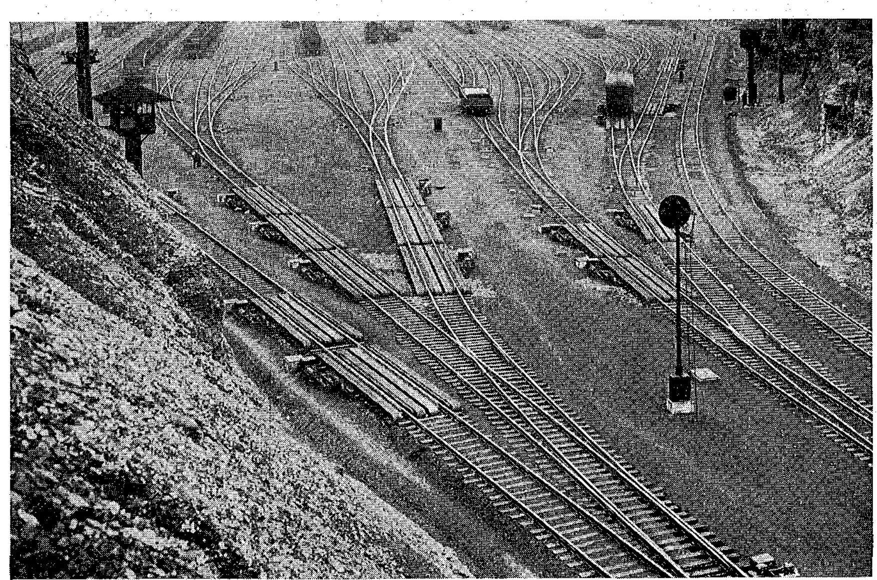
Practically every type of engineering is represented in a railroad company, and on the larger roads one will find a very definite line drawn between the different engineering departments. Civil engineers are probably in the majority, with mechanical engineers a close second, while electrical engineers will be found in both the electrical and the signal departments. It is this latter, signal department, around which I shall build most of this discussion.

### Scope of Railway Signaling

Briefly, railway signaling is the science of keeping trains moving safely. Not many years ago, railroad officers regarded an automatic block signal as a safety device, yes, but one which might at any time delay trains unnecessarily. Today, thanks to the rapid development of signal and track engineering, signaling devices—and this term embraces a great deal more than automatic block signals—are being applied extensively on railroads in all parts of the world, not only because of the safety they provide, but principally because they are one of the few things that the railroads can rely upon in cutting their operating expenses.

Signal engineering, as practiced on most railroads today, comprises the design, construction, operation and maintenance of block signals of all kinds: automatic train control systems and cab-signals, car retarder systems, centralized traffic control, interlocking plants and highway crossing signals. The design and construction of these systems is generally handled by a signal officer whose title is superintendent of signals or signal engineer, and who reports to either the chief engineer or the operating vice-president; while the signal maintenance force reports to the division superintendent.

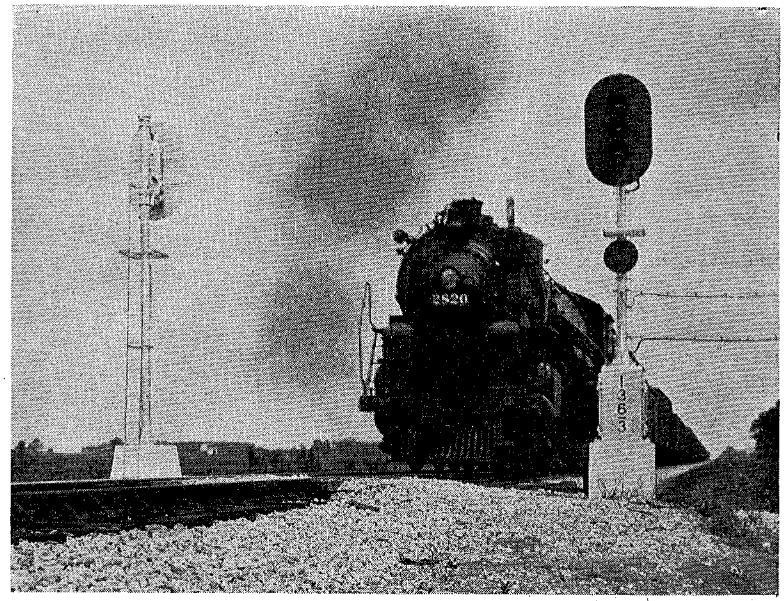
Many of our signal engineers today are men who have been educated in the University of Hard Knocks, men who started railroading with a shovel or wrench back in the days when a pipe-connected signal was an oddity and interlocking plants were looked upon with suspicion. The signal engineer of tomorrow will be a trained, experienced engineer, for signal engineering has de-



ELECTRO-PNEUMATIC CAR RETARDERS IN PITCAIRN YARD OF THE PENNSYLVANIA RAILROAD

# Engineering

## —a career



AUTOMATIC BLOCK SIGNALS WITH COLORED LIGHTS IN OPERATION ON THE WABASH

veloped into a highly specialized branch of electrical engineering.

We think first of block signals, in connection with railway signaling. Automatic block signals protect almost every main railroad line in America today, as well as many branch lines. The wayside signals which the passenger sees from the car window are daily rendering a service that is appreciated by only a few. Still fewer realize that, on thousands of miles of road, cab signaling and automatic train control make our railroad journeys immeasurably safer than any other means of transportation available.

### Automatic Train Control

Automatic train control systems were installed extensively on the Class I railroads in 1922-24, as a result of an order issued by the Interstate Commerce Commission, the intent of the order being to promote the development of such devices. It is doubtful if automatic train control has justified itself economically, while the psychological effect of dispensing with the human element is also of doubtful value. But the knowledge which has been gained through the development of automatic train control systems has opened the door to that more important field—cab signaling.

The reader is probably more or less familiar with the operation of wayside automatic block signals, but very few of us have had an opportunity to learn that several railroads are removing these wayside signals and are substituting cab signals, with or without automatic train control, in their place. The cab signal does everything that the wayside signal did—more—and does it better. It is ever present directly in front of the engineman, and, on some installations, in front of the fireman as well. Its aspect can not be lost or forgotten, and its operation is automatic almost to the point of being human.

### Centralized Traffic Control

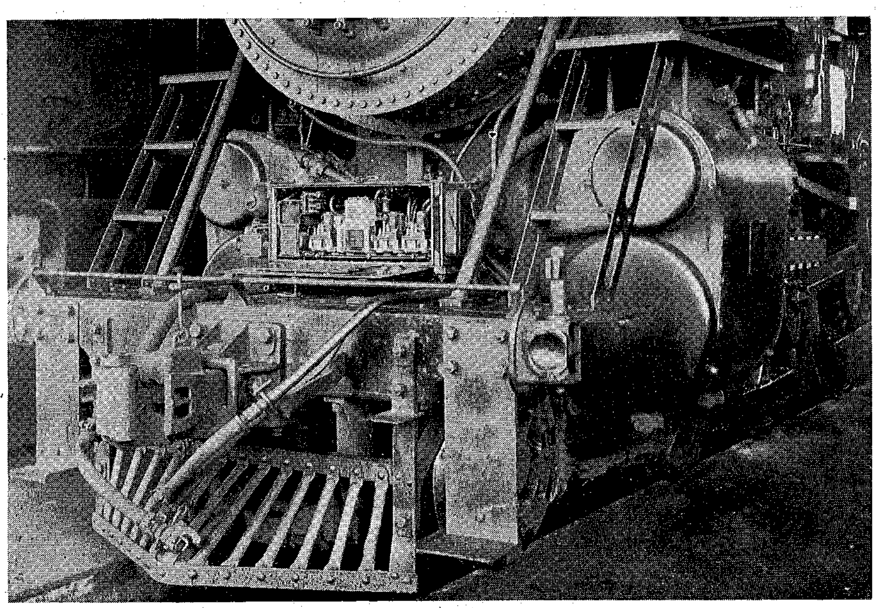
At the present time centralized traffic control is being installed extensively. The idea of operating trains by signal indication alone is not new, but the cost of such systems has, until recently, made their use prohibitive. In a centralized traffic control system, train-orders and time-table rights are dispensed with. All the switches and siding signals on an entire division can be placed under the control of one man. With complete information, regarding the location of all trains, present on the control panel of the control machine, the dispatcher can align the switches and set the signals for any train movement he desires. Delays and long waits are almost entirely eliminated, running time is reduced, fuel costs are lowered, operators' salaries are eliminated, and undue wear and tear on the rolling stock is lessened. The inquisitive engineer will be interested in the fact that only three small wires extending over the entire division are needed for the control and indication of all the switches and siding signals on that division.

During the last ten years far greater advancement has been made in the development of railway signal systems than during any preceding period. This has been due chiefly to the application of electricity. Mechanical interlocking plants are being replaced by electric or electro-pneumatic plants, power-operated car retarders are used for freight classification, the cumbersome mechanical locking in interlocking machines is being replaced by all-relay locking, and highway crossing signals are finally approaching something like a fair degree of standardization and legibility.

### Start "On the Line"

Probably a railroad career is not so lucrative as many other careers that a

(*Continued on page 19*)



THE UNCOVERED EQUIPMENT BOX OF A LOCOMOTIVE OPERATING IN CONTINUOUS CODED TRAIN-STOP TERRITORY

# "Is the Course in Engineering

## By O. S. ZELNER,

FOR the past several years, the College of Engineering and Architecture and the School of Chemistry of the University of Minnesota has had in operation a course designed to assist the engineering freshman in selecting the particular branch of the profession he thinks best suited to his particular abilities or tendencies.

It has been found by questionnaires distributed at the first session of the freshman class, that almost to a man, the newcomers have decided what they propose to do in the matter of the selection of their future work. It is also true, however, that not a large per cent of the class knows very clearly what each division offers in the way of work, living conditions, salaries, probabilities of advancement, etc., and for this latter reason the College conducts a series of lectures designed to assist these boys to a better understanding of the profession into which they are proposing to go.

The course at Minnesota is not new. My first memory of the forerunner of the present course dates back probably fifteen or more years. In those days, the course known as "Engineering Technology," instituted by Francis C. Shenehon, then Dean of the College, was in force.

This course sought to attain the desired result by use of inspection trips to various industries or construction jobs such as power plants for the embryo Electricals, railroad shops for Mechanicals, the (Ford) high dam or the Third Avenue bridge, both under construction at that time, for the Civils.

These inspection trips were supervised by men from the various faculties, and in order that the student be induced to pay proper attention to the instructional talks given by the man in charge of the trip, the local guide, or job superintendent, each one was required to write a rather complete report of the trip, citing the important points observed and giving a fair outline of the entire project.

These reports were read and graded for their engineering content, and then passed on to the department of engineering English where they were in turn graded as English themes. A fine bit of cooperation which might give a student a pair of good marks or something entirely different. At any rate the idea was all right and the freshmen prospered under the scheme for quite an extended period.

Those Technology trips with their resulting reports demonstrated clearly that a group of students, after seeing and hearing the important features of a construction job, would return to their rooms and write widely varying opinions about it. This fact was so apparent, that instructors often were at a loss to know whether the trips were bearing instructional fruit as they should. As an example of these varied, or peculiar results I shall cite two or three high lights as I remember them from my own experience. In explanation it should be said that, in preparing for these trips, it was customary to secure first hand information for our groups by arranging for lectures by the engineer in charge or some other competent person. The result was a sort of progressive lecture which was given as the squad was led over the job. These lectures were of great value, of course, but the results obtained certainly kept the written reports out of the realm of monotony.

### Dean, Freshman, Professor

*The Orientation Course serves to introduce the freshmen to various phases of their college life, but especially, it assists them in obtaining a general view of engineering to confirm their choice of a profession or to enable them more intelligently to choose the courses they desire.*—O. M. LELAND, *Dean of the College of Engineering and Architecture and the School of Chemistry.*

*For those freshmen entering engineering who have little or no idea of the course they wish to follow, I think orientation is of value in aiding them to select that course for which they are best suited. Moreover, for those who have decided, orientation presents the nature of their future relationships with engineers.*—RUSSELL A. BAKER, *Freshman President.*

*I believe that the orientation course is worthwhile, but I believe that it could be made more valuable by expanding it and giving credit for it. The introduction of economies in other freshman courses would allow this to be done.*—PROFESSOR FREDERIC BASS, *Head of Civil Engineering Department.*

As examples: The engineer on the High Dam pointed out that the "fishway" or "fish-ladder," usually required by law, was purposely omitted as the fish could travel up or down stream with the passage of boats through the ship lock. One student reported that a "fish-ladder" would not be necessary after the power plant was built, as the fish could pass up or down stream through the turbines.

On the Third Avenue bridge construction job, the engineer in charge had all of my party carried out to the piers in mid-stream in the concrete bucket which travelled over the job on the high cable-way. He very clearly and carefully outlined the apparent difficulties encountered in laying out a suitable triangulation system necessary to the accurate location of piers, etc., and indicated that the principal trouble was in finding a suitable place for chaining a usable base line from which to compute the triangulation system. He also had all of the small group let down into the coffer-dams so that there could be no possible misunderstanding as to the methods of pier construction.

That engineer was very much surprised when he saw some of the ideas resulting from his instruction.

One student wrote as follows about the "Base Line"—"The engineers had a very hard time finding a good base line, but they finally found one up near the pumping station and brought it down to Third Avenue where they could use it."

Another student, after having wandered around inside the pier coffer-dams produced the following as his conception of the pier construction: "The construction of the piers is a very hard job because of the deep and swift water, so the engineers decided to build the concrete piers up stream and float them down into position."

The above digression has been made to point to the fact that serious efforts have been made in the past to bring to our freshmen a clearer vision of the branches of engineering, and to indicate that not all results are satisfactory, regardless of the effort made to submit the lessons in the most concrete form.

During the past few years, under the guidance of Dean Leland, the course has been presented with the purpose in mind of picturing to the freshman class the various fields of engineering by means of lectures given by department heads or by men selected by them. As the course is now administered, it is given for one and a half quarters without credit, the only requirement from the student being that he must be in his assigned place for all lectures. Whether he pays attention or not depends on the lecturer as well as the student. Some

# Orientation Worth While?"

**In Charge of the Course in Eng. Orientation**

students apparently would pay no attention to any lecture, be it ever so fine. However, that type is in the minority, decidedly. It is my belief after considerable observation, that not to exceed five per cent is inattentive. It should be noted also, that that same five per cent is inattentive most of the time.

The course in Orientation has also made it possible for a wider service to the freshman than merely an orientation in engineering. The average freshman knows but little of the University, despite the good work of Freshman Week, and until the last two years a great portion of the available time was given over to helping the student acclimatize himself in the University community. Under the present plan of an All-University Orientation course, engineering freshmen do not report for Engineering Orientation until about the middle of the Fall Quarter.

The course this year was outlined as follows:

### Fall Quarter

First Session, Nov. 16. "Outline of Course," O. S. Zelner, and "Three Mental Attitudes of Freshmen Students," by Dean E. E. Nicholson.

Second Session—"The History and Purpose of the Student Work Committee," by Prof. R. W. French.

Third Session — "How to Make Profitable Use of Your Time," by Prof. F. S. Beers, Psychology.

Fourth Session—"Fifty Years of the University of Minnesota" with analysis of the relation of the College to the University, by E. B. Pierce, Secretary of the General Alumni Association.

### Winter Quarter

First Session—"The job of the Agricultural Engineer," by Prof. H. B. Roe, Prof. of Agric. Engineering.

Second Session—"Business Training for the Engineer," by R. A. Stevenson, Dean of Business Administration.

Third Session — "Architecture and Architectural Engineering," by Prof. F. M. Mann, Head of the Department of Architecture.

Fourth Session—"What Is Chemical Engineering," by Prof. Chas. Mann, Chief of the Department of Chem. Engineering.

**Results of Orientation Questionnaire**

| | Same | Changed to other course in Eng. | Changed to from other courses in Engineering | To change to another College |
|---|---|---|---|---|
| Arch. | 24 | 1 | 3 | 2 |
| Arch. E. | 16 | 5 | 1 | 0 |
| Aero. | 71 | 5 | 2 | 2 |
| Agri. | 6 | 0 | 0 | 0 |
| C. E. | 42 | 2 | 10 | 1 |
| E. E. | 91 | 5 | 1 | 1 |
| M. E. | 49 | 3 | 2 | 1 |
| Pre-B. | 8 | 1 | 3 | 1 |
| Total | 307 | 22 | 22 | 8 |

Grand Total, 337
Undecided, 2

Fifth Session—"The Mechanical Engineer and His Job," by Prof. John R. Du Priest, Head of the Department of Mech. Engineering.

Sixth Session — "Civil Engineering and Its Branches" by Prof. F. H. Bass.

Seventh Session—"What Is Aeronautical Engineering," by Prof. John D. Akerman, Head of the Department of Aero. Engineering.

Eighth Session—"What the Electrical Engineer Does," by Prof. John M. Bryant, Head of the Department of Elec. Engineering.

Ninth and Last Session—Closing lecture by Dean O. M. Leland. A general outline of the engineering field, with advice to the class on scholarship, behavior, honors, etc.

Whether the above series of lectures influence students greatly in making their decisions, is problematical. They never have been asked definitely about it.

The appended record of changes, as determined by a questionnaire circulated at the final session this year, is interesting. It is my belief that most of the changes were made because of the better understanding the student had of the various branches.

In any case, it is a safe guess that given any two or three men of the Engineering Faculty, an argument can be started by asking them if the course in Engineering Orientation is worth while, assuming, of course, that they are interested.

Furthermore, some of the strongest arguments against the course as it exists, would be made by men who have never attended a session of the class or who have never in any other way attempted to learn what material is presented.

The most frequent suggestions are about as follows:

1—Make the course much more extended and require a written report from every student on every lecture. Give credit.

2—Keep the course as it is, but make it elective.

3—Keep the course as it is, but make it a required course with credit.

4—Make the course exclusively technical.

5—Keep the course as it is, without credit, but require a report.

What I do hope is that constructive criticism may come of this small effort, and it should, as every faculty man and student should have some definite idea and some definite interest in the one course that brings our entire freshman class together for an hour each week.

The opportunity for doing good is certainly there, and I believe the Dean has expressed the case clearly when he says, "If but five or ten men of the class can be definitely helped, our efforts will be well repaid."

# engineers Help Orient Frosh of 1931

By RALPH BACHMAN, A '33

STUDENTS in the college of Engineering and Architecture have aided materially in welcoming the class of '35 to the University of Minnesota campus. Working throughout the summer vacation on plans for Freshman week under the surveillance of Philip Neville, mid law student and Freshman week chairman, and Willis Smith, assistant chairman, they have organized the necessary work and carried out the details to make the reception the most successful ever attempted here. Smith, a senior in the school of mechanical engineering, was the choice of the all-University council for the position of assistant chairman.

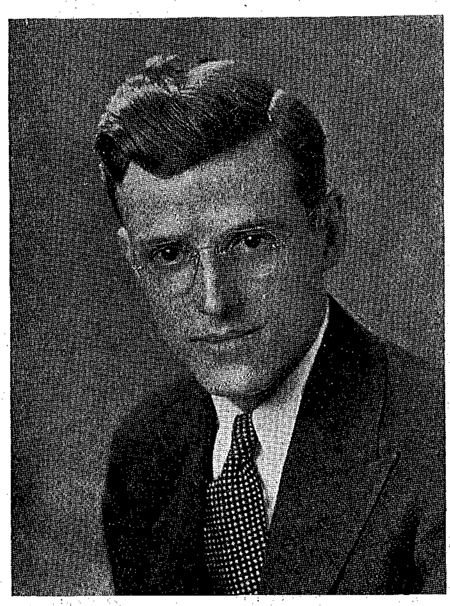
Aided by the experience of previous committees, students working on the project have benefited greatly from the records left by their predecessors. Keeping this in mind they have endeavored to put into a convenient form all material that will assist Freshman week organizations in years to come. Scrapbooks of publicity material, programs, contracts with business firms, reports of outside assistance, records of contacts made with broadcasting stations and a complete budget of expenses have been kept to be left with the all-University council for committees that will follow.

### Orient Freshmen

Orientation is the one word that can best describe the workings of the Freshman week committee. The one word has been used so often in articles dealing with the committee's work that it has become rather trite, but it is the only word that can properly cover the assigned meaning. Newcomers to an institution as great as our University must be oriented. They must know why they are here; what they will study; how to go about getting what they desire in the way of curriculum and extra-curricular activities; how to find their way about the campus; how to find their way about the twin cities in which the University campus is located; and many many more facts too numerous to put into print.

This University and higher education business—for it is nothing else but a business—has to be learned from the beginning and from the bottom. The sooner the newcomer learns his way about, the easier it is for him. After he becomes wise to the ways and means of University life, he is set for the remainder of his college career. Like everything else, some of the new Freshmen learn easily, others never learn, but turn home after failing their courses with the blame for their failure directed at everyone but themselves. These students got off on the wrong foot.

To get the yearlings off on the right foot is the end toward which the faculty and administration of the technical schools are working when they insist that all freshman engineers take the prescribed course in orientation. These



Willis Smith, M'32
*Assistant Chairman*

savants know through years of experience with University freshmen that a large percentage of them do not know what course they want to take or what walk of life they wish to travel after they have been graduated with a degree from a college of higher education.

The students working on Freshman week also attempt to orient the Freshman. Before school is out in the spring, they hold meetings with the high school seniors. During the summer vacation similar meetings are held on a smaller scale throughout the state. The part of vocational guidance is taken care of by the University administration. Men and women are employed by the University to work solely on this matter. Also several professors spend part of their time in consulting with and advising students.

To the student committees who are hardly mature enough to cope with this larger problem of vocational guidance is left the problem of acquainting the newcomers with University life.

### Three Thousand Frosh

The task is an enormous one. Every fall approximately three thousand new students arrive at Minnesota to start their academic careers. The Freshman week committee tries to contact every one of these men and women before they come to the campus and again during the short week they spend here before their classes commence.

One of the outstanding phases of orientation accomplished by workers this year was the complete coverage of the state by means of district committee heads and a definite schedule of publicity for 350 state papers. Before school was out last spring Guy B. Arthur, senior engineering business student, and Russell Johnson, senior student in the school of Business administration chose 26 men and coeds to represent the larger committee in each of their respective districts. They were in reality miniature Freshman week committees. These students held rallys and meetings from time to time during the summer vacation. They organized gatherings at which E. E. Nicholson, dean of student affairs, and Anne Dudley Blitz, dean of women, spoke to the new students and their parents as well as those high school graduates who were planning to attend other institutions. They also held personal interviews with the parents of the prospective undergraduates.

### Deans Tour State

The two deans made tours to all of the principal towns of the state during the summer. After their talks, they held open forums, when anyone could ask questions. The type of questions asked at these meetings was only one proof of the necessity of such tours of the state.

Otis C. McCreery, dean of men, also conducted similar meetings. The preliminary work for these gatherings was taken care of by the student committee members. Where there was a chairman in the town the deans were to visit, he was advised of their intention and made ready for their reception. In most cases he secured the use of the high school auditorium, attended the meeting himself to introduce the speakers and also secured a third speaker of local importance in educational circles.

At the same time through the aid of the publicity committee, the high school graduates in the immediate neighbor-

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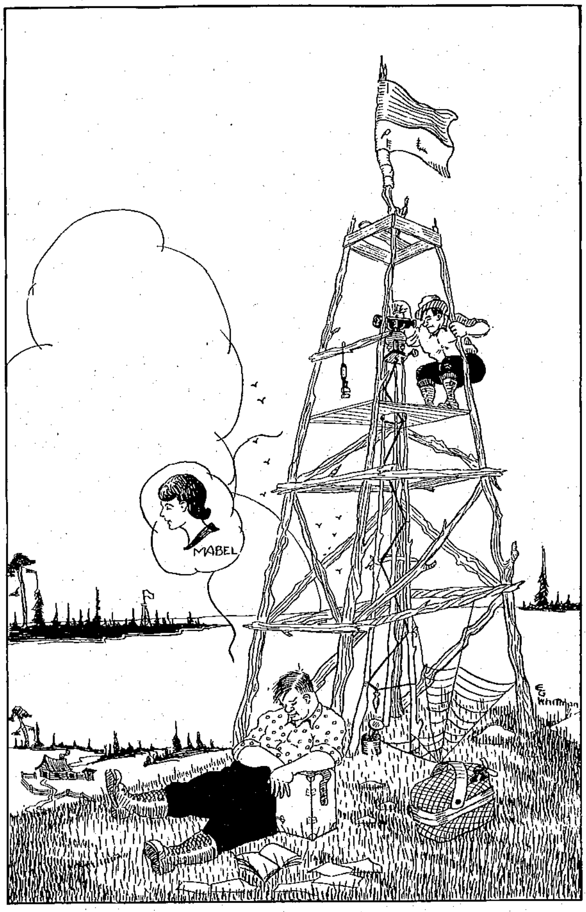


# How D'ya Check?

By J. PHELAN SHIRLEY, Ex. 32

BLACK NIGHT. Cass Lake lay quiet, its peaceful waters lulled to rest by the distant stars. Yet there was a certain provocative air that shrouded the camp that night, that portended great events. Suddenly the silence was broken;—from the distance came sounds of approaching motors making more noise than the proverbial twenty cats on a tin roof. And then pandemonium broke with all its fury. It seemed as though all the demons of Hell had been loosed at one moment to pour out their hearts in song. And what strange songs, reminiscent of that dim age when an instep was a thrill and an ankle an orgy.

Twenty odd voices—twenty odd songs. "I am just a prairie flower, growing wilder every hour." "O the horse stood around with his foot on the ground, and the horse stood around with his foot on the ground, and the horse stood around with his foot on the ground, etc., etc." "O there was a little bird and he—and he flew to a telegraph pole." All this was interspersed with Indian whoopee calls, cowboy yells from the leathery lungs of a Wyoming tenor, strident calls of "Who shot cock-robin? The blue or the grey?" "Yoo-hoo Mabel, Yoo-hoo," etc., etc. ad nauseum.

And then those voices went to their respective tents and once again Cass Lake lay quiet, its peaceful waters lulled to rest by the distant stars. But sleep was not for me that night—four of us Civils gathered together to cuss and discuss the preceding six weeks of camp. The whole story was reviewed before the fingers of dawn proclaimed that day was at hand.

For awhile we just sat there and kind of got adjusted and settled and contented ourselves with blowing smoke at each other. Believe it was Big Jim, "Windy" Jim that broke the silence.

"Probably the funniest thing that happened during the entire session was the snipe hunt," he began. "And to think that such an old fly would still attract fish to say nothing of suckers. Imagine those two stump heads sitting out there in that cold swamp, with the rain pouring down upon them, holding a gunnysack in one hand and beating one stone against another with the other hand,—sitting there, soaking, and waiting,—waiting in vain for the snipe that never came, while all the rest of the boys were back at camp either laughing themselves sick or making plans for the pajama parade. One of the boys told me before the hunt that he had shot quite a number of snipe, but that he had never been on a snipe drive. Can you beat that for unparalleled ignorance? Guess Barnum was right, but his rate for production was a little slow. But, say, did you ever hear the rumor concerning the way those boys got back to camp. Well, here's the dope,—now I don't want you to take this as an absolute fact because neither of the boys would ever confess to me, but nevertheless I firmly believe that a certain member of the faculty got soft hearted and picked the boys up. I'm not mentioning any names, but if you remember the date you can recall that only one member of the faculty who has a car was in camp that week-end. But I really don't blame him, it was pretty tough on the boys,—cold and raining, and darker than pitch. It's a damn good index of that faculty member's character,—and shows just how concerned he is with the welfare of each and every one of us boys. And there's no blustering about him either,—always the same,—no favorites,—everything open and above board."

"Yah," broke in Bill, "He sure is O. K. But you fellows know pretty well that although we've had a lot of fun up here, we have also amassed quite a bit of useful practical knowledge. And the funny thing about it all is, that the whole thing has proven to be so vitally interesting. Take triangulation for instance.

"To hear the procedure described in the class room, it is pretty easy to get the idea that there's nothing much to it except three normal, three plunged and you're done. But believe me that isn't all. And I want to tell you all right now that there's no thrill quite like the one obtained when sighting for the final time the initial station and offering kind of a mute prayer that she'll check O. K., and then looking down at the vernier to see that she reads 00-00′-00.″ And say, boys, you don't want to overlook the fact that we did some darned accurate work in the field, for every bit of the work had to measure up to the requirements of Second Order Triangulation. And that's pretty precise stuff, and believe me it demands a lot of careful work to keep the average triangular closure of the whole camp

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# THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

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## Hail, Freshman

WELCOME, Frosh, welcome. At last you are full fledged college men. College men? I'm willing to wager that such a name raises images of Apollo faced men with "style book" clothes and long masculine pipes. Or probably a robust young person with unpressed trousers and no hat. How odd. Most students are only hybrids of the two types.

Now that we have that settled, let's look into the successful college man (assuming, of course, that you want success). How did he do it? Simply by much hard work and getting *started early,* and getting *started right.*

Starting right is hard. You are here primarily to study. All right, study. Then, you want to join in some extra-curricular activity. Try some such work. Something you enjoy and still have time to do properly. Opportunities abound in the departmental societies, campus publications and campus government. Pick one activity and then work hard and steady. Remember, it may take time to realize recognition. But keep plugging, there are always jobs for earnest men.

But let's slow up. We have been assuming that you are very much interested in your chosen field. If you're not, change. Now is the time. Perhaps this point cannot be stressed too much to the incoming Freshman. But then, let us go on.

## But Think, Frosh, Think

IN nearly every case Freshmen base their choice of a profession on some minor detail of reason or fancy. The future engineer who has actually considered his abilities and decided on a technical education as a result of his considerations is rare.

Some students elect engineering because of the romance they seem to see in it, others because they enjoy tinkering with automobiles; but very few elect engineering because their ability in mathematics and other fundamental subjects supports their interest. A failure in technical studies, as the result of a misconception of abilities demanded, does not mean the student is inferior mentally or otherwise, but it does prove that earnest effort should be exerted by the Freshman in the selection of his work. Failure in anything tends to lower the morale, consequently ill-formed decisions should be avoided as much as possible.

Satisfaction in life must come from either an inherent or cultivated interest in anyone's life work. High remuneration in engineering is rarely reached and as a result it cannot be made the end to be striven for. Engineering demands a true interest in it and hard work is the price of even moderate success. Remuneration is small compared with the satisfaction which comes when a job has been sucessfully completed.

Freshmen, be introspective, sincere and fair with yourself and your future. Solve yourself—only you have the data.

## A New Tongue?

IT appears odd that the engineer should have a hand in the development of a language. Yet, in the future some new tongue may be the product of the engineer.

English is a well developed language. It contains a trace of Latin, French, and Gaulic tongues. And practically all of these traces were introduced by conquerors of England. These fighters came, conquered, settled, and then were driven out by more powerful peoples. However, each conqueror left his well defined stamp upon the inhabitants of the country.

And so the engineer. Like those ancient tribes he enters a new country, settles, and builds an industrialized nation. But how can he affect the language without moving some of his own people over to that country?

Let's refer to Mr. Glockler's article in this issue of the TECHNO-LOG. In Japan we find that medical men speak German as well as their native tongue. Germany introduced medical methods into Japan and thereby convinced many of the younger generation to go to Germany to study medicine. Therefore, they know German.

And likewise with the engineers, who are familiar with English. The English speaking engineer has been largely responsible for Japan's industrialization. Consequently, English is being used constantly in engineering circles.

And what will this contact with a second language do to Japan's present tongue? Time will tell:—Time and the Engineer.

## Men and Engineering

IN order to turn out good graduates, the engineering colleges must have good material to work on. The raising of entrance requirements is the only way in which the standards of the engineering colleges can be improved and better graduates turned out. It may be argued that all should be given an equal chance in the technical schools, but this system, which has been in force for so long, can be definitely proven wrong for a state university, where the state must pay part of the training costs. Many are the students that have dropped by the wayside in the various engineering courses, and many are the graduates that have found themselves all at sea after slipping past the professors term after term with D's and conditions. The greatest part of the instructors' time is now devoted to the trouble makers—the lowest half of the class, and that time is practically all wasted, for those students will finally fall out, here in college, or in the professions after they graduate.

The engineering profession does need more men, but it needs real men, men who have the training, the ability, and the courage to tackle a tough job and carry it through to a successful finish.

# NEWS FROM THE TECHNICAL CAMPUS

## *Former Managing Editor Sails for Canal Zone*

Mr. J. P. Shirley, formerly managing editor of the MINNESOTA TECHNO-LOG, has forsaken the technical campus for an engineering position in Panama with Peterson, Shirley and Gunther, an engineering firm with offices in Omaha.

"Phil," as Mr. Shirley is known to his friends, proceeded to New Orleans by train where he intends to embark for Panama. The location is about twenty-five miles from Panama City and the work is known as the Madden dam construction program. A large dam 250 feet high and 1800 feet long is to be built in order to provide additional water for the Panama canal during the dry season. It is estimated that approximately 600,000 yards of concrete will be used. In addition seventeen small earthwork dams will be constructed as supplements to the large work. The whole contract calls for the expenditure of over $4,000,000.

In addition to being managing editor of the TECHNO-LOG for two years "Phil" introduced the "Tech-Banquet" last year. He was a member of the Arabs, engineering dramatic society, and associated with Alpha Tau Sigma, honorary engineering journalistic fraternity. He was also a member of the Delta Kappa Epsilon fraternity.

## *Engineering Enrollment Shows Slight Change*

Showing a slight decrease in the College of Engineering and Architecture and an increase of 35 students in the School of Chemistry the technical schools have apparently been little affected by the world-wide economic depression. The total university drop in enrollment is about two hundred as compared with drops of 500 in the University of Michigan and 200 in the University of Iowa.

The Junior class in the department of electrical engineering showed a surprising increase of over fifty per cent due to the influx of students from other colleges. The School of Chemistry increase was due to a large number of transfer students in the Sophomore class.

The electrical engineering department, with a registration of 416, has the highest registration of any engineering school. The mechanical department have 252 students, the civil department 231, the aeronauticals 145, and the agricultural engineers but 18. The total registration in the College of Engineering and Architecture reached 1390 students.

### Entrance Requirements

High school graduates desiring to enter engineering, architecture, and chemistry schools must have passed higher algebra and solid geometry, according to a new ruling of the College of Engineering and Architecture and School of Chemistry which takes effect in the fall of 1932.

These courses are no longer offered by the mathematics department, but this year entering students who are lacking these subjects may take them in the day classes of the extension division by paying special fees.

## *Engineering Alumnus Addresses Students*

Mr. H. E. Gerrish, M.E. '05, and president of the Morgan-Gerrish Co., in an address before the Mechanical Technology class, expressed the thought that an engineer's success is determined to a great extent by his pride and confidence in addition to his ability.

According to Mr. Gerrish an engineer should cease to be taciturn. Interest in civic duties and participation in civic work of all kinds broadens the knowledge and interests of the engineer with consequent benefits to himself and fellow citizens. In addition the trained mind of the engineer will solve many problems more effectively than is ordinarily possible. The engineer will find a new life if he will place a portion of his interest in duties other than those purely technical.

Personal appearance and ability are sources of confidence, Mr. Gerrish said, and consequently every engineer should take pride in his own well-being. Confidence, of course, is that faith in yourself and in your ability that makes success possible. Half-hearted interest and mediocre appearance does not signify confidence to the prospective employer.

In the game of life things are constantly being sold and the engineer has to sell not only himself but also his ideas, and for this reason the engineer has to be a master salesman in addition to being a technician, continued Mr. Gerrish. Therefore, it behooves the engineer to accentuate those qualities which will exhibit his abilities to the best advantage.

Above all "the engineer should play the game of life," Mr. Gerrish opined.

## *Civil Engineering Group Holds First Meeting*

The Civil Engineering Society of the University of Minnesota held its first meeting of the school year Thursday, Oct. 1, at 11:30 in the Engineering Auditorium. William Hill, who was elected last spring, presided over the meeting. Prof. Bass of the Civil Engineering Department, spoke about the coming convention of the A.S.C.E., which will take place in St. Paul October 7 to 10. The members were urged to attend as many of the various meetings and conferences as possible and in particular the Student Chapter Conference, Wednesday at 4:00 P. M. Prof. Bass reminded the student body that theirs was one of the largest student chapters and ought to make a good showing at the conference.

The secretary, James Nelson, read a proposal for revision of the constitution. One of the main changes in the proposal concerns the name of the society. The new name suggested is "The University of Minnesota Student Chapter of the American Society of Civil Engineers." The various changes will be voted on at the next meeting of the society.

## *Student Senior A.S.M.E. Societies Plan Meets*

In order to acquaint the Freshmen and Sophomores with the season's work the first meeting of the student branch of the A. S. M. E. will be a smoker held in the Union, in collaboration with several other engineering societies. In addition to monthly meetings the students have joint quarterly meetings with the senior society. Present plans also include a banquet during the winter quarter and a picnic in the spring quarter.

At the closing meeting last spring the following students were elected officers for the ensuing year: C. O. Anderson, president; Morris Knight, vice president; Albert Lilja, treasurer, and Neil MacDonald, secretary. Professor B. J. Robertson is the faculty advisor.

This year there will be $75 in prizes awarded by the Twin City branch of the A. S. M. E. to seniors for the best papers written on some seminar or research problem. First place will receive $25, second place $15, and third place $10. The rest of the money will be used to purchase Technical books which can be chosen by the winners.

In order to be eligible for the prizes, seniors must be members of the A. S. M. E.

# Minnesota Plays Host to Math Conventions

Minnesota played host to two conventions on the subject of mathematics this summer, both being held within a period of 18 days. The first convention, that of the Society for the Promotion of Engineering Education, was held from August 24 to September 5. The other, a joint convention of the American Mathematical Society and the Mathematical Association of America, met from September 4th to 11th.

The Society for the Promotion of Engineering Education's meeting was the 1931 session of the summer school for engineering teachers. The origin of the school dates back to a general investigation conducted by the society from 1924 to 1929. The organization has for its purpose the improvement of the teaching of engineering. Sessions of the school are held each year in different institutions throughout the country each session being devoted to the study of the methods of teaching a particular subject of the curriculum. The subject this year was mathematics.

The local director of the session was Dean Leland and the secretary Professor Herrick of Minnesota.

The total attendance of the session, including staff members, was 112. This number represented 31 states and 3 provinces of Canada. Sixty institutions were represented, which number is the largest in the history of the society.

During the session statistics were brought forth in the lectures which showed need for changes in requirements of entrance and kindred topics.

On the social program of the session was a banquet held at the Minneapolis Athletic Club, Thursday, Sept. 3, at 6 P. M. The entire group was photographed Monday, Aug. 31, on the steps of the main engineering building.

Some of the visiting staff members included R. C. Archibald, of Brown University, E. R. Hedrick, of the University of California at Los Angeles, and Edward V. Huntington, of Harvard.

### Also Annual Meeting

The joint session of the American Mathematical Society and the Mathematical Association of America was also an annual meeting. The A.M.S. holds a number of meetings during the year but has its most important session in this annual joint meeting with the M.A.A. The A.M.S. is a 40 year old organization devoted to mathematical research. In all of its meetings, papers of a highly technical nature are given. The M.A.A. is devoted entirely to mathematics of the college level and deals with problems of that category.

The colloquium, a set of four lectures presented annually, was given this year by Prof. Marston Morse of Harvard. E. Landau of The University of Gottingen, Gottingen, Germany, gave a paper on the Schnirelmann Theorem. Another on the Ideals of Linear Algebra was given by C. C. MacDuffe of Ohio State. Prof. Scherberg gave a paper on the degree of convergence of a series of vessel functions.

The convention attendance totaled 240, many of whom remained for this convention after having attended the session of the S.P.E.E.

On September 4 a joint session was held with the Society for the Promotion of Engineering Education, whose convention was still in progress. Lectures were given by Dean Slichter of Wisconsin and Prof. Rover of St. Louis. A reception was given in Sanford Hall Monday, Sept. 7, by the University. On Tuesday a luncheon was held for the ladies at the Lafayette Club on Lake Minnetonka. The major social event of the convention was the dinner held at the Minneapolis Auto Club Wednesday, Sept. 9, at which President Coffman spoke. On Thursday the delegates went on an excursion to Taylors Falls.

Some prominent visitors were: Virgil Snyder of Cornell, G. A. Bliss of Chicago and T. C. Evans of Rice Institute, Houston.

# Chemical Engineers Hold Smoker; Plan Trips

The American Institute of Chemical Engineers opened their program for the year on Thursday evening, October 8, with a smoker. Such an informal gathering at the beginning of the school year is usually resorted to in order to acquaint new members with the policies of the organization. Doctor G. H. Montillon, of the department of chemical engineering, addressed the group and explained the code of ethics of the institute. A greeting from the American Chemical Society was tendered by Doctor R. E. Sherwood, research chemist and chairman of the Minnesota section of the society.

The group was entertained by Mr. G. A. Vacha, who played a number of selections upon an accordion. A humorous skit was presented by Robert Conary, Sophomore in the School of Chemistry. An amusing demonstration by Winfield Foster and George Flanagan, senior Chemical Engineers, completed the program.

Arrangements have been made for representatives from various chemical engineering firms to give talks on different phases of the industry during the regular monthly meetings of the institute. In addition to these regular meetings, a series of inspection trips to plants in the Twin Cities has been contemplated.

# Nation's Student A.S.C.E. Societies Convene Here

Nationally known engineers from every part of the United States were guests of St. Paul from October 7th to 10th as visitors at the fall meeting of the American Society of Civil Engineers.

Addresses of welcome from Governor Olson and Mayor Bundlie, responded to by Mr. Stuart, president of the society, started the meeting program Wednesday morning.

Meetings were held at the Hotel Lowry, which served as the society's meeting headquarters and as residing headquarters to many of the visitors.

Prominent engineers present at the meetings include Ralph Budd, president of the Great Northern, a director of the society and chairman of the entertainments committee; George T. Seabury, secretary of the society; Francis Lee Stuart, president; Anston Marston, past vice president; Charles H. Stevens, a director, and John F. Coleman, past president.

### Civils' Classes Disbanded

Senior civil engineering students of the University of Minnesota welcomed the chance holding of the society's meeting in the Twin Cities gave them to get in contact with the profession they plan soon to enter. They were excused from university classes in order that they might avail themselves of this opportunity to fullest extent.

Topics of general technical interest were reported on and discussed in Wednesday's meetings. J. C. Lawrence, University of Minnesota dean, among those speaking, reported on recent studies of unemployment and industrial conditions.

Sessions of the technical divisions occupied Thursday and Friday mornings, the highway division and the sanitary engineering division holding meetings on Thursday morning and the city planning division and the engineering-economics and finance division, Friday morning.

### Dean Ford Speaks

Wednesday evening, a formal dinner followed by a dance at the Hotel Lowry provided entertainment for the visitors. Guy Stanton Ford, dean of the graduate school, University of Minnesota, was the principal speaker at the dinner.

The A. S. C. E. is the parent organization of the Minnesota Student Chapter of A. S. C. E. and other student chapters in engineering schools throughout the country. Delegates from several student chapters came to the society meeting, the Minnesota Chapter acting as their host. A student chapter conference was part of the society's meeting program. This conference, taking

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# AROUND THE WORLD WITH OUR ALUMNI

## *Chemical Engineering*

'24—Ph.D.—Lauer—Walter M. Lauer, who is an assistant professor in the School of Chemistry, University of Minnesota, is on a sabbatical leave in Germany.

'25, '28—Sprung—Murray M. Sprung is now an assistant professor of Organic Chemistry in the School of Chemistry, University of Minnesota. He formerly was an instructor in chemistry at the same institution.

'25 — Bekkedahl — Norman Bekkedahl obtained a Ph.D. degree in Chemistry last June from American University by attending night school. He is working at the Bureau of Standards in Washington, and has been transferred from the Electrochemical section of the Bureau to the Rubber section. His present research problem is Free Energy of the Rubber Hydrocarbons and Allied Compounds.

Norman's home address is 1444 W St. N. W., Washington, D. C.

'27—Beal—John Beal is now associated with the School of Chemistry, University of Minnesota as an assistant in Chemistry.

'30—McConnell—John R. McConnell has left the DuPont Ammonia, Wilmington, Delaware, to study for a Ph.D. at Harvard.

'30—Beyer—Frederick C. Beyer is now residing at 3729 2nd Ave. South, Minneapolis. He is an assistant in chemistry at the University of Minnesota.

'31—Garvey—Arthur Garvey has accepted a position with the A. O. Smith Corporation, Milwaukee, Wisconsin.

'31—Jewett—Clifford Jewett is now associated with the chemical department of the University of Wisconsin, Madison, Wisconsin.

'31—Swenson—Oscar Swenson is serving as an assistant in chemistry at the University of Minnesota.

## *Civil Engineering*

'07—Blomquist—Hjalmer F. Blomquist, superintendent of City Water Works, Cedar Rapids, is living at 1837 7th Ave. S. E., Cedar Rapids, Iowa. He writes in as follows, "As an old timer I follow the progress of the University and especially enjoy hearing about the activities of the teachers of my day, among them being Professors Brooke, Bass, Erickson, Zeleny, Springer, and some who have gone to other institutions.

"Some of my most interesting experiences since leaving school have been in the studying of human nature, made possible by my close associations with the public in directing public works and utilities."

'21—Sverdrup—Leif J. Sverdrup writes from 7401 Arlington Drive, St. Louis: "I took a fishing trip to Northern Minnesota this summer—up along Loon and Lac La Croix Lakes, where the Class of '21 had their summer camp in '20.—But the old places didn't look like they used to—too many people and motor boats around and not the same number of fish."

Leif is now a consulting engineer with the firm of Sverdrup and Parcel. His business address is 2095 Railway Exchange Building.

'24—Wilson—C. E. Wilson visited the camp at Cass lake this summer. He is with the E. W. Coons Company of Hibbing, Minnesota. He was formerly with A. N. Nelson, Contractor, Duluth, Minnesota.

'24—Thompson—Theodore S. Thompson was married August 20, to Louise Leonard of St. Cloud. Mr. Thompson is a resident engineer with the Minnesota State Highway Department with his home office at Rochester. Ted formerly was stationed at the St. Paul office.

'27—Borrowman—John K. Borrowman was married July 25 to Margaret Shambaugh of Hillsdale, Michigan. John is a U. S. C. E. with headquarters at Milwaukee. After a motor trip through the west, Mr. and Mrs. Borrowman are at home in Detroit.

'27—Sperling—Abe J. Sperling's home address is at present 1635 N. Queen Ave.

'27—Lund—Stanley Lund who is with the Genfire Steel Company as a sales engineer, introduced his wife to the boys at the civil engineering camp at Cass lake last summer.

'27—Preus—Christian K. Preus is now with the Minnesota Highway Department with offices in Minneapolis. He was also among those who visited the summer practice course at Cass Lake.

'28—Bergford—John F. Bergford who at the present is employed in the Minnesota State Highway Department gave the boys a bit of cheer this summer when he visited the summer camp for civil engineers at Cass lake.

## *Mechanical Engineering*

'10—Frear—J. B. Frear, testing and designing engineer with the Don L. Quinn Company of Chicago, is living at 2239 Asbury Ave., Evanston, Illinois. He was present at a class reunion held at the Minneapolis Athletic Club, together with Messrs. Shipley, Du Toit, Salisbury, Moyer and Comb, all of the mechanical engineering class of 1910, except Professor Shipley.

'20—Odergaard—Harold T. Odergaard is spending his time at the roundhouse of the Chicago, Milwaukee and St. Paul railroad at Aberdeen, South Dakota. His home address is 908 S. Main St., Aberdeen, South Dakota.

'24—Boyd—Paul M. Boyd, test pilot with the Curtiss Aeroplane and Motor Company, was one of two pilots killed when the plane which they were testing crashed on the outskirts of the Municipal Airport of Buffalo, New York. According to airport attaches, the plane seemed to fall apart in the air, and then plunged to the ground.

'26—Comfort—Clifford E. Comfort is now located at 1854 St. Clair St., St. Paul. He moved from 1704 Pinehurst Ave., St. Paul.

## *Electrical Engineering*

'06—Albrecht—George M. Albrecht appears in our June 1931 Directory as with Allis-Chalmers Manufacturing Company of Milwaukee, Wisconsin, through an error. Mr. Albrecht, formerly an examiner in the United States Patent Office, was patent attorney for the Allis-Chalmers Company for thirteen years but left that company early in 1931 to open offices in association with Hadley F. Freeman, at 807 Mariner Tower, Milwaukee, Wisconsin, for the practice of the law of patents, trademarks, and copyrights. Mr. Freeman remains resident in Cleveland, Ohio, and Mr. Albrecht is in charge of the Milwaukee offices.

'21—Swenson—George W. Swenson writes: "Professor F. W. Springer, '93 E.E., paid me a visit while the Octororo stopped here. He was taking a lake cruise to Buffalo and back to Duluth. We are always delighted when Minnesota alumni visit us and Michigan College of Mining and Technology." Mr. Swenson's new address is 61 College avenue, Houghton, Michigan.

'24—Waligoski—Adam A. Waligoski is now connected with the Southern New England Telephone Company, of New Haven, Connecticut. He is married and living at 215 Fountain Street, New Haven. He has just transferred to New Haven from the Western Electric Company of Kearny, New Jersey.

'26—Barron—John H. Barron is eastern representative of the Marion Steam Shovel Company of Marion, Ohio. He has charge of engineering, sales, and service in China, Japan, the Philippines, and Singapore, and his headquarters are at Tokio, Japan, and Rairen, Manchuria. His vacation was spent at his home, located at 5403 46th Ave., Robbinsdale, Minnesota, and at Marion, Ohio. He is now back in the east for his company. He writes that 80 per cent of the "Steam" shovels now sold are electric, gas electric, or Diesel electric; only 20 per cent actually being steam powered shovels.

'27—Moses—Marlowe Moses was married August 18th to Andrea McDonald of Bismarck, North Dakota. Marlowe provides kilowatts by working for the North Dakota Power and Light Co.

'28—Tebo—Frank Tebo, instructor in Engineering Drawing, The Pennsylvania State College, State College, Pennsylvania, visited the engineers at Cass lake.

'28—Bolton—John M. Bolton was among those who visited the camp at Cass lake. John is still employed as instructor at the Pennsylvania State Forestry School, Mont Alto, Penn.

'29—Lohn—Robert N. Lohn is now associated with the Minnesota Highway Department with offices at Elbow Lake, Minnesota. Bob was at the civil engineering camp this summer for a visit with the boys.

'30—Snodgrass—George F. Snodgrass introduced his wife to the engineers when

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## *New Machines Installed In Engineering Shops*

To most students and many professors the summer vacation is a period of relaxation, but for those in charge of the Engineering shops it is a time of considerable activity. During the past three months several additions were made to the equipment.

In keeping with the modern trend in teaching methods the department has purchased a 16 mm. motion picture camera and projector for use in conjunction with shop lectures. Films demonstrating production methods and technique will be obtained from various concerns. There are many types of machines too expensive or too bulky to be installed in the shops, consequently students will see pictures demonstrating the operation of these machines instead of operating them themselves. If certain special shots are desired they will be taken with the camera.

In order to make things a little more comfortable for the incoming freshmen, the Forge and Foundry lecture room has been rebuilt. Tiers have been constructed extending the full width of the room. Mr. Moffet's private corner has been preserved and he has obtained a new machine which tests the permeability and moisture content of foundry sand.

Five new Porter Cable lathes have been installed in the machine shop. These special lathes are designed for teaching production methods with the use of modern cutting tools. They are semi-automatic and are much smaller than the older lathes.

Considerable floor space has been added to the shop by rebuilding a former office room. Only motor driven machines will be placed in this space. The new machines and some of the old will be equipped with motors and set up on the new floor so that more space will be available in the remainder of the shop.

The woodworking department has added a tilting arbor motor-driven circular saw and a bench type motor-driven jointer to their equipment. During the past few months this department has constructed three classroom demonstration cabinets. Two were placed in the Pattern shop lecture room and one was placed in the Forge lecture room. They are large, flat-topped cabinets with inner shelves for storing demonstration material.

Some new equipment has been built in the shops.

Five more wood lathes have been constructed. Three of them are motor-driven and two are belt-driven. A large motor-generator base has been installed and a 75 kw. D. C. motor-generator set has been mounted on it. This generator furnishes direct current for the shops during the warm months. The large Corliss compound will be used in the winter, since its exhaust can be used to heat the mechanical engineering building.

The large Corliss has been completely overhauled in order to assure uninterrupted power during the winter.

## *Technical Schools Name Assistant Professors*

One of the most interesting of the new appointees in the Engineering College is Michael A. Sadowsky, assistant professor of Mathematics and Mechanics. Mr. Sadowsky was born in Russia in 1902, graduated from the Russian Secondary school at Viborg in 1919, and then went to Germany where he received the degree of Dr. Ing. from the Technische Hochschule of Berlin in 1927. He remained at this institution as an instructor and later as an assistant professor until this summer when he came to the United States.

James J. Ryan, assistant professor in Mechanical Engineering, received a B. S. (M. E.) from Iowa in 1925. After graduating he worked for the Westinghouse Mechanical Engineering Department in East Pittsburgh and at the same time earned his master's degree at the Pittsburgh University. Another new assistant professor in Mechanical Engineering, Russel E. Gibbs, worked at the Columbia Gas and Electric Company for three years, the Louisville Gas and Electric Company for two years, the National Transit, Pump & Machinery Corporation for one year, and then matriculated at Purdue University, where he received a B.S.(M.E.) in 1929. After being graduated he worked for the Westinghouse Electric and Manufacturing Company in Pittsburgh until February, 1931. From then until September, 1931, he was employed by the Beloit Iron Works of Beloit, Wis.

Ira D. Beal has been appointed assistant professor of Architectural Design. Mr. Beal received a B.S.(Arch.) in 1927 and a M.S.(Arch.) in 1928 at the Massachusetts Institute of Technology. The following year he taught at Illinois and then traveled in Europe for one year on a scholarship. Last year Mr. Beal taught at Pennsylvania State.

Ralph E. Brewer, new assistant professor of Technological Chemistry, received an A.B. at Simpson College, a M.S. at Purdue University and his Ph.D. at the University of Minnesota.

Two new instructors in Organic Chemistry are Donovan E. Kvolnes, B.A. University of Montana, Ph.D. University of Minnesota; and Murray M. Sprung, B.S.(Ch.E.), Ph.D. University of Minnesota.

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## *Engineers to Build Homecoming Blaze*

Engineers will have their usual big assignment in the 1931 Homecoming celebration, that of getting the traditional bonfire in readiness to be touched off as a signal that the thousands of students and alumni massed around the huge pile need wait no longer to shout defiance to the Homecoming foes.

Paul Salo, chemistry senior, has been appointed chairman of the committee that will be responsible for getting the big job done in a fashion that will make it the usual important factor in raising Minnesota spirit to the heights and thus insure the success of the 1931 Homecoming. Engineers who compose this committee are Harry Heltzer, Martin Swanson, Nelson Anderson, Glenn Christie, Max Risley, Harluf Peterson, and Miles Hubbard.

Although the bonfire is the most spectacular event on the Homecoming program it by no means will be the only spectacular feature of the 1931 celebration to be held on Oct. 30 and 31, according to Kenneth Simpson, general Homecoming chairman. The celebration is to be known as the Roundup Homecoming, and the Western theme selected promises to make for two boisterous days.

Decorative effects will convert the campus into a cow town of the Old West, and in this setting of sage and cactus, saloons and dance halls, hitching posts and corrals, Roundup exhibitions of riding, roping, and bull-dogging skill will take place. The streets of the "town" will be jammed with cowboys and cow girls, arrayed in Western garb of chaps, boots, and ten gallon hats.

The traditional Homecoming parade will precede the football game Coach Crisler's men will play with the Badgers on Saturday. Plans for the parade call for having it made up largely of troops of horses and riders in full Western regalia, stage-coaches, chuck wagons, and floats that may take any form as long as they conform with the theme. The battle-cry for the football game will be "Rope Wisconsin." Several thousand Badger rooters, making their official football trip of the year, will be on hand in an attempt to give the lie to the Gopher battle-cry.

Fifteen engineers, including the bonfire committee, have been appointed to positions on the organization that has been at work since early last spring to get the Roundup in readiness. Gordon Bodien is chairman of the Finance committee, and Philip Biesanz is asistant chairman of the parade. Six engineers—Alva Kaliher, Gayle Priester, Claire Armstrong, Charles Fox, Charles McDonough and Jack Tews—are members of other committees.

## Technical Schools Name Assistant Professors

*(Continued from page 14)*

In Mechanical Engineering Jesse M. Campbell has been appointed instructor. Mr. Campbell received a bachelor's degree at Mississippi Agricultural and Mechanical College in 1921. After being graduated and until he came here Mr. Campbell was employed by the Cochrane Corporation of Philadelphia.

F. D. Knoblock received a master's degree in aeronautical engineering at Michigan in 1927, and is now instructor in aeronautical engineering at the University of Minnesota.

Truman W. Manning, B.S., M.S., is here on a year leave from Iowa State. Mr. Manning is an instructor in economics and accounting for engineers and at the same time is working for his doctor's degree.

### Fellowship Awarded

Teaching fellowships have been awarded to S. Paul Kingston, B.A.,-C.E. '29, University of Minnesota, to Edward S. Loye, B.S. in E.E. '31, University of Minnesota, and to Alfred Nier, B.S. in E.E. '31, University of Minnesota.

Francis Garman, B. Arch. '31, University of Minnesota, is a new assistant in the architectural department.

New assistants in Inorganic Chemistry are Charles E. Bartsch, B.A., Lawrence College; Melvin Calvin, B.S., Michigan College of Mining and Technology; Charles S. Copeland, B.S. in Ch.E., University of Minnesota; Russel O. Denyes, B.A., Lawrence College; Charles L. Faust, B.S. (Ch.E.), M.S. (Ch.), Washington University; Lucille R. Hac, B.A., M.S., University of Nebraska; George E. Larenz, B. S., University of Illinois; Lloyd B. Thomas, B.A., John Hopkins University, and Francis B. Lanning, B.S. (Ch.E.), University of Denver.

### Montana Man Appointed

Romund Moltzau, B.A., University of Montana, is a new assistant in analytical chemistry, while Oscar Swenson, B.A. (Ch.E.), University of Minnesota, is a new assistant in Technological Chemistry.

In Chemical Engineering John L. Beul B.A. (Ch.E.), University of Minnesota, Edward E. Titkenhous, B. S. (Ch.E.), University of Louisville, and Charles Winding, B.A. (Ch.E.), University of Minnesota, are engaged as assistants.

Research fellowships have been awarded to Anton Schwertfeger, B.S., (M.E.), Oregon State Agricultural College '31, Charles H. Pesterfield, B.S. (M.E.), Arkansas '31, and Earl J. Feldt, B.A.-C.E., University of Minnesota '31.

## Fred Scobey, Irrigation Engineer, Addresses Ags

Fred Scobey, Senior drainage engineer of the United States Department of Agriculture at Berkeley, California, gave an illustrated talk at the Farm Campus Auditorium on October 7. The lecture covered the hydraulic experiences of Mr. Scobey in the irrigation and power districts of the West, chiefly in California and New Mexico.

Colored slides of the actual conditions of water flow in the scores of channels and canals studied by the Department of Agriculture were shown.

Mr. Scobey, working under the direction of Mr. W. McLoughlin, Chief of the Division of Irrigation, of the U. S. Department of Agriculture, Bureau of Agricultural Engineering, has studied the actual conditions in the many irrigation and power channels and streams in the West. He has given special attention to the frictional losses between the water and the channel sides, and by actual tests has shown that as little as one-sixteenth of an inch projections on concrete channel sides brings a material increase in the frictional losses. He recommends that only good, well seasoned lumber having no unevenness or cracks be used for the concrete forms, or for the sides of wooden channels.

Mr. Scobey has also experimented with various shapes of channels and has shown that the catenary form of channel is the most efficient.

The Irrigation Division has made numerous observations of the hydraulic jump. This phenomenon is one which for many years has not been understood correctly, and only recently have channels been designed to properly care for this condition of flow.

## Nation's Student A.S.C.E. Societies Convene Here

*(Continued from page 12)*

place late Wednesday afternoon, was devoted chiefly to a discussion of the programs of the past year, progress during the year, and plans for the coming year of the various chapters represented. William Hill, local chapter president, entered into the discussion on the part of the Minnesota Chapter. Dean Leland, of the engineering school, University of Minnesota, member of the chapter committee, presided at the conference.

Women visitors at the meeting were well entertained. Automobile tours gave them opportunity to visit scenic and historic points of interest in and about the Twin Cities. A bus and boat trip provided an enjoyable morning Thursday. Buses took the visitors to Hudson, Wisconsin, where they embarked on a steamer for a two hours' trip down the St. Croix river to Prescott, and returned to St. Paul by bus along the Mississippi River.

An excursion by special train to Duluth and the iron range Friday and Saturday made the closing part of the meeting program an interesting and entertaining feature.

## W. H. Hunter, Organic Chemistry Head, Dies

During the summer the chemists lost one of their best pals. Professor W. H. Hunter, who was well known by both students and faculty, died of Bright's disease on August 19 after an illness of about three months. His death is mourned by all who knew him, for many reasons: their liking of him personally, their appreciation of his research and teaching, and their loss of a man whose room it was possible to visit whenever they needed help or advice.

### Born in Boston

Professor Hunter was born in Boston, Mass., on September 3, 1882, forty-nine years ago. He began his education in the Boston Latin School and then went to Harvard where he received his B.A. degree in 1904, his A.M. in '05, and his Ph.D. in 1910. He taught chemistry in Bucknell in 1905-06 before finishing his university training. He began his work in the University of Minnesota in 1909. The School of Chemistry was at that time located in the Union and he helped move it to the new Chemistry Building in 1914. He became Assistant Professor in 1913, Associate Professor in 1916, and in 1920 Professor of Organic Chemistry, which position he held until his death.

He was one of the best professors on the campus. He was on the Executive Committee of the Faculty and belonged to many societies of chemists including the American Physical Society, American Association of Chemists, American Chemical Society, and the Dutch Chemical Society.

### Active in Research

He was very active in the research field. He is probably best known for his work on Haligonated Phenols, in which he studied their salts, oxidation, and decomposition. He also worked on the Reimer-Tieman reaction, reaction of levels, intermediate reaction stages, and electro-organic chemistry.

Professor Hunter is survived by Mrs. Hunter; his son of six, William Junior; and his daughter of seven months, Joanne. We all grieve in remembrance of that man we knew as a pal, a teacher, and a leader in whose room at 327 we could feel at home.

# HOW D'YA CHECK?

(*Continued from page 9*)

around four or five seconds. That's what the boys had last year, you know, and I'm willing to bet any of you two to one that we beat the record they established."

For a short time there was silence filled quite adequately by the clouds of smoke that continued to arise from our pipes. Finally Charlie spoke up, "May-be you're right about triangulation, Bill, and I'll admit it was mighty interesting and mighty instructive, but to me the railroad work, and especially that part of it which concerned itself with curves, turnouts and crossovers was the most interesting part of the camp. You know that I've done a lot of railroad construction during the past ten years, and I've bumped into some pretty funny things. Was on a job in Canada just a few years ago where the resident engineer himself was unable to run in a simple curve. You can take it from me that I would have given anything in the world to have been able to compute that curve and run it in for the resident. And now I know damn well that I can do it, and so do you, Bill, and you, Jim. And we can do a lot of things that are tougher than simple curves. Bring on your old spiral, your turnouts, your cross-overs between non-parallel tangents,—we can compute 'em, we can run 'em in. And that's something to be proud of."

"Seems to me," said Jim, "that you blokes are getting altogether too serious. Relax for a second and hold your sides while I tell you a few of the swifties and turning points of the last six weeks. The one about Arne leaving the dinner table a little early is pretty good. Anderson asked him what he should say and good old Arne comes back real swift 'Why, I didn't bump you, you big stiff.' Not bad, eh? And as long as we're on the subject of Arne, Stafford was telling me that one afternoon when they were coming in from the field that old car of Arne's began to spit and sputter and Arne pipes up 'Couldn't very well be out of gas,—puta gallon in two days ago.'

"And say, this camp developed plenty of personalities,—there are Star Island Lovell and Warner, The-Boy-Stay-Out-All-Nights, and Mellin and Hooper,—so thin it nearly makes you cry to see them in bathing suits, and that incomparable trio made up of Two-ton Wrucke, Wine-sack Solheim, and What-a-man Stafford. Some tonnage believe me. And by the way it was a shame that they wouldn't let the fight of Katz and Holmstrom vs. Boon continue any farther than the eighth round.

"As for famous last words,—a book could be written of those. Santelman with his 'Here's my dime, I'm in,' Katz with his, 'Huh, so you won't talk,' Whitman's now justly famous 'Closed flat,' Stout's guttural cry of *' . . ., Johnson,' Ekar's much repeated statement, 'I've shot many snipe but I've never been on one of these here snipe drives.'

"And that immortal chorus of voices saying 'See you tomorrow, Mabel'."

"O. K., son," put in Bill. "We've had some great daze. But to return to our former topic. I think it's pretty hard to classify any branch of the work we've had this summer as 'most interesting' or 'most useful.' Of course I suppose it's possible, but it seems to me that the entire period must be taken as a whole,—and that in the final analysis the intimate contact that we had with the many branches of surveying is the important thing. It would be of little value to us to know how to measure a base line if we were not able to choose suitable triangulation points and carry out the series of computations leading to the solution of the correct positions of the various points."

"You're probably right," broke in Jim, "and to continue your story,—what good would those triangulation stations do us if we were not acquainted with the various types of topographical surveying,—the use of the plane table and the transit in that kind of work. I for one always thought that the plane table and alidade were about as much use to an engineer as the appendix is to homo sapiens—about as much use in other words as a toothache. But now I know that it is a damn efficient instrument for obtaining topographical detail,—and it certainly combines speed and accuracy."

Again there was a long pause. And Mac came into the tent. He had been reading poetry or some such stuff. He was a tall angular chap,—quick at sizing up situations and he seemed to catch the general tenor of the evening immediately. He asked for a match and soon his pipe was belching forth huge clouds of smoke. We all waited expectantly knowing that he would talk if given time. Since we all knew that Mac's father had captained a Great Lakes steamer, we were not surprised that he began speaking about soundings,—finally he branched off into stream measurement.

Suddenly he stopped talking and after a brief pause began equally as suddenly. "Do you know," he said, "seems to me you fellows are overlooking a few things of tremendous importance in this discussion. First of all what about the intimate contacts we have all had among ourselves. We came up here hardly knowing each other even after three years of work together. And yet in scarcely six weeks we have learned all about character, disposition and capabilities of some 40 men. Seems to me that this is of the utmost significance. For a long time I have felt that human engineering is a subject that every one of us needs. If we can't handle men when we get out of school we're about as useless as wooden legs to Twenty Grand. I claim that this camp has been of benefit principally because it has offered an opportunity to study individuals and obtain some sort of an understanding of human nature. We have seen a lot of different types and those types have been to a large extent stripped of all the pretext and veneer of reserve that is so frequently affected on the campus. We have had ideal conditions for study.

"And there's another thing that we have learned and it wasn't included in the prescribed curriculum either. Each one of us learned the necessity of obtaining accurate results which engendered a sense of responsibility that could be fostered in no other way. 'How Dya Check' has become a by-word. Not that I see much to be gained from a base line closure of 1/750,000 as opposed to 1/250,000,—for that's not the important thing after all. But responsibility is all important. And our training up here gave us that and most of us didn't even know when we obtained it. The tonic was certainly administered cleverly."

CLANG! CLANG! CLANG!

My God. Breakfast bell. Rushing feet. Clashing wash pans. Shouting voices. Think it'll rain today I hope. And another day was at hand.

*Deleted by Editor.

# WITH OUR ALUMNI

(*Continued from page 13*)

they were in camp at Cass lake this summer. Mr. Snodgrass is now employed as a United States Engineer stationed at Sioux City, Iowa.

'30—Wall—Two hours after Cyril T. Wall was married to Grace B. Lee he was killed in a taxicab by a Soo train. After the ceremony and a brief reception at the bride's home, they took a taxicab to reach the garage in which their car had been left to prevent friends from following them. The cab started over the grade crossing at Carroll avenue and Aldine street. The driver, blinded by the sun, failed to see the oncoming Soo train which collided with the cab. Mrs. Wall suffered severe injuries and at present she is in a critical condition.

'31—Welies—E. W. Welies who is in Duluth, Minnesota, as U. S. E., was at Cass lake for a visit during the summer.

'31—Blyberg—R. E. Blyberg, E. J. Felt and U. W. Hella were up to Cass lake to visit the civil engineering camp.

'31—Meszwerter—John Meszwerter visited the summer camp at Cass lake also. His present home address is 1618 Irving Avenue, Minneapolis, Minnesota.

## *Crane On New Dentistry Building Topples: Scores*

Something gave way and the crane used for hoisting girders in the construction of the new Dentistry building tipped over Saturday morning, October 10, damaging the Anatomy building, wrecking the crane, and tearing one man's overalls from him.

What caused the crane to tip was not definitely known. There was no undue strain on it at the time, as no load was being lifted. The pin which connected the supporting A-frame to the top of the vertical turn-table post was snapped off, but whether the pin broke under the ordinary strain on it, allowing the turn-table to tip, or whether the timbers serving as the foundation for the base slipped and allowed the crane to become unbalanced, putting a severe strain on the pin which caused it to break, was a matter of conjecture.

The crane hoisting-engine operator saw the crane start to go over in time for him to leave his position under the downcoming girders and escape little hurt except for a bad scare. His overalls caught on something and were torn from him as he rushed to safety.

The crane's keeling over caused its seventy-five foot boom to swing around from a position over the new building through a large arc to strike the Anatomy building. To observers it appeared at first that the boom would swing far enough to miss the Anatomy building, but it was retarded by the boom cable, so that the end of the boom struck the roof wall of the building, slid along to knock out a third story window and destroy the window sill, and continued downward along the wall of the building to knock some chunks out of the ornamental stone foundation before it came to rest.

The end of the boom was bent back when it struck the building, and the boom was twisted in several places along its length. The two members of the A-frame were somewhat sprung, and the base members appeared twisted beyond repair. The hoisting engine and boiler, in spite of everything coming down around them, were apparently little damaged.

## Signal Engineering

*(Continued from page 5)*

graduate engineer can enter. A college graduate, taking a job in a railroad office without having had any experience "on the line," is very likely due for a disappointment. It has been said that many a good engineer's ambition has been stifled by railroad seniority rights, fixed salary rates and straight-jacket conservatism. But there are goals, even on the railroads, worth striving for.

Experience on the right-of-way or in the shop is of first importance to any college man who thinks that he wants to enter railroad work when he graduates. He can get this experience by working with signal crews, section gangs or bridge crews, or in other ways, during his summer vacations. Certain large signal manufacturing companies take a limited number of engineering graduates each year into a one or two year training course. A few railroads, also, have apprenticeship courses in which graduate engineers have an opportunity to learn about rattlers, drags, hoggers, shacks and cons.

## A Dozen Men

filled the pages of this first issue of the MINNESOTA TECHNO-LOG . . . .
But we need a dozen more.

## Remember

Editorial and Business Staff positions are always open.

Drop into Room 37, Electrical Engineering Building and try out.

## ORIENT FROSH of 1931

*(Continued from page 8)*

hood were contacted. The weekly papers carried stories of the meetings and in this way a very satisfactory attendance was secured at all the towns. In two instances, the district chairmen were not on the job and students from the city went ahead of the dean to prepare for their appearance. Many of the local papers carried pictures of the deans as well as that of Philip Neville. In many instances the meetings were covered by reporters from the papers and the newspapers carried excerpts from the deans' talks.

The publicity committee periodically sent out news of Freshman week proceedings to 350 of the state papers. The response accorded the committee on this project was very gratifying and through this channel numerous freshman that were unable to attend the meetings were kept informed of activities throughout the summer. It was found that the method of sending the publicity material directly to the editors of the papers themselves brought far better results than sending it to the district chairmen as was the practice in former years.

The workers carried their welcome farther afield than in previous years in the hope that they would be able to contact more Freshmen. Respect for the similar undertaking of the Universities of surrounding states kept the committee from contacting the border towns from which Minnesota draws many of her students.

### WORK STARTED IN SPRING

Other preliminary work was carried on in the twin city high schools before vacations started last spring. Through cooperation with the high school principals special assemblies for the high school seniors were held at which representatives of the administration and members of the Freshman week committee spoke. In this way all freshmen from the twin cities were prepared in advance for the University. These high school tours were inaugurated and carried through by Willis Smith.

Along the line of preparing the prospective Freshman even before Freshman week began, many radio broadcasts were sent out over the air during the summer. Radio station KSTP gave the committee four quarter hour programs, WCCO was secured for an hour through the assistance of the Minneapolis Junior Association of Commerce, WRHM gave over a half hour of its time and WDGY advertised the carnival for a week in a daily announcement. Then the University station WLB under the direction of William Gibson put on several programs. Plans for Freshman week and instructions for registration procedure as well as talks on University life were broadcast.

All in all, many of the Freshmen really lived over the week of their reception in their minds before they ever set eyes on the campus.

### CARNIVAL PAYS EXPENSES

The professional fraternities, realizing the benefits of running booths at the carnival and desiring to take their part in an all-University project, joined in with the academic fraternities and sororities to make the carnival a huge success. The carnival was not run for profit, but charges were made to cover the expenses of Freshmen week. This undertaking was the only event of the week where the Freshmen did not get things for cost or for no charge at all. Working on a budget, Neville's committees were limited very strictly in regard to expenditures. The income from the carnival had to cover the expense of the entire undertaking.

The carnival was inaugurated last year and was still in an experimental stage until Fallon Kelly and Maxine Kaiser took it over. All details were taken care of in a strictly business like manner. Contracts were made and signed with the few business firms that were necessary where the University did not have the materials needed.

Over fifty organizations had concessions at the carnival. Way back last spring they submitted their ideas to the Freshman week office. When an idea was duplicated there was a drawing and the loser had a choice from a long list of games and attractions compiled by the carnival committee.

For the first time in three years the Freshman men wore green caps. The coeds wore green feathers as their distinguishing insignia. Freshman week officials felt that restoring the green cap to the campus would be restoring a tradition that should live forever at Minnesota. The caps and the feathers were sold at cost to the wearers as it was felt that there should be no profit realized on the sales. In former years the cost was so high that it was prohibitive for many of the yearlings.

Students in the college of Engineering and Architecture that served on committees are: Willis Smith, assistant student chairman; Guy Arthur, General district co-chairman; Ralph Beightol, Radio broadcasting chairman; Harvey Daley, signs and posters chairman; G. A. Anderson, Clifford D. Bloom, Alden Elstrom, Martin Swanson, Arnold Johnson, James Dowd, William T. Shepherd, Edward Kuphal, Archie Armstrong, Thomas Rankine, Robert Englin, Cledo Brunetti, John Ott, Harold Oelslager, Martin Farel and Alva Kaliher.

## Engineers Help Japan

*(Continued from page 3)*

respect. Mr. G. Pierce of St. Paul who went to Japan for the Westinghouse Air Brake company as their expert and served as consultant to the Japanese Government Railways in the matter of airbrakes, was one of the men to aid in the railroad's development.

His work is a case in point and of course it is possible to multiply such instances by the dozen just from one's own experiences. Several members of the faculty of the University of Minnesota have been called by the Japanese government as experts and consultants and so they have had their share in the modernization of the Japanese empire.

It is interesting to note that some professions have been developed by certain western nations almost single-handed. The medical profession has been put on a modern basis by several German medical men who went to the Imperial University of Tokyo. Their influence caused medical students of Japan to continue their studies in Germany and Austria and as a consequence many Japanese doctors speak German.

However, general business, manufacturing and engineering were developed in Japan by the contact between Anglo-Saxons and Japanese. Most Japanese of education who are following a business career can therefore speak English. Many American firms have of course branch houses in Japan and by their frequent business contacts naturally serve as teachers of the Japanese. In order to develop trade and the use of commodities it is necessary to instruct the buyer in the use of the articles which it is desired that he should buy. Then again it is found desirable to manufacture articles within a country rather than to import them, on account of tariff barriers, freight costs, etc.; and on this basis many western firms have become manufacturers within the Japanese Empire. Of course the Japanese are wide awake and prefer to have industries controlled by their fellow countrymen. It is only reasonable that they will work for the exclusion of foreign control whenever possible.

Whenever the Japanese have as yet not developed a certain line of industry they do not hesitate to invite foreign engineers to help them. Many of the larger buildings in Tokyo are of American steel construction and have been erected by American firms under the supervision of American engineers.

The Imperial Hotel in Tokyo was designed by a famous American architect and the construction was supervised by an American contractor. This structure was designed to be earthquake proof and it is a fact that the building withstood the terrible shocks of 1923.

Detailed research into the question of the place which the foreign engineer has had in the development of the modern Japanese Empire would no doubt completely substantiate the thesis that his place as a teacher in the progress of the Japanese nation has been a very important one indeed.

There is no question that the Japanese have been apt pupils and of course many students have come to this country and to Europe to learn our western methods, and have learned so well that they have reached positions of international eminence in their profession.

Drayman: How about some nice fresh eggs today?

Chef at the men's dorm: I can't use any eggs, but I'm short on chops. How much would you take for your mule?

---

"I heard your kid bawling last night."

"Yes, and after four bawls he got his base spanked."

---

She's stopping at the mountain house,
But great seclusion seeks;
She always dresses in the dark,
Because the mountain peaks.

---

She: "Getting mighty cold, isn't it?"

He (reflectively): "Winter draws on."

She: "Sir!"—*Wisconsin Octopus.*

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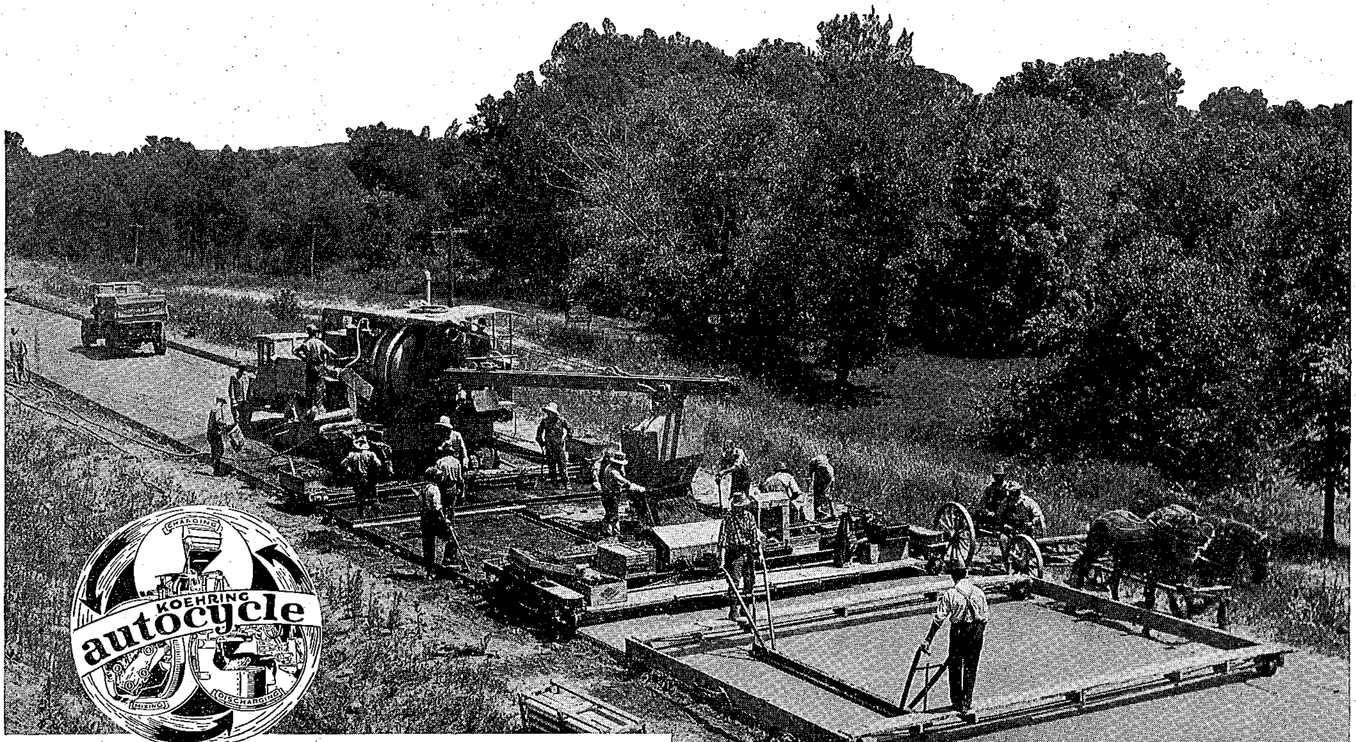
"Papa, what are cosmetics?"

"Cosmetics, my son, are peach preserves."

# KOEHRING AUTOCYCLE PAVER




A PIONEER and a leader among pavers, the Koehring leads in basic developments—the latest of which is the Koehring autocycle.

Just as Koehring developed the boom and bucket, batchmeter, and the five action re-mixing principle—Koehring developed the auto-cycle, a principle for automatically controlling the cycle of charging, mixing and discharging, creating entirely new standards of efficiency in paver operation.

The Koehring autocycle is a means of providing a fast, exact automatic sequence of batchmeter-timed operations. It makes the most of every minute and provides an ample factor of safety. Time is saved at both ends of the cycle, in charging the materials and in discharging and placing the concrete, resulting in increased output per day.

The concrete roadbuilding industry has experienced the importance of this principle—the Koehring autocycle of charging, mixing, discharging. The industry knows the Koehring is more than merely a paver—that it is a plus service rendered, that it sets the pace on a concrete paving project, that it produces standardized dominant strength concrete of unvarying uniformity!

"Concrete—Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, will be gladly sent on request to engineering students, faculty members and others interested.

KOEHRING
Pavers, Mixers; Power Shovels, Pull Shovels, Cranes, Draglines; Dumptors.

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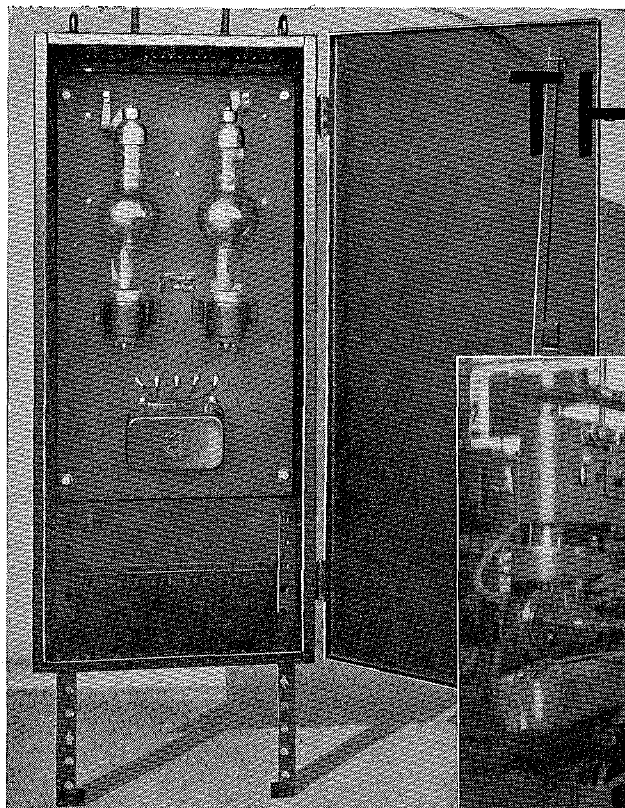
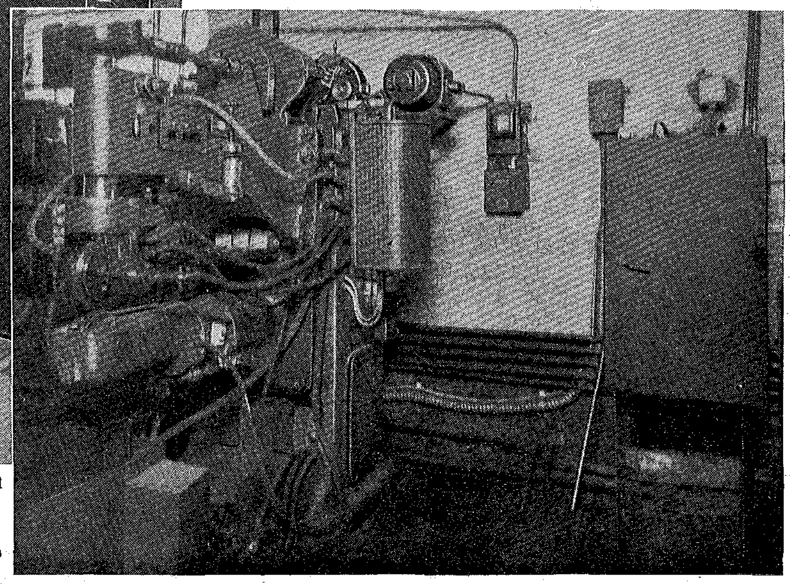
# THYRATRON
## THE OPEN DOOR



Close-up of a Thyratron control panel for high-speed welding applications



G-E Thyratron control equipment (in case) operates this line welder through a reactor

THE new electron tube, the Thyratron, is the most versatile servant developed in recent years. Already it has a host of applications. It will open windows, count anything that will interrupt a beam of light, operate welding machines, sort beans or buttons, operate drinking fountains as you bend over them, light buildings, windows, and theaters, and measure the intense heat of furnace interiors. And it has a thousand other applications.

Thyratron control has made possible high-speed welding machines, for no contactor-actuated resistance welder can approach the speed of several hundred interruptions per minute that are required. High-current Thyratrons interrupt the current in the welding transformers and swing the impedance from high to low, the welding rate depending on the speed of these changes. Thyratron control can be used for as many as one thousand interruptions per minute.

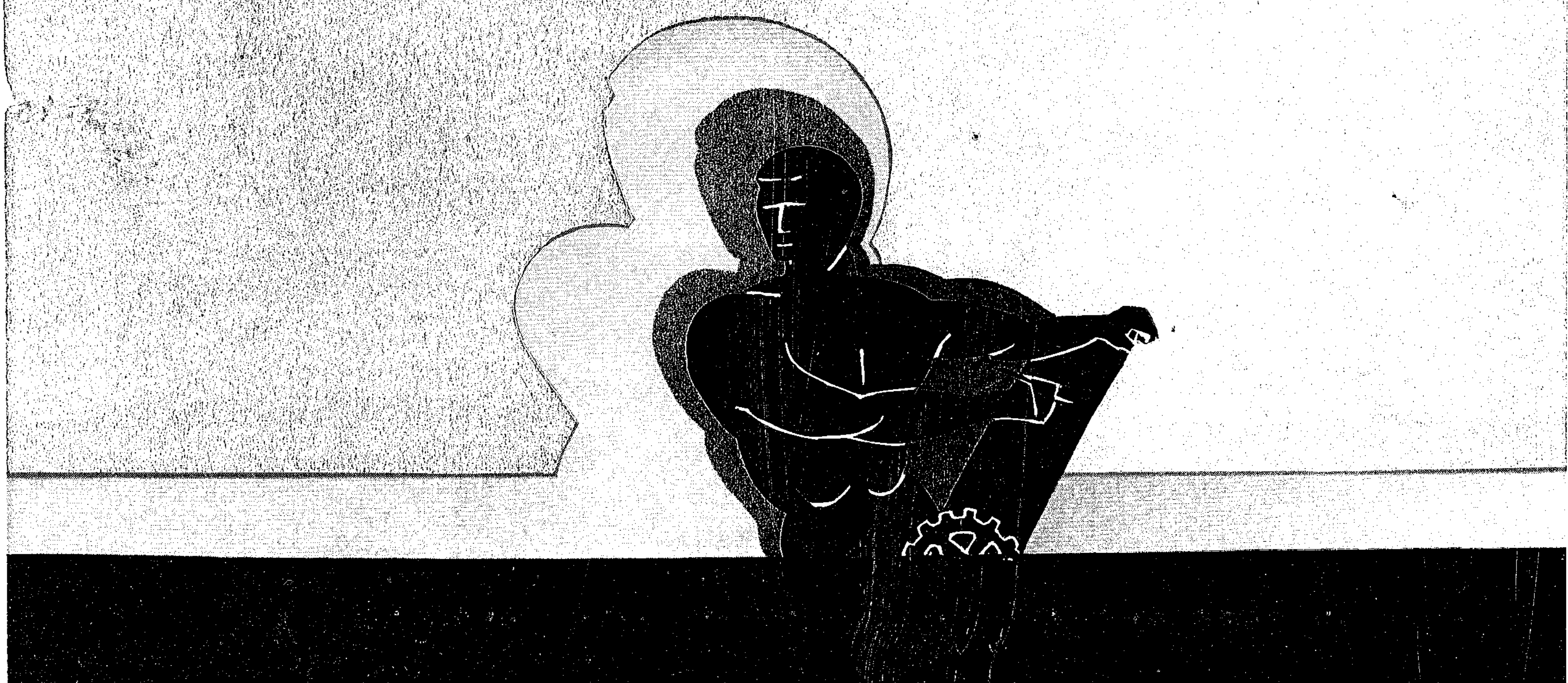
The name Thyratron comes from a Greek word which means "door". Not only does this tube act as a door, or valve, for electricity, but some scientists say that its possibilities are so great that its use will revolutionize the electrical industry. If these predictions are correct, the Thyratron is an open door of opportunity for young men now in college and for graduates already in the employ of the General Electric Company.

95-883DH

# GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

# THE MINNESOTA TECHNO-LOG



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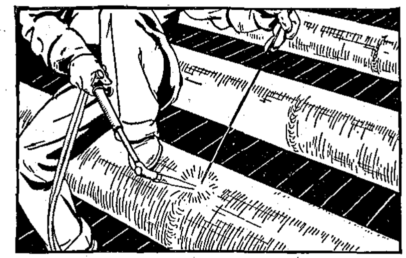
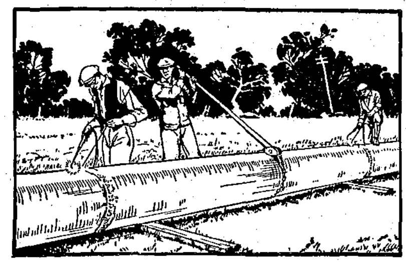
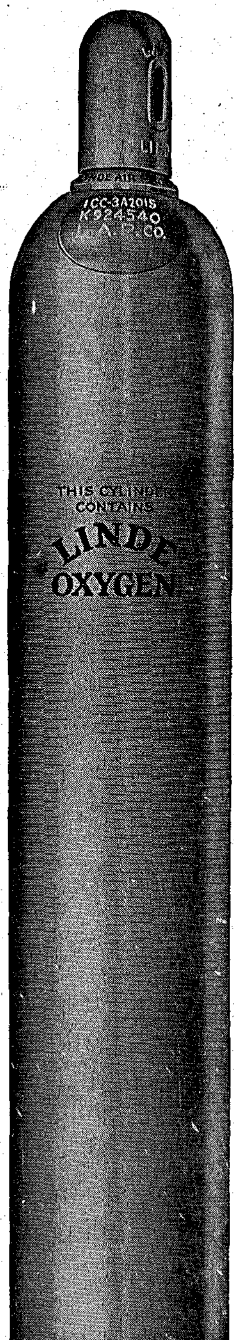
MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

# In the Mill



# and on the Firing Line



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November, 1931

Volume XII, Number 2

# the MINNESOTA TECHNO-LOG

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

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A '29 GRADUATE *discusses modern air conditioning.*

THE DESIGN AND ERECTION *of our Akron hangar—a mammoth factory for the manufacture of large dirigibles.*

MANGANESE *from Minnesota's low grade ore. Mr. T. L. Joseph, supervising engineer of the North Central Experimental station of the U. S. Bureau of Mines, brings us a story in December on the process as developed by this station.*

THE AKRON—*Mr. Arthur offers a description of the dirigible Akron as a conclusion to his series beginning in this issue.*

THE WINNER *of the Techno-Log prize contest shows the construction and operation of a twin city radio station.*



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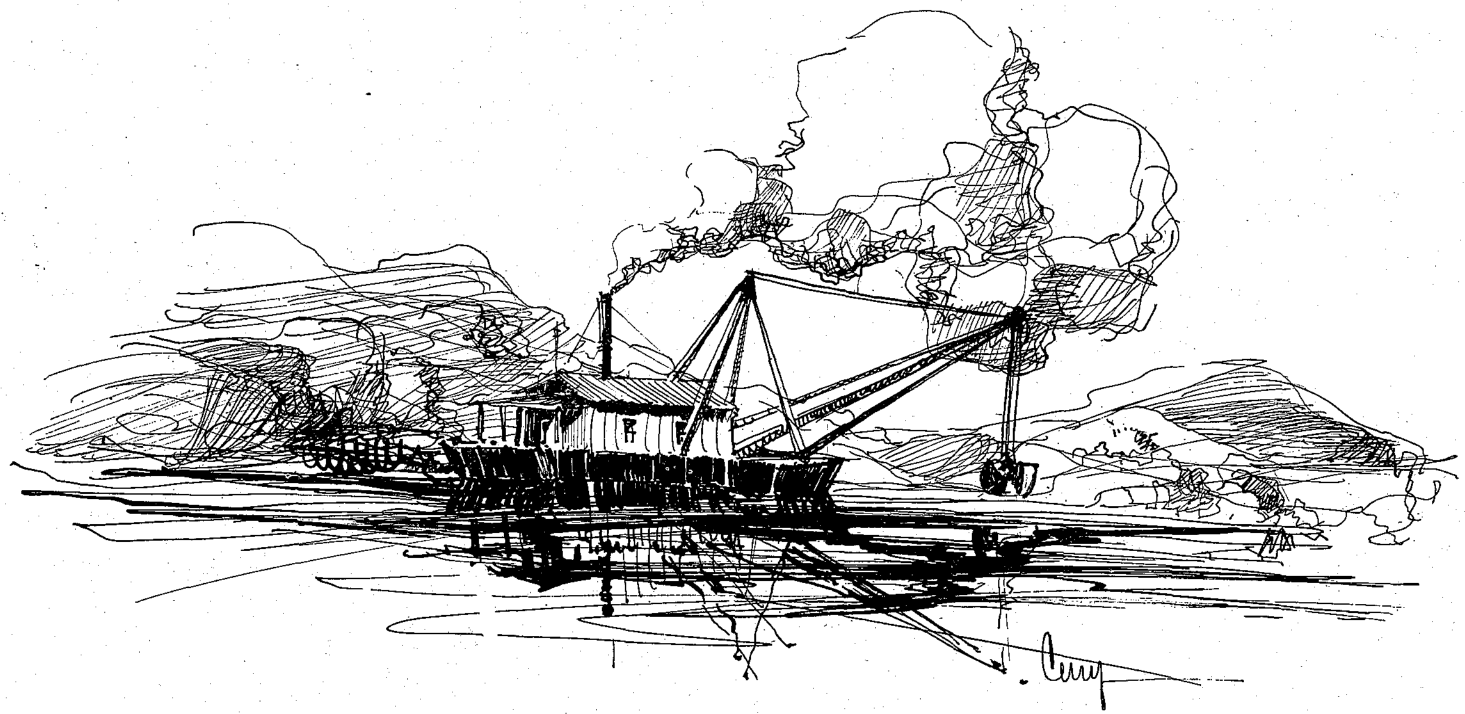



A Mississippi River Dredge
—A Sketch
By Robert Cerny

# THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Volume XII NOVEMBER, 1931 Number 2

## twentieth century

# Weather—Its Production

By REALTO E. CHERNE, M. E. '29

Engineer, Carrier Engineering Corporation

ISN'T it proper and customary to start conversing by talking about the weather? We say it's too hot, too cold, too humid and that's as far as we go. The old adage "everyone talks about the weather but *no one* seems to do anything about it" has been definitely annihilated. And to this we return later.

You enter a class room, you note the fixtures, the furniture, the windows, some hieroglyphics on the blackboard, or perhaps even the quizzical expression on the countenance of the professor. But you pay no atention to the air—unless it's too hot or too cold, and then you adjust the windows to give the best conditions available. Suppose someone suggested that you couldn't carry a weight equivalent to the weight of air in that class room. Such a remark would, no doubt, induce a snicker. But suppose this room to be of ordinary class-room size, say 30x35x10½ feet, with cubical contents of about 11,000 cu. ft. Since a cubic foot of standard air weighs about .075 lbs., the quantity of air in the room will weigh approximately 825 pounds. Perhaps a Samson could carry this weight—but even he wouldn't carry it far, at least without undue exertion.

To make this fact more impressive consider the Empire State Building in New York City with its cubical contents of approximately 36,000,000 cubic feet. The weight of air, at standard barometer and temperature conditions, in this building is 2,700,000 pounds—no insignificant matter now!

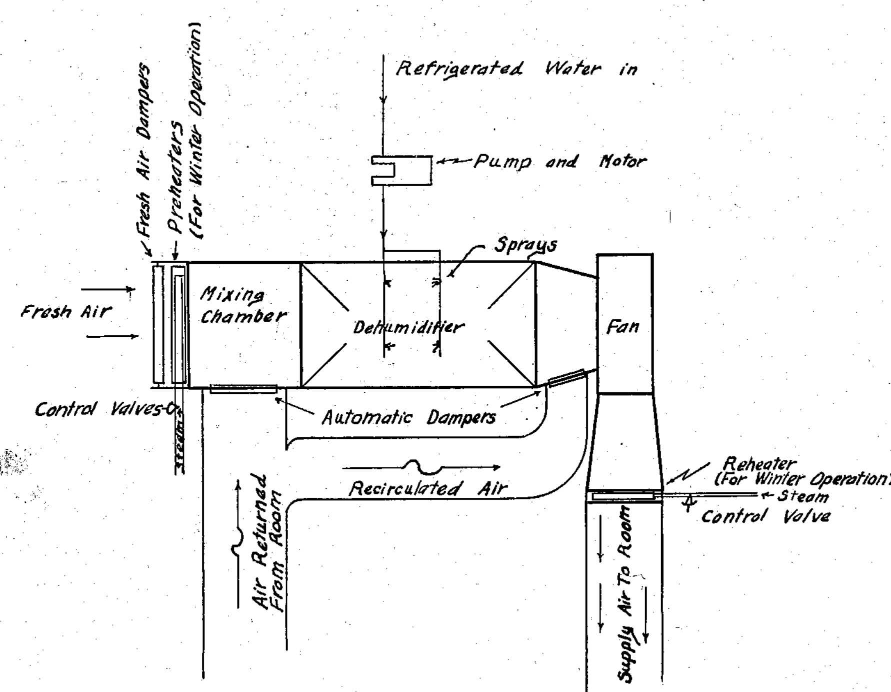
Return for a moment to the classroom wherein just for example, there are gathered 29 students and an instructor. Neglecting the fact that one may be at the board illustrating a basic fundamental and also the friction due to the rapid play of the slide rules of those following, there is enough work being generated in this group to raise the above 2,700,000 pounds about .7 of an inch. 11/16 of an inch isn't much, you say, but this is 1,350 tons; suppose we have that much coal at $5.00 per ton. In money this becomes $6,750.00; enough to buy—say a Packard Sedan, a Ford Roadster, with enough over, perhaps, to secure a Baby Austin.

As a means of explaining the above illustration, adjourn to the Minnesota Theatre where we find a gathering of about 3,000 people. Here the heat being given off would produce enough work to raise our weight 69 inches. If it is not possible to take this heat away, the air in the theatre will be heated to an unbearable and unhealthy temperature.

If it is desired to get this weight to the ceiling of the class-room we need only to utilize the work given off in heat by some 6,300 people assembled in the Roxy* Theatre in New York City. It might be possible by similar calculations to show that such a weight could be raised the entire height of the world's tallest building by converting to work

(*Continued on page 47*)

* Largest movie house in the world.




SCHEMATIC DIAGRAM OF A MODERN AIR CONDITIONING PLANT

# the world's
# Largest Airship Factory
## —the akron's home

*A business-engineering Senior takes us on a trip through the mammoth Akron, Ohio hangar in which the world's largest airship, the Akron, was constructed. Although called a hangar, the large building is, in reality, a factory. Here all equipment is designed to aid dirigible construction.*

By GUY B. ARTHUR, '32

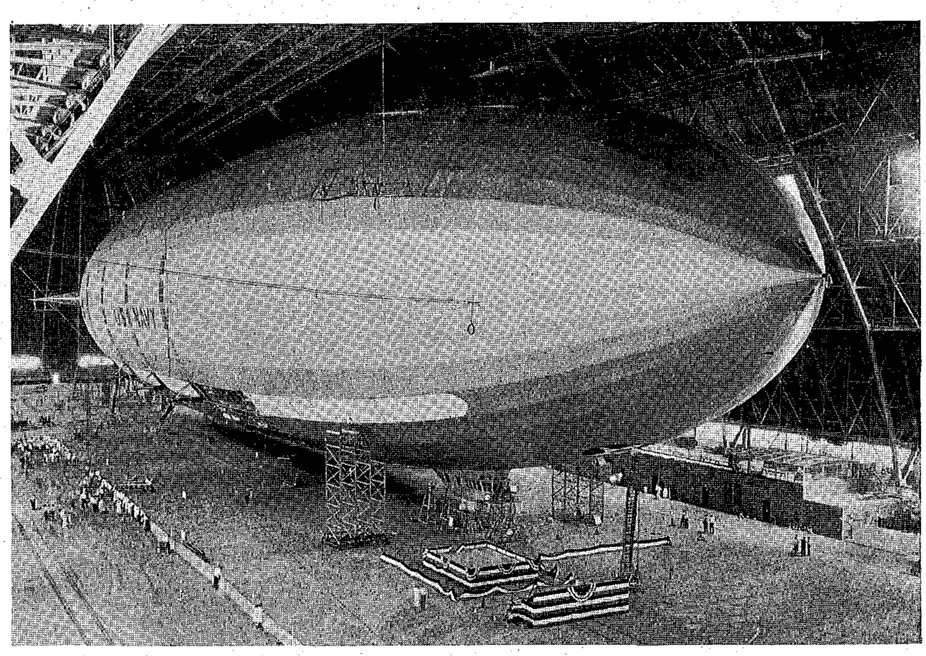
RISING triumphantly up into the sky just south of Akron, Ohio, one gazes upon what at first appears to be a mountain but, getting closer, you find a man-made structure of seemingly unimaginable proportions: 1175 feet long, 325 feet wide, and 211 feet from the floor to the platform at the top. The largest single uninterrupted floor area in the world covering 364,000 square feet. In comparison with other similar hangars it is found that the original Zeppelin hangar at Friedrichshafen is 603.5 feet long, 150.8 feet wide, and 65.6 feet high; the newest hangar at Friedrichshafen 787.2 feet long, 150.8 feet wide and 114.8 feet high; the large hangar at Orly, France, 984 feet long, 298 feet wide, and 194.5 feet high; and the largest built by the British government at Karachi, India, for the proposed England-India service, is 850 feet long, 230 feet wide, and 170 feet high.

It is often interesting and amusing to make comparisons between the size of such a structure and that of a more familiar object. For example, ten football games could be played simultaneously under the roof of this hangar. Its height is equal to that of a twenty-two story apartment building. The Woolworth building could be laid inside and there would still be room for the Washington monument.

There were 1,000,000 cubic yards of earth removed during the preparation of the site for this hangar, all of which were used to fill in the low parts of the site. Under the building itself is six feet of selected gravel and clay deposited in nine inch layers and rolled. The substructure work consists of concrete footings for the arches carried on vertical and inclined piles driven to rock, concrete ties across the building laid on the sand and clay and heavily reinforced to take the thrust from the arches, concrete door circles for supporting the rails carrying the doors which are also carried on concrete piles, a concrete service tunnel the full length and one half the width of the building, and lines of concrete docking rail supports. The piles are of the McArthur type, about thirteen hundred being required and carrying maximum loads of 30 tons each.

Perhaps the most difficult part of airship operation is the launching and docking of the ship. Therefore, it is essential that the building should cause the least practicable interference with the normal wind currents in order that the launching and docking operations may not be complicated by cross currents created by the building itself or the opening of the doors. It is this consideration which suggested the shape of this building and, as it is desirable that airships head into the wind when landing, the longitudinal axis of the hangar coincides with the direction of the winds prevailing during flying weather.

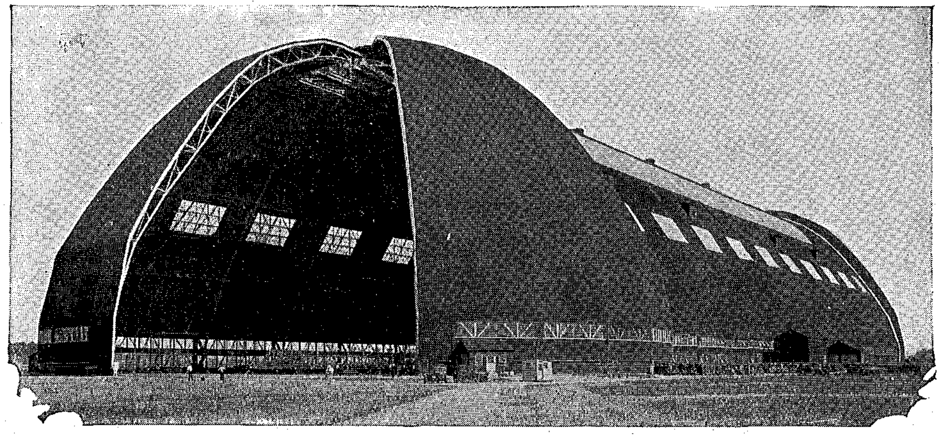
In general, the structural design as developed by William Watson and associates consists of eleven parabolic arches spaced 80 feet on center and connected by the system of vertical and horizontal trusses placed between the upper and lower cords of the arches known as the Dietz system of bracing. In addition to forming the bracing system of the structural shell, these trusses carry light trussed rafters, spaced 10 feet on center. On these are placed the Z-bar purlins 8 feet on center. At each end of the main shell are two diagonal arches 800 feet apart meeting the end arches at the pins. The doors are built up of similar arched and braced ribs. All material is of structural steel except the silicon steel chords. The horizontal thrust from these arches is



THE INTERIOR OF THE MAMMOTH HANGAR. HERE CAN BE SEEN THE STRUCTURE OF THE BUILDING AND THE ADMINISTRATION OFFICES.

taken up by reinforced concrete ties placed under the building.

One of the unique features of this design is the absence of all expansion joints. The center arches are fixed in position, while all others rest on rollers placed transversely to the axis of the structure allowing it to expand freely as a whole from the center to the ends. This allows the end arches supporting the upper door pintles, or hinges, to move laterally about four inches under the maximum range of temperature. This motion is taken up partly on the pins and partly transmitted to the doors and absorbed by the deformation of the door frames.



—"A QUARTER OF HALF AN ORANGE PEEL."

The American Bridge Company developed the unique plan for erecting the structural work of the building. This method consisted in erecting the lower sections of a pair of arches, about one hundred feet in height and eighty feet apart, upon temporary bents: placing all bracing between the arch ribs to this height; and assembling the center portion on the ground, upon a cradle, and lifting them into position by means of counter weights carried upon the side sections already erected and the drums of locomotive cranes.

The shell of the building is supported by eleven full arches and two sets of end diagonal arches. Only the center arches have fixed shoes, the balance being supported upon rockers allowing the structure to expand and contract from the center to the ends.

The erection plan involved the use of eight lines of railroad tracks, two outside the building and six inside, over which ran seven locomotive cranes, five with 50 foot booms and two with goosenecks giving each a total reach of about one hundred and twenty-five feet. Each center section erected weighed about three hundred and sixty tons. During the lifting of the center section of the arch truss the four corners were kept level by means of weighted piano wires and graduated boards which served very well as height gauges or "tell-tales."

The insulation of the roof was one of the important factors in the roofing requirements. Temporarily a strip 100 feet wide along the roof was insulated with seven-eighths inches of "Insulite" covered with tar and gravel. The roofing finally chosen met the following specifications. For the upper half of the structure, a test load of 200 pounds per square foot applied downwards or upwards with a deflection of not to exceed two per cent of the span. For the lower half of the structure a test load of 100 pounds per square foot, applied in the same manner and with the same limit of deflection. All elements of the roof were to be fastened by positive fastenings, roofing or steep section to be nailed or riveted or bolted to the steel sheathing and all clips or bolts securing sheathing to the steel purlins to be capable of withstanding a test load the same as specified for the roofing material itself.

Aside from its huge proportions the most unusual and unique features of this building are without a doubt the special doors with their hinges, supporting trucks, and operating mechanism for opening and closing. Unlike the great hangars mentioned in comparison above, which have vertical doors that open horizontally from the center outward, these are in the shape of a quarter of one half an orange peel set up on a flat surface; held with a pin at its pointed top, and resting on a set of rollers distributed under the bottom edge. Now imagine that this eighth of an orange peel is 202 feet high, 214 feet wide at the bottom, fastened or hinged at the top point with a huge hollow forged base, and you will have some idea of their size. The weight of one of these doors, without taking into consideration the snow that may accumulate on them or the wind pressure, is 600 tons or 1,200 tons for each end of the building.

These doors are mounted on trucks similar to railroad trucks. Under each leaf of doors there are forty forged steel, double flanged wheels, 27 inches in diameter, running on two rails, weighing 100 pounds per yard each, set like a railroad track and to the standard railroad gauge. The pin at the top is estimated to carry a maximum inward pressure of 550,000 pounds and 450,000 pounds outward, depending on the snow and winds. The pin is 17 inches in diameter, six feet long, and free to move four inches in any direction to allow for expansion or contraction.

Because these huge doors must be under control at all times and not subject to starting off by themselves to swing around and cause wreckage in a heavy wind, it was decided to use a "rack drive" system for operating them. These devices consist of a very large gear called a "bull gear" mounted horizontally on a fixed concrete base just outside of the dock (one at each corner of the building) and far enough to the side to leave an open yard in the front. This gear is revolved by a 125 horse power motor through a worm reduction. The worm gear reduction is selected because of its characteristic of being "self locking" so that as soon as the power of the motor is shut off, the gear stops and cannot be started again in either direction by pressure of the wind. The large bull gear engages a rack built to surround the base of the door at the bottom just above the wheels. This track is rigidly attached to the door in a vertical position. As the motor revolves the bull gear slowly, the rack is driven back and forth and pushes the door along with it. The motor is special in that it is capable of being used at two speeds with a constant torque effect. It can be connected up to drive the doors at a maximum speed of twenty feet of travel per minute or at forty, as desired.

The brake for holding is on the armature shaft of the motor and is a so-called hydro-electric brake, capable of being set with a time limit so that a second or so can be allowed for the motor to slow down before the brake begins to stop it too suddenly. Electric cut out switches are mounted on the runway adjacent to the driving units so that, as projections from the door operate them, the door comes to a slowdown and creeping speed

(*Continued on page 43*)

## senior chemical

# Engineers Turn Laborers

## —run school factory

By GEORGE FLANAGAN, Ch. E., '32

SOME years ago the wise and experienced fathers of our chemical engineering department decided that young and aspiring chemical engineers from Minnesota were not well enough trained in the practical rudiments of the industry. After some deliberation a course was designed which involved many of the problems that confront most of the men who step out into the field of chemical technology. This plan met with success and the course has been presented ever since during the summer just previous to the senior year. So it was that the present senior class of chemical engineers embarked last spring upon their first adventure in the quest for knowledge concerning their chosen profession.

Every morning the "gang" gathered in a little room to discuss the work at hand and to unravel, if possible, any difficulties which we were so adept to bringing about. As time went on it was really surprising, and not a little embarrassing, to consider obstacles and impediments which we had up to that time believed perfectly obvious and explainable. Whenever one of us was so unlucky as to be persistently bothered by some tricky quirk of nature, we were soon set upon the right path again by our able and jovial "boss." What a responsibility! It may be safely said that the "boss" had no snap.

Just before everyone began his first problem we were organized into "corporations" of two. Then came the timely advice that it might be a good idea if we wore old clothes. Here was a chance to demonstrate to our fellow laborers our traits of individuality. Accordingly on the following day a very cosmopolitan group gathered in the big lab in which all of our truly remarkable work was done. There were costumes ranging all the way between those of the black shirted Fascisti to those of the Swede from Nort' Dakota. Imagine the scathing comments and scorching criticisms.

Most of us wandered about the big lab for a while to acquaint ourselves with the large amount of equipment that had been placed there for our use. Then we were assigned to our first problem. It was a problem of crystallization which was meant to demonstrate some of the general considerations that must be regarded in order to execute the operation properly. In that respect it succeeded remarkably well for, as we struggled on,

—"OUR ABLE AND JOVIAL BOSS."

we were most emphatically reminded as to how little we knew about unit operations in general and recrystallization in particular. But weren't we proud when finally we obtained big batches of large, well shaped and beautifully colored crystals of the product we were after.

Soon after learning something about the operation of crystallization our efforts were directed to the consideration of high temperature work. Here for the first time we were confronted with the problem of regulating a furnace so that it would operate under reducing or oxidizing conditions. Memories of our experiences with the furnaces will haunt most of us for a long time. Truly did we earn our bread by the sweat of our brow and, after toiling amid the infernal blasts of those furnaces, our only relief was to go out and sit beneath the oak trees where the temperature at that particular time of summer was very close to one hundred and three in the shade.

The ordeal of the furnaces came to an end however and the "gang," not in the least subdued, were rar'in to go. So the "boss" assigned each "corporation" some good stiff problems. We were now at a stage of the game where our work involved the use of different units of equipment and combinations of the same. Here again was a chance to display originality and individuality. The equipment we had available was such that there were numerous possibilities in the way of arrangement and utility. Consequently most of the hook-ups looked for all the world like some of the more elaborate dreams of Rube Goldberg. But they worked, at least sometimes they did, and that fact brought us a good deal of satisfaction.

Apart from the actual manufacture of the various products we made, there were responsibilities which had to be met in the way of quantity and quality. To that end our work was supplemented by a certain amount of control and test procedure. This was done in a small laboratory adjacent to the big lab in which our main processes were being carried out. In some cases tests were made during each stage of the particular problem under consideration, thus affording an accurate and representative resumé of the project as a whole. There were times when some of us became so interested in cultivating our bents toward research that the chief objects of our endeavor fell into decline. That condition was usually very quickly remedied by a well directed remark from the "boss." Of course the adverse con-

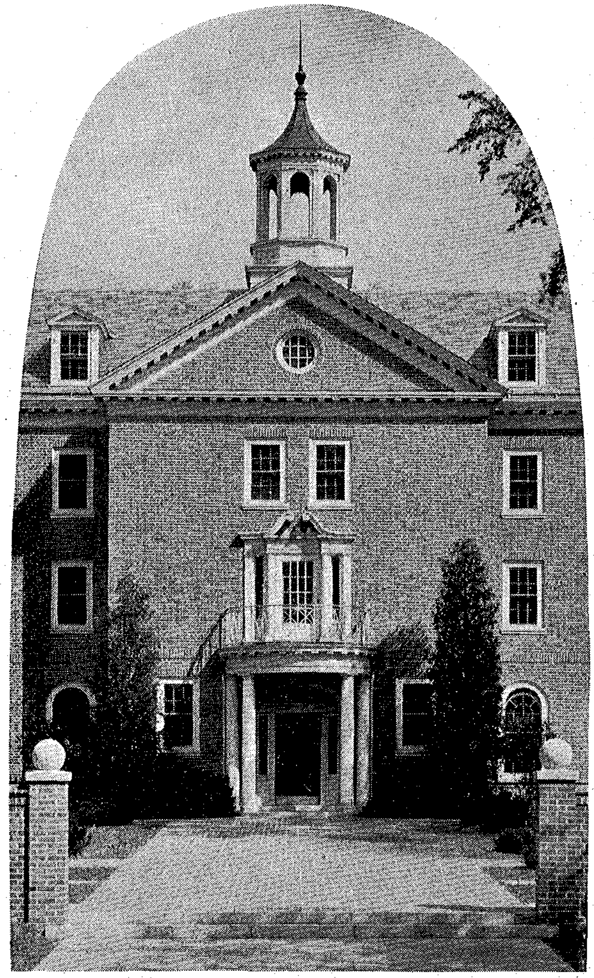
(*Continued on page 46*)

# pioneering

# In Pioneer Hall

## —the why and how

By I. O. FRISWOLD
Counselor, Pioneer Hall



MAIN ENTRANCE — HALL

PIONEER HALL is more than a dormitory— it is a residence hall for men. Those responsible for its creation conceived of it as more than a place where merely lodging and board would be supplied. Before it emerged phoenix-like above the smoke and fire of personal opposition and legal strife, Pioneer Hall was conceived to become, as it now is, the campus home of every man who resides in it.

"Bare walls do not a prison make, nor iron bars a cage"—so said the poet. Perhaps he was right, but the modern educational leader cannot, by any distortion of his imagination, bring himself to believe that it makes no difference under what physical and social conditions the male college student may live. Discerning college and university educators have come to the realization that the social life of students must receive serious consideration as an important element in the educational process. What occurs in the class-room today is as important as it was yesterday, but the educational process necessary to develop a competent, socially minded, well integrated personality has burst class-room bounds and projected itself into every phase of student environment. As a consequence, the idea that the usual rooming and boarding accommodations provided for the non-resident student are satisfactory is no longer acceptable.

Competent and progressive leadership led the University of Minnesota to discard the medieval pattern of the dark dungeon and the ascetic's cell in housing the twentieth-century scholar. Alumni and students are familiar with efforts of the University to house students in Sanford Hall and in cooperative cottages. Although the number of students thus accommodated is small, these experiments are highly significant. Even more significant is the policy of the University in extending its housing activities as exemplified by its new residence hall for men.

The physical environment of Pioneer Hall approximates ideal conditions. The structure itself arrests the eye of the observer with its attractive freshness, its pleasing proportions, and the unity and appropriateness of its colonial design. Arranged in the form of an open rectangle the structure forms an inner court which creates an impression of unity and privacy. Instead of long unbroken corridors with veritable cubby-holes arranged with monotonous regularity on either side, Pioneer Hall consists of eight units each with its special entrance, hallways, and other accommodations. The number housed in each unit ranges from 24 to 38 men who have at their disposal three types of rooms: single, double, and three-room suites. In single and double rooms, beds, wardrobes, and study facilities are provided in each room. Each suite for two men is provided with a separate bedroom for each man and a common study and social room of generous dimensions. The central section of the building contains a small but attractive lounge, the dining room, hall office, and lobby.

I. O. FRISWOLD

The physical provisions and plan of a structure may affect significantly the reactions of its residents. This fact has been recognized in planning Pioneer Hall. To better assist in the promotion of cooperative effort, the cultivation of personal friendship, and the development of much desired amenities among its residents, it consists of eight distinct units, each of which will be named after some outstanding Minnesota pioneer. Each of these physical units is also a social unit. The lounge and the dining room supply avenues for the cultivation of group consciousness, house unity and morale. It is no exaggeration to assert that the mere residence of a group of students in Pioneer Hall creates conditions which readily lead to the development of closer and mutually beneficial ties between the individual student and his university. Attractive furnishings, adequate modern facilities and cleanliness, each and all may influence student standards of good taste and student appreciation of attractive surroundings. These and similar educational outcomes can be encouraged by properly planning the physical environment of the college student. Advantage has been taken of this fact in the arrangement and furnishings of Pioneer Hall.

Social elements in student environment are even more important, it may

(*Continued on page 44*)

**Competing against a dozen other entries in the 1930 MINNESOTA TECHNO-LOG article contest this description of the radio station KSTP was awarded first place. Laddy Markus, the author, was then a junior in the electrical engineering department.**

**The MINNESOTA TECHNO-LOG yearly awards fifteen dollars as first and ten dollars as second prize for the two best articles submitted by members of the College of Engineering and Architecture and the School of Chemistry. Articles may be submitted by any student not a member of the TECHNO-LOG staff.**

**The second prize winner, a story by Richard Nickolson of the novel sewage disposal plant at Austin, Minnesota, will be published in a following issue of the TECHNO-LOG.**

# constructing A Modern Plant for twin city station

By LADDY MARKUS, E. E. '33

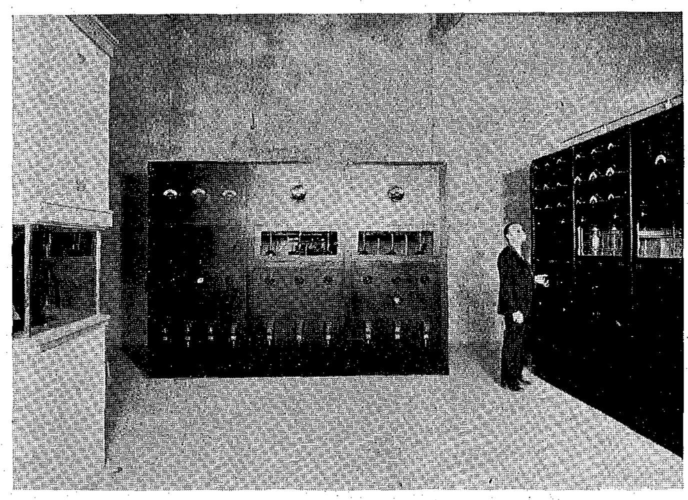
KSTP has practically completed its installation of a 50,000 watt transmitter in a new building at Westcott, Minnesota. This new station went on the air for the first time on March 28, 1931. It is not planned to use the entire capacity of the transmitter at present, but it will soon go on the air regularly at a power of 16 kilowatts.

The many outstanding features of this new station mark a great advance in the field of radio transmission. KSTP will be the only radio station of its size that has its own independent power supply, in the form of a 3-cylinder full Diesel engine directly connected to a 480 volt alternating current generator of 175 kilowatt capacity. A special spur of the Milwaukee Railroad is being constructed to transport the crude oil used as fuel for the engine. The design of this power supply is so simple that it may be operated with no more difficulty than an electric motor of equal power. In starting the huge engine, compressed air at a pressure of around 240 pounds per sq. in. is used in one cylinder to get the other two pistons moving at a speed sufficient to ignite the fuel fed into them. A single switch then shuts off the compressed air and turns the fuel on for this cylinder. The installation of this Diesel engine makes KSTP fully independent of power failure due to storms or other unforeseen events.

The transmitter, in every detail from the power supply to the new antenna towers, has been designed to give the maximum of reliability. The controls are fully automatic—the station being put on the air by the pressing of a button, through a series of relays properly timed and delayed to suit the needs of the successive operations. Likewise the entire system may be shut down by pressing a button. A special feature of the stopping operation is that the water supply to the high power tubes is kept up for five minutes after the power is off, insuring that these high power tubes, of 35 kw. capacity each, do not overheat from residual temperature.

Protective relays, automatic indicators, and pilot lights throughout, fully protect the station and give the operator due warning of faults that might shut down the station if not given immediate attention. Specially patented devices will automatically shut down the station in the event of failure of the water supply to the tubes. These devices function both on the flow and on the pressure of water, and will operate on the failure of either. Because of the large amount of power dissipated as heat in each of the tubes in the high power amplifier, it is absolutely necessary that a large supply of cooling water be guaranteed at all times.

Cooling must not be hampered by the formation of scale or sludge in the system, so distilled water is used. Distilled water is further advisable in that under service conditions it has the exceptionally high resistivity of 3,500 ohms per cubic inch. The cooling water is connected to the plates of the high power tubes through twenty-five feet of the best quality rubber hose. The resistance of this long column of water is such that, in spite of the 17,000 volt potential on the plates, a current of only .015 amperes results—corresponding to a negligible energy loss of only 250 watts. In order to take care of the cooling requirements of this water, two copper radiators of the automatic type, through which the cooling water passes, have been installed. A 42 inch multi-blade electric fan draws air through these radiators. The ducts to this fan are so arranged that the heat dissipated in the cooling water may be re-circulated through the building at will, thus providing for all heating requirements of the building in winter and all the ventilation desired in summer.



CONTROL ROOM OF KSTP. THE SOUND PROOF BOOTH IS TO THE LEFT

Absolute safety is everywhere the watchword in the operation of the transmitter. The operator can make no adjustment whatsoever on any of the high voltage apparatus without automatically shutting down the station by the mere act of entering the protective cage containing the high voltage tubes and condensers.

The experiment is shielded from lightning and the antenna field by a careful planned system of shielding. Metal laths used both on the inside and outside walls and the ceiling, and in addition, copper shielding with all sheets united by arc welding, are grounded at many points.

Although the new station is complete in itself, the old station will still be maintained, to be used in case of emergency. The control booth of the new station contains apparatus that will place the old station on the air in less than a minute, if it is necessary.

Another factor in the dependability of KSTP's new station is the interconnected network, by which any part of the equipment may be switched back and forth at will between the Power Company's lines and the Diesel engine power supply.

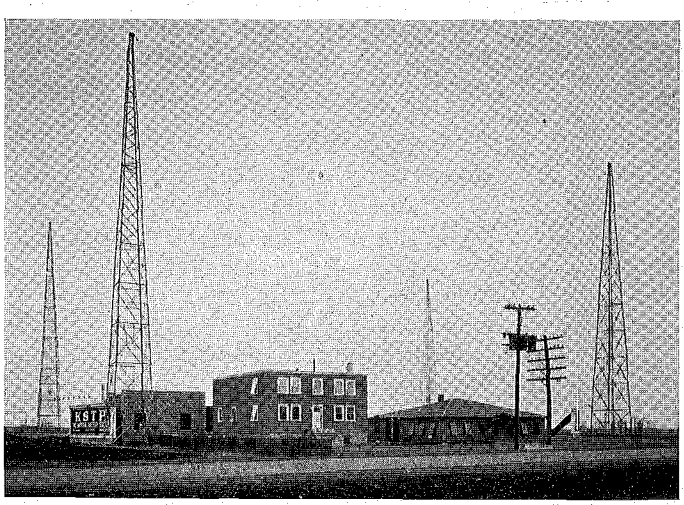
To supply the high voltage necessary for the plate, three 85 k.v.a. transformers are used, converting 440 volts a.c. to 17,000 volts a.c. Two large choke coils, a condenser bank, and a large resistance are used to regulate the load. This alternating current is changed to direct current in a high power mercury arc rectifier. Under normal operation of this rectifier, dangerous and destructive flashbacks occasionally occur, especially under heavy loads. Automatic relays and special resistors of the proper value were developed, so that in case of flashback, the station is kicked off the air and back on in such short time that it cannot be noticed by listeners. Ordinarily, it takes from thirty to ninety seconds to get back on the air after a flashback.

The principal tube used on the high power stages has a filament rating of 61 amperes at 21 volts and a normal plate voltage of ten to twenty thousand volts. The temperature rise of the cooling water through the tube is 75 degrees F., and the maximum allowable temperature is 170 degrees F.

A synchronous motor generator set is used to furnish current for the filament and plate of the tubes regulating the frequency on which the station operates. The quartz crystal is kept constantly at a temperature of 140 degrees F. by sensitive temperature control apparatus, using a mercury thermostat. The entire frequency control apparatus has been so carefully designed that the operating frequency will never deviate more than two cycles from the assigned frequency of 1,460,000 cycles. A clock driven by a quartz oscillator, having an accuracy of 1 in one million, is used for frequency comparisons. By adhering so closely to the assigned frequency interference will be avoided giving to KSTP practically all the advantages of a cleared broadcast channel.

WORKMEN INSTALLING THE NETWORK FOR GROUNDING THE STATION

The sound proof control booth of the new station will be in itself a masterpiece of engineering achievement for from this room every piece of apparatus will be supervised. The tonal quality of the program can be judged at all times in this booth with no interference from the sounds of the transmission apparatus. Adjoining this booth is a studio room equipped with a microphone and a phonograph. Programs may be broadcast from here, in case of accident to the lines to the studios. However, if the lines to the studio should be down for a long time, the programs would be broadcast from the regular studio over a short wave transmitter, picked up by a short wave receiver at the station, and rebroadcasted with no loss in quality of speech or music. This short wave arrangement was last used at the National Golf Tournament at Interlachen, where KSTP picked up the event for the National Broadcasting Company.



THE NEW TRANSMITTING STATION AT RADIO CENTER, MINNESOTA

A short transmitter is also installed at the new station. According to tentative plans, this transmitter will be used by the government for air transportation.

The new towers also represent the highest developments of their class. The towers, which are 165 feet high, are entirely insulated from the ground. At present a cage type antenna is being used, but the final type is not yet determined. Careful signal measurements are being made, with different aerials, to determine the ideal antenna.

Three feet under ground around each tower are two circular copper ribbons, one 60 feet, and the other 120 feet in diameter. Sixteen copper spokes connect these two ribbons, and at each intersection, a rod is driven into the ground to ground the ribbon. By this method, the best possible ground is maintained at all times. The new antenna is connected to the station through a 400 foot transmission line.

KSTP's new station will go on the air regularly as soon as the apparatus has been thoroughly tested and adjusted for maximum reliability. For the time being, the station will operate on 16 kilowatts.

One hundred per cent modulation is obtained in the new station, so at 16 kilowatts it will give over six times the effective power of the old transmitter, which has 50% modulation at 10 kw. It is readily seen that a great advantage accrues from increasing the per cent of modulation.

(*Continued on page 42*)

# THE MINNESOTA TECHNO-LOG

## UNIVERSITY OF MINNESOTA

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## Books! Old Books!

EVER since its establishment, the Engineer's Bookstore has not handled second-hand books. And what an inconvenience that arrangement was for the engineer. He could sell the old books he happened to have, but it sometimes took days before the buyer was contacted. And likewise, the purchaser was handicapped for several days by the lack of that particular book.

Now the Engineer's Bookstore has started a department for the sale of these old books. It is undoubtedly to the store's advantage. The present arrangements call for a slight profit for the store on each book sold. Then too, each sale attracts an engineer to the store.

This second-hand bookstore should not affect their sales of new books. Heretofore the engineer has been able to dispose of his books, although a little time and trouble was necessary. Also, many engineering books are kept by the student for his private library and consequently not placed back into circulation. For the students' sake let us hope that these predictions are not false.

## "Fritz"—Our Man

COACH "Fritz" Crisler has indeed won our respect. He came to Minnesota last year with the unpleasant prospect of trying to shape a respectable football squad from the poorest of material. Not only that, but he had to satisfy an exacting student body. The first year he produced a fairly good team. Nothing exceptional, but still a little better than we had hoped for.

But Mr. Crisler's second year! He has produced a team which, according to pre-season "dope," should have tied for the Big Ten "cellar" championship. This squad ruffled Stanford, then trod roughly over Iowa. The Badgers were the second Big Ten team to fall before the fast improving Gophers. And now that same "cellar" champion squad has severely mauled the Wildcats. I say, "Hats off to Crisler!"

But the best thing about Crisler is not his team. It is his method of developing that squad. Starting with a handful of raw recruits and without making an effort to attract outstanding outsiders he has taught them all the football they know. He didn't bring football players to this university. Coach Crisler made football men of the students already here. And such a method undoubtedly is of greatest value to the student body.

Yes, we like Coach Crisler. Win or lose—we're for him.

## Engineers and Initiative

INITIATIVE, which has long been considered one of the most important components of success, is well on its way to extinction if the progress of our civilization continues in its present direction.

That initiative which has brought success to American business and engineering during the last two decades is now almost a quality of the past. Every year the American is becoming more satisfied with himself and consequently will not exert any effort by way of doing more than is required by the circumstances. Every year more laws are made to control the liberties of the citizen in school as well as in the country at large. Now the situation is diametrically opposite from that of twenty years ago. Now the citizen is not credited with enough common-sense to be able to actually manage his own life. A thousand and one regulations are decimated through as many agencies in an attempt to keep the citizen on the "perfect" path.

Educational systems have followed the general trend of the country at large. Certain regulated amounts of work are required from each student and, as a consequent result, real effort of the "self-starting" kind on the part of the student is regulated to an inconsequential position. If one delves into the matter, it is evident that some professors have made an attempt to rectify that fault. No daily work is required or assigned. The whole matter is placed up to the student's own initiative and working-ability. It may be that this method would produce fewer graduates, but regardless of the number, the quality of work and the interest of the graduate would be much improved over that existing in the present technical graduating classes.

One of the most important questions reiterated again and again by men in business is, "Is the fellow a self-starter?" In other words has the graduate initiative, the quality that means success in any field of endeavor? Since initiative is of prime importance, it behooves the student to take cognizance of his every-day endeavors and eradicate those things which tend to destroy that quality. Make it a habit, not an exception, to do a little more work than is required each day. Make an effort to participate in some activity in which success is dependent to a great extent on your own moving-interest.

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*Are you a member?* The Minnesota Techno-Log, although one of the largest college engineering magazines, has one of the smallest staffs.

# « « « SLIP STIX » » »

## hiking with buns and puns

NOW that autumn is here, it is altogether fitting and proper that engineers demonstrate their skill with other things than a slide rule. For instance, building a fire on the banks of the tranquil Mississippi and then roasting wieners to a bursted, sizzling brown. Suiting said thought to action, two worthy followers of St. Pat and two other friends (the kind that wear Princess Eugenie hats) put their heads together and had a mild brainstorm. When the clouds cleared away, these four campers emerged from their huddle with a plan to cook their supper on the banks of that mammoth creek known as the Father of Waters.

Arriving at the scene of their fiery powwow, the outdoor fiends built their fire and cooked (that's stretching the meaning a little) their supper. Someone mentioned the buns were dry, whereupon a pal said that was a rather crumby remark. Someone else thought the pickles ought to be passed, but another pal spoke up and said it seemed like a sour thought to him. Suddenly someone asked somebody else how old was that somebody else? Quick like a mosquito one of the pals said to never look a horse in the mouth. Well, a few more remarks like this and the party had to break up or the participants split their sides. Fortunately, or maybe unfortunately, everyone decided that it ought to be the party which should break up.

Now the moral of all this is: try a similar expedition yourself—it's bound to make you happy and is guaranteed to clear those cobwebs out of that overworked brain. But don't wait till winter comes. Just write down the word "Mississippi" and remember, that's a lotta "i's" in the winter time.

## satire?

Hear Ye—Hear Ye—Hear Ye—and other similar expressions to lend thine ears. This section of our monthly publication is brand new. It is not a funny page, neither is it a compilation of wise and sagelike anecdotes. But it is a bundle of human interest stories in which there will be an attempt made to incorporate a little wit, humor, satire and news. *You* can very materially aid in its success by writing a few lines about some incident you might witness but which probably would be missed by us. Just drop your epistle in P. O. 8535 and you will immediately receive 2 free tickets to the hog callers bawl which has been called off on account of the shortage of pigs.

Thanx!

## about electricity

Sparking is not only confined to park benches, river banks, lake fronts and spark plugs. Recently one electrical wizard was explaining to his eager class the precautions necessary in operating electric motors. Said he, "When you turn on the current, be sure to have the shunt field current on. If you should accidentally pull it off, the armature will turn at a helluva fast rate, the commutator bars will probably fly off, and you'll get a high pitched hum, like a ladies aid society of bumble bees. The machine will probably whirl itself to pieces and you'll run for cover whether you know anything about electricity or not." After some further admonitions for care and tales of dire consequences should instructions go unheeded, the worthy instructor paused for breath. In the slight interim, one student suddenly sat upright in his seat and chortled, "Uh—now what was that again?"

## guns, chaps, and the west

Cowboys, broncho-busters and bull throwers may have originated in the wild and fleecy West, but Minnesota has its own thrower of the male cow. As a rodeo cowboy stalked into the Union one day, one of our own Westerners was reminded of the days he used to fork a bronc. He told how he had a hat that cost $12.00. Then he remembered a pair of chaps which had set him back over $100.00. Yea verily, he had once owned all kinds of expensive cowboy attire. Swelling with pride, he told about the nice shirts he had worn. When he had worked himself up to a high state of self importance, some yokel across the room inquired, "Say, pard, how much did yuh pay for yore underwear?"

## worthy ambitions

Everyone has a secret ambition. One student recently remarked how austere and quiet the Physics and Mines buildings seem. Nothing like the Chemistry building. In Physics and Mines one almost has to walk on tiptoe to avoid criticism, while in the other Engineering buildings you can just be yourself and walk and talk as you like—so said the philosophical engineer. Maybe it was the Rodeo atmosphere, but anyway this student claimed he would give his little finger-nail for enough nerve to go into the Physics building and beller and shout "Whoopee" and other such expressions of don't-carishness at the top of his voice. What an ambition. But wouldn't it make the day doubly complete if he were to also run and slide down the front hall on second floor while smoking a couple of cigarettes, one in each hand?

## buttons and buttons

Feminine saleswomanship smacks of high pressure when Homecoming Buttons go on sale, for many sales resistance excuses are offered by fast thinking students. One swarthy engineer, when accosted by a diminutive coed, replied in a forlorn voice—"I bought a button this morning, but some one took it off my coat." Perhaps sound advice to the baffled exponent of the slide rule would be to bend over the end of the button pin after fastening it on the coat so no long fingered classmate could remove it. But then—could the button owner remove it himself? Maybe it's not such a sound engineering project after all. Anyway, Homecoming is over till another year, so all this advice is about as useful now as a rumble seat in an Austin. But give it thought, brethren, give it thought.

## ketch on?

Author: Now if we close the switch, we'll get a powerful flux induced, won't we?

2nd Drunk: Naw, not very much. How d'ya figure?

1st Ditto: Oh, yes. There will be just flux and flux.

# AROUND THE WORLD WITH OUR ALUMNI

## *Architecture*

'26—Lighter—Clyde Lighter, formerly located in the office of Ellerbe & Company in Cleveland, has been relocated in their office in St. Paul and says he is glad to be back.

'26—Nelson—Neil Nelson has given up architecture for the present having taken a more lucrative position with the Rye Krisp corporation of St. Paul.

'27—Stolte—Sidney Stolte is at present working with the firm of Magney and Tusler and their designs for the new Minneapolis post office.

'29—Hovik—Larry Hovik is one of the few to have been retained by Ellerbe & Company of St. Paul, and is naturally justifiably happy.

'29—Santo—Louis Santo and Harold Fridlund, '30, are "architects" for the Minneapolis School Board. "Friddy" says they have things "pretty well sewed-up."

'29—Leach—Stowell D. Leach and wife were mighty proud and happy to announce last August the arrival of little Janet Helen Leach, who seemingly likes her new home. "Stow" is employed by General Bronze Company, Minneapolis, as a designer-draftsman.

'29—Redmond—Fabian Redmond, erstwhile "pug and pigskin tosser" for the "U," has taken for a bride Lila Modine. "Red" is superintendent of construction on a new school building in Brainerd, Minnesota, working for Craft and Boerner, architects of Minneapolis.

'29—Shifflet—Glynne Shifflet recently passed the cigars to celebrate his captivating engagement to Flora McCulloch of Minneapolis. "Marriage dependent on depression," says Glynne.

'30—Hanson—Edward Hanson, after spending the summer as designer-draftsman for a home building contractor of Minneapolis, is now working in the same capacity for Fairbanks, Morse & Co. of St. Paul.

'30—Wallace—Bruce Wallace was for a time in charge of the Eau Claire, Wisconsin, offices of Lang, Rangland, and Lewis, Minneapolis architects. Bruce is now living in Minneapolis and has been married to Velva Lindahl since September.

'31—Bergstedt—Milton Bergstedt, who was well known as art editor on the staff of the The Minnesota Techno-Log, is at present employed by Lambert Bassindale, architect in St. Paul. Milt is associated with the designing and drafting for the new St. Paul post office.

'31—McMahon—Sherman McMahon and Gene Gray are now connected with the Minnesota State Highway department —"lucky to have a job," as they say.

'31—Barber—Edward Barber is at present eking out sheckles from the architectural firm of Ekman, Holm, and Company of Minneapolis. Ed filed papers of incorporation for life with Lola Voightlander, '29, of Lake City, Minnesota. They are living at 234 North River Boulevard, St. Paul.

—*Rentschler Studios.*

RALPH W. HAMMETT

'19—Hammett—Ralph W. Hammett has received the appointment of Associate Professor in the architectural department of the University of Michigan.

Ralph received his B.S. degree in Architecture from the University of Minnesota in 1919. He was draftsman for Toltz, King, and Day of St. Paul in 1919 and 1920, and for the following two years he was instructor in the architectural department of the University of Minnesota. While he was Associate Professor of Architecture at the Washington State College, he was awarded the Robinson Travelling Fellowship at Harvard, and he received his M.S. degree in Architecture from Harvard in 1923. In 1926 Mr. Hammett was chief designer for Hall, Lawrence, and Ratcliffe, an architectural firm with offices in Chicago. Ralph was also a member of the faculty of the Armour Institute in Chicago.

Among Mr. Hammett's works on architecture is "Romanesque Architecture of Western Europe."

## *Chemical Engineering*

'14—Gauger—W. A. Gauger is now the head of the chemical engineering department at Pennsylvania State College. Dr. Gauger was formerly director of the Division of Mines at the University of North Dakota.

'26—Thompson—Warren L. Thompson recently returned to Minneapolis to visit some of his old friends and acquaintances about the campus. During his stay Warren addressed the junior and senior classes in the School of Mines upon some of the modern practices involved in the refining of petroleum. At the present time Mr. Thompson is the chief chemist in the plant of the Mid Continental Petroleum Corporation at Tulsa, Oklahoma.

'29—Kobe—Kenneth A. Kobe, who receiver his doctor's degree in the spring of '29, has accepted a position on the faculty of the University of Washington. He is now engaged in teaching industrial and engineering chemistry.

'30—Beyer—Fred Beyer, in company with two other graduate students, traveled through the East just before resuming his duties as an assistant this fall. Fred attended a meeting of the American Chemical Society held at Buffalo, New York.

'31—Pemble—Carl Pemble is becoming a regular family man. He is the proud father of a bouncing youngster born last August. Carl completed his work for the bachelor degree while working as a chemist in the plant of the Waldorf Paper Products company in St. Paul.

'31—Yohe—Dr. Robert V. Yohe has joined the research staff of the Goodrich Rubber company. Dr. Yohe served as an assistant in the School of Chemistry while studying for his doctor's degree.

## *Interior Decorating*

'30—Thian—Helen M. Thian, who was graduated here with a degree in Interior Architecture, is now working with her classmate, Inez Wood, at the Northern States Power company's Model Home.

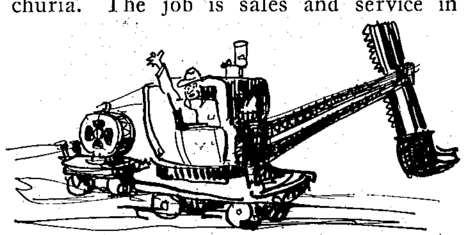
'31—Johnson—Beatrice Johnson is in charge of the redecorating of the New England Furniture company's Model Home in Minneapolis.

'31—Espeland—Bertha Espeland has a position in the drapery department of Powers department store in Minneapolis. She is living at 3205 41st Avenue South, in Minneapolis.

'31—Betlach—Elvira Betlach is at work for A. Lorria, in Minneapolis.

## *Electrical Engineering*

'26—Barron—John H. Barron is at present associated with the Marion Steam Shovel company of Marion, Ohio, as Eastern Representative. John's headquarters are at Tokio, Japan, and Dairen, Manchuria. The job is sales and service in



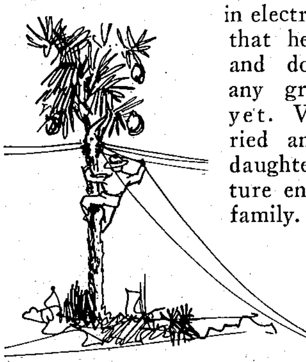
China, Japan, Philippines, and Singapore. John has been visiting his home at 5403 46th Avenue, Robbinsdale, Minnesota, for a short time. Mr. Barron adds that he is with the Marion Company because the shovels are now eighty per cent electric or diesel electric.

'08—Sturtevant—Percy C. Sturtevant is still with the Erie County Electric company, Erie, Pennsylvania. Mr. Sturtevant writes, "Just finishing my twentieth year with this company—six as Meter superintendent, seven as engineer, seven in charge of operation and construction. The Erie County Electric company is one of the pioneer organizations of the country since it was chartered in 1886. It is, since May

1929, a subsidiary of the United Gas Improvement company of Philadelphia. Erie is normally a good town to live in, about 115,000 population, industrially diversified, beautiful harbors and beaches in the center of the fruit belt, handy to good hunting country of western Pennsylvania, and last, it is only thirty miles across the lake to Canada.

'23—Engstrom—Elmer W. Engstrom is at present with the Radio Corporation of America, Victor Corporation, Camden, New Jersey. Elmer is in charge of engineering development work on radio receivers. The Engstroms drove from the East last summer to visit their respective families. The Engstrom home is at Haddenfield Manor, Haddenfield, New Jersey.

'20—Carlson—Victor Carlson, who is with the Chile Exploration Company, Tocopilla, Chile, as assistant to the Electrical Superintendent, writes that he is engaged in electrical work and that he is not bald and does not have any gray hairs, as yet. Victor is married and has one daughter and no future engineers in the family. His pet hobby is driving a 30-61 Buick sedan about the Pampas, but is interested in tennis and golf as a pastime. Mr. Carlson states that E. H. Knowles '20 is still with this company but is located at Chuquicamata, one hundred miles from Tocopilla. Victor continues, "No jobs are available, but there is lots of fishing and I manage to raise a few flowers and vegetables in this place where it never rains." Mr. Carlson has provided himself with protection against lonesomeness for the "old gang" by subscribing for the TECHNO-LOG for five years.



'23—Forbes—Henry C. Forbes writes, "J. O. Barton, H. T. Tholstrup, and I are with the General Motors Radio Corporation and we, with former Professor E. R. Martin, have frequent Minnesota 'get-togethers.' Mr. Martin is with the Delco Products Corporation, also of Dayton. The Martins boast of two boys, the Tholstrups and Forbes have one, and the Bartons a cat."

Henry's home address is 1100 Broadview Blvd., Dayton, Ohio.

'26—Lostrom—Herbert Lostrom is back from the West where he has been working for the Northern Pacific Railroad. He was recently made special engineer for the North Pacific Railroad and as such is in charge of all the company's power plants. His office is now in St. Paul. Hub's residence is at 616 Lincoln Avenue, St. Paul.

'26 — Tholstrup — Henry Tholstrup whose home is at 905 Sunnyview Avenue, Dayton, Ohio, recently visited the campus. Henry was surprised at the great change and manifest progress. "The campus now has an exceptional atmosphere for students and the betterment of their ideals," Mr. Tholstrup opined.

Henry is connected with the General Motors Radio Corporation in the Radio Engineering Department.

'26—Nimmer—Walter B. Nimmer is now assistant superintendent of electrical distribution, Wisconsin Power and Light Company, with offices at 529 North 8th Street, Sheboygan, Wisconsin. Walter is married, but he says that there are as yet no future engineers in the family. Mr. Nimmer's home address is 1206 South 17th Street, Sheboygan, Wisconsin.

'28—Brown—Glen Brown and Jean Felton were married in York, Nebraska, and are now at home in Milwaukee. Glendon is employed with the Cutler Hammer Manufacturing company.

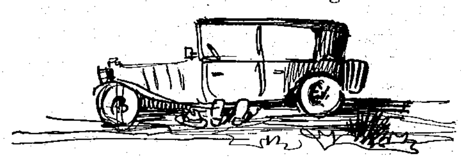
'29—Anderson—Arnold Anderson and Ann May were married in Pittsburgh in August, and for their honeymoon made a trip back to Minnesota. Arnold is with the Westinghouse Electric company.

'30—Wherland—Fred Wherland and Belle Allen, who were married May thirtieth, kept things a secret until Fritz passed the cigars recently.

## *Mechanical Engineering*

'98—Wright—Stevens Institute of Technology, at its commencement exercises on June 6, conferred the honorary degree of Doctor of Engineering upon Roy V. Wright, managing editor of the *Railway Age* and president of the American Society of Mechanical Engineers. The citation of Mr. Wright's accomplishments reads as follows:

"Roydon Vincent Wright.—Mechanical Engineer, whose practical experience in railway engineering has during twenty-seven years expressed himself through his work as an author, publisher, and editor, whose sincerity and clarity of thought has given him a place of unusual significance among the interpreters of an age determined by mechanical achievement, who as President of the American Society of Mechanical Engineers now presides over the affairs of a great fraternity of engineers founded within our college walls."



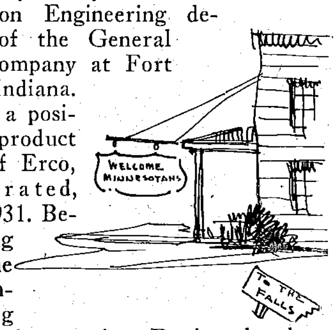
'10—Johnson—Leonard T. Johnson is assistant steam engineer with the Grasselli Chemical company with offices at 1400 Guardian Building, Cleveland, Ohio. Leonard writes, "I am engaged in power work in the chemical industry. Am married and have six children with the possibility of two engineers. My hobby, if any, is a Studebaker which receives a good bit of attention. I have not taken up golf as yet even though I am a bit gray. I hope to be in Michigan rooting for the team on November 21st."

'10—Frear—J. B. Frear writes that he enjoyed a luncheon early in September at the Minneapolis Athletic Club which was kindly given by my classmate Fred Comb. There were present Messrs. Professor Shipley, G. A. Du Toit, M. B. Moyer, and F. R. Comb. Mr. Comb was a visitor in Chicago and Washington recently.

Mr. Frear is engaged by the Don L. Quinn company as a designer and tester of shipping containers. His home address is 2239 Asbury Avenue, Evanston, Illinois.

'20—Odegaard—Harold Odegaard is at present living at 908 South Main Street, Aberdeen, South Dakota. He produces the "living energy" by running the Aberdeen Round House for the Chicago, Milwaukee, St. Paul and Pacific Railroad. Harold states that Mr. Lende visited him some time ago and that he is the same old Lende he used to be.

'29—Shannon—Harold Shannon writes to resubscribe for the TECHNO-LOG for five years. Harold has been doing things, "Spent nearly two years in the Refrigeration Engineering department of the General Electric Company at Fort Wayne, Indiana. Accepted a position with product manager of Erco, Incorporated, May 11, 1931. Before starting I talked the president into giving me two weeks vacation. During the short two weeks I married Miss Alice Montgomery of Grove City, Pennsylvania. Our wedding trip included a visit to the campus of the alma-mater and tour of Northern Wisconsin.




"Our home is at 299 Nassau St., Kenmore, New York. We are only fifteen miles from Niagara Falls and are always at home to Minnesotans."

'30—Johnson—Elmer Johnson was back to witness the Homecoming game and dropped into the Mechanical Engineering office. He is employed as a master mechanic in a packing plant in South Dakota.

'31—Grant—Irving Grant is employed by Northern States Power of St. Paul running tests on boilers and such apparatus and is living at 1227 S. E. 4th St., Minneapolis, Minn.

'31 — Giese — Howard Giese returned for the Homecoming celebration and dropped into the TECHNO-LOG office to see some of the boys. He is in the heating and ventilating business with his father at Mitchell, South Dakota, and his address is 118 E. 1st Avenue in the same city. Last spring Howard was awarded the first prize for his seminar paper by the Twin City Branch of the A. S. M. E. He has consented to write an article for the December TECHNO-LOG on welded piping.

'31—Jordre—W. S. Jordre is traveling for the Babcock and Wilcox company in Ohio and is believed to be somewhere near Akron at the present time.

'31—Nordeen—Harold E. Nordeen has been working under the directorship of Professor Koepke on the Industrial Survey sponsored by the National Unemployment Committee. His office is in the Northrop Auditorium of the University of Minnesota.

'31—Whaley—F. J. Whaley, O. J. Wiggins and T. P. Sawyer are also working on the Industrial Survey. A future issue of the TECHNO-LOG will contain an ar-

(*Continued on page 42*)

# NEWS FROM THE TECHNICAL CAMPUS

## *Senior Engineer Heads Minnesota Cadet Corps*

Forton A. Christofer, engineering senior, who at the 1931 military review last May was awarded a saber for demonstrating the greatest proficiency as a platoon commander, is now cadet colonel, highest student officer in the advance corps of the R. O. T. C., by appointment of Major Hester.

Major Hester announced the selection October 15.

Other appointments in the advance corps were announced at the same time.

Russel F. Erickson and Clifford J. Hauge, engineering seniors, were appointed cadet lieutenant colonels in the coast artillery corps and signal corps, respectively.

Robert Lommen, signal corps, was appointed cadet assistant adjutant with the rank of major.

Arthur Johnson, Harold Anderson, and Richard Thomson were appointed majors in the coast artillery corps; Lowell Parker and Paul Markson, majors in the signal corps.

## *Mechanicals Visit Riverside Power Plant*

The Student Branch of the American Society of Mechanical Engineers made an inspection trip to the Riverside power station of the Northern States Power Company on November 4. The students were conducted through the station by representatives of the company, and were shown just how electric power is obtained from coal. The huge steam turbines and the highly efficient boilers proved the most interesting features to the mechanical engineers.

The present officers of the organization are: C. O. Anderson, president; M. C. Knight, vice-president; Neil Macdonald, secretary; A. E. Lilja, treasurer, and Professor Robertson, faculty adviser.

Committees appointed for the school year include: membership — Willis Smith, George Mooney, John Appert, Roy King, Don Leslie, Francis Hammerski, Otis Mueller, Edward Kells, and Russell Johnson; program—James Dowd, Roger Hayes, and Milford Juten; entertainment — Gayle Priester, Russel Erickson, and Forton Christofer; publicity—Maurice Norton, Thomas Rogers, and Philip Hedback.

## *Artillery Fraternity Initiates Seven Men*

Seven new men were pledged November seventh by the Minnesota battery of Mortar and Ball, national artillery fraternity. Six of the new initiates are first year advanced corps and one initiate is a second year advanced corps man. Alan M. Bruce, Le Roy Du Bruce, Harold Foefer, Harold Mattlin, Earl H. Ruble, and Raymond J. Weidlick are the first year men and Laddie Olexa the second year man initiated.

Other appointees to the Coast Artillery corps were, cadet captains: William Budge, Maurice Norton, Mirza Gregg, Alan Hutchins, Wilfred Darling, Ray Warner, C. Waidelich, and George Johnson; Cledo Brunetti, Earl Hanson, Scott Linslet, John Huey, and Wilbur Schorr were appointed cadet captains for the Signal Corps.

## *Station WLB Installs New Transmitting Equipment*

WLB, the University of Minnesota broadcasting station, has installed a new amplifier to its transmitting equipment.

The new equipment is installed in the control room of WLB, on the third floor of the Electrical building. A mercury vapor rectifier, mounted on the same panel with the amplifier, and auxiliary transformers give voltages of 140 volts direct current and supplies the three stages of amplification.

WLB now has remote control facilities available in the Music Auditorium, the Northrop Auditorium, the Stadium, the Field House, and the Minnesota Union. When broadcasting from any of these places, a portable amplifier is used to amplify the signals from the microphone, before they are brought by telephone wires to the control room in the Electrical Engineering building. Here the signals are sent through the new amplifier. The signals now go by wires to the transmitter on the golf course and after being again amplified and modulated in the transmitter, they are put on the air.

Improvements have been made on the transmitter, which is located next to the University golf course. A Volume Indicator, together with a Monitoring Amplifier, has been added to the transmitting equipment to check the quality of the broadcasts.

A new ground system has also been installed at the transmitter this summer. Twelve hundred square feet of copper screen were buried three feet underground directly under the center of the aerial wires. The two foot strips of wire screen were laid across each other to form a grid network, with firm connections made to each strip, to insure the best possible contacts.

## *Gomberg, A. C. S. Head, Addresses Chemists Here*

Dr. Moses Gomberg, president of the American Chemical Society, delivered a lecture on the chemistry of the free radical on Wednesday, October 14, at the Chemistry auditorium.

According to Dr. Gomberg the radical is a part molecule but is not necessarily charged. The cyanide radical was first isolated by Lavoiser. Bunsen followed him 21 years later with the free Ethyl arsonite radical and in 1860 Franklin prepared the free Ethyl radical by the action of sodium metal on ethyl iodide.

In addition to this work on the free radical Dr. Gomberg, who is professor of organic chemistry at the University of Michigan, has made a study of trivalent carbon.

Because of his research on quino-carbonium salts, tautomerism in triphenylamine series, ethylene chlorhydrid, and many other compounds, Dr. Gomberg is recognized as one of the country's foremost organic chemists.

## *O. P. Cleaver Addresses Engineers, Architects*

Mr. O. P. Cleaver, Divisional Engineer for the Westinghouse Electric Company, will discuss European lighting practices before a joint meeting of the electrical engineering, interior decorating, and architectural societies on November 19. Mr. Cleaver has recently returned from the International Conference of Illuminating Engineers in London. He will show slides illustrating the most recent developments in illumination engineering.

Mr. Tyler, construction superintendent of the recently completed First National Bank building in St. Paul, gave an address before the Architectural Society on November 4. The many problems which confronted the builders of this skyscraper were discussed.

## *Frosh Clean Sophs to Win Annual Battle*

Shirts were ripped, faces scratched, and in general a good time had by the Freshmen and Sophomores of the College of Engineering on Saturday, October 17th.

When the men lined up, the Freshmen were picked to win by a good margin. It seemed as though all the Freshmen had turned out to uphold the honor of their class. But—the Freshmen met a group of men who had received experience the year before, who gave them a good battle, although they were outnumbered. Everyone entered the scrap wholeheartedly.

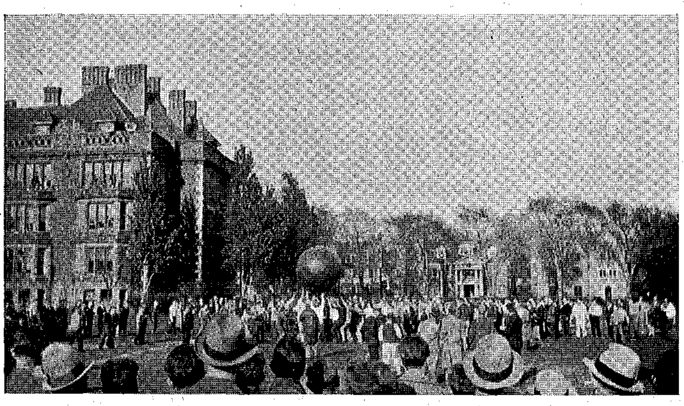
The first event was the sand bag race. It was a lively fight, and a good bit of damage was done to the participants. Practically all the men came out with dirty faces, muddy clothes, and a little less skin. The point of this race was to carry the water-soaked sand bag over the opposite team's goal line. The Freshmen received the most points for this event.

The next skirmish was with men riding pick-a-back. The man on top tried to knock his opponent off the back of his partner. Five or six pairs were matched here. The Sophomores came out on top this time.

The men in charge of the scrap then allowed a few minutes time for the teams to catch their breath before rolling the giant pushball out. The men lifted it up above their heads, and upon a signal the fun began. The great ball was moved backwards and forwards a little at a time. The teams appeared to be matched quite evenly here. The Sophomores persisted, though, and seemed to make more progress than the Freshmen.

The horizontal greased pole was great fun—for the ones looking on. The iron pipe was supported on either end by wooden posts, which raised it a foot or two over the heads of the spectators. The pole was well covered with a heavy, thick grease. Two men, a Freshman and a Sophomore, sat on either end of the pole, facing each other. Each man was given a piece of burlap with which to hit the other man. The idea was to hit the opponent unexpectedly, causing him to lose his balance, and of course he was generally unable to right himself, because of the presence of the slippery grease. The Sophomores received the most points for this.

The most important event on the program is always the tug of war, which proved to be exciting as usual. A heavy rope was used, with the stream of water from a fire hose as the center line. It was a cold day too! As he did last year, one of the big Sophomore men tied the end of the rope around his waist, and then braced himself for the pull. The men on the Sophomore side pulled rhythmically, counting with a sing-song rhythm which was quick, short, and effective. The Freshmen went through the stream of icy water.



PUSH AND PULL. C'MON, GANG, LET'S MAUL 'EM! THE FRESHMEN AND SOPHOMORES TRY TO MOVE THE BALL IN THE CLASS SCRAP.

## *Bookstore to Handle Second Hand Books*

A new policy has just been established by the Engineers Bookstore which will meet with widespread approval on the part of all students in Engineering, Architecture, and Chemistry. This consists of a plan for handling used textbooks, and is referred to as the Engineers Book exchange.

Two methods will be used. In the one, the student will deposit the books he wishes to sell with the Bookstore having designated in each case the selling price. When a book is sold, the owner will receive 90 per cent of the selling price, the Bookstore retaining the remaining 10 per cent to cover the cost of this service. In the other plan, the bookstore will purchase outright certain books which are in satisfactory condition and which are certain to be used during the following quarter, paying 50 per cent of the regular retail price of the book when new.

The bookstore explains that these expedients have been adopted as temporary measures in view of present economic conditions in order to render all possible assistance to students who find it necessary to sell their textbooks which are no longer required. However, the bookstore adheres to its opinion that, wherever possible, students should retain their textbooks for reference.

From time to time over a period of many years, students have expressed the desire that facilities be provided for the sale of secondhand books in this college. Up to this time, however, it has not seemed feasible to carry out such a plan in connection with the Engineers Bookstore which would be the logical agency for such service.

The bookstore is also announcing a new plan whereby portable typewriters will be rented to members of the bookstore with the provision that rental charges may be applied to the purchase of the machines. Also the rentals participate in the bookstore dividends.

## *Chemical Engineers Inspect Gas Plant*

A group of forty chemical engineers were conducted through the Minneapolis city gas plant on Saturday afternoon, October 17. This excursion marked the first of a series of trips to be made to industrial plants in the neighborhood of the Twin Cities during the year.

The procedure followed in the manufacture of gas at this plant is quite different from that of any other plant in this country. Water gas is made by passing steam through a bed of glowing coke. The heating value of the gas is then increased by treating it with vaporized oil. The entire process is continuous, the units being so arranged that the process is under control at all times. In the course of inspection each section of the equipment and every phase of the operation was explained by an employee of the company.

During the afternoon of November 7 an inspection was made of the beet sugar plant located at Chaska. The plant is one of the largest of its kind, more than four hundred pounds of refined sugar being manufactured in one day. Standard unit processes studied by chemical engineering students form the basis of the sugar refining industry. Edgar L. Piret, senior chemical engineer, made arrangements for the trip.

## *Alternating Currents Text Revised by Bryant*

John M. Bryant, Professor of Electrical Engineering, University of Minnesota, together with James A. Correll, Professor of Electrical Engineering, University of Texas, has just published a revised edition of "Alternating Current Circuits." This book, first published in 1925, is an introduction to the study of alternating current circuits and transmission lines. The first six chapters discuss the theory of alternating currents and develop the equations applying to the various types of circuits from fundamental physical and mathematical principles. The remaining chapters apply these principles to polyphase circuits and transmission lines.

In this new second edition a set of problems has been added at the end of each chapter. The entire text of the book has been carefully revised, bringing it up to date and in step with the latest developments in this branch of electrical engineering. A new chapter dealing with the consideration of unbalanced loads and voltages in polyphase circuits by means of symmetrical phase co-ordinates has been included in this edition.

## *Minnesota Grad Proposes Plan for Train Routing*

A rerouting plan proposed by Edward P. Burch, a '92 Electrical Engineering graduate of the University of Minnesota, for the various lines of the Milwaukee Railroad in the Twin Cities is now under consideration by an engineering commission appointed by the city council. A report of the findings of this commission is soon to be made before the Minneapolis city council.

The rerouting plan involves the diversion or rerouting of the through freight and passenger traffic now on the main line of the Milwaukee railroad between the Twin Cities from the Milwaukee tracks to the Great Northern, Northern Pacific, and other available railroad tracks which are now practically without grade crossings.

The rerouting plan is a substitute for the elevation or depression of the Milwaukee tracks heretofore proposed and has for its objective the elimination of the dangers and delay to street traffic at about forty grade crossings in the following districts: on the southeastern diagonal in Minneapolis between the flour milling district and East Twenty-fourth Street; near the east end of West Seventh Street in St. Paul, including the Ancker Hospital crossing; at the west end of West Seventh Street and across the Mississippi River Boulevard in St. Paul; between Fort Snelling and Lake Street in Minneapolis; and at the University Avenue and Washington Avenue crossings in Minneapolis.

With this plan, the long one and a quarter per cent grade through Merriam Park in St. Paul, which requires double heading and which has produced one of the worst railroad nuisances in the Twin Cities, would be entirely eliminated, together with the remainder of the track crossing West Seventh street and running to the Midway industrial plants. Service to the Midway district would be made from the West and from the Minnesota transfer yards.

A. S. Cutler, professor of railway engineering, acted as chairman of the committee of the Engineer's Club of Minneapolis which considered the plan before proposing it to the Minneapolis city council.

## *Former Chemistry Prof Accepts Eastern Position*

R. E. Kirk, formerly professor in the School of Chemistry, is now head of the chemistry department of the New York Polytechnic Institute. In the fall of 1929, Dr. Kirk accepted the position as head of the chemistry department at Montana State College in Bozeman, Montana. In the spring of 1931, he was selected as one of three men to fill the same position at the New York Polytechnic Institute and was later notified of his appointment.

While at Montana State College, Professor Kirk was commissioned Major in the United States Reserves as an acknowledgment by the government for his work during the World War.

## *Electrical Department Installs Generators*

Seven new 5 kilowatt motor-generator sets have been purchased this year by the Electrical Engineering department. Each set consists of a 115 volt direct current shunt wound motor, three phase alternating current generator, and a group of three tranformer units. On the sides of the assembled sets will be placed meters and resistors to give a high degree of control of frequency and voltage. The sets are now being assembled and will be ready for use at the start of the winter quarter. With this new equipment, a wide range of alternating current frequencies and voltages may be obtained.

## *Anderson to Arrange Aeronautical Smoker*

The Minnesota Society of Aeronautical Engineers held its first meeting of the school year in the Experimental building October 22. Kenneth Haugen, president of the society, explained the associate memberships for the benefit of the non-members who attended the meeting.

Home coming plans were made; Walter Spivak was appointed chairman of the committee to decorate the Experimental building. A maroon and gold glider was placed against the building and white letters "ROPE WISCONSIN" were placed above the main doorway as if they had been written by an airplane.

At the second meeting of the society, October 29, a smoker was planned to acquaint the new and old members. George Anderson, appointed chairman of the general arrangements committee, is securing a speaker from the aeronautical field for the occasion.

## *Major Shippam Describes Philippine's Highways*

The University of Minnesota Student Chapter of the American Society of Civil Engineers held its second meeting of the scholastic year at 7:30 Thursday evening, October 22, in the Minnesota Union. The business end of the meeting was omitted, the program being turned over to the speaker of the evening, Major Shippam.

Major Shippam spoke of the general situation in the Philippine Islands during the years he was stationed there. The speech was especially interesting to the civil engineering group, for it dealt with the construction and development of roads in inland hills. The highways, according to Major Shippam, are built mainly of gravel and dirt. They are usually exceedingly narrow when compared to our highways being rarely over ten feet in width. The Major also spoke of the head-hunters and savages of the islands, and displayed some of their weapons. The meeting was concluded with the serving of refreshments.

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'30—Viebahn—W. W. Viebahn who is at present enrolled in the Westinghouse student course at East Pittsburgh was home to Aitkin, Minnesota, for a visit. Bill's present interest is mercury rectifiers.

'31 — Anderson — O. J. Anderson is working for Butler Brothers and can be reached at Cooley, Minn.

# It pays to look over the wall

The industry that succeeds today is the one that looks outside its own "back-yard" for ways to make itself more valuable.

For many years, Bell System men have been working out ideas to increase the use and *usefulness* of the telephone. For example, they prepared plans for selling by telephone which helped an insurance man to increase his annual business from $1,000,000 to $5,500,000—a wholesale grocer to enlarge his volume 25% at a big saving in overhead—a soap salesman to sell $6000 worth of goods in one afternoon at a selling cost of less than 1%!

This spirit of cooperation is one reason why the Bell System enjoys so important a place in American business.

## BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

## A Modern Station

(*Continued from page 33*)

This new transmitter was built in twelve weeks time by the Western Radio Engineering Company of St. Paul, with a force of twenty-eight men working under the direction of Stanley Hubbard, Kenneth Hance, Lynne Smeby, Hector Skifter, Verne Gunsolley, Albert Asch, and Fred De Beaubien. The Western Radio Engineering Company makes a specialty of manufacturing transmitters of all types, and has also manufactured several police transmitters and the associated receiving equipment.

Among those at the University of Minnesota who have been associated with the design of this station are Prof. M. E. Todd, who did some consulting work on high voltage meters, and Mr. C. E. Swanson, who made some difficult measurements of antenna constants which were found, on good authority, to be very reliable.

The range of a radio station has long been a much debated question among different stations. The following figures, based on an average broadcast frequency, and reasonably representative of American topographical conditions, are given as a reliable basis of comparison for daylight reception.

Strange as it may seem, for Class A service, which has a field intensity of 20 millivolts per meter, the service radius of a 50 kilowatt transmitter is only 17 miles, of a five kilowatt transmitter ten miles, and of a one kilowatt transmitter five miles. Class A service is free from all disturbances except most severe local storms, and is independent of time of day and season of the year.

Class B service, which is free from interference from average local electrical disturbances, but subject to occasional interruptions from storms, and to moderate diurnal seasonal variations, has a field intensity of 5 millivolts per meter. For a 50 kilowatt plant, the radius of Class A and B service combined is 31 miles, for a five kilowatt plant 20 miles, and for a one kilowatt plant 12 miles.

Class C service, which is not complete or of high signal strength, but which is generally used by large numbers of broadcast listeners to whom better service is not available, and which is subject to interruptions from fading, atmospheric, and electrical disturbances, and seasonal and diurnal variations, has a field intensity of one fourth millivolt per meter. For a 50 kilowatt transmitter, the combined A, B, and C service is 125 miles, for a five kilowatt transmitter 90 miles, and for a one kilowatt transmitter 70 miles.

In the evening, under favorable conditions, these ranges for the various classes of service are so enormously extended as to cause many broadcasting stations to greatly overestimate the extent of their service. Obviously claims based on exceptional performance rather than an average, reliable, hourly service greatly mislead the purchasers of a broadcast service.

The foregoing applies to all stations in general, operating under average conditions of location and climate. They are the result of much expert investigation, and are stripped of all enthusiasm which may arise over an occasional distance record. Any station which makes claims greatly in excess of these values has not properly analyzed its statements. Other things being equal, the area served by a transmitter is purely a function of the power radiated from the antenna.

KSTP is the only station in the higher frequency part of the broadcast band which has any appreciable power, practically all other stations in the bands from 1,200 to 1,500 kilocycles being of 1 kw. or less in power. This means that it is the first time that any appreciable power has been used at this range of frequencies, a fact of great experimental interest to radio engineers generally, in as much as there has been a great deal of argument about the relative advantages of various frequencies. While an increase in frequency favors radiation, it hinders propagation of radio waves, so that short wave stations find it necessary to have much higher power for a given nearby service range. This is apparently due to absorption and dissipation in the atmosphere and terrain, but less power is required for distances beyond the local service range. This means that KSTP, with its higher power, will cut through not only the local absorption, but also will greatly increase the power and brilliancy of long distance reception. It is expected, therefore, that when KSTP goes to 50 kw., it will not be matched in either its national or local service, by any stations operating at the present time, regardless of their power.

## Alumni News

(*Continued from page 37*)

ticle describing the work being accomplished by this survey.

'31—Watson—Duncan H. Watson has been employed since graduation by the Cargill Elevator company of Minneapolis performing tests on the ventilation of grain elevators. He is living at 1227 S. E. 4th St., Minneapolis.

'31—Clysdale—E. G. Clysdale is back in school this year doing graduate work.

### *Civil Engineering*

'00—Shenehon—Francis C. Shenehon is serving as expert for the Northern Pacific Railway in a flood case in Montana and as expert for the Milwaukee and the Burlington railways in adjusting damages caused by the building of the Hastings dam. Mr. Shenehon's office is at 2308 Foshey Tower, Minneapolis, Minnesota.

'07—Blomquist, now Superintendent of the City Water Works, Cedar Rapids, Iowa, writes:

"As an old timer I follow the progress of the University and especially enjoy hearing about the activities of the professors of my day, among them are Professors Brook, Bass, Erickson, Zeleny, and Springer.

"Some of my most interesting experiences since leaving school has been the study of human nature made possible by close association with the public in directing public utility work."

Mr. Blomquist's home address is 1837 7th Avenue South East, Cedar Rapids, Iowa.

'14—Olaison—C. E. Olaison, who is at present associated with the State Tax Commission of the State of Washington as Chief Engineer visited the campus recently. He commented on the rapid growth of our school and he said that it was a great pleasure to see a few of the old landmarks still in existence. Mr. Olaison's home address is Bigelow Apartments, Olympia, Washington.

'21—Enke—Fred A. Enke is making a bit of athletic history which is unusual for an engineer. He is now head football coach at the University of Arizona at Tuscon. Fred played football and basketball while he was here at Minnesota, but no one thought that Mr. Enke would become a football strategist.

'26—Erickson—Hugo G. Erickson is resident engineer with the Minnesota Highway Department. Mr. Erickson's home is at 3609 10th Avenue South, Minneapolis, Minnesota.

Nordstrom—M. E. Nordstrom is an estimator and designer with the Cowin company of Minneapolis. He is married and lives at 3223 James Avenue North, Minneapolis. Nordy is the proud father of a future Minnesota co-ed.

'27—Youngquist—Vernon Youngquist, whose present work is stream gauging Ohio Rivers, is with the Water Resource division of the United States Geological Survey. Vernon is married and has a daughter one year old.

'28—Wielde—John A. Wielde is with the United States Engineering Department and is at present acting as head of a surveying crew on channel work. John's home is at 111 Norton Street, Duluth, Minnesota. He visited the campus for the annual Homecoming celebration.

'29—Lohn—Robert N. Lohn is at present located at Alexandria, Minnesota. Bob's job is making Minnesota roads safe for would-be "Peter de Palmas." Robert dropped over to the engineering campus to have a little visit during Homecoming.

'29—Rykken—Nordahl T. Rykken is now located at Northrop Auditorium. He is with the Industrial Survey. Mr. Rykken's home address is 629 Washington Avenue South East, Minneapolis, Minnesota.

'29—Fredrickson—F. C. Fredrickson was married to Vivian Di Marco, a former student of the University of Minnesota. Mr. Fredrickson is now in the logging and contracting business with his home address at 1005 North 57th Avenue West, Duluth, Minnesota.

'30—Stoebe—Rolland Stoebe is now working on a real estate development project at Duluth, Minnesota. Rolland was on the campus for Homecoming.

'31—Laska—Frank Laska is doing construction and drafting with the Minnesota Highway Department at Rochester, Minnesota. Frank had more than his share in the celebration of the Homecoming victory over Wisconsin.

## A Dirigible Factory

*(Continued from page 29)*

automatically as the two leaves come together at the center, or as the doors come to the extreme open position. This makes it only necessary for the operator to push a button to start the door after which it will open and stop, or close and stop, as the case may be, automatically.

As this building is primarily a factory for the construction of airships, there is a considerable amount of mechanical handling devices. Most important of these are the two six ton electric hoists that run on two crane runways at the center of the building overhead. There are also runways the full length of the building and at different levels designed to carry working platforms as well as catwalks the full length of the dock. Access to the upper platforms is provided by two stairways at each end and by a specially designed inclined railway which consists of two counterbalanced cars running on a curved track but so built that the car itself remains horizontal at all times.

At the center of the building under the floor extending the full length of the building is a service tunnel containing electric outlets for both lights and power, water lines, compressed air lines, and gas lines for inflating the gas cells. Shops and offices will eventually occupy a strip 42 feet wide and 640 feet long on each side of the building. The floor is of concrete construction, six inches thick on a six inch rolled slag base, and has especially designed inserts for holding down clamps spaced 10 feet on centers, as well as holding down rings, also designed for securing the ship itself.

It is interesting to note that engineers considered it useless to attempt to heat such a large structure. The offices and shops are heated independently and electric heaters will be used on the floor on the working platforms during cold weather. Artificial light is used entirely and electric current is brought to the site at 22,000 volts; this current, as well as all other utilities, being brought to the building underground since no overhead wires can be tolerated above the ground surface. The general lighting consists of adjustable projectors of 1,000 watts each located along the catwalks from 65 to 150 feet above the floor. Outlets for extension cables are provided at all trusses on both sides of the building and also from the service tunnel. Power at 460 volts is brought to the crane and hoist motors. Under this immense building are storage facilities for over a million cubic feet of helium gas at 750 pounds pressure.

This building was built to house two super-Zeppelins during construction, but these were to have a capacity of 10,000,000 cubic feet, whereas the "Akron" has a capacity of only 6,500,000 cubic feet. The United States is leading the world at present with this splendid airship factory and dock, thanks to those many wonderful minds that have pictured such a dock and such wonderful ships as the new "Akron" many years ago and have persisted in their efforts until such dreams have come true.

The writer wishes to thank the Goodyear Zeppelin Corporation for their hearty co-operation in the compilation of materials, pictures and cuts.

# Pioneering In Pioneer Hall

(*Continued from page 31*)

be maintained, than are those physical in nature. The harmonious blending of line, materials, and color, adequate and well designed equipment, and suitable modern conveniences are all important in a residence hall. Of equal or even greater potential importance are the socializing experiences which a student may encounter in the course of his college career. This fact may long have been recognized in theory, but only in comparatively recent times have our higher institutions made direct provisions to foster an adequate social, recreational, and educational program in connection with student housing projects. A writer in a current periodical points out that our numerous publications devoted to the amenities of community and home disclose a singular avoidance of the broad subject of institutional housing and that "not a word is to be found concerning the environment in which the students in our educational institutions live." In its most recent student housing experiment the University of Minnesota happily has given careful consideration to the problem of shaping student environment to promote educational objectives. In this connection a counselor and two assistant counselors have been selected to serve as coordinating and directive agents.

Counselor service in Pioneer Hall may be classified as social, educational, and personal. These types of service are inextricably interwoven, one with another, and in so far as the individual student is concerned, all counselor service is distinctly personal in character. Nevertheless, social service in Pioneer Hall may be said to embrace all activities directed toward the development of desirable group morale, institutional loyalty, and the formulation and promotion of a socializing program. Special efforts are being made by the counselors to become acquainted with the residents in the Hall and to made them acquainted with each other. One of the primary objectives is to create the feeling that Pioneer Hall is truly the home of each man during the period of his residence. Whether this objective will be realized is a matter for conjecture, but it appears to be within reach. The social program involves also the promotion of social activities within the Hall. Dances, stag parties, special interest groups, interhouse competitions—these are proposed and will be provided.

The educational program includes all efforts designed to orient the student on the campus, to assist him in planning his class and study program, to acquaint him with campus personalities, problems and events, to promote an appreciation of desirable social attitudes and conduct, and to encourage the development of his individual personality through campus and house contacts and experiences. Lest the reader conclude that the educational program in Pioneer Hall is formal, pedantic, or figuratively a "fiendishly irritating itch that cannot be scratched," the writer wishes to point out that it is none of these. Whereas it is true that some educational services are direct and scheduled, for the most part the educational program will be indirect and incidental to the larger problem of assisting men to live together harmoniously and intelligently in their campus home and to enable them to profit to a greater extent than otherwise would be possible by their campus and institutional contacts with the university.

Personal service by counselors in Pioneer Hall embraces all attempts on their part to assist the individual student with his personal problems. A student may be lonesome, he may be homesick, he may encounter some difficulty with an instructor or in some class, he may be ill, he may be worried about something, he may be unsocial, he may need friendship or a sympathetic listener to whom he can talk about his troubles and from whom he can secure friendly disinterested advice. The object is not at all to encourage individuals to dwell unduly on their personal problems but rather to provide friendly personal assistance to those who need and invite it.

The problem of individual and group control is always a fascinating one although often a troublesome one as well. Discipline is an onerous word and a process to which many of us rebel. Wherever a large group of men are gathered together, as in Pioneer Hall, some form of direction and control, of course, is essential if group welfare is to transcend personal selfishness, as it should. Direction in some form cannot be avoided. The problem of control must be faced with both eyes open. In Pioneer Hall desirable control is conceived to be neither arbitrary nor purely authorative. Rather, control is conceived as a social, educational, and individual problem. In keeping with this concept an approach to the problem of student control in Pioneer Hall is being made through an attempt to develop an appreciation of the relations of an individual to the group, by direction designed to establish desirable standard of behavior, and by personal conferences where a need is felt for such procedure. The problem of control thus becomes a problem in education rather than compulsion, a problem for the student rather than the counselors. The counselors do not conceive of themselves as "police-men," but primarily as guides and advisors to students in the progress of learning self-direction and self-control in their personal conduct and relations with one another.

In furtherance of the idea that students in Pioneer Hall are responsible largely for the student conduct and the tone of their respective house units, a tentative form of cooperative government has been established. One student representative has been selected and elected by the residents in each of the eight units comprising the Hall. These eight students, together with the head counselor, form a House Council whose purpose is to permit student residents to cooperate with University officials in the conduct of Pioneer Hall and to permit students to participate actively in planning their own social, athletic, and educational program for the year.

Numerous features, other than those which have been enumerated, deserve mention. For those who desire to use it, a pressing room with ironing boards and electric irons is provided. A trunk room provides ample storage space for trunks and baggage in individual compartments. In the unoccupied space in the trunk room a "hangout" for residents of the hall is planned where students may purchase minor supplies, play bridge, and chew tobacco if they are inclined that way. Kitchen equipment represents perfection in machinery and facilities for preparing food. Under competent direction the kitchen force prepares and serves well-balanced meals which excel the fabled excellence of most "home cooking." Charges for room and board range from $130.00 to $155.00 per quarter. Excellent accommodations can be secured in Pioneer Hall at rates no greater, if as great, as those paid for less desirable accommodations by students living in private homes or who rent rooms and eat where they choose. The furniture in the dining room is so constructed that tables may be folded and readily stored to provide suitable space for dances and other social affairs. These and other features

(*Continued on page 46*)

# « « MENTAL TILTS » »

## ENGLISH ENGINEERING

Last week Mr. Harlow Richardson, head of the engineering English department, was worrying about the alphabet. He wondered how many words a Freshman engineer could make each having five letters with the consonants and vowels alternating. Each word had three consonants. The alphabet contains 21 consonants and five vowels.

## THE LIGHTNING CALCULATOR

The late Mr. Einstein and several of Professor Brooke's students were once marooned on a deserted island. One night the students worked late. The following morning Mr. Einstein was presented a fine problem. He was asked what number, when raised to the thirty-first power, had 35 digits.

He bowed his head in thought for a few moments and then gave the students the answer. What was the number and how did Mr. Einstein derive the answer?

## CARDS—AND CHANCE

If the number 1, 2, 3, 4, 5 are each written on a separate card and two cards are then withdrawn from the pile, what are the chances that the sum of the two numbers drawn will be even?

(*Continued from page 44*)

indicate the efforts made to make Pioneer Hall a comfortable and thoroughly desirable place in which the male university student may live.

Pioneer Hall is an interesting and significant experiment. If successful it will speed the day when the housing needs of the non-resident male student will be adequately met at the University of Minnesota. The social and educational significance of providing a campus home to replace the unsatisfactory housing conditions of the past should lead everyone interested in promoting student welfare to be deeply concerned with its success.






## Engineers Turn Laborers

(*Continued from page 30*)

dition also became evident, especially when the analytical work happened to be particularly tedious or difficult. The "boss" certainly was hard put to keep such a wilful crew interested in the happy medium between rapid but efficient production and proper control.

In all of our activities we tried very hard to act as much as possible like the honest-to-goodness men who are employed in the big plants which we someday hope to manage. Just as the real laborers gather together during the lunch hour to dispatch the contents of their dinner pails to the accompaniment of a lively prattle upon topics of every conceivable subject, so did we. Most of us, like genuine plant workers, faithfully lugged our own lunches to work every day and ate them with our buddies out on the lawn beneath the spreading oaks that surrounds the chemistry building. It became a general practice to drink large quantities of milk directly from the bottle. Anyone who has ever tried that stunt will fully comprehend that a blubbering and slobbering time was had by all.

Just after lunch there was usually a big ball game. Those who did not play always remained to cast wise-cracks and pointed directions in regard to the method of play. Anything these critics lacked in their capacities as plant men they certainly made up in being very true to form as ball fans. One thing which we lacked and which would have aided greatly the completeness of our sham was a one o'clock whistle. The only guides we had which prompted us to return to work were the prods of our tender consciences and the reproachful remonstrances of our "boss." At any rate these urges, especially the latter, found the "gang" very busy early in the afternoon.

In the progress of the chemical industry during the last few years great advance have been made in the industrial applications of organics. To provide a background and an understanding of these important advances our course has been supplemented with problems of organic manufacture and technology. One of the most interesting phases of this line of study was that of the preparation of dyes and dye intermediates. Due to the more complex nature of this sort of work, the "gang" did not encounter these problems until the latter part of the summer session, at which time we were much more experienced in the manipulation of plant equipment. Practically all of the material used in the processing of our dyestuffs were made in the laboratory. After their manufacture we examined and tested the products according to the accepted methods used in commercial practice. It was really quite a thrill to remove pigments made with our own hands from the filter presses. Another interesting problem dealing with organic technology was that which concerned the unit operation of nitration.

Present day requirements in respect to accurate and complete records of any undertaking are met by the engineer in his reports. The reports which were presented to the directors of our "plant" comprise a complete treatise upon every phase of our work together with the proper considerations of costs and applications to mass production. These records were indicative of the type of resumé statements which we would be held responsible for when presenting results of investigational work after we had stepped out into the field of chemical technology. At times those reports proved to be regular bugbears, especially on those balmy evenings which offer so much in the way of distractions and enticements to other pastimes more in keeping with romantic fantasy.

There are always certain considerations and reflections which accompany the closing of any human enterprise by which individuals measure the worth of their labors. Such was the case when our adventure in chemical manufacture came to a close. A bit of thoughtful inquiry brought most of us to the conclusion that our course had brought us more than a mere knowledge of some of the principles of chemical practice as applied to industry. We had likewise been initiated to a slight understanding of some of the humanisms of industrial relations; an understanding of what some one has well called "human engineering." Each individual had observed the methods by which his fellow students met their obligations, and had improved his own resourcefulness by a careful selection of those qualities most suited to his needs. All of us had experienced success and failures, enough of each to regulate and stabilize our viewpoints. Perhaps the most important consideration lies in the fact that our summer course was a period of trial during which some decided or not they were fitted to carry on. Those of us who have decided to carry on feel certain that our experiences have been a source of inspiration and advancement to new and better ideals.

## Twentieth Century Weather — Its Production

(*Continued from page 27*)

the heat given off by people—say at the Army & Navy game. But here the people are not merely "normally clothed" nor are they merely "slightly active."

This brings us down to where it is possible to explain the basis of the calculations. After quite some research by the American Society of Heating & Ventilating Engineers, the Smithsonian Institute, and the U. S. Bureau of Mines, it has been found that an average man (150 pounds) normally clothed and slightly active, will, under ordinary affective temperature conditions, give up about 400 B.T.U's per hour. Some of this heat is given off by means of perspiration and is known as latent heat. The heat removed by radiation and convection is known as sensible heat. At low temperatures most of the body heat is dissipated by radiation and convection while at high temperatures the greater share is dissipated by evaporation of perspiration.

All are familiar with days of high humidity when the perspiration ceaselessly falls from a "furrowed brow." The body, being the best automatic thermostat ever conceived, attempts to keep itself at about 98½° regardless of weather conditions. As the outside temperature builds up, more and more moisture will be given off to help maintain this temperature. If the temperature in a room is maintained at 80°, it has been found that 45% of the 400 B.T.U. given off by an average man will be latent heat. In other words, the moisture given off will be about .167 pounds per hour. For 3,000 people this totals more than 500 pounds or approximately 60 gallons per hour. Such continuous moisture addition, unless taken away in some manner, will increase the humidity greatly, causing discomfort. This brings us to the manner or means of accomplishing the task of keeping the air in a building comfortable and healthful—AIR CONDITIONING.

Scientific air conditioning consists essentially of controlling, automatically, temperature, humidity, air motion and air purity. As a science it embraces a detailed study of the thermodynamic treatment of the fluid, air, in addition to the physiological and psychological effect of proper conditions on human comfort.

In diagramatic form, the working of a complete air conditioning system is easy to understand. Refer to figure one for a diagramatic sketch of a typical modern air conditioning layout using refrigeration. Fresh or outside air enters the mixing chamber as is shown, where it combines with the return air before being drawn through the spray chamber. The temperature of the saturated air leaving the chamber is regulated both by controlling the temperature of the spray water and properly proportioning the mixture of fresh and return air. After being drawn through the eliminator plates, which rid the air of free moisture, the air is mixed with recirculated air before entering the fan to be supplied to the distributing system. For winter operation, the only changes necessary would be to place a set of preheaters (which prevent freezing of sprays) in the fresh air intake and a set of reheaters which heat from the washer saturation temperature to the room temperature and provide for the heat losses, when necessary. These may be located in the fan inlet chamber, recirculated air chamber, or main supply duct. Naturally, the use of refrigerated water will be unnecessary. In its place, the spray water may be recirculated—as is done in common practice.

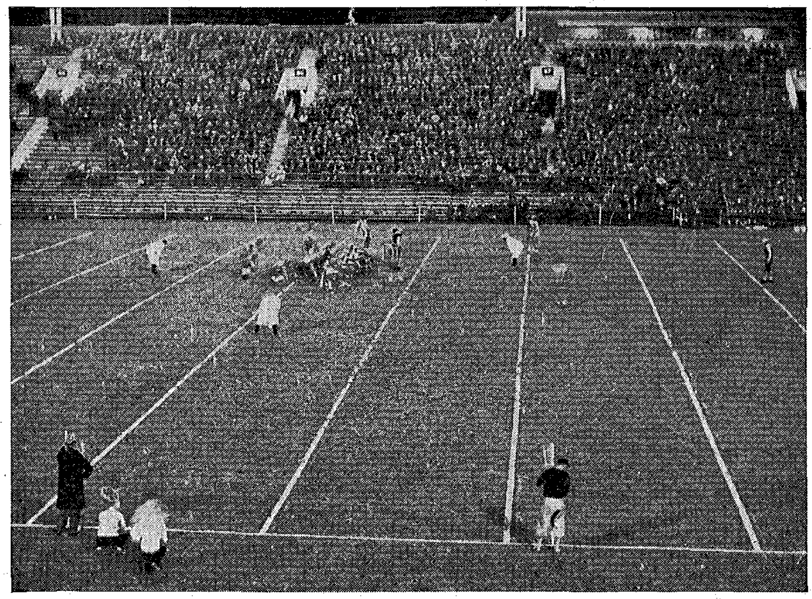
The term "ventilation" is often confused with "air conditioning." Many people think that the introduction of outside air in sufficient quantities will produce the same cooling effect as use of a small quantity of properly conditioned air. Under certain favorable conditions this may be true while under others the circulation of any quantity of outside air may prove of less value than if no ventilation is used at all. Under summer conditions the outside air is normally very high in humidity. Passing this air through an air washer without use of refrigerated water will not entirely correct the comfort conditions since the saturation temperature, or temperature leaving the washer, will take the temperature of the outside wet bulb. Should that wet bulb temperature be greater than the saturation temperature which will give the right conditions within the room, it is evident that it would be better to by-pass the washer. Under winter conditions the outside air is at a low temperature, and, even though saturated, cannot have a great moisture content. (The amount of water vapor which may be held in a given quantity of air is governed entirely by the dry bulb temperature.) After this air is heated, the relative humidity lowers, and thus no quantity of such air can give the desired humidity conditions without the use of a washer humidifier. Here again, in heating, the temperature of saturation must be maintained so as to give a proper moisture addition to the air so that after reheating to room temperature the correct humidity will result in the room.

The air conditioning engineer has applied his skilled efforts toward regulating the effect of weather conditions on manufacturing processes in more than 200 different industries, among which we find textiles, tobacco, candy, pharmaceuticals, ceramics, and leather. A comparatively short time ago he started to direct this new science into the field of conditioning for comfort with the result that we now find that modern theatres, auditoriums, dance halls, department stores, restaurants, railroad cars, hotels, and apartment houses beginning to make provisions for effecting comfort for employees, patrons, and tenants.

Still more recently this science has entered the field of conditioning private homes. Undoubtedly, this will some day prove a major field for air conditioning equipment since it is essential to have comfortable and healthful conditions the year around at the place where the major portion of our time is spent.

It is the earnest hope of the writer that the sketchy discussion on non-technical air conditioning as presented may be of some value in clearing up the supposed "mystery" surrounding the subject. It may even serve to acquaint a few with the fact that there is such a specialized branch of engineering—which may occupy the minds and hands of a great number of future technical graduates.

# College-trained engineers revisit the athletic field



*Temple Stadium, Philadelphia, Pennsylvania, floodlighted with G-E projectors*

ON more than a hundred floodlighted fields, football is being played and practiced in the cool evening hours, before larger audiences than ever before — with fewer injuries and in better conformity with classroom duties.

This constructive revolution in athletics is largely the work of college-trained engineers — young men personally familiar with the needs of college and school. They are dedicating the technical experience gained in the G-E Test Department to the practical service of undergraduate athletics — designing and installing floodlighting equipment for virtually every sport — football, baseball, hockey, tennis, and track.

Other college men in the General Electric organization have specialized in street-lighting and floodlighting projects, or in the electrical equipment of industries and mines or of immense power stations; some are designing and applying electric apparatus to propel ocean liners and locomotives. All are engaged in the planning, production, or distribution of G-E products and so are performing a work of national betterment and creating for themselves recognized spheres of personal influence.

*You will be interested in Bulletin GEA-1206, "The Light that Started Sports at Night." Write for it to the nearest G-E office or to Lighting Division, General Electric Company, Schenectady, New York.*

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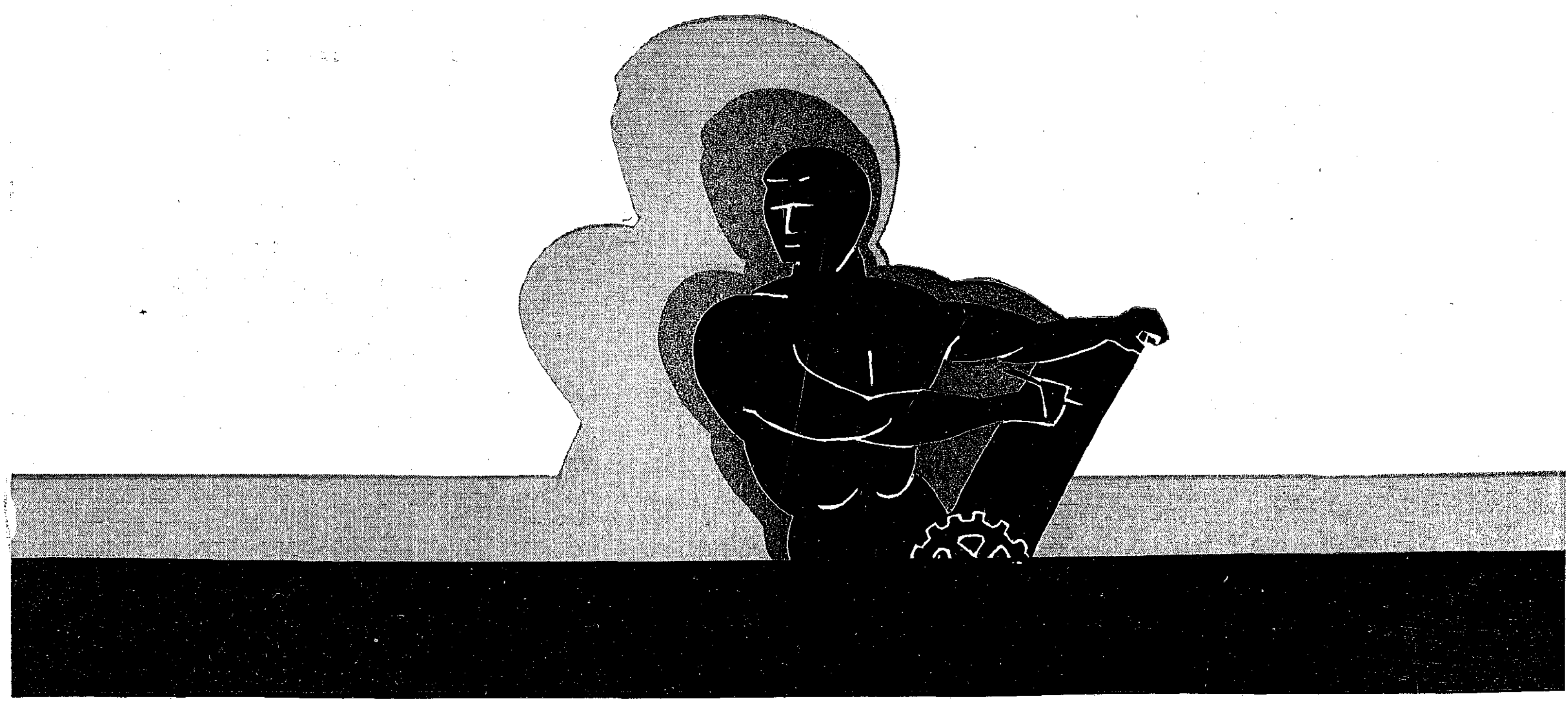
GENERAL ELECTRIC

# THE MINNESOTA TECHNO-LOG



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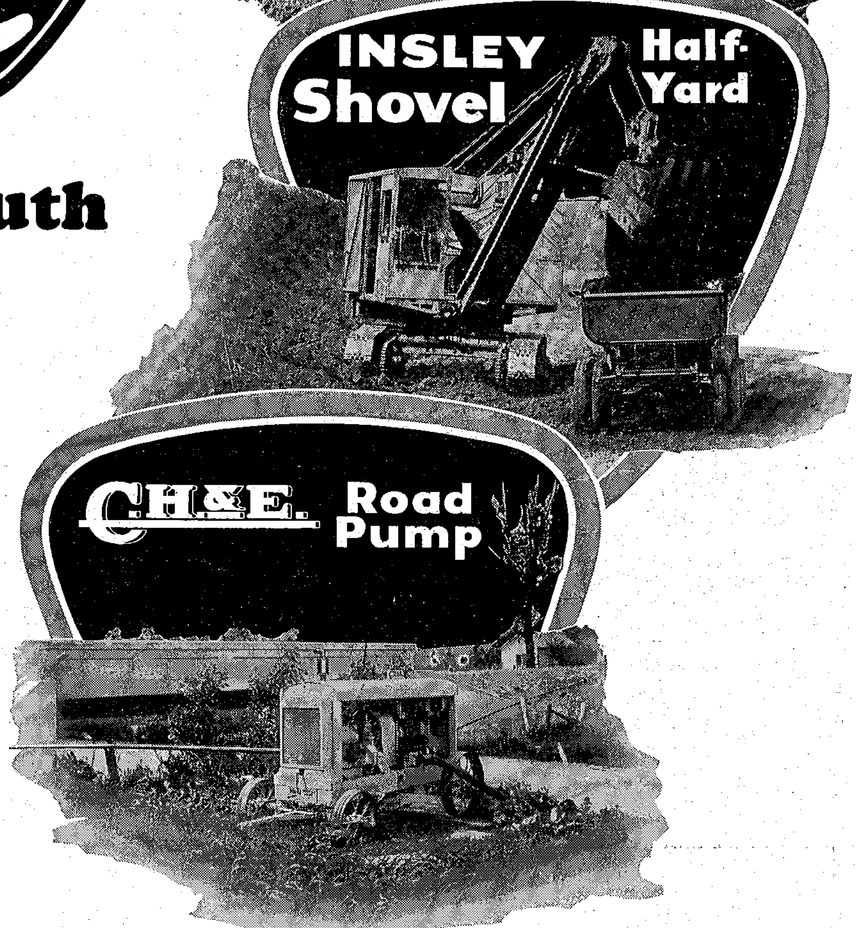
MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED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*Milwaukee*

December, 1931

Volume XII, Number 3

# the MINNESOTA TECHNO-LOG

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AN ENGINEER FROM COLORADO *shows us how the Bureau of Mines Northwest Experimental Station succeeded in wresting manganese from the low grade Minnesota ores.*

DESIGNING AND BUILDING THE AKRON. *A student describes the ship and its construction and design. A detailed story of the world's largest ship and the Navy's pride.*

SPAIN, *the home of Don Quixote. Mr. Huchthausen, a Minnesota graduate of 1928, leads us through Spain and describes its people, their habits, their games, and even what they think about. An interesting story of an interesting country.*

A PERIODIC TABLE *designed by several sophomore chemistry students will show us in January a new classification of the elements. The table goes one step farther in its classification than Mendeleef's.*



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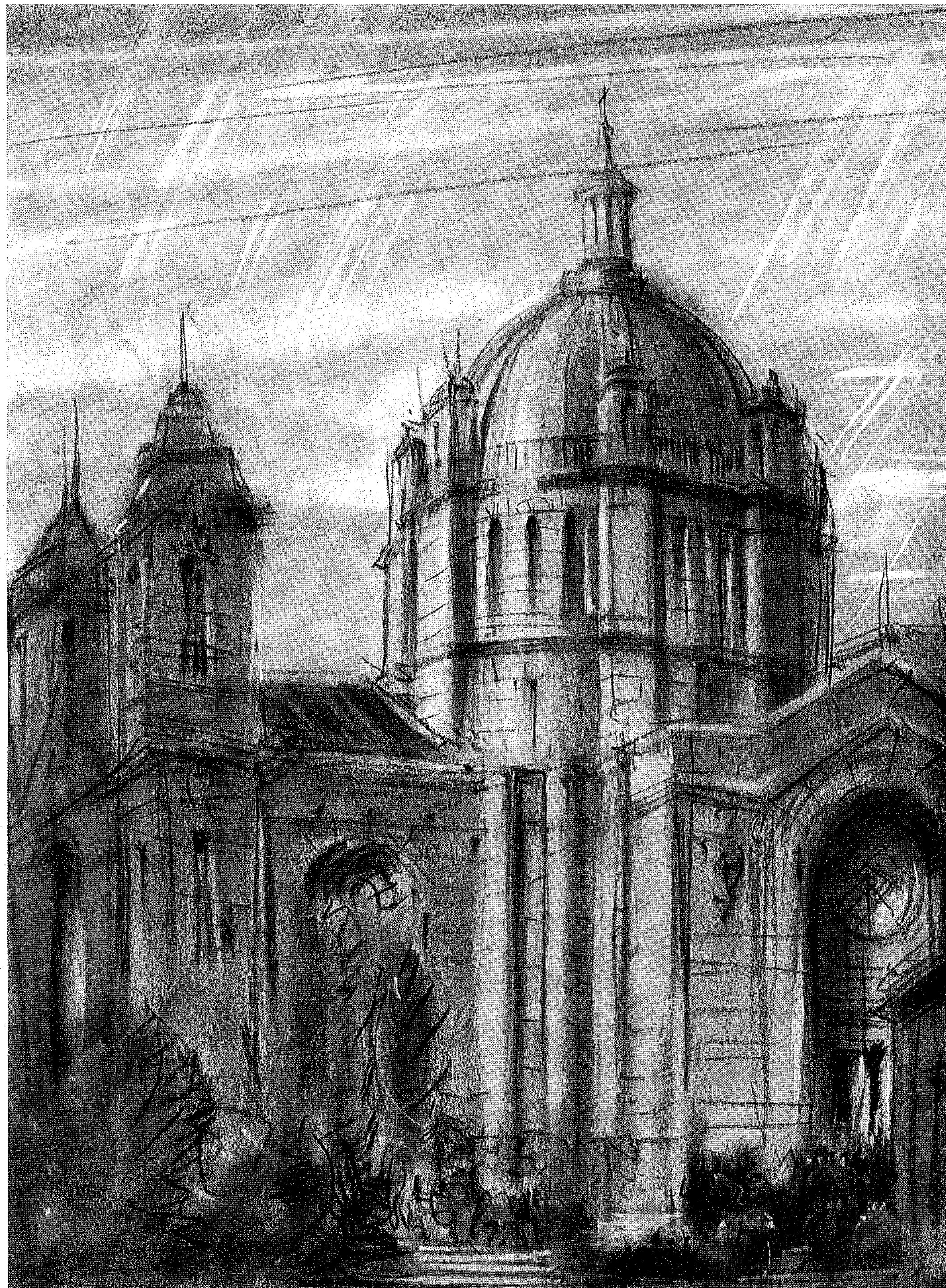


Cathedral Hill, Saint Paul
By Robert Cerny

# THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Volume XII DECEMBER, 1931 Number 3


## bureau of mines

# Produces Ferromanganese

## from minnesota ore

*Manganese ore, one of the steel industry's most valuable raw materials, has long been one of the United States' industrial necessities. Heretofore practically all manganese used in this country has been imported, either as ferromanganese or the ore. Now, after years of research, the vast quantities of manganese in the low grade Minnesota ores show possibilities of being developed and used. The process presented by Mr. Joseph would make the United States independent of outside sources of manganese in time of war.*


By T. L. JOSEPH,

Supervising Engineer,

North Central Experiment Station,

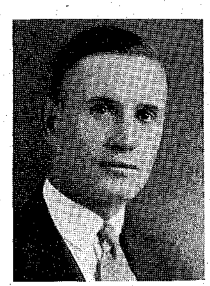
U. S. Bureau of Mines




MANGANESE occupies a unique position in ferrous metallurgy. It is the most important auxiliary metal used in the production of steel. A brief resumé of the development of the iron and steel industry will show how the need for manganese arose and why its use is necessary.

Prior to the early part of the 14th century metallic iron was produced from iron ore in short furnaces in which a mixture of iron ore and charcoal was heated until a small quantity of pasty metal was obtained. This metal, which was low in carbon and therefore malleable, or ductile, was then forged into useful articles. About 1350 the iron masters of central Europe increased the height of the short forge furnaces and by so doing created conditions under which the metallic iron absorbed several per cent carbon. This product, known today as pig iron, was hard and comparatively brittle due to the presence of carbon. It could be cast or poured into molds to obtain useful shapes but lacked ductility necessary for forging or rolling when hot.

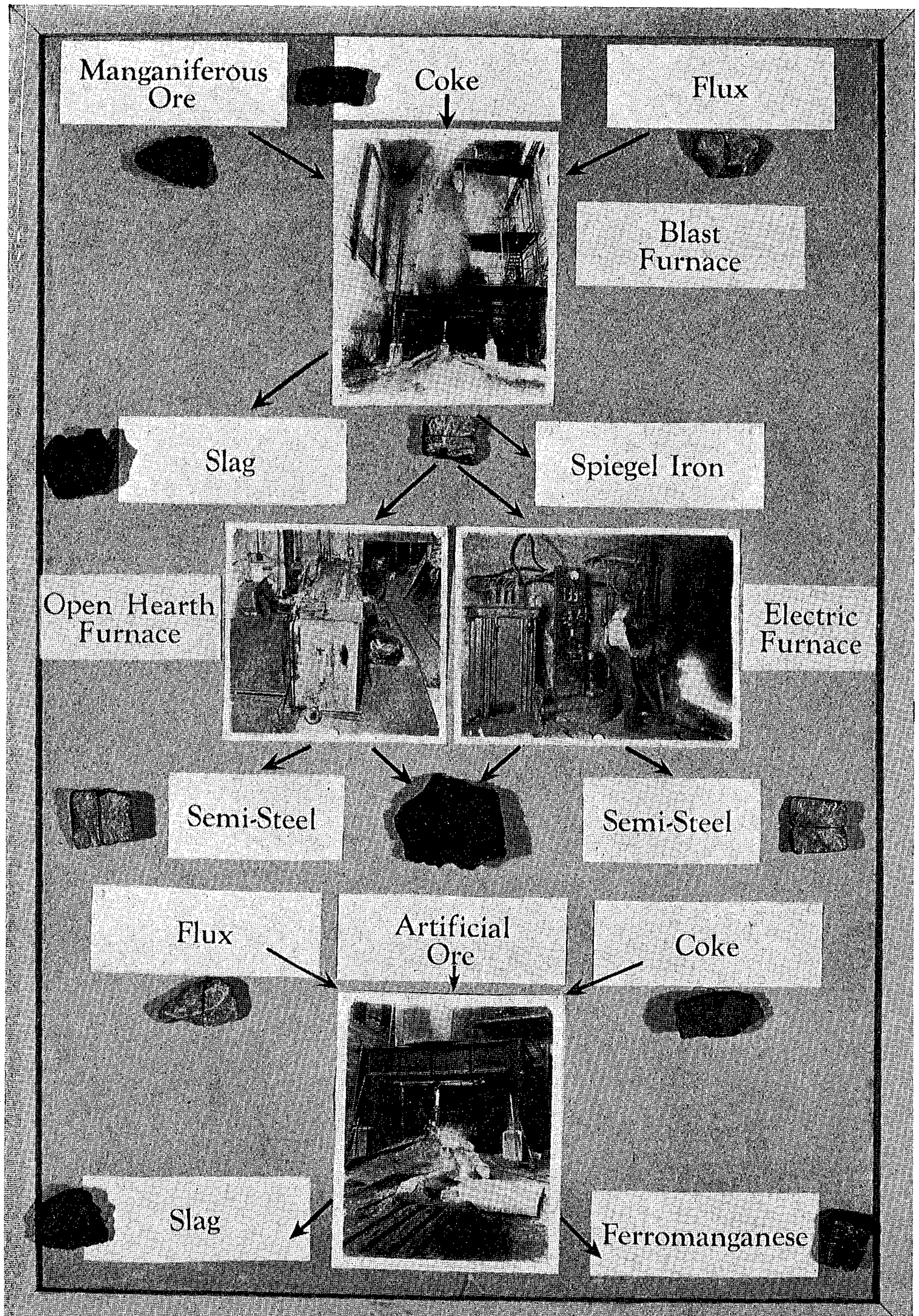
About 500 years after pig iron, sometimes called gray iron and cast iron, was first produced, Sir Henry Bessemer in England and William Kelley in this country conceived the idea about the same time of blowing air through a bath of molten pig iron in order to burn out the carbon. The object of eliminating carbon and several other impurities which distinguish cast iron from steel, was to produce a stronger and more ductile material that could be rolled into useful shapes. This objective was only partly realized in the early efforts to make steel by the Bessemer converter process because, under the strongly oxidizing conditions necessary to eliminate the carbon, iron oxide was dissolved in the bath of steel. When the carbon had been reduced to the desired amount, the metal contained sufficient iron oxide to make it "red short," that is, it could not be heated and forged or rolled without cracking and tearing.



T. L. Joseph

Failure to obtain metal with proper hot-working characteristics threatened the success of the new process because the utility of steel could not be fully realized until solid rectangular blocks of metal, called ingots, could be forged into a variety of useful shapes such as sheets, rods, and wire. Although the underlying reasons were not clearly understood at the time, the difficulty due to dissolved oxygen ocurring largely as iron oxide was overcome by adding manganese to the steel at the end of the purifying operation. This addition of manganese, as suggested in 1839 by Josiah Heath and in 1856 by Sir Robert Mushet, made the Bessemer process a practical success. When the Siemens Martin open hearth process was developed later, manganese was used as a deoxidizer.

At the present time manganese is used as a deoxidizer in producing practically every grade of steel. In addition to reducing the amount of oxygen in the steel, it also combines with sulphur in such a way as partially to eliminate another cause of hot brittleness. About 14 pounds of manganese are added to make a ton of steel. A part of this manganese is used in eliminating oxygen, but most of it enters the steel, producing finer grained metal. Exceptional properties are obtained by adding increased amounts of manganese to steel. The most common example is so-called manganese steel containing from 10 to 14 per cent manganese. This steel which is very re-




**The flow sheet of the Bureau of Mines process for producing ferromanganese from manganiferous iron ores. The apparatus is that actually used in developing the process at the North Central Experimental Station. The raw materials and products are also shown.**

sistant to impact and wear, is used in railroad and trolley frogs, in crossings and switches, in rock crusher parts, and in steam shovel dippers and teeth.

### Manganese Supplemented with Other Deoxidizers

Manganese is not the only metal used for eliminating oxygen from steel. Silicon and aluminum, which are both more powerful deoxidizers, are used in a supplementary way. The end products of deoxidation with manganese, silicon, and aluminum are metallic iron and manganous oxide, silica, and alumina, respectively. The last two oxides are objectionable because they are highly refractory and tend to remain in the steel, while the manganous oxide rises to the surface and enters the slag. Because of a combination of desirable results, no satisfactory substitute has been found for manganese. The World war plainly demonstrated that manganese is a strategic metal.

### Alloys Used in Adding Manganese to Steel

About 90 per cent of the manganese used in making steel during the period 1911 to 1929 was added in the form of ferromanganese which contains from 78 to 82 per cent manganese, about 12.5 per cent iron, 6 to 7 per cent carbon and small percentages of silicon, phosphorus, and sulphur. Most of the remaining 10 per cent is added in the form of spiegeleisen, a lower grade alloy containing about 20 per cent manganese, 5 to 6 per cent carbon, 1 per cent silicon, and small amounts of phosphorus and sulphur. According to past practice an assured supply of metallurgical manganese means either an assured supply of ferromanganese or an assured supply of ore from which it can be produced.

### Minnesota Deposits of Manganiferous Iron Ores

With few exceptions domestic deposits of manganese ore, suitable for producing ferromanganese, are irregular, pockety, and occur in most cases at locations remote from steel centers. As a result of this condition from 90 to 95 per cent of the manganese ore used in this country is imported from Russia, Brazil, Africa, and India. The threatened shortage of manganese during the World war and the increase in the price of ferromanganese from $100 to $400 per ton have prompted the proposal to stock sufficient imported ore to meet a reasonable period of no importation. Imports of manganese ore depend not only on the relation between our country and others but also upon the political and economic conditions in those countries from which our supply is obtained. In view of the extent to which we rely upon imported manganese ores, the development of processes for producing ferromanganese from manganiferous iron ores, such as occur in Minnesota, is an outstanding metallurgical problem; important to the nation as well as to the state.

It has been estimated that Minnesota deposits of manganiferous iron ore contain between 4 and 5 million tons of metallic manganese. Compared with other domestic manganese deposits, the deposits which occur on the Cuyuna range are large, well developed, and have the advantage of water transportation by the Great Lakes to steel centers. The Cuyuna ores have been grouped into black and brown ores according to color. The brown ores, for which the process herein described was developed, contain from 40 to 45 per cent iron, 6 to 10 per cent manganese, 0.2 to 0.3 per cent phosphorus, 5 to 10 per cent silica, 3 to 5 per cent alumina, and 10 to 15 per cent moisture. These ores are essentially iron ores containing substantial amounts of manganese.

**T. L. JOSEPH**

*who was graduated from the University of Utah in 1917, is Supervising Engineer of the North Central Experiment Station of the United States Bureau of Mines. This station, which is maintained by federal appropriations, is located in the Mines Experiment station building. Its work is conducted in cooperation with the Minnesota School of Mines Experiment Station. Mr. Joseph received the J. E. Johnson, Jr., award in 1927 in recognition of his blast-furnace investigations and contributions to technical literature on this subject. He has served as chairman of the local chapter of the American Society for Steel Treating and of the Blast-furnace Committee of the American Institute of Mining and Metallurgical Engineers. He is a member of other technical societies and the Sigma Xi fraternity.*

## Description of Three-Step Process

Typical manganiferous iron ore of the brown type contains about 8 per cent manganese and 40 per cent iron. The ultimate objective is to produce an alloy containing 80 per cent manganese and about 12.5 per cent iron. Such a concentration of manganese requires several operations which will first be stated in general terms and then described in greater detail.

Manganiferous iron ore was first converted into metal in a small blast furnace. The metal so produced and commonly known as spiegeleisen contained approximately 80 per cent iron, 15 per cent manganese, and 0.5 per cent phosphorus. This metal was next treated in a small basic open hearth furnace or an electric-arc furnace to separate the manganese from the iron and phosphorus. The iron was recovered as metal, and the manganese in the form of slag containing from 65 to 70 per cent manganous oxide. In the third and final step the high-manganese slag or artificial manganese ore from step 2 was charged into a blast furnace and converted into ferromanganese. Photographs of the small furnaces used have been arranged in the form of a flow sheet shown on page 52.

## Blast-Furnace Tests on Minnesota Ores

Although the brown manganiferous iron ores of the Cuyuna range have been mixed with iron ores to introduce from 1.5 to 2 per cent manganese into basic pig iron, they have never been used alone. Therefore, it was not definitely known whether an ore charge composed entirely of these ores could be smelted without difficulty. Two characteristics, high ratio of alumina to silica and large amounts of combined water, indicated that their behavior might differ from ordinary iron ores. In order to investigate the smelting characteristics of these ores and to provide metal for use in investigating subsequent steps in the process, several hundred tons of the ore were smelted in the experimental blast furnace shown on page 52. This furnace, which was designed and operated by the United States Bureau of Mines' staff, was paid for out of special state legislative appropriations.

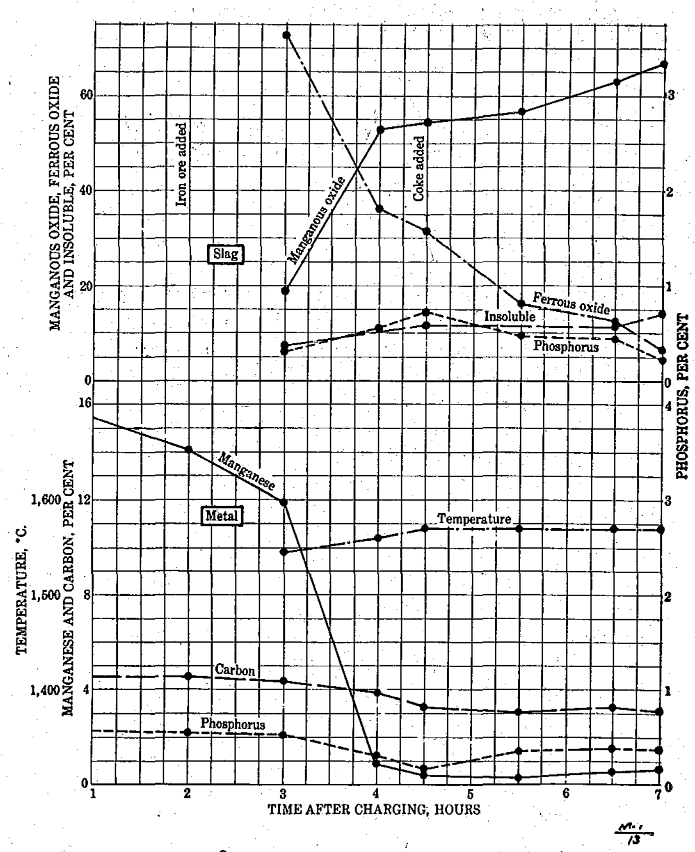
The blast furnace is, broadly speaking, a piece of equipment for converting ore into metal. Ore, coke, and limestone are charged into the top of the furnace and move countercurrent to hot gases generated by burning coke with preheated air forced into the lower part of the furnace through water-cooled openings called tuyeres. Hot carbon monoxide gas generated in front of the tuyeres, accompanied by about twice its volume of nitrogen, moves up through the column of stock along a tortuous path formed by the openings between the lumps of ore, coke, and limestone. Both of these gases carry heat to the stock in the upper part of the furnace, but the carbon monoxide performs the additional function of removing oxygen from the ore. The iron oxides are reduced, or deoxidized, before melting temperatures are reached, but the oxides of manganese are reduced out of the slag formed by the calcium oxide from the limestone, manganous oxide, and the gangue in the ore. The metal and slag collect as separate liquids in the crucible of the furnace below the tuyeres and are tapped at regular intervals.

The manganiferous iron ore entering the furnace is composed of about 50 per cent iron plus manganese and 50 per cent of combined oxygen, plus moisture and gangue. Therefore, when the moisture, and gangue are eliminated, a metallic product containing about 80 per cent iron, 15 per cent manganese, and 0.5 per cent phosphorus is obtained.

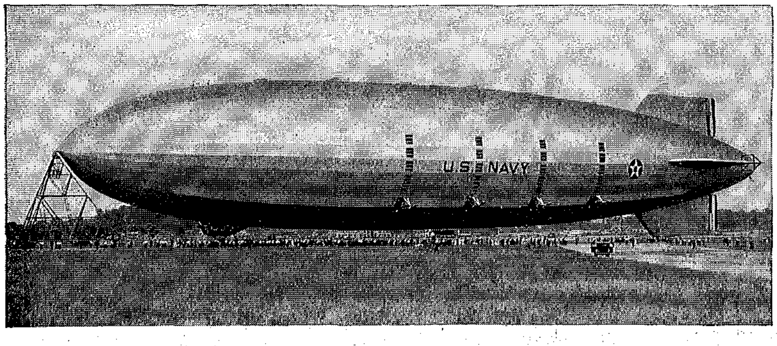
## Open-hearth and Electric-furnace Tests

Metal, containing 15 per cent manganese, 80 per cent iron, and 0.5 per cent phosphorus, is not a marketable product because it contains manganese, iron, and phosphorus in undesirable proportions. By removing most of the manganese from such metal, two useful products

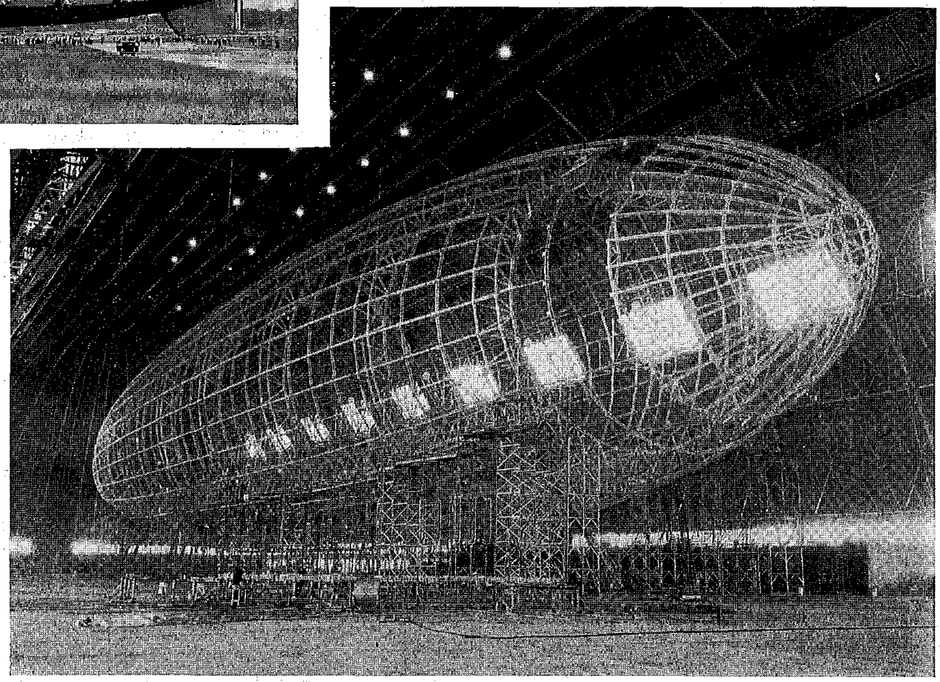
(*Continued on page 72*)




**The changes in composition of slag and metal in heat number 437 plotted against time show the transfer of manganese from metal to slag**



To the left is shown the Akron moored to its portable mast. The cabins, fins, and propellers can be seen. This mast is a means of eliminating the large ground crew.



The almost complete hull is resting on its cradle. The annular rings are inherently designed, being connected by small girders.

## designing and building

# A New Navy Airship

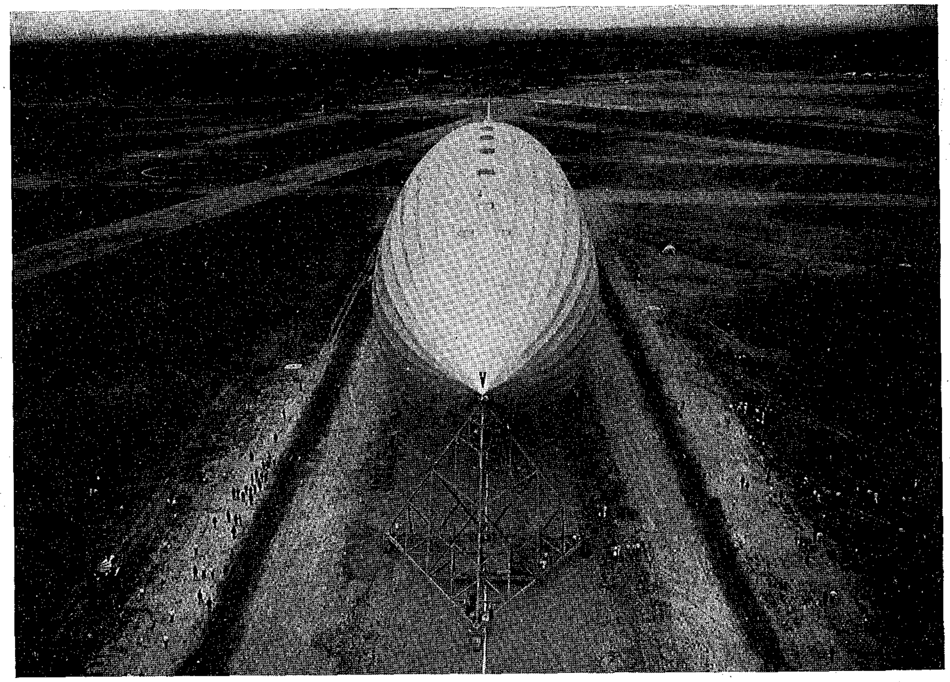
## —the uss akron

***Guy B. Arthur, business engineering Senior, continues his description of the Akron dirigible factory by showing how the new navy dirigible, the Akron, was constructed there. Besides being the world's largest airship, the Akron contains many new features. Its design is particularly adaptable to commercial ships.***

THE GOODYEAR COMPANY in 1911 installed machinery for the spreading of rubber on cotton fabric and, in 1913, the Goodyear balloon won the James Bennett Gordon cup race out of Paris. Today, they have completed the first of the two Zeppelins authorized by Congress in 1926.

This new ship "Akron" is the largest dirigible in existence and its size in comparison with the "Los Angeles" and "Graf Zeppelin" can be seen in the accompanying table. Its cubical content is about twice that of the Graf Zeppelin and about 35 per cent larger than the R-100. The tendency of modern airship design is in the direction of a more curved profile, making the ship appear shorter and fatter. The Akron is 15 feet longer than the Graf Zeppelin with nearly twice the capacity due to a 34 feet greater diameter. This gives the Akron an aspect radio of 5.9 compared to the 7.7 aspect ratio of the Graf. In other words, the Akron is only about six times as long as it is thick.

The Akron, or ZRS-4, is built on the triple-layer principle of Zeppelin type construction, which has the advantages that one part may assist and to some extent replace another. The framework of the ship is composed mainly of transverse rings connected by longitudinal girders, the latter extending from nose to tail. These so-called rings are, over most of the length of the ship, 36 sided polygons with their corners connected by the longitudinal girders. Near the tail of the ship the number of sides reduces to 24. Diagonal wires form a network, bracing the outside panels described by the above structure, while another system of wires



**The Akron on the Akron, Ohio, field. The black spots on the ship's top are ventilators and gas escapes. The door in the nose can also be seen.**

and cord nettings transfers the gas cell pressure to the framework.

### Two Types of Ring Girders Used

The transverse of ring girders are of two types, main and intermediate. The main girders in the Akron constitute a new feature in airship construction. Whereas former designs required a great number of wires connecting all possible corners to maintain a stiff unit, the ring in the U.S.S. Akron is built inherently strong, consisting of two annular rings connected by cross girders, in zigzag fashion, to an inner annular ring, forming a triangle. The main rings are spaced usually about 74 feet apart, the gas compartment being set between them. There are 12 gas cells in the ZRS ships, forming a bulkhead system similar to that in surface ships, since the loss of buoyancy in even whole compartments in the ship does not seriously endanger the craft. Again the ring girders are large enough to form corridors for crew members to climb entirely around the circumference of the ship, facilitating inspection and maintenance.

The intermediate rings are of the single girder type and are spaced between the main rings, usually three to a compartment. Their function is merely that of stiffening the longitudinal girders, the load carrying being left to the main rings. The longitudinal girders connect the transverse or ring girders and run from one end of the ship to the other, forming fore and aft ribs which are discernible from the outside of the completed ship. Throughout most of the length of the ship there are three gangways or corridors, triangular in shape. One extends along the top center line of the ship. The other two are placed symmetrically in the lower part about 45 degrees from the vertical. This arrangement is another departure from the past practice which employed a single corridor along the bottom of the ship with a "catwalk" running from nose to tail.

**Principal Characteristics of the**

| | Los Angeles | Graf Zeppelin | U.S.S. Akron |
|---|---|---|---|
| **Nominal Gas Volume, Cu. Ft.** | **2,470,000** | **3,700,000** | **6,500,000** |
| **Length Overall, Ft.** | **658.3** | **776** | **785** |
| **Maximum Diameter, Ft.** | **90.7** | **100** | **132.9** |
| **Height Overall, Ft.** | **104.7** | **113** | **146.5** |
| **Gross Lift, Lbs.** | **153,000** | **258,000** | **403,000** |
| **Useful Lift, Lbs.** | **60,000** | | **182,000** |
| **Number of Engines** | **5** | **5** | **8** |
| **Total Horsepower** | **2,000** | **2,750** | **4,480** |
| **Maximum Speed, M.P.H.** | **73.1** | **80** | **83.8** |
| **Range without refuelling at 50 Knots Cruising Speed, Land Miles** | **4,000** | **6,125** | **10,580** |

### New Fabric Used

Gas cells in previous rigid airships were made of goldbeaters skin, but the size of the present ship prompted the investigation and use of a new type of fabric. Goldbeaters skin is composed of small portions of the intestines of cattle, and was discovered by Amsterdam goldsmiths to be the most durable and tough substance through which gold leaf might be pounded out. To make gas cells for the Los Angeles, 750,000 of the skins were required, while approximately 1,500,000 cattle would have been necessary to make gas cells for the Akron. About half of the cells for the new ship are of rubber paraffin construction, consisting of rubber impregnated fabric over which paraffin has been spread.

It is claimed that in actual use cells of this type have demonstrated that they are efficient and inexpensive, although not quite as low in resisting diffusion of gas as those made of goldbeaters skin. As a compromise between goldbeaters skin and rubber paraffin, the Goodyear engineers have developed a new gelatine-latex process for the manufacture of gas cells. Test cells of this material have shown a performance comparing favorably with goldbeaters skin in gas retention, while keeping their durability and flexibility over a long period of time. The remainder of the cells of the Akron are made of this material. The cells are built to definite dimensions as each of them has a particular bay with a particular shape to fill.

### Over-pressure Valves Necessary

The lifting gas in an airship expands and contract with changes in altitude, temperature, and barometric pressure. The various cells of the Akron have over-pressure valves for immediate re-

(*Continued on page 74*)

## an architect talks

# About Spain and Its People

## and their architecture

*What is a Spaniard? How does he think, what does he do, how does he live? Walter Huchthausen tells us about the modern Spain after a journey through the rugged country in an American automobile. The peculiar temperament of the Spanish people played an important part in the country's artistic development. Mr. Huchthausen traces that growth during his journey.*

WHEN the fragrant air of premature summer lurks about, and the soft languid breezes of the Mediterranean caress one like the breath of an Andalusian maiden; and, when the blazing southern sun sends one joyfully to its sandy blue shores for a few carefree hours!—then it takes more than the combined power of this mortal earth to arouse a nature-loving individual as I from these self-imposed pleasures of "where I am" to the retrospective "where I was." But I shall try the impossible by recalling a few facts which have left a permanent imprint.

Although I have been in Europe for less than a year, it seems double that at least: a natural reaction from having had such a variety of experiences among such a variety of people. Like all travellers of the continent I went through the long orgy of being initiated into Paris, a small spot in this huge terra firma, but one that just shimmers with life and enthusiasm, turbulent whirl, and ever-honking taxi horns—which environment would forbid all painful decorum of manner.

For the architect Paris narrows down to two spots, Les Deux Magots and Le Brasserie Lipp, both of which are the age old hangouts of the ever thirsty and equally jolly architects. Deux Magots has handed out more than one smacking operatif to the embryonic builders who sit about in chatting circles with a decided look of expectation on their hungry faces. But not until hunger overbalances desire for gossip does the group migrate to one of the favorite restaurants for the evening to enjoy a dinner in a true French fashion. Cooking is an art of the French and one cannot help enjoying it from the hors d'oeuvres to the last bit of Camembert.

Lipp's beer is elegant, so the merry group repairs chez Lipp to finish the evening. Each jolly toper has his bumper filled to the brim according to his desire or capacity, and the evening changes from quiet soft laughter to a more turbulent shouting and roguish good humor ending, perhaps, by smearing hard boiled eggs all over your best friend's back with a friendly chuckle or in hitting each other over the head with long sticks of French bread in true cavalier fashion. This is only one of the phases of Parisian life which, as a rule, are not of such boisterous nature. Paris has the best to offer, especially in the field of the fine arts of music, opera, art, and architecture; and one will find it ever stimulating.

When leaving France for Spain one almost involuntarily changes from an epicure to a gormand. Delicacy turns to quantity—to a life of unmitigated feasting. Restaurants hardly exist so one must eat the dinners given at the hotels. Noon and evening meals are equally large, consisting of the preliminary "ordubres," soup, two orders of meat, one of fish, eggs, such plebeian delicacies as jellied eels of the tasty Paella a la Valenciana, and other dishes following naturally. An ordinary Spaniard eats it all, but we other mortals were compelled to insult the waiter by refusing.

*WALTER HUCHTHAUSEN, graduated from the Department of Architecture in 1928, is now studying in Europe on the Robinson Memorial prize and the Frederick Sheldon scholarship. From Paris, his headquarters, he has toured England, France, Belgium, Holland, a part of Germany, Spain and Italy. Most of these tours are carried out in a Ford roadster with a fellow Harvard classmate.*

*While a Senior in the University of Minnesota, Mr. Huchthausen won the Moorman prize, first place in the Magney-Tusler and Minnesota Chapter of the American Institute of Architects contests, and the American Institute of Architects prize. As a Junior he was elected to Tau Beta Pi and Tau Sigma Delta. He won the Alpha Alpha Gamma and the School of Architecture Faculty prizes.*

Spain is one country that most people know very little about. The few large cities that offer conveniences and a variety of interests are so far apart and so remote from the average itinerary, that the country is either neglected entirely or a hurried dash is made to Madrid or to Barcelona to get a glimpse of the romantic country. Both cities, however, are so modernized, so cosmopolitan, and so stripped of the true spirit and nature of the people, that it is impossible to know Spain having seen only these.

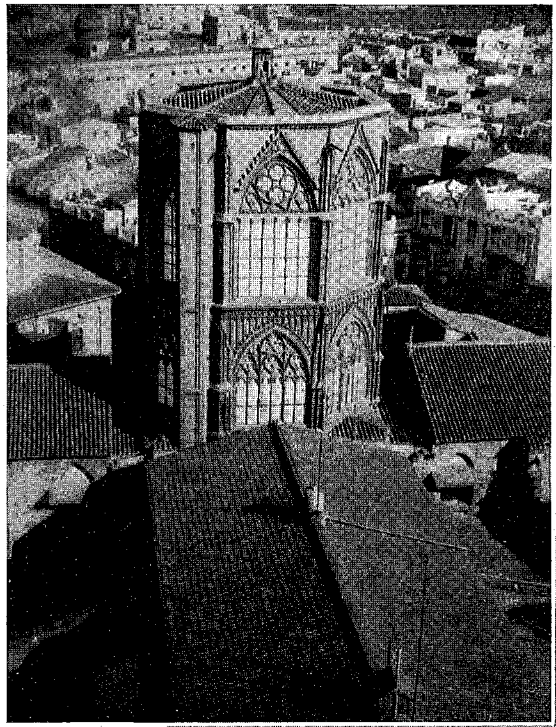
With a speedy Ford roadster as a means of travel I have been able this last winter to get a fairly good idea of the real beauties of Spain and its wealth in architecture and painting. It takes a fiery steed like Henry Ford's to climb the endless crags and mountains of rock which compose the peninsula. Particularly, the Eastern and Southern coasts pile up into mountains or barren rock from which grows nothing except the hardy, scraggly olive and the small groves of less inviting cacti which grow high to shade the sand huts of these people. In the very midst of these sun baked mineral hills, which colorfully reflect the paintings of Jules Guerin, as if hidden by the gods as something sacred, one will find the real Spain of romance, the real Spanish people, real Spanish customs, and the quiet primitiveness of a people so individualistic and different from any other people. I have spent some of my most delightful moments in such small hill-towns as Ronda and Guadalupe among the pleasant, humble people who seem always radiantly happy and content in their isolated little nests.

Except for their romance language, the Spaniard is brother to no country. His natural isolation, due to seas and mountains, caused him to form a distinct race strangely foregn to the rest of Europe. The Catalonian, however, can hardly be classed with his Spanish brothers because he has a different temperament entirely, being a mixture of the original Iberians and the Visigoths who settled in Catalan. Having entered and left Spain through Barcelona, I noticed strongly the contrast between the mentally alert Basques—quick, eager, and business-like as real Americans are—and the much more inert, leisurely Castilian or the contented somber Spaniard of Andalusia and Estremadura. Even his language is different, being a peculiar mixture with the French Provincial.

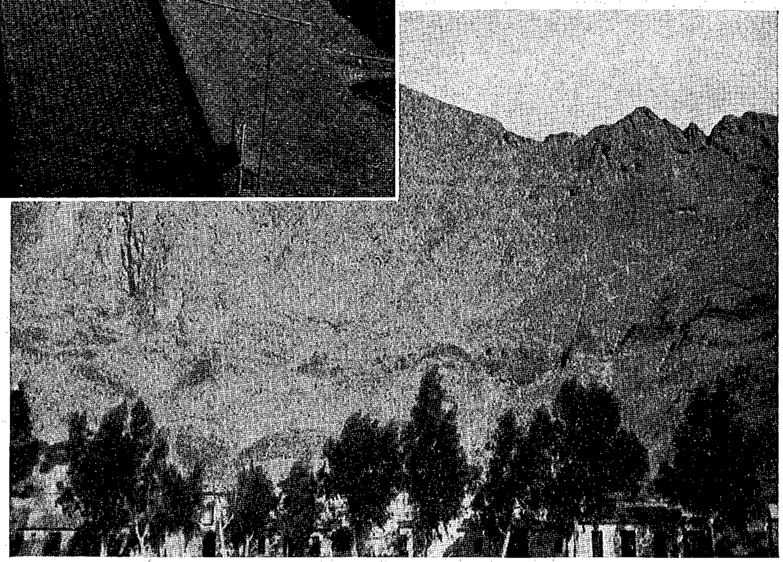
In Barcelona I had my first and only opportunity to visit a Juegos de Pelota, the swift Basque ball game similar to squash-ball except at much greater scale. The players catch the ball with the greatest skill in basket-like extensions in their hands and whip it back at a terrific speed. The spectators get as excited as the game is fast. Everyone bets, and, as the odds change continually, the racket caused by the bookies and the crowd resembles an infuriated chicken ranch. It is the fastest sport I know of and extraordinary expressive of the race.

Farther south the type is more inert and indolent, being content in barely eking out a living. This is obviously reflected by the great percentage of poor who live in crowded little huts and beg for a meager crust or send their insistent flock of gamins to ask for "un perro chio." But as illiterate and poverty stricken as much of Spain is, I soon became accustomed to these impoverished surroundings to find much warmth and optimism, which at first seemed almost entirely absent.

Walking down the Calle de las Sierpes of colorful Seville or watching the people at the Café through the hazy smoke of a cigarello during one of the afternoon siestas, one will find them much less the brooding type. And one need not strain his ears to hear the mellow voices of the senoritas singing the Malaguena or some young caballero strumming an accompaniment, presumably singing soft arias of love. One cannot mistake the emotional character of the people, who are much less the materialistic American type. Their peculiar temperament crops up in everything they do being reflected particularly in the architecture, painting, and sculpture.



**This nine sided tower over the crossing of the cathedral, La Seo, in Valencia, occupies the site of the original temple of Diana, Christian church and Moorish mosque. Lt was founded in 1262 and finished in 1482. This picture was taken from the unfinished Gothic bell-tower, El Miguelete, erected in the period 1381 to 1418.**



**". . . It takes a fiery steed like Henry Ford's to climb the endless crags and mountains of rock . . ." A scene, near Murcia, which is typical of the Southern and Eastern Spain.**

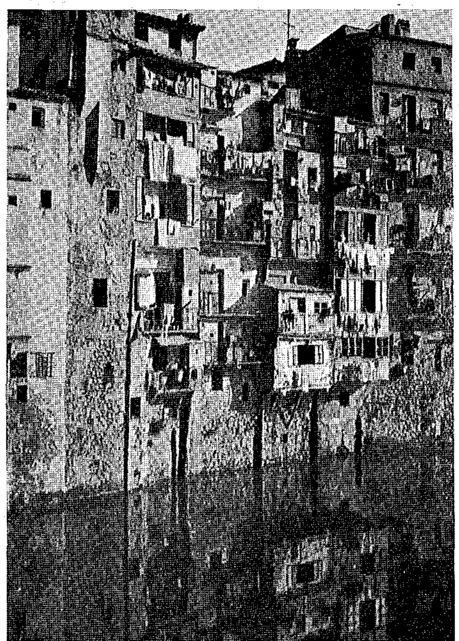
From the very beginning the Spaniard had not been blessed with a creative instinct and therefore lacked the power to originate a definite style which we may class as "the Spanish style" as we do Italian Renaissance or French Gothic. Buildings often have an unmistakable Spanish flavor and may be classed as Spanish, but exactly what the style is and to trace it is much more difficult. The architectural history of all countries seems to have been reflected in this one peninsula only to be hashed and rehashed to fit the local requirements, so that one cannot but feel the distinct Spanish spirit which was grafted on, not because of any feeling of plagiarism, but because of the peculiar temperament that invariably came to the fore. Often their artistic taste was as bad as their creative ability, their tastes being governed by their strong passions to exaggerate a certain fancy and to pile up meaningless elements that had no reason whatsoever behind them. Their borrowing nature was influenced much more by external appearances of a style than by the underlying organic principles of true architecture. Architecture was to them an applied decoration. Their Gothic structures often lacked the structural organic beauty and perfect mathematical function which are so obvious in the stately Flemish cathedrals. The beautiful Cathedral of Seville, for example, has flying buttresses that are raised considerably higher than the flat thrusts of the nave vaults.

Their fickle nature did not allow them to develop a style and exhaust its many possibilities. Instead, like a jack-rabbit, they jumped from one style to another without the slightest impulse from within. Enthusiastic over the new, they grafted on the old skeleton which was to be clothed with Gothic pinnacles and crockets, the much more popular Renaissance florid designs. This weakness to influence was modified, however, by a strong national feeling of wanting to be different, a desire to do something out of the ordinary and contrary to the obvious. This over-enthusiasm and wild fantasy took the place of a starved imagination and finally drove them toward a style so entirely Spanish that one can hardly class it as foreign.

As much as Spanish architecture lacks continuity, its chronological sequence can be followed very easily. Its Roman monuments rival those of Italy in both size and grandeur. One would hardly think that Seneca was a native of old Iberian Cordova and that the extinct Italica or Santiponce was the birthplace of Trajan, Hadrian, and Theodosius. The old Spanish Rome, Merida, as well as Segovia and Tarragona with their perfect aqueducts, and the impregnable Roman fortress, Sagunto, are reminders of the strength and wide scope of the old Roman colony. Visigothic churches and ruins can still be found in the northern sections of old Castille and Catalonia. I have found two most charming Visigothic churches in San Pablo del Campo at Barcelona and the small church at Veuta de Banos, the latter the oldest church in Spain, showing very definitely that the horseshoe arch was a Visigothic institution and not Moorish as so often thought.

Of all the conquerors the Moors have influenced the architecture of Spain most strongly. They came without any definite style of their own but possessed a strong oriental feeling of delicate fancy and unreality that hints of the Arabian Nights. The Alhambra at Granada, a stately red palace of almost Spartan simplicity, looked all the more ureal perched up against the green mass of trees and the snowcapped Sierra Nevada. Interior courts and rooms are a contrasting profusion of ornament, slender coupled columns, large expanses of intricate patterns of colorful arabesque, stalactite ceilings, half orange domes, pools, patios, and fountains that suggest the atmosphere of nomad Semites. They had a peculiar dislike for animal representation which accounts for the free use of border inscriptions. The Arabian motto, "There is no conqueror but the Most High God," I found a modest contrast to the frequent and boastful "non plus ultra" of Charles V, who spoiled so much by over-heavy classical additions wherever he found it possible.

The Alhambra may be considered the culmination of Moorish art, but of equal interest are the Giralda or tower of Seville, now incorporated with the Cathedral but originally the minaret of the



**Storied shacks facing the small river of Onar at Gerona, Province of Catalina, Spain.**

mosque, and the huge Mezquita Aljama at Cordova, a most oriental looking structure with a forest-like interior of some 850 columns. Although only thirty-eight feet in height, it occupies an area equal to that of St. Peters in Rome. El Cristo de la Luz in Toledo is a little jewel which carries with it almost all of its original charm. Other original examples are the Aljaferia at Saragossa, ruined beyond a state of interest, and the Alcazar at Seville, the huge palace that was remodelled to a great extent by Peter the Cruel and the self-loving Charles V.

After the conquest of the Moors the subjects continued the style which, being primarily an architecture of ornament that suited the Spanish fancy, was soon applied to a base of Gothic that just happened to be the popular style. There are a number of minor examples of this mongrel mixture of Moorish and Christian which is called Mudejar. I found most interesting a number of churches in Toledo, particularly Santa Maria la Blanca, the Casa del Duques de Alba in Seville, and the interesting well-house in the Monastery at Guadalupe. But when they add to their vocabulary of Moorish and Gothic the possibilities of Italian Renaissance, as in the Casa de Pilatos in Seville, I shudder at the absurdity.

I regret having failed to see the greatest of the Romanesque monuments, the church of Santiago de Compostella, which is a copy of the striking St. Sernin in Toulouse. As a whole the Romanesque churches in Spain have much more restraint than one would expect. They have the simplicity, strength, and solidity which make the style so praiseworthy. Of all Spain I was most impressed by these unpretentious, solemn examples and the equally artistic early or transitional Gothic churches of northern Spain. It is a pleasure to see such churches as San Millan and San Juan de los Caballeros at Segovia, with their sunny south porches; also San Vicente at Avila and the Cathedral Vieja at Salamanca, the latter of which very obviously inspired Richardson in his building Trinity church of Boston.

The cloister of the monastery of Santo Domingo de Silos, near Burgos, and that of the cathedral of Tarragona I found the jewels of them all. In both, the sculptured storied capitals are of exquisite beauty, often humorous representations of fantastic monsters and biblical scenes. The Cathedral of Tudela in Navarre, Lerida in Aragon, and Tarragona in Catalonia are examples of the transitional Gothic. Tarragona is especially inspiring because of its stateliness, sheer simplicity, and sparkling golden color. I am positive that Goodhue was quite familiar with this cathedral when he designed the Euclid Avenue Methodist Episcopal church of Cleveland. Of the later Gothic, Burgos Cathedral is the best, but it is the least Spanish, having been built by the German Meister Hans of Cologne in a character very similar to Cologne Cathedral.

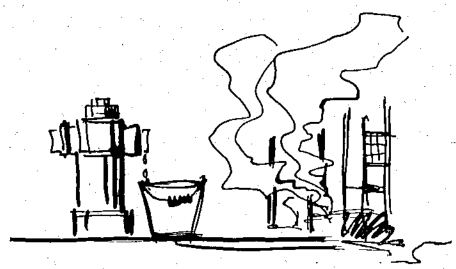
At a very early date the Cistercian order of monks had brought its universal style to Spain starting a number of strong groups such as Las Huelgas near Burgos, Santas Creus, and Poblet, both near Tarragona. Poblet is the most complete Cistercian Abbey I have ever seen, a city in itself and, before its revolutionary outburst, one of the richest treasure houses of Spanish reliqueries.

(*Continued on page 70*)

# « « « SLIP STIX » » »

## quakes beget quakes

Geology students have learned the cause of earthquakes. Also the results. A class in the mysteries of mother earth was being told about the San Francisco earthquake and how the water supply was broken temporarily. No one could think of a way to stop these earth move-



ments, but to some the loss of city water seemed a big problem. Said one, "What would they do after such an earthquake if a big fire broke out?" That stumped most everyone—except those who were positively treed. There was a pause when a voice in the back of the room (funny how they's always in back) piped up, "Get a water bucket!"

Everybody thought that was funny, but then, they still wouldn't have any water for the pail. That's not a very good idea.

## ice slipping

Both cars sped on, hoping the other would stop. It was too late. Both caused their wheels to stop rotating, but they slid closer, closer. Whereupon they smacked and bounced apart like two lovers surprised on a park bench. Both immediately jumped out of their gas buggies and looked for scratches on their vehicles. Both looked at each other. Both began to speak. "It was all my fault." "Oh, no, it was all mine." "I insist I am to blame." "Oh dear no. I saw you coming for three blocks and could have turned in any driveway."

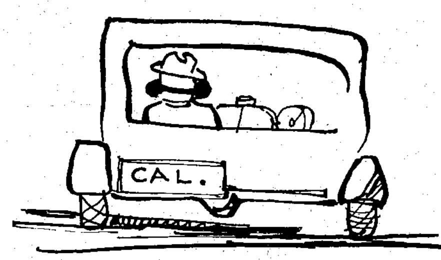
Well, maybe that isn't exactly what they did say, but it isn't the policy of this column to print such discourse as would injure a student's eyes—not so near finals.

## not knott watt

Two guys on a telephone:
"Are you there?"
"Who are you, please?"
"Watt!"
"What is your name?"
"Watt's my name."
"Yes, what's your name."
"My name is John—John Watt."
"John Watt?"
"Yes."
"I'll be around to see you this afternoon."
"All right. Are you Jones?"
"No, I'm Knott."
"Will you tell me your name then?"
"Will Knott."
"Why not?"
"Not what?"
"No, Knott Watt, William Knott!"
"Oh, I beg your pardon."
"Will you be home this afternoon?"
"Certainly, Knott."
"What?"
"Yes—"
"Aw, shut up!"

## just old overcoats

In our northern climate we think nothing of cold weather. We take it on the toes and like it. On a warm early winter day an automobilist was observed who not only was bundled up like Santy Claus at the North Pole, but there was




an article of wearing apparel gracing the gentleman's upper extremities which provoked at least mild mirthful consternation. Soft, fluffy earmuffs. And on a nice day, too. Wonderment was short lived, however, when the license plate offered complete explanation with one abreviated word: Cal.

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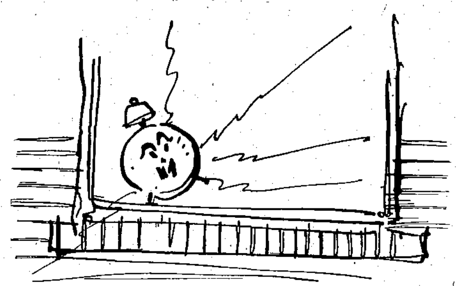
Frosh: Holy cow, that prof surely talks the lungs off a guy.
Senior: What does he talk about.
Frosh: He doesn't say.

## alarming

The 4-11 alarm might come at any time, but the 7:30 alarm always comes too soon. One morning a sleepy engineer got off to a very early start for school. Walking along with never more than one sleepy eye open at a time he



was suddenly jerked out of his reveries by some curious, familiar sound. He paused in his plodding, lifted his head, woke up, looked around in an effort to determine the source of that strange something. Finally his eyes rested on the house he was passing. Aha! At last he saw everything. From an open upstairs window came the steady cry of a baby demanding attention: a baby alarm clock.

## this 'n' that

He was only a mathematician's son, but he knew his curves.

Secret ambition. To be able to carry a tray in a cafeteria to a table without sloshing more than half the coffee onto the bread. (I don't mind dunking my bread in the coffee, but I hate having the coffee de-dunked on the bread.)

After looking at these resemblances to the bow of a shipwrecked boat which are called Empress Eugenie, it seems we should create a chapeau for the men and call it Emperor Eugene. Couldn't we just take an ordinary hat and bang it up a bit, smash in the top, and wear it upside down? In case of rain it would catch the water, thereby preventing a bad case of water on the brain.

The young man bought a suit from a tailor and swaggered out of the shop like a swank from Manhattan. Thought the tailor: Is that a pantomine?

He was only an architect instructor, but he knew his drawers.

Ah, Toodle-o, Old Topper.

# THE MINNESOTA TECHNO-LOG

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## Quizzes—and More Quizzes

THE average engineering student during his four years of university work carries an average of five subjects quarterly. Each of these subjects requires a final examination of about three hours duration. Therefore, the student will spend some one hundred and eighty hours in writing final exams during his four student years. Then he must also write about sixty hours on mid quarter quizzes. Add to these two figures the hours spent on weekly or monthly examinations, assuming another sixty hours for these, and we have a total of three hundred hours required of each engineer for examinations alone.

But let us go one step farther. Assuming that the College of Engineering and Architecture and the School of Chemistry has an enrollment of two thousand students, we find that during a regular school year 150,000 hours are spent as a grand total in writing examinations. Truly an enormous figure.

There is apparent only one way in which to eliminate this large waste. That is to eliminate some of the examinations. But, say the faculty, how are we to fairly grade all these students if we have no way in which to determine their knowledge of the study? At present the examination is the only practicable method of classifying our students.

We know of no way to eliminate entirely the examination. But couldn't their number be materially reduced by entire omission of the weekly quiz? Wouldn't monthly exams give the faculty sufficient data for grading? And meantime students could learn something of the subject without cramming for the next quiz.

## Time Versus Training

THE present condition of educational programs in many technical schools is not only a disadvantage to industry, but also a supreme disadvantage to the student.

Four years filled with technical subjects and then entrance into a complicated business and social world is the program of every present-day student of engineering. The effort to produce adequately trained engineers in four years of college work has led to a schedule of studies that is so purely technical that many courses are pursued by the student before he has received the fundamental training in mathematics and physics that is so necessary to complete appreciation of the study. As a result of this policy cultural subjects and business economics are entirely eliminated from the average engineering student's curriculum.

When a student is asked to master many subjects which require fundamentals he is not even familiar with, the extraordinary effort which mastery of the subject requires places such a high premium on thorough knowledge that the student is inclined to forget the purpose of the education. In addition the student is called upon to enter the field of business and social relations in a few years. He finds himself without any background of culture and even without the knowledge of the duties of the average citizen.

The over emphasis on technical subjects in a four year course and consequent elimination of cultural and business subject has produced an alien citizen who neither realizes his civic duties or finds interest in the interests of his fellow men.

A five year engineering course would make possible the injection of a certain amount of cultural subjects, mainly English, literature and speech, into the curriculum. It would still be possible, however, to emphasize more than ever on technical subjects without destroying the student's initiative because of the fact that it would be possible for him to master the fundamentals before more complicated and specialized technical courses are introduced. The mind of the prospective engineer would be more familiar with real concentration on problems introduced in technical studies than is now the case.

More thorough technical training, a better citizen, and a student inspired with initiative will be the result of a five year engineering course.

## Sign Here

THE various engineering societies have been organized to help students in their chosen professions. Perhaps the greatest benefit obtained at these meetings is in listening to talks by men who have already made good in their respective engineering fields. These men tell of just what they are doing, and perhaps illustrate their talks with lantern slides. Large industrial companies often send motion pictures of engineering projects to these meetings.

The students themselves will talk on subjects in which they are especially interested. These student talks are of real value, in that they give the students that self-confidence and poise which is so necessary to a successful speech or conference.

The opportunity of inspecting industrial plants in the Twin Cities is also open to society members. These trips are especially valuable, for in no other way can students obtain competent guides to take them through the plants and explain all interesting features.

Now, when all societies have begun their membership drives, is the time to join your respective societies. You will obtain a value in experience and in practical knowledge far greater than the small sum asked as a membership fee. You will become better acquainted with your fellow students and will thoroughly enjoy these monthly gatherings of members.

When we stop to consider this problem of abandoning engineering for an apparently easier and more profitable profession, the lack of interest, not in the entire engineering field but in single subjects, seems to cause the greatest difficulty. It is up to the first quarter Freshmen to see that this interest is developed.

## Freshmen— to Sophomores?

OF this year's Freshmen how many will actually become Sophomores? According to Professor Young of Dartmouth college only sixty per cent will advance. And why? Largely because of lack of interest, ability, and preparation.

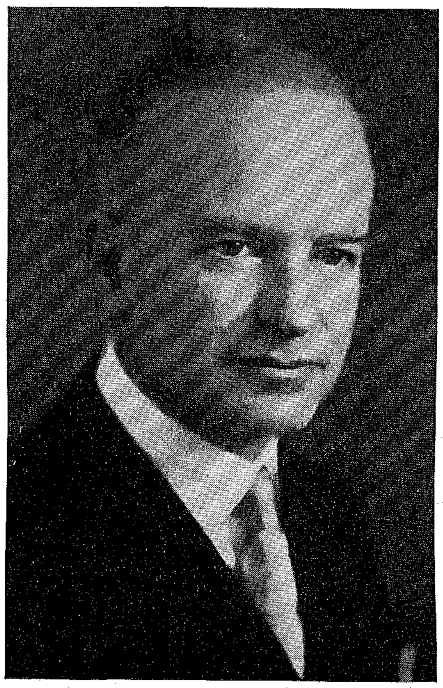
A railroad trestle—to the average freshman engineer such a structure raises dreams of aseries of difficulties overcome by a sturdy engineer undoubtedly clad in the proverbial boots and breeches. But does he see the word "mathematics" written across every girder, in fact every rivet? Years of mathematics were involved before that bridge was ever conceived. And still the incoming student believes he can study engineering without even being highly interested in his lowly algebra courses. Lack of interest is probably more noticeable in mathematics than any other one subject.

Lack of ability, of course, can not be told until engineering has been tried. Indications are given by work in high school, but even the poorest ability has been known to be overcome by an almost profound interest. But to the student afflicted with a lack of interest coupled with lack of ability engineering would not only be difficult but also unprofitable. Such a student should change his course of study immediately.

Freshmen are usually conscientious. Still a large percentage of them, particularly towards the end of the quarter, fail to prepare their daily assignments. The result is a development of a lack of interest as the work collects. And this problem of preparation together with lack of interest forms a vicious cycle "putting it off" until a position is reached from which it is impossible to rise. The student finally fails his course and is further discouraged to continue his engineering career.

EVERY student has his favorite instructors, and with every engineering student Professor Harlow Richardson is one of the favorites. An interesting lecturer, a fair marker, a broadly educated man. Professor Richardson is liked and respected by everyone who knows him.

This winter Professor Richardson is keeping his classes interested with stories of his latest trip. He spent all of last summer traveling and seems to have visited every place in Europe that one hears about—London, Cambridge, Paris, Florence, Rome, Venice, Munich, and Berlin are only a few of the places he stopped at on this trip. Most interesting to an engineer is Professor Richardson's account of the "Deutsches Museum" at Munich. Here are gathered together reproductions of all the machines or devices which have played a part in the scientific or mechanical development of things as they are today. Electricity, transportation, television, liquid air—the development of all these is shown there, and no "Hands Off" signs are on the machinery. Anyone may go in and operate and study the exhibits.



This is not the first trip Professor Richardson has made, but rather only one of many. He has been to Europe several times, has spent many summers in the Canadian mountains, and in general has indulged in his traveling hobby. His plans now include Honolulu and probably other parts of the Pacific and Asiatic lands, for next summer.

Harlow C. Richardson was born and educated in Cedar Rapids, Iowa. He graduated from Grinnel College in 1908, and did graduate work at the University of Chicago. He started teaching at the Washington High School at Cedar Rapids, but came to Minneapolis soon and taught at Central High School here for a number of years. During the war he was head of the School Office of the "Aviation Mechanic Training School" in the Overland Building, St. Paul, where fourteen trades were taught. In 1921 Professor Richardson came to the University of Minnesota. He is now head of the English department of the College of Engineering, and for two years was director of the summer session.

Professor Richardson belongs to the American Association of University Professors, the Minneapolis Athletic Club, and the Campus Club, as well as Alpha Rho Chi, Lambda Alpha Psi, Plumb Bob, Alpha Tau Sigma, and Theta Xi fraternities.

## Are Women Engineers?

WHICH make the better engineers, women or men? Due to the almost total lack of women in the engineering profession it has been difficult to answer that question. But now we have some enrolled in this college. How are they coming?

Reports on last year's scholastic averages reveal that in both the College of Engineering and Architecture and the School of Chemistry the women students averaged less than the men. In only one other college did this condition prevail. Why did this happen? What does it mean? As the School of Chemistry has practically all of its women registered as chemical engineers, let us use that school for comparison.

One explanation may be that the men are much more interested, and therefore scholastically better, in the practical courses. They have had closer contact with the practical side of engineering before their entrance into college and have some background for their theoretical studies. Previous to this time convention has told the women to leave this type of work to the masculine world with the result that even vitally interested women were unable to gather that experience through work or observation. If this is the cause of the difference between the two sexes, women planning on entering the engineering field must strive to gain some good practical knowledge.

There may be another cause of their inferiority. How many women students are members of their school's technical societies? Such membership is a stimulation for advancement in the engineering field and a means of correlating the text book with the commercial application. It may be the women's best method of raising their average to a level with the men's. Surely it could be tried.

# AROUND THE WORLD WITH OUR ALUMNI

## *Architecture*

'27—Kilpatrick—Porter W. Kilpatrick is now head of the department of architecture at the University of North Dakota. Following his graduation he came to Grand Forks, securing a position with Theodore B. Wells, an architect in Grand Forks, as an architectural designer, and is still employed by him.

Porter began teaching in the fall of 1929 as a graduate assistant in the department of architecture and took over the department in 1930. Mr. Kilpatrick was the 1927 St. Patrick.

'29—Cameron—Grace Cameron, who has been with Stair and Andrews, New York decorators, is living at 400 East 49th street, New York.

'30—Brunet—James A. Brunet was recently married to Hazel M. Marking. Jim is employed with the Flour City Ornamental Iron company of Minneapolis, Minnesota.

## *Chemical Engineering*

'96—Gruenberg—Benjamin C. Gruenberg writes: "Forgot to take a vacation this summer, so at the end of August I allowed myself to be convinced that it would be a good thing to stop working and get off on the water, which I did, going over to England and back on the same boat. Got a feeling of the excitement in London during the week of the opening of Parliament, but traded in all the sterling I had on the return journey, just before they went off the gold standard. . . . Left my youngest son in school in Devonshire; took a run up to Cambridge; saw a Hollywood film at the cinema; ran into some Americans; wrote two magazine articles, three chapters for a book, edited copy for four chapters of other people's writing, and read five books on the boat. Besides editing I am writing a book with my wife and another with a couple of other partners. I really enjoyed my vacation."

'17—Luft—Oscar v. d. Luft, a captain in the Ordinance Reserve of the United States Army, attended summer camp at the University of Michigan as an instructor in the course in high explosives.

Mr. Luft is in the Technical Development department, National Aniline and Chemical company. Oscar's home address is 18 Norwalk avenue, Buffalo, New York.

## *Minnesota Professor Now German Student*

Dr. Walter M. Lauer, associate professor of organic chemistry, has gone to Germany to study during his sabbatical leave of absence. He has just begun some investigational work in the laboratory of Professor Heinrich Wieland at the University of Munich on certain alkaloids. After completing his work at Munich Dr. Lauer intends to go to Gray and study microanalysis.

Before beginning work Dr. Lauer and his family traveled through Norway, Denmark, and parts of Germany. At one time the party had considerable difficulty in obtaining information from a conductor on one of the Danish trains, and as a consequence were very nearly separated from one another. While in Berlin Dr. Lauer visited Dr. Bull, a former student of Dr. Gortner at University Farm, who is now doing some work at the Kaiser Wilhelm Institute. The party visited many of the old castles and art galleries around the cities which they toured.

While in Copenhagen and Berlin Dr. Lauer visited some of the famous laboratories of such men as Bohr, Coster, Hevesy, and Liebig. He was shown some of the equipment and preparations of these men. The laboratory in which Dr. Lauer is now working was at one time used by Liebig.

He writes, "The laboratory is quite old, but is well equipped. There is a statue of Baeyer in front of the building and a bust of Liebig outside the room in which I work with the inscription that Liebig was director of the laboratory from 1850 to 1873."

Dr. Lauer has sent his best wishes to his friends and acquaintances at the University and has requested that they write him.

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'07—Halvorson—John O. Halvorson attended the meeting of the American Chemical Society at Buffalo, New York, in September, where he gave a paper on "Cotton Seed Meal." John is associated with the Agricultural Experiment Station at Raleigh, North Carolina, and has been studying the subject of his paper for a number of years. Mr. Halvorson's home address is 110 Wakefield avenue, Raleigh, North Carolina.

'17—Luxford—Ronald F. Luxford is still producing the "greenbacks" by engaging in reseach work at the Forest Products Laboratory at Madison, Wisconsin. Ronald has a new English type house in Shorewood Hills, a suburb of Madison, Wisconsin, for a castle.

'25—Scandling—Joseph E. Scandling and Louise Bannister were married October third. They are at home at 2650 Pleasant avenue, Minneapolis. Mr. Scandling is employed with the Northwestern Steel and Iron company.

'29—Fuller—D. L. Fuller is now a teaching assistant in Physical Chemistry, School of Chemistry, University of Minnesota. Donald's present address is 817 Essex street South East, Minneapolis, Minnesota.

'29—Shabaker—Hubert A. Shabaker, formerly with the Du Pont Ammonia company at Wilmington, Delaware, is now working in the laboratories of the Vacuum Oil company in Paulsboro, New Jersey.

'30—Petrie—Theodore Petrie is associated with the Vacuum Oil company at Paulsboro, New Jersey. Working with him is Dr. George Schultze, who was formerly at the University of Minnesota as a Petroleum Institute fellow.

'31—Gustafson—George Gustafson is teaching chemistry and coaching football at Clifton College, Clifton, Texas. George states that he likes the teaching but has some doubts as to ability as a football strategist.

'31—Metzinger—Edgar F. Metzinger is now a research chemist in lacquers for the Sherwin-Williams company in Chicago. Ed lives at 6247 Blackstone.

'31—Hechman—Russel Hechman is now with the Shattuck Chemical company of Denver, Colorado.

## *Civil Engineering*

'17—Riekman—Herman W. Riekman, who was engineering in Russia a year ago, is now with the Leonard Construction Company, Chicago, as structural engineer. Herman spent one year in Russia making the "five-year plan" safe for Russians.

'23—Nelson—Glenn H. Nelson, in a letter to Professor Zelner, writes: "You never can tell from one day to another just what you will next be doing. The engineering game came to such a standstill on the Pacific coast that I reached out into a new field of endeavor. For the past year I have been managing the Harris Theatre for Warner Brothers at Findlay, Ohio. Just how long I will be in the show business I do not know. If conditions change, I may go out west again and enter the engineering field once more. I still am keeping up my engineering license that I received in the state of California, so that I will be in a position to practice that profession in that state at any time I wish."

Glenn continues, "Since the last time there has been a change in the status of my own life, and that is that I am now married, and have been since April 15. It would be a great pleasure to come back to the old stamping grounds again, but I may have to forego this pleasure until some future time, when a better opportunity lends itself. I certainly would like to know what happened to some of the fellows of the class of '23. No doubt they are pretty well scattered and some of them like myself, have been in a measure lost track of. There is one fellow that I would like to know the whereabouts of, if possible, and he is Albert W. Johnson." Albert Johnson's present address is 1725 Wilson Avenue, Chicago.

'22—Anderson—N. Sevrin Anderson is field office engineer, construction department, Minnesota Highways. Sevrin's home address is at 404 North Third street, Montevideo, Minnesota, and as he himself puts it, "on the old Yellowstone Trail midway between Plymouth Rock and Puget Sound."

'25—Larson—Fred H. Larson is now a draftsman with the Northern Pacific Bridge department of the Northern Pacific Railway company in St. Paul, Minnesota. Fred is married and lives in a house devoid of future engineers at 55 Melbourne Avenue South East, St. Paul, Minnesota.

'27—Borne—Floyd O. Borne is also associated with the engineering department of the Northern Pacific Railway with offices in the Northern Pacific Railway building, St. Paul. Floyd's destiny was settled on August 22, 1931. He married Louise J. Elder of Red Wing, Minnesota.

'30—Snodgrass—George F. Snodgrass is with the United States Engineering office in Sioux City, Iowa. George is associated with the surveying and construction work necessary to give "Big Muddy" a six-foot channel. George says that he has married and settled down like a good citizen.

'30—Antilla—George W. Antilla was in Minneapolis for the Ohio game. George is, according to his statement, "still single and expect to be for a while." He states that he is doing survey work which consists of triangulation, discharge, topography, and levels for experimental determination of the best kind of works to be used on the proposed six-foot channel for the Missouri. The business address is the Department of War, Engineering Office, Sioux City, Iowa.

Clive Hastings, president of the Railway Specialty Company of Atchison, Kansas, died unexpectedly while visiting his daughter in Akron, Ohio. Mr. Hastings was one of a class of four mechanical engineers who graduated from the University of Minnesota in 1896. He was owner of the Locomotive Finished Materials company of Atchison, Kansas, and during his life was associated with a number of prominent railway manufacturing companies. He is survived by his wife, one son, and three daughters.

'30—Ralphe—Mr. and Mrs. Wendell W. Ralphe of Hastings, Minnesota, have a son, James Francis, born October second. Reports say that the future engineer is another Wendell. Mr. Ralphe is employed with the United States Engineering Office.

'30—Kab—Ben J. Kab is working with the Department of War, United States Engineering Offices, Sioux City, Iowa. Ben has charge of all cost-accounting and is chief clerk on the construction work for the six-foot channel on the Missouri River. Ben states that he is still single, but that nevertheless he has become an accomplished golf player.

'30—Louk—Frank Louk came back to the campus to see the Gophers trounce the Badgers. Frank is a United States Junior Engineer stationed at Kansas City, Missouri. Mr. Louk is at present engaged in estimating and designing for flood control for the Missouri river and its tributaries.

'31—Suell—Leonard J. Suell is now located at Gibbon, Minnesota. Leonard is working on a sub-grade treatment job for the Minnesota Highway Department.

'31—Dartt—Harvey S. Dartt whose present address is 2747 17th Avenue South, Minneapolis, Minnesota, was up to Cass lake for a chat with the Civil summer class.

'31—Merzweiler—John Merzweiler has been on a paving project at Bagley, Minnesota, all summer and is now going to Remer, Minnesota, on location work for the Minnesota State Highway Department.

'31—Schoettler—J. Lewis Schoettler was on the campus to see the Gophers defeat Ohio State. He is with the Minnesota Highway Department at Henning, Minnesota, and his work is "convincing the contractors on the relocation of highway 36 that they have moved many yards less than they estimated."

## *Electrical Engineering*

'00—Thaler—Professor J. A. Thaler of Montana State College was elected president of the new branch of the American Institute of Electrical Engineers for Montana. The section was organized with Bozeman as its headquarters.

'00—Dow—J. C. Dow of Great Falls was elected a member of the executive board of the recently organized Montana section of the American Institute of Electrical Engineers. Mr. Dow is an operating engineer with the Montana Power company.

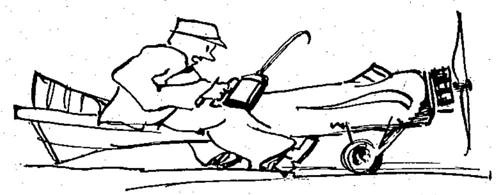
'08 — Schoepf — Alfred W. Schoepf writes: "I have been living in Campinas, Brazil, about one hundred miles toward the interior of the state from the city of Sao Paulo, since last March, although my family is in Sao Paulo on account of school for my daughter, Shirely Jean. They will move here next month." Mr. Schoepf is with the Emprezos Electricas Brasileiras of Sao Paulo, Brazil.

'28—Burris—Arthur Burris and Marjorie Merritt were married September twenty-first in Minneapolis. After a trip to Gateway Lodge in Northern Minnesota they were at home at 518 street South East, Minneapolis. Art is employed by the Minneapolis Electric Machinery Manufacturing company.

'29—Specht—James E. Specht has left the ranks of the Westinghouse company, and is now with the Hagen Corporation of Orville, Ohio. Jim is working with photo-electric cells and vacuum tubes, using them in the design of control equipmen for electrical apparatus. His address is 208 W. Oak Street, Orville, Ohio.

'29—Kuefler—Edward L. Kuefler has been transferred from the Chicago office of Westinghouse Electric company to the Westmont, Illinois, office. Ed is a sales engineer, and is staying at 110 Case avenue W., Westmont, Illinois.

'29—Fisher—Addison M. Fisher has been transferred to the Chicago sales office of Westinghouse Electric company. Bud formerly worked in the Pittsburgh office.



'08—Hoppin—Glenn H. Hoppin is still in the airplane business with Bill Stout in Dearborn, Michigan. Glenn is secretary for Stout Air Service, Incorporated, with offices at 400 Dearborn building.

'29—Bohrer—Donald M. Bohrer is now with the Chicago sales office of Westinghouse Electric company.

'29—Abrahamson—LeRoy M. Abrahamson is associated with the Wisconsin Power and Light company in Sheboygan, Wisconsin. LeRoy, a versatile engineer, is doing work on a new substation, laying bases for the generators, surveying locations for foundations, and everything else that requires more than a knowledge of electrical engineering.

'30—Norman—Vernon R. Norman no longer has to darn his own socks as he was married on June 14 of this year. Vernon passed the summer by the waters of Minnetonka, and is now living at 5421 43rd avenue South, in Minneapolis. He is a toll engineer with the Northwestern Bell Telephone company.

Vernon is taking up advanced electrical courses in night school here, with a view towards a Master's degree, hence he is as yet not out of the range of mid-quarters and finals.

'30—Wang—Harold S. Wang is still working for Western Electric and believes that he is quite fortunate. Harold is now living at 4704 Ferdinand street, Chicago.

## *Mechanical Engineering*

'27—Little—Fred W. Little and Mildred S. Plummer were married on August fourteenth at Hawley, Minnesota. Fred is employed by the National Lead company, Chicago. They are at home at 6 North Lotus, Chicago.

'30—Elliot—Carroll L. Elliot has recently been appointed superintendent of the Austin Municipal Water and Light plant at Austin, Minnesota. Carroll is married, of course, and he says that they like Austin very much.

'31—Hill—Ralph W. Hill was recently honored by the acceptance of his application for enrollment in the Chrysler corporation graduate engineering course.

# NEWS FROM THE TECHNICAL CAMPUS

## *Koepke Toastmaster at Honorary Dinner*

Members of the Minnesota Chapter of Tau Beta Pi, honorary engineering fraternity, dined at the Curtis hotel Tuesday, December second, in honor of the fraternities latest initiates. Professor Charles A. Koepke of the mechanical engineering department acted as toastmaster. Reverend John Lewis, pastor pastor of the First Methodist Church of Minneapolis and a member of Tau Beta Pi, delivered the address of the evening.

The 22 new initiates are John Appert, Robert Calton, Winfield Foster, Robert Geehan, Marvin Johnson, Richard Jordan, Julius Katz, Robert Kreiss, Albert Lilja, Cecil March, Hugh Meindl, Einer Michalson, Milton Olson, Ralph Peck, Edgar Piret, Paul Salo, Milton Schmidt, George Weigel, Benjamin Axilrod, Carl Christiansen, and Archie Japs.

## *Honorary Fraternity Elects New Members*

Eta Kappa Nu, honorary electrical engineering fraternity, on December 3, 1931, initiated Robert Kutzler, Carl Christiansen, Albert Olson, Laddy Markus, John Hancock, Robert Haxby, Fred Bauman, and Raymond Milner.

The formal initiation, held in the Electrical Engineering building, was followed by a banquet at the Francis Drake hotel with Professor Bryant, head of the Department of Electrical Engineering, acting as toastmaster. Professor Ryan of the electrical engineering department, as guest speaker, discussed his tour through Europe and the United States last year.

Cledo Brunetti, chapter president, gave a formal report of the national convention, held recently at Ithaca, New York.

## *Sophomore Engineer Heads Hall Weekly*

Featuring sports, news, editorials, and promising telephone numbers, *Mississippi Mud*, Pioneer Hall's new publication headed by Merlin H. Berg, sophomore Civil, recently appeared on the campus. A weekly mimeographed sheet, *Mississippi Mud* was first published November 16.

## *Bernt Balchen, Aviator, Describes Polar Flight*

Forced to change his speech from a highly technical to a more general nature, Bernt Balchen, world famed aviator, told a large cosmopolitan audience November 24 in the Engineering auditorium of the part played by airplanes in the Byrd Antarctic expedition. Mr. Balchen had planned to speak on the design and testing of aircraft. The meeting, held under the auspicies of the Minnesota society of Aeronautical Engineers, attracted such a large number of students other than engineers that Mr. Balchen abandoned his original topic.

Difficulties involved in the selection and preparation of aeronautical equipment for the polar trip were first discussed. For the principal flight a Ford tri-motor was chosen, rather than the Fokker previously used on a trans-Atlantic flight, because the former lent itself more readily to disassembly for shipment. To increase the service ceiling, a larger motor was substituted. This necessitated rebuilding practically the whole ship. Additional gas tanks had to be placed where they would interfere least with the ship's maneuveribility. It required several months to solve these, and attendant difficulties.

Flying conditions at the South Pole were described by Balchen as being erratic. On a nice day, at forty below zero, the only trouble experienced is with motors. However, during storms the wind attains a velocity of 150 to 200 miles per hour and not only is flying impossible, but it is only with difficulty that planes can be kept from blowing away.

The flight to the pole was made in the face of a steady headwind. The party was forced to discard gas and precious emergency supplies to attain altitude to cross a high plateau on the route. Photographs were taken all along the way and constant radio communication was maintained with the base.

Of special interest to the engineers were Balchen's descriptions of the methods of plotting load and cruising speed curves and of the design of ski landing gear. The ideal ship for polar flights suggested was a low wing monoplane that could be taken into five pieces for shipment. Balchen stated that if ever another similar expedition were formed, he would like to be included.

## *Techno-Logs Travel 7500 Miles to Display*

After traveling 7,500 miles to Tiflis, Republic of Georgia, U. S. S. R., representative issues of 12 volumes of the Minnesota TECHNO-LOG will be placed on exhibition in the second All Nations Press Exhibition. The copies sent will represent every volume of the TECHNO-LOG from 1920 to the present year.

The first International Press Exhibition, held at Cologne, Germany, showed representative press publications from 90 different countries, in 100 different languages. The sponsors of the 1932 exhibition plan to have publications from the periodical presses of 249 different countries, printed in 181 different languages. Newspapers, magazines, yearbooks, almanacs, calendars, posters, and maps will be used to show "the Life of the Press, the Press in the Life, the Press and the Life, and the History of the Press." The Graphics of Today, the Book, the Newspaper, the Blind Press, and the Development of Modern Printing will be made a part of this exhibition.

## *Women Turn Chemists: Largest Registration*

With fifteen women registered for undergraduate study, the School of Chemistry this year has the largest group of women students on record. One of the fifteen is registered in Chemical Engineering; the others are studying Chemistry. The increase in women enrollment is attributed to the opportunities offered during the past few years in the fields of chemical education and industrial research.

The course in chemistry provides ample training for work in research and control laboratories. Work of this sort is now being done by a number of graduates from the School of Chemistry. Others are engaged in teaching at various colleges and schools in the country.

In addition to the students registered in undergraduate courses there are a number of women working for advanced degrees. Some of the women who have obtained their Ph. D. degrees at Minnesota now hold responsible positions on the faculties of some of the largest universities.

## *Wibaut Discusses Catalytic Addition*

Dr. Wibaut, professor of organic chemistry at the University of Amsterdam, Amsterdam, Holland, spoke on the catalytic addition of hydrogen halides to gaseous olefines and acetylenes, as guest speaker at the one hundred and seventy-first meeting of the Minnesota section of the American Chemical Society held Monday, November 30.

Dr. Wibaut's topic aroused much interest among the attending organic chemists. He discussed the importance of hydrogen halides as catalysts in organic research and further developments through continued research.

At the invitation of the American Coal Conference in Pittsburgh, Dr. Wibaut came to the United States November 10. He was very much interested in the research work in chemistry being undertaken by various American universities and expressed his enthusiasm after having visited Princeton University, the University of Michigan, the University of Minnesota, and the University of Illinois.

Dr. Kolthoff, professor of organic chemistry in the School of Chemistry, knew Dr. Wibaut when they were both in Holland. In a letter to Dr. Kolthoff, shortly after Dr. Wibaut left Minneapolis on his return trip, he expressed his interest in American enthusiasm for research and especially lauded research being undertaken at the University of Minnesota in the School of Chemistry. He also said that the American people had left a lasting impression on him of courtesy, industry, and sincerity.

## *Technology Students Hear Prominent Men*

Prominent engineers actively connected with the many varied aspects of industrial engineering came to the University during the fall quarter to present a wide view of the engineering field in industry to aeronautical, mechanical, and business engineering students enrolled in the mechanical technology course.

W. H. Richards of the mechanical engineering department, who directed the course, put a great deal of effort into securing a series of speakers to give the students a general perception of industrial engineering planned to include the ethics of engineering, safety engineering administration and the obligations of the engineer in this respect to both employer and employee, the use of efficient mechanical methods in the securing of raw materials and the fabrication of these materials into structural parts, engineering phases of structural work and considerations in the use of structural material, the engineering problems involved in supplying power and water for industrial and public use, the protection afforded to engineers by the right of patent, the selling of industrial products through advertising, and the financing of industry.

Discussions by men connected with the engineering administration of companies engaged in the manufacture of glass, cement, paints and varnishes, insulating materials, petroleum products, and steel structural material brought out the engineering problems pertaining to the production of these various commodities, and something of their many uses.

Speakers well acquainted with their respective subjects told of the making of talking pictures, the problems of the aeroplane engineer and the influence of the principles of areoplane design on the design of other commercial equipment, interesting features in the construction of modern office buildings, engineering problems in the production and distribution of electric power, development of the automobile and the automobile industry, and the engineering aspects of the telephone and telegraph systems.

Students taking the course were required to write a number of reports on topics of their own selection from those presented in the series of talks. Mr. Richards said, "I have been well pleased by the reports the students have turned in, and I feel that the students have gained something of great value to themselves from the practice in technical writing which the preparing of these reports has given them."

## *Engineering Library Book List Grows*

The engineering library has announced among recent accessions, a copy of the latest (1930) edition of Who's Who in Engineering. This book, listing engineers of high standing, now living, who have contributed materially to the advancement of engineering, and giving short sketches of their lives and achievements, should prove a valuable biographical reference to those interested in the engineering profession. Other accessions during the fall included authoritative, up-to-date treatises on a variety of engineering subjects.

## *Chemistry Exhibition Has Student Products*

In one of the corridors which constitutes part of the School of Chemistry museum there is an exhibit of chemicals manufactured by chemical engineering students. These specimens have been collected over a period of several years from samples of the products made during the regular summer sessions. Many materials made and used industrially are included in the collection.

One of the interesting features of the exhibit is the fact that it demonstrates the extreme versatility of chemical engineering operations. Inorganic colors and pigments, for example, are shown together with organic dye-stuffs made by very different methods.

Some additions are made to the collection after every summer session. Each new specimen represents a substance which has not been made before in the chemical engineering laboratory.

## *Engineer Discusses Decorative Lighting*

Mr. O. P. Cleaver, illumination engineer for the Westinghouse Electric Company, discussed the relations between decorative lighting and modern architectural design at a joint meeting of the electrical engineering, interior decorating, and architectural societies on November 19. The many novel and interesting features of the lighting decorations found in various European countries were given special attention in this lecture.

In many buildings in Germany, the lighting effects provide the only decoration, with the red and gold combination of colors being a favorite. Many bizarre effects have been obtained in the cafes, hotels, and theaters of this country by the use of reflected light from concealed sources. Neon and other gas filled tubes play an important part in the lighting decorations found in European buildings. The blue light from argon tubes, the green from mercury vapor, and the red from neon are the only colors now in common use, although a great deal of experimental work is being done in the development of other colors and of white for the gas-filled tubes.

In France, some variation of the crystal chandelier is usually a part of the lighting decorations. England, ever a conservative country, is reluctant to adopt the fantastic effects so loved by

French and German decorators, so here we find a more austere form of decorative lighting. Russia is not a bit backward in expressing its ideas, and photographs of some of its noted cafes and theaters look much the same at any angle, erect or inverted. Sharp angles and massive columns, sometimes of glass with light sources inside and sometimes lighted by reflection, are used in obtaining these weird and grotesque effects.

Up to only a few years ago, little attention was given to the appearance of a building at night in the design of the structure, and the result was that, as the lights came on at night, many of the striking architectural features of the building were lost in the glare of light from row on row of boxed windows. The present trend, in many places in Europe, is to do just the opposite, making buildings rather commonplace in the sunlight, but very distinctive at night with the decorative lights turned on. In outdoor decoration, lights from hidden sources, directed parallel to the wall surfaces, are used to outline certain parts of the building and to shadow others.

He also showed some of the latest developments in tungsten lamps, including the longest 100 watt lamp yet constructed for actual industrial use. The filament of this lamp is over twenty-four inches long, and is supported at intervals of three inches to reduce the sag when it is used horizontally. A 150 watt lamp with a one foot filament, the longest ever used with a lamp of this rating, was also shown. These long bulbs are used where an extended source of white light is desired.

## *Honorary Fraternity Holds Smoker in Union*

Members of Phi Lambda Upsilon, honorary chemical fraternity, were hosts at a smoker Wednesday evening, December 2, in the lounge room of the Minnesota Union. The speakers of the evening were Dean Leland, Dr. S. C. Lind, director of the School of Chemistry, and Dr. Ross A. Gortner, head of the Department of Agricultural Biochemistry. Dr. Gortner, at one time national president of Phi Lambda Upsilon, explained the historical background and ideals of the organization. Charles Winding, graduate student in Chemical Engineering, acted as toastmaster and director of entertainment.

## *Architects Yearbook Subscription Large*

With well over fifty per cent of the architectural students subscribed the subscription drive for this year's Architectural Yearbook, student publication of the Department of Architecture, is well under way. The Junior architects have gained the lead in the drive by being the first group to subscribe 100 per cent to the Yearbook.

Subscription to the Yearbook also carries a membership in the Architectural Society, sponsors of the publication. This year's Yearbook will be volume five. Volume one, published in 1916, appeared under the title of Annual of the Department of Architecture. Volume two, issued in 1922, was Designs and Drawings by Students of the Department of Architecture of the University of Minnesota. Volume three was published in 1924 under the same name. Last year's issue was volume four, and was the first to be called the Architectural Yearbook.

The 1932 staff, as appointed by the Architectural Society, is headed by Rudolph Dahl, editor-in-chief, and Dean G. Ball, business manager. Gordon Wall and Russell Baker are assistants while Frank Skillman heads the art department and Adolph Erickson the circulation department. According to Mr. Dahl, work on this year's issue will begin in the winter quarter, and the yearbook will be published in May, 1932.

## *Architects Design Modern Terminal*

The final awards for the senior architectural problem have been made with Gordon Wall receiving first mention and Joseph Gates taking second place.

The problem involved the design of a large passenger station having combined facilities for railroad, motorbus, and aircraft circulation. The site of the station is on the outskirts of the Twin Cities at the junction of two main arterial highways. Railroad tracks enter the station from the rear and the aircraft landing field is located along the tracks. About 100,000 square feet of office space are needed for administrative purposes. Streets and city block boundaries are to be arranged to fit in with the station approaches. All other specifications are left for the students.

The students were given a week to investigate the problem, in order that they might make reasonable close estimates as to the number of passengers using planes, buses, and trains served by this station.

A jury of professors from the architectural department judged the problems. Two students aided the jury by giving explanations of the different views of the problem.

The problem of the sophomore class was to design a music building consisting of an auditorium, a number of school rooms, a foyer, a memorial room, and a number of locker rooms. The essential part of the problem was the combining of the three main elements, the auditorium, the school, and the foyer.

According to the jury's decision, there were three equally good arrangements of the three elements of the problem. In the first scheme, the foyer was placed on the main street, at the entrance to the auditorium, and the school was located in the rear of the auditorium, isolating it from the noise of the entrance and auditorium. In the second scheme, the schoolrooms circled the auditorium, and in the third, the rooms were placed on only two sides of the auditorium.

## *Electricals Visit Pillsbury Mills*

On Friday, November 13, the student chapter of the A.I.E.E. visited the Pillsbury "A" flour mill. This mill is entirely devoted to the production of white flour, and is the largest of its kind in the world. The mill, when running at maximum capacity, uses up the total wheat production of a plot of ground seven miles long and three miles wide in twenty-four hours. The building contains thirty-two dust collectors and has three men continually sweeping on each floor. In this way the building is kept perfectly clean and fire hazards and dust explosions are avoided. Induction motors are also used throughout to avoid the sparkling characteristic of other types of motors.

The greater part of the power for the mill is supplied by a large turbine working under a head of 45 feet of water from St. Anthony Falls. This power is transmitted to the various crushing and sifting machines by means of a rope belt, which runs from the turbine to the sixth floor. For the smaller machines electrical power is used to the extent of 18,000,000 kilowatt hours. One million kilowatt hours is supplied by the steam used in the radiators, another million supplied by the excess output of the water turbine, and the rest by the Northern States Power company.

# Spain — Its People

(*Continued from page 60*)

The Gothic style, however, allowing such a limited flexibility and possibility for surface decorations, proved too stiff and severe for the Spaniards. In the new cathedral of Salamanca they went so far as to apply pieces of finials against the flat transept exterior for no reason except to cover a blank surface. So, when the Italian Renaissance was introduced, they welcomed the opportunity to use such fine florid ornament and arabesque pilasters. There was striving for technical perfection and a minuteness of detail which accounts for the name "plateresque" (from the word meaning silversmith). Good examples of the style are the old Town Hall in Jerez de la Frontera (much more popular because of its world-famous white Sherry wine) and the Aguntamiento, or town hall of Seville, built by Diego de Riano.

Rich Spaniards traveling in Italy thought that a copy of its architecture would advance the refinement and culture of their countrymen, so they gave huge donations for the erection of colleges, universities, and palaces in the Renaissance spirit. The strong families of Fonseca and Mendoza started colleges at Alcala de Henares and at Salamanca. At Alcala is the excellent Colegio de San Ildefonso and the less interesting archbishop's Palace.

At Guadajara the facade of the Palace of the Duques del Infantado is interestingly peppered with patterns of pyramidal projecting stones. At Salamanca the equally interesting facade of the Casa de las Conchas is similarly studded with scallop shells and spots of very rich iron work. The facade of the Salamanca university is famous enough to require no comment. All these examples are unmistakably Spanish through and through. Of the many churches, good examples may be found in Salamanca in the rich sixteenth century facade of San Esteban and in the excellent doorway of Esperitu Santo by Berruguete, who finally pushed the style to carricature and grotesque.

The Plateresque is the rich sixteenth century Gothic blooming in a coat of Renaissance in the same manner that Mudejar is the queer Gothic clothed in Moorish detail. It had its immediate predecessors in the Colegio de San Gregorio and in the church of San Pablo, both in Valladolid. The facades, often called Plateresque, are a profusion of a hybrid mixture of realistic ornament such as basketweave, trees, shields, and ornament that is not Italian. Still, in part, it is the same as plateresque in which stateliness and contrast are gotten by areas of profuse ornamentation placed against a plain surface; and in the bright sunshine of Spain these two very definite areas are even more in contrast. The Spaniard has finally gotten by gradual development something that is unmistakably his own and characteristic of his nature and country.

As to planning, Spanish churches are entirely wrong. In order to conform to their particular ritual, they set the huge enclosed choir into the very center of the nave and crossing disregarding the necessary spaciousness of the church. This "most holy" spot is used only by the chanting priests and bishops, while the entire public must be content with the transepts and chapels. Ambulatories have only the use of corridors because the huge retablos hide everything. They should have frankly adopted a new plan which conforms to their ritual. Catalan churches, quite different, show a decided influence of Southern France. Like the cathedral of Albi, they are daringly wide and without side-aisles. The churches of Barcelona, especially the Cathedral of Gerona, are typical examples. In contrast to the well lighted, cheerful interiors of Italian churches, Spanish churches are dark and mystical and smell strongly of incense, with an occasional diagonal streak of light from the thin slits of windows.

Retablos are an important Spanish element reaching often to the vaulting in superposed rows of either painted panels, as in the earlier churches of Tudela and Tarragona, or of sculptured designs, which were common during the sixteenth century. Since there was such a predilection for ornamental surfaces, technical dexterity developed very strongly. Early Gothic sculpture reached perfection in the white marble tombs of Gil de Siloe, of whose work are the monument to Don Juan de Padilla in Burgos, the sepulchres in the Cartuja de Miraflores, and Faucelli's huge tomb for Ferdinand and Isabella in Granada.

During the Plateresque period there was a strong leaning toward copying Michael Angelo, because his seriousness and unusual poses suited the emotional spirit of the Spaniard. Later followers, however, exaggerated, as the Spaniard is so apt to do, and the figures became a squirming distortion. This was stopped by a certain Andalusian called Montanes, who revived the Medieval polychrome sculpture, which spread like wild fire because, during its short reign, it found itself into every church. This ghastly realism appealed strongly to the Spaniards because it expressed exactly their attitude of mind—slim, meager replicas of Christ in pathetic condition and often bleeding from head to foot, set up in conspicuous spots so as to incite the emotion and pity of the people.

Montane's sculpture is considered very artistic by many critics, and it is well done for what it is. But, I personally abhor statuary of such realism in pose and execution. The followers of Montanes and his student, Alonzo Cano, went so far as to use human hair and finally to stuff an actual human body to be worshipped as is being done in the Capilla del Santisimo Cristo in the Cathedral de Burgos. Baroque soon drew the attention of the Spaniards who decided to give full expression to their wild fancy. Churriguera led this horrible movement.

The Interior of La Seo at Saragossa and the transparente of the Toledo Cathedral are excellent examples in which one beholds something that resembles a spontaneous explosion of a squirming human mass or Dante's Inferno itself.

One cannot study Spanish architecture without studying its painting, because the two are so closely related. Every church is a picture gallery. Due to close trade relations with the North there was a great importation of Flemish art. However, it did not take them very long to notice the broadness and purity of Italians like Raphael and Andrea del Sarto, whom they copied in a strict mannerism. One can notice without effort the cold spiritless imitation in the paintings of such men as Juan de Bargona and Berruguete.

The broad and vigorous handling of the Venetians fitted the Spanish fancy much more, so Titian and Tintoretto were studied fervently. But since Venetians painted to portray nature, they taught the Spaniards how to be natural. Ribalta and Ribera, in the early seventeenth century, started the great Spanish school with their principles of realism. They expressed their own feelings and those of all Spain in their religious seriousness and pathos which often turned to morbidity. Ribera appeals to me especially with his strong contrasts, expressions, and broad thick surfaces, so much like those of Rembrandt. It was interesting to notice in the Prado the difference of interpretation of the same subject, "Prometeus Bound," by Titian, the Italian, and by Ribera, the Spaniard. The first strong and colossal; the second wiry and grewsome expressing extreme pain and torment of the gods. The Carthusian monk, Francisco Zurbaran, went to the extreme painting, in a cold stiff manner, exactly what he saw.

None come up to the two Andalusian geniuses; the Spanish Murillo, who painted with such religious insight and purity that even the stupid agnostic could find warmth and strange consolation in his unnatural simplicity, or the noble Velasquez, Philip IV's court painter who painted with such intelligence. In Murillo's paintings there is no Zursaran stiffness but a yielding intimacy and friendliness in the large brown eyes of the religious personages, who seem as friendly mediators between God and the people. Without seeing his best works one cannot realize this unnatural charm in which the history of the Bible is translated in the dialect of the Spanish people.

Velazquez can hardly be compared to Murillo, because in his portraits he portrayed the natural. He was much more of a realist. Although his compositions are quite ordinary, he brought out the natural in such a striking manner and with so much thought (as is seen in his Las Meninas and Las Hiladeras) that one can only wonder at his insight and ingenious mastery.

The most curious exponent of Spanish art is the revolting El Greco (Domenico Theotocopoli) who lived just three hundred years too early. He could not bear the eclectic mannerisms of his fellowmen. Craving originality, he dropped all realism and painted to give impression rather than photographic interpretation, a reason for his modern popularity. His colors are radical and raw, figures often unnatural. Composition at first seems confused, but upon study one will find a grouping of masses, direction and movement between planes, a pleasing repetition, a brilliance in the shadows which are often omitted, and an intelligent subordination either by reduction of size or by complete obliteration of an element. As one must go to Seville to study Murillo or to the great repository, the Prado, to study Velazquez and Goya, so one must go to Toledo before he can understand and appreciate El Greco. His paintings are impressionistic and require analyzation and therefore appeal more to one's intelligence than to one's visual powers.

Exactly in this same manner the people of today have tired of the adherence to stiff eclecticism, the static styles of the past that leave so little for the imagination and utterly fail to arouse the enthusiasm of the progressive public. I know that many people, especially in America and England, look with opprobrium at these new-fangled notions which to them seem to be dehumanized. But, if it were up to them, the world would produce classic until doom's day and adapt it to modern conditions regardless of the changes in construction materials and requirements. These academic-worn fogies, who stick stubbornly to their shameful sentimentalities, may spit with disdain at anything that is not a copied adaptation of something old and "true," but the whole world is surging toward something that is economical and logical besides beautiful. The world must first crack before anything purely functional and beautiful will be discarded by the progressive public.

But as much as I am inspired by this direct appeal of the modern, its reasonableness, its play on the imagination, its range of usable materials, its flexibility and frankness, I do not condemn mediaeval and classic works of art as an unnecessary evil. On the contrary, I find them necessary in broadening one's knowledge of architecture. Their sound fundamental principles will sharpen one's ability to discriminate, increase one's architectural vocabulary and culture, solve problems, and be an impulse to modern creative work. A prominent modern scientist once said, that to do creative work, one must first find out what everybody else knows and start creating where they left off.

# Bureau Produces Ferromanganese

(*Continued from page 55*)

can be obtained. The one containing manganese can be converted into ferromanganese, and the other, containing the iron and most of the phosphorus, can be further refined into steel. In fact, the step should be regarded as an extra operation for recovering manganese as a by-product incidental to the main operation of converting the iron content of manganiferous iron ores into steel.

In the field of ferrous metallurgy, crude metal is refined in open-hearth or electric furnaces which are merely pieces of equipment for maintaining a bath of metal at temperatures of 1,550° to 1,650° C. Although the greater part of the work on the second step of the process was conducted in the small open-hearth furnace, tests were also conducted in the small electric furnace of the arc-type. The procedure, which was essentially the same in both types of furnaces, can best be explained by following the details of a typical open-hearth heat.

In heat 437 the furnace was first charged with 500 pounds of metal containing 15.75 per cent manganese. As indicated in figure 2, page 53, iron ore was added two hours after charging. The iron oxide in the ore immediately reacted with the manganese in the metal according to the following equation,

$$\underset{\text{(in metal)}}{\text{Manganese}} + \underset{\text{(in slag)}}{\text{Ferrous oxide}} = \underset{\text{(to slag)}}{\text{Manganous oxide}} + \underset{\text{(to metal)}}{\text{Iron}} \quad (1)$$

The process of this reaction is shown by the change in slag and metal composition. The manganese in the metal gradually decreased, while the manganous oxide in the slag increased. At the end of 4½ hours the manganese in the metal had decreased from 15.75 per cent to 0.5 per cent. The transfer of manganese from the metal to the slag was practically completed at that time; but, as a result of excess iron oxide used to drive reaction (1) forward at a practical rate, the slag contained too much ferrous oxide to be used in making ferromanganese. In place of the ratio of 9 parts of manganese to 1 part of iron, required in manganese ores, the slag contained roughly only twice as much manganese as iron.

Under similar conditions of temperature, manganous oxide is deoxidized much more slowly by carbon monoxide than ferrous oxide. This fundamental difference in the two oxides furnishes a means of reducing the iron content of the slag to the desired amount without returning excessive amounts of manganese to the metal. Under a reducing atmosphere established over the slag by adding coke, the ferrous oxide gradually decreased to about 6 per cent, while the manganous oxide in the slag increased to about 66 per cent. The results of a great many heats show that when the iron in the slag has been properly adjusted the amount of the phosphorus in the slag will not be prohibitive.

In most cases the slag is a waste product. In this operation, however, the slag is a valuable by-product because it contains manganese, iron, and phosphorus in proportions suitable for producing ferromanganese. The metal, composed largely of iron, was not treated further as its conversion into steel would present no difficulties.

### The Production of Ferromanganese

The slag from the second operation should be regarded as an artificial manganese ore which can be used in place of imported ores. There was some questions as to whether it was necessary to demonstrate that ferromanganese conforming to the chemical specifications usually set for manganese ores could be produced from this artificial product. In view of the importance of being able to make ferromanganese from Minnesota ores, particularly in an emergency, it was finally decided that the process should be carried through to the final product. Slag from the second step was accordingly reduced to ferromanganese in the experimental furnace. During a continuous operation for one month data were obtained to show conclusively that the artificial ore or high-manganese slag can be converted into ferromanganese by the same process now applied to imported ores.

The blast-furnace test was the last of three operations by which an ore containing 8 per cent manganese was converted into an alloy containing 80 per cent manganese. Furnaces similar to those employed every day in the iron and steel industry were used in the various steps. For this reason the method can be turned to very quickly without large expenditure for new equipment.

### Commercial Application of the Process

Except under unusual conditions, domestic manganese projects must succeed in competition with imported ores. A tariff on managanese ore amounting to 1 cent per pound of metallic manganese has been in effect since 1922. At present low prices, the duty is almost equal to the cost of the ore at ports of entry. It has been stated that Russia, which is known to have large deposits of high-grade ore, holds the key to the world's manganese situation. No one can predict the level at which prices will be stabilized. The process herein described is being investigated by a number of companies but no definite plans have yet been made to apply it commercially.

More detailed information of this process may be obtained from published reports as follows:

Joseph, T. L., Royster, P. H., and Kinney, S. P., Utilization of Manganiferous Iron Ores: Bureau of Mines Technical Paper 393, 1926, 28 pp.

Joseph, T. L., and Kinney, S. P., Minnesota Manganiferous Iron Ore in Relation to the Iron and Steel Industry: Bull. 12 of University of Minnesota, published as co-operative work between U. S. Bureau of Mines North Central Experiment Station and the Minnesota School of Mines Experiment Station, vol. 30, No. 8, February, 1927, 101 pp. Transactions, Am. Inst. Min. and Met. Eng., vol. 75, 1927, pp. 292-345.

Joseph, T. L. Barrett, E. P., and Wood, C. E., Research Aids in Fostering a Domestic Mining Industry: Engineering and Min. Jour., vol. 127, Feb. 23, 1929, pp. 308-313.

Joseph, T. L., Barrett, E. P., and Wood, C.E., Experiments Demonstrate Method of Producing Artificial Manganese Ore: Am. Inst. Min. and Met. Eng. Tech. Pub. 310, 1930, 29 pp.

Joseph, T. L., Wood, C. E., and Barrett, E. P., The Production of High-Manganese Slag in the Electric Furnace: Bureau of Mines Report of Investigations, serial 3080, February, 1931, 9 pp.

# A New Navy Airship

(*Continued from page 57*)

lease of any surplus expansion that might come under unusual conditions since the degree of inflation is calculated for any given flight so at the peak of expansion, the helium will merely fill the cells completely. In the larger cells, there are four of these valves in the gangway along the top of the ship. The valves open automatically under pressure to release any surplus. In addition each cell has one valve which may be mechanically operated from the control car. Each of the valves is 32 inches in diameter, and will discharge 500 cubic feet of helium per second. To afford easy escape of the gas from the ship's structure, an opening is provided in the top of the hull above each set of valves. The opening is shielded by a hood which affords protection from the weather.

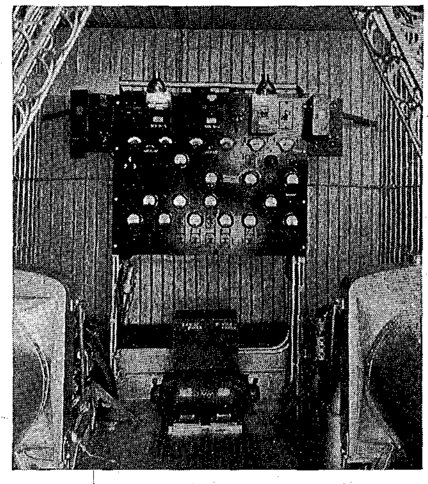
### Rudders Use Balancing Vanes

The control surfaces by which the ship is steered, either as to direction or altitude, are arranged in pairs near the stern of the ship. The main fixed section gives stability to the ship and the hinged after-sections or rudders give it altitude and direction control. The fins, or fixed section, are of angular cross section, rigid enough in themselves that but little external bracing is required. The rudders are controlled by cables leading to the control car or may be steered by emergency helms in the lower fin. Exertion at the wheels in handling is reduced by providing each rudder with balancing vanes.

The control car is placed forward, projecting below the streamline and built as an integral part of the ship. In this car, containing all the latest devices known for efficient navigation, the commander and his staff are stationed. The radio cabin and commanding officer's cabins are directly above the car inside the hull. Near the middle of the ship and along each gangway are located a number of rooms for officers and crew. Each sleeping room contains four berths. Besides these there is a large galley with ample cooking facilities, mess rooms, and toilets, making complete and comfortable living compartments for the men while in the air.

### Transmissions and Motors Severely Tested

The Akron, using non-inflamable helium gas, will house all of the motors within the ship's hull with only the propellers extending outside the ship, and will therefore have a roomy engine room instead of a cramped car for the crew along the gangway. These motors are of the Maybach type and each of them have gone through a rigorous test, ranging from 310 to 500 hours duration, to test the motors and transmissions. Another important change, is the use of bevel gears at the outboard ends of the rigid drive-shafts making it possible to use the propellors, not only for thrust in the fore and aft direction (the engines themselves being reversible), but also in a vertical direction by tilting the propeller axes through 90 degrees. This feature of tilting propellers will be of great importance in starting and landing maneuvers. It will also permit carrying a greater load and avoid the loss of lifting gas when the ship has to land against surplus lift.



**The electrical power plant. Months of work were necessary to decrease the size and weight of this unit.**

### Condensate Forms Ballast for Burned Fuel

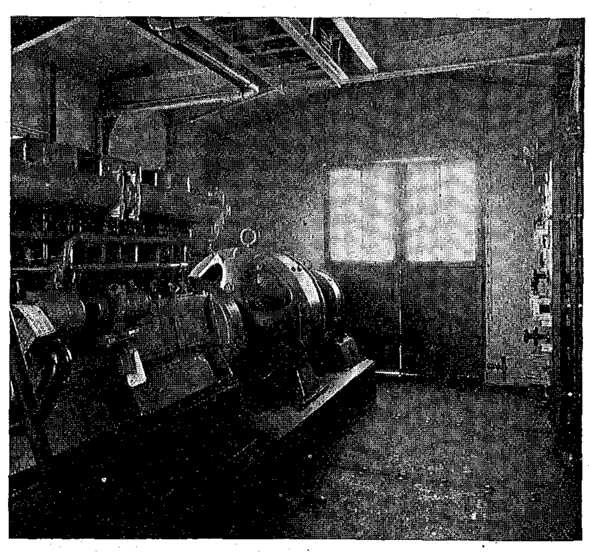
When liquid fuel is used in an airship engine, a definite loss of weight is experienced from hour to hour as fuel is consumed. In past practice this has required the release of a corresponding amount of lifting gas. In the Graf Zeppelin, this difficulty was met by the ingenious device of using the well known blau gas fuel, which has approximately the same weight as air, so that fuel consumption did not affect the ship's weight or lift. The U. S. Navy Department met the difficulty in still another way, namely, by installing condensors on the motors at their exhaust, liquefying the combustion vapors. Due to the oxygen taken from the air in the gasoline, the exhaust gas contains water vapor in greater weight than there was fuel burned, so that the consumption of fuel does not lighten the ship but builds up a supply of water ballast (this being also a highly useful feature in flying the ship) and maintains constant equilibrium.

One of the most novel and picturesque features of the design of the Navy airship is the provision made for the storage of five completely assembled airplanes. Collapsible doors in the bottom of the ship cover a T-shaped opening through which a trapeze, with an airplane attached, can be hoisted or lowered. The airplanes may attach or detach themselves from the trapeze during flight, and such a possibility increases the scouting value of an airship and aids her in warding off an attack.

### Ship Designed with Many Safety Factors

The safety of this new ship will be the combined result of a great structural strength, multiplicity of independent means, practically entire elimination of fire risk, and accessibility. Too much emphasis cannot be given to the ship's structural strength, which is considerably in excess of that found in previous ships.

(*Continued on page 76*)



**This generator set is mounted on the Akron's tri-legged mooring mast and furnishes power for its manuevering.**

# « « MENTAL TILTS » »

## CHESS AND WHEAT

A Hindu, the inventor of chess, showed the game to his King. The King offered to reward the man and was surprised to find that the inventor wanted wheat for a prize. He wanted one grain on the first square, two on the second, four on the third, eight on the fourth, and so on until all 64 squares had been covered. How much grain did he receive?

## SQUARES AND SQUARES

A square is composed of twenty-five smaller ones. How many squares composed of from one to twenty-five of the smaller squares are possible?

▲

### Answers to Last Week's Tilts

THE LIGHTNING CALCULATOR. Einstein knew that such a number must have a log lying between 34 and 35. Dividing these two numbers by 31 he found that only one number had a log in this range. This number was 13.

CARDS AND CHANCE. The first card drawn does not make any difference in the sum of the cards. The answer depends on the second card. Therefore, eight out of twenty chances are even.

ENGLISH ENGINEERING. The TECHNO-LOG will not answer this problem until the Bystander, columnist of the world's largest college newspaper, tries it. Following last month's publication above mentioned columnist said he had the answer. We'll give him until January 15, 1932.

(*Continued from page 74*)

The feature of multiplicity of means has already been mentioned in respect to the triple-layer hull principle. Also, the gas retention is not in one cell, but in a number of cells. As the propulsion does not rely on one motor unit, but on eight of them, the ship may still maintain progress if several engines fail. Moreover, the ship may keep in the air by use of its dynamic lift, which results from flying her at a slight angle of pitch, to compensate for the extreme case of losing more lifting gas through large ruptures in the cells than can be compensated for by jettisoning ballast. The fire risk has been reduced to a minimum through the use of the inert helium gas. The possibility of a gasoline fire is no greater than in an automobile. Precautions are taken however: the engine rooms have fireproof walls and elaborate fire fighting systems; ventilation of the entire ship to prevent the accumulation of any possible gasoline vapors; gas-tight electrical connections to prevent the ignition of any local fumes. There is no danger from lightning, contrary to general opinion. And finally, there is the feature of accessibility permitting inspection of every part of the ship at any time.

**Design Applicable to Commercial Vessels**

The structural designs of the Akron may easily be adapted to a commercial ship, one carrying passengers and mail over-seas. In a ship of the general dimensions of the Akron accommodations may be built comfortably providing for up to 100 passengers, according to the weight of fuel required for any certain route. In the case of a hundred passenger ship, the following dimensions are interesting: a total deck area of 12,000 square feet, of which each stateroom (for two people) uses an average of over 70 square feet; promenade decks and corridors have a total length of about nine hundred feet, while about three thousand, five hundred square feet are used for public compartments. Promenades, lounges, dining salon, and smoking rooms are not dreams but soon to be actualities. Spacious compartments, the lack of noise and odors and sea sickness, speed of ocean travel greater than is possible by any surface craft: these are some of the advantages the airship has in store for travelers.

Its contribution to overseas transportation will not be in competition to the surface carriers but supplementary to them for that proportion of passengers and merchandise to whom higher speed is essential. It will do this without subtraction of business from existing carriers for all history has shown that speed of travel means volume of travel. Surface lines and air lines will alike be beneficiaries as this new vehicle takes its place in the field of transport, applying in the international field what America has long learned nationally—namely, that better communication means better understanding, has vast economic advantages, is equally impressive in the field of human relations.

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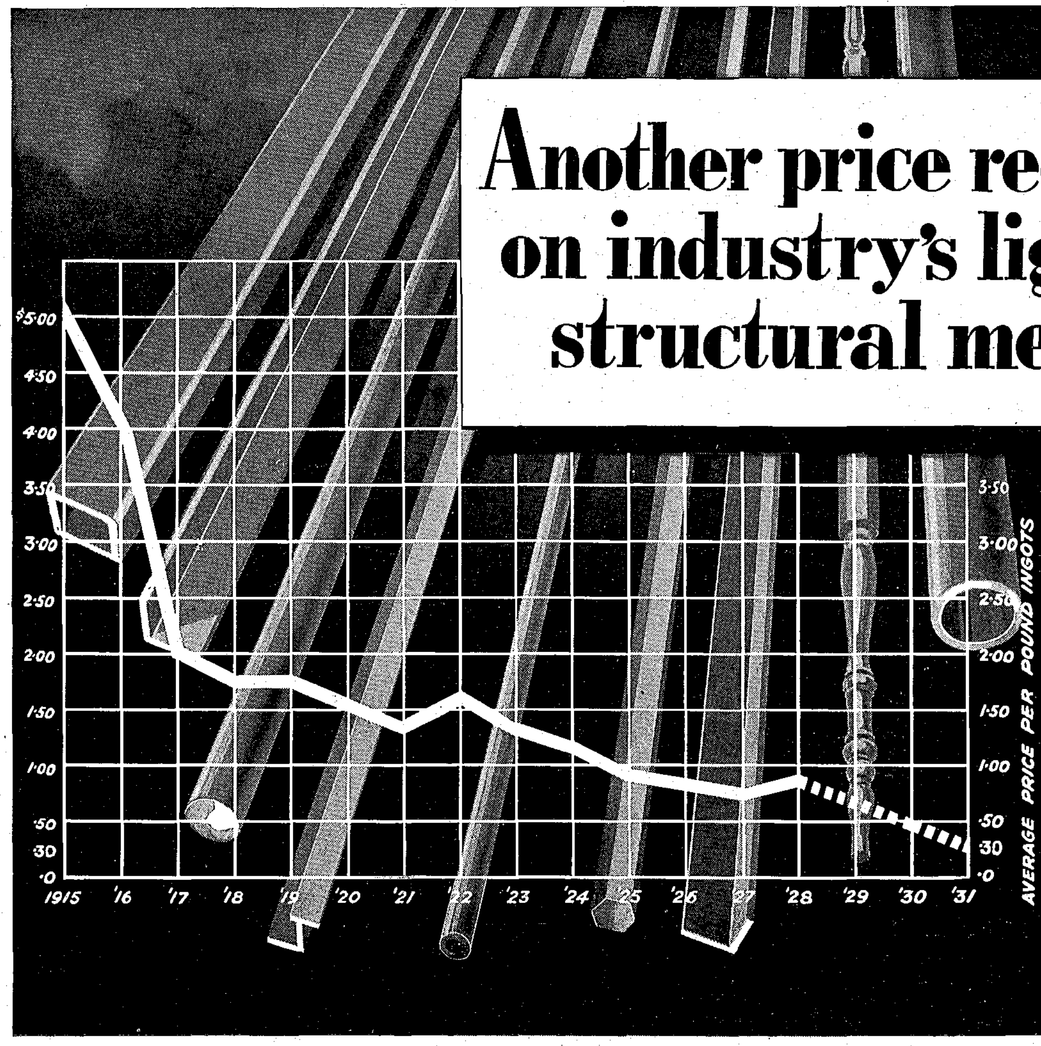


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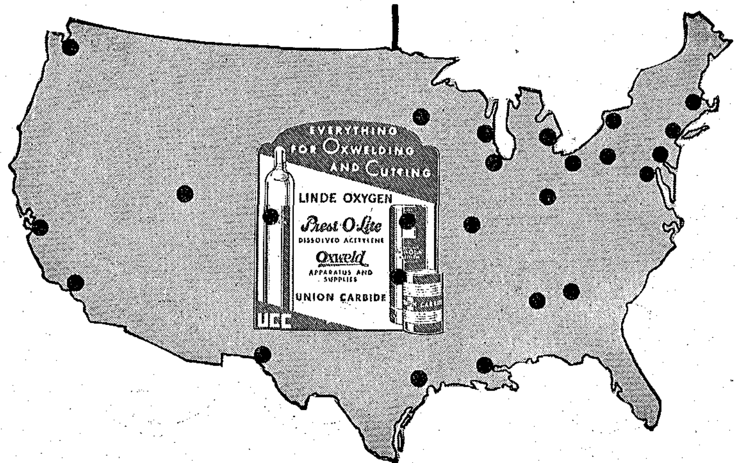
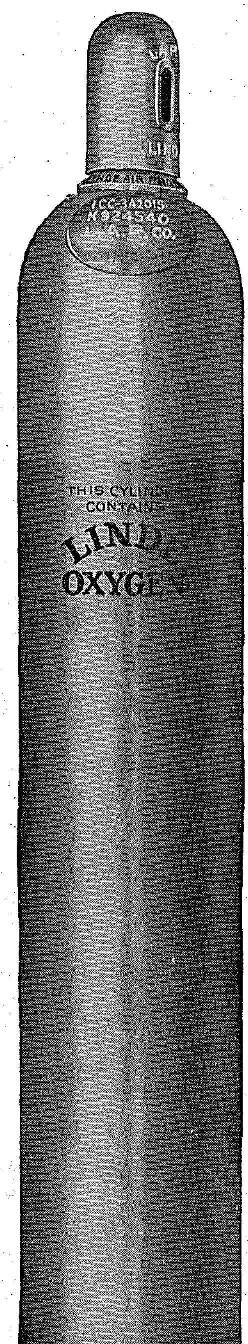
Vol. XII MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED No. 4

JANUARY, 1932




# from COAST to COAST

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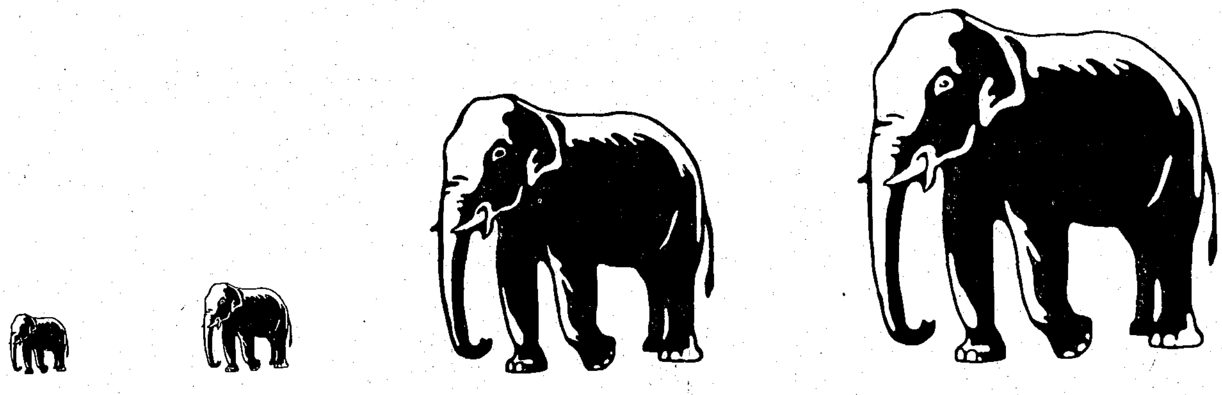

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January, 1932

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HOW, WHY, WHEN, AND WHERE *welded piping should be used for maximum service and economy. A valuable survey of a growing practice.*

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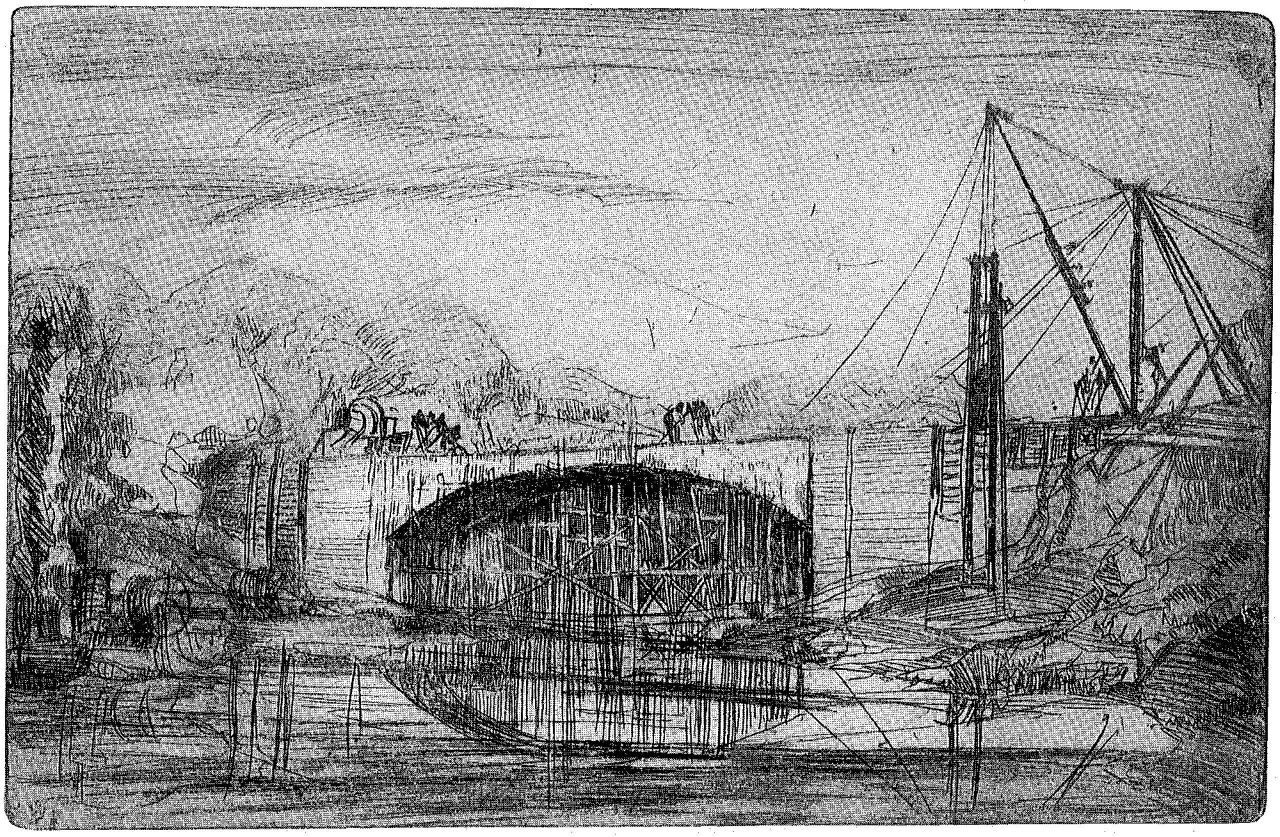


Construction of a Bridge
From an etching
By Robert G. Cerny

**This survey of the welded piping practice is condensed from Mr. Giese's WELDED PIPING, first prize winner in a contest conducted by the Twin City branch of the American Society of Mechanical Engineers for student members of that society. O. J. Anderson and H. D. Watson, graduates of June, 1931, received second and third places respectively. Twenty-five, fifteen, and ten dollars were awarded for first, second, and third places, each winner receiving in addition a mechanical engineering handbook of his choice.**

# the why and how Of Welded Piping construction

By HOWARD GIESE, M.E.,'31

*(We wish to thank the Linde Air Products company and the General Electric company for the illustrations in this article.)*

THE history of the application of welding methods to pipe fabrication is quite recent even though the use of welding for other purposes has been accepted widely for years. Only in the last ten years, and more especially in the last six years, have the welding methods of joining pipe and making fittings been employed on a large and responsible scale. Fusion or gas welding had been used on long pipe lines and in other industrial fabrication considerably before the electric arc method was introduced in a substantial manner. One writer has stated that no long pipe line was constructed by electric welding before September, 1928, but within a year over 2,500 miles of electrically welded pipe lines had been laid.

Whatever uncertainties discouraged industry from adopting the welded method have been or are being rapidly removed until welding has become standard for joints in oil and gas pipe line projects and an indispensible auxiliary in heating, ventilation, and power plant construction. The early failures were due to a rapid acceptance of a promising method by those who understood the basic principles imperfectly or not at all. Probably one important reason for the slow acceptance of welding by some industries has been the influence of tradition upon changing to the welded form of pipe joint. To the older designers tradition appeals most strongly.

Like most contributions to progress the history of the application of welding to pipe fabrication records some failures. Unlike most contributions, however, this history reveals earnest and active efforts to eliminate the possibility of failure immediately after the first mistakes were made.

**Pipe Size Influences Welding Field**

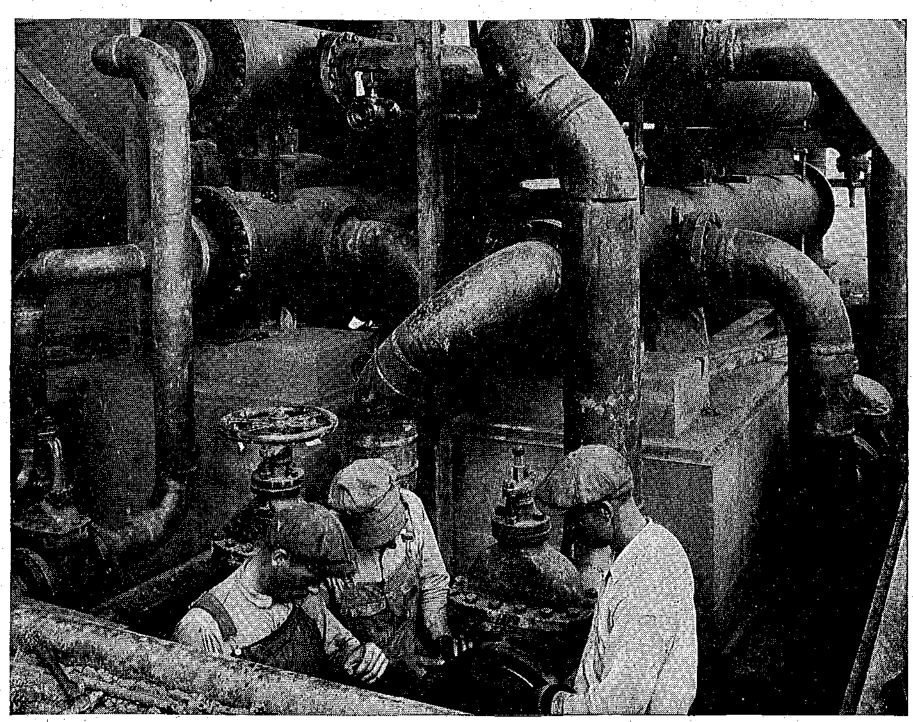
The size of the pipe to be joined influences the field of application. There is reasonably good agreement that pipe lines under three or four inches in diameter cannot now be joined economically with welding.

Walker and Crocker in the *Piping Handbook* assert that there is a considerable difference in opinion among engineers as to the type of service for which welded piping is best suited. The same authors continue in saying that few engineers object to the use of welding in pipe lines for carrying air, water, gas, or steam with pressures up to fifty or seventy-five pounds per square inch and moderate temperatures.

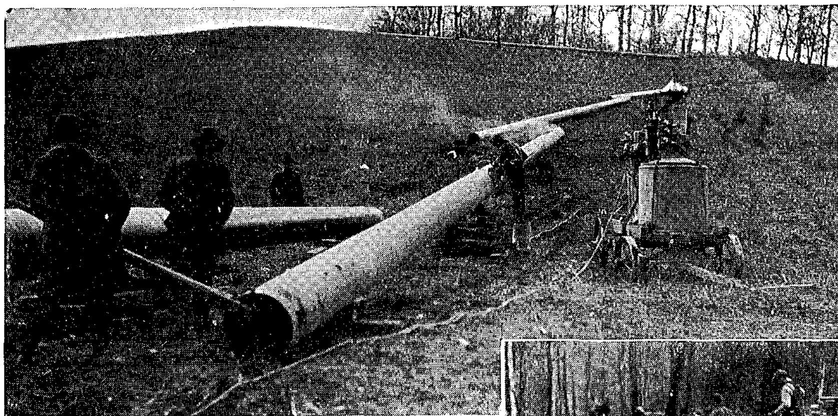
Much higher pressures than these, however, are now being successfully impressed upon welded joints. The opinion of Walker and Crocker that welding methods should not be employed where there are elevated temperatures, 700 degrees Fahrenheit or more, does not appear to be a valid objection because the commercially standard materials now made into pipe will not withstand much higher temperatures. Just as there are special and higher grades of piping materials to be used for the very high temperatures, so can special welding rods be developed and a high grade of skill be applied for the more severe conditions.

**Welding Applicable in Many Cases**

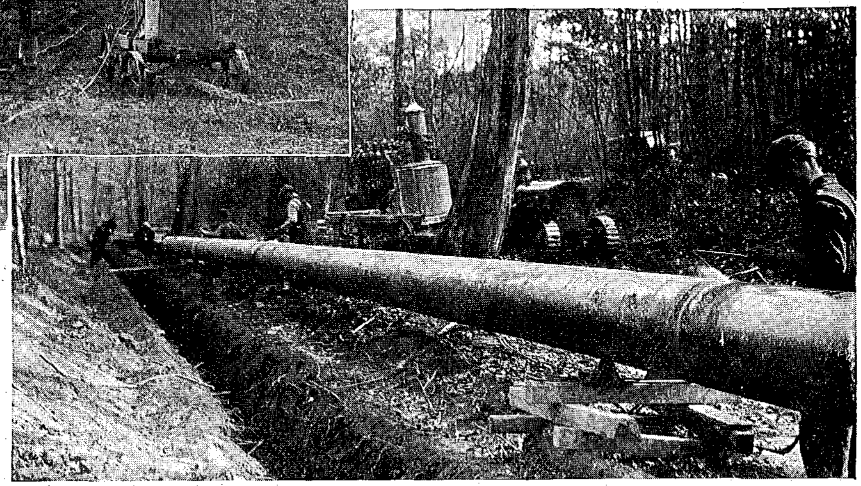
In general, welding methods are applicable to light sheet metal ducts and fittings; high pressure crude oil and natural gas lines; district heating projects;



**This installation of welded piping in a steam plant shows the neat appearance of welded piping**



Left—the fire line gang weld sections of several lengths. Note the method turning the pipe



Below—typical outdoor line. Gas welding apparatus is in the background

severe conditions arising in conjunction with the operation of crude oil stills; high and low pressure power plant and process steam transmission; hot and cold water service; sanitation and plumbing projects; and brine and ammonia transmission in refrigeration.

The materials now welded successfully include brass and galvanized iron, copper, aluminum, cast iron, monel metal and most steels.

Of the two electric arc methods, the metal arc requires no puddling action to aid the union of the metal as the carbon arc and gas weld methods do. For this reason the metal arc method of welding is adapted to use in any position such as overhead. The electric methods are more effective on heavy sections because of the higher temperatures produced. There is greater concentration of heat at the weld and less danger involved than with the gas method.

### Two General Methods Now Used

The two methods of welding, electric and gas, have sincere endorsement from many groups. The whole field is so new that the province of application of each does not appear to be clearly defined. A group which may favor the one method of welding may not have made truly comparative tests to substantiate their preferences. Certainly persons directly interested in the manufacture of either type of equipment would be expected to support that particular method.

Of the electric methods, one in which the electrode employed is a carbon pencil has a limited use; the other in which the welding rod itself is used as an electrode predominates. The exact phenomenon of the manner by which the metal is deposited from the electrode is not known but is believed to be a bombardment by a stream of vaporized metal.

To furnish energy for electric welding, specially designed generators are employed. Alternating current is not as common as direct current for welding. In a pipe fabrication or industrial plant the generators may be driven by a motor or turbine; in the field, the generators are driven by gasoline engines. A common generator-engine set for handling large work in the field would include a six cylinder commercial gasoline engine and a 300 ampere direct current generator with a closed circuit voltage of fifteen to twenty-two volts. This engine-generator set is usually mounted on a truck or carriage for portability.

In order to do gas welding a supply of acetylene and oxygen must be available. If the equipment is to be permanently situated and used to any extent, an acetylene generator should be installed. In the field on long pipe lines acetylene generators are a part of the moving equipment and are required to furnish large amounts of gas.

The workman who tries to become skillful in welding has no difficulty if he has a normal mental capacity and is physically fit. The technique can be acquired in a relatively short time. Before the workman is allowed to go on a regular job, he undergoes a test for speed and efficiency in making an acceptable joint. The test weld, when finished, is subjected to destructive and other tests to determine strength, porosity, penetration, and uniformity. Appearance may also enter in the standards by which the weld is judged. The welder should be able to make a weld having at least ninety per cent of the strength of the metals joined. If the test is not satisfactory and the company sees promise in the man, he may be sent to a welding school for further instruction. Frequently the company maintains its own welding school.

The work of welding is strenuous and the workmen should receive rest periods and changes regularly. The wages paid to a welder are equal to or above the average in the trades of a similar type.

The human factor is the controlling one in the making of welds and must be carefully considered by the supervisors. For the supervisors there are now available data to be used as a guide in the proper application of methods of welding. Procedure control is the name attached to these methods and standards for insuring an efficient weld. These precautionary methods in which the welder attacks the job, completes it, and subjects it to inspection and test are to be emphasized in contrast with methods for making the weld satisfactory after it has been completed.

### Firing-Line and Bell-Hole Gangs Usually Used in Field

In the construction of long pipe lines, the work is assigned to two or more complete groups. Each group has a foreman and is itself sub-divided into two units called the firing-line and the bell-hole units. From twelve down to six welders may be included in the firing line unit depending upon the amount of welding to be done. These men align the pipe in sections of several lengths and completely weld all the joints in the section. Each welder has a helper who turns the pipe as the weld progresses and chips and scales the first weld in preparation for the second in the case of the electric arc method. Each gang has a mechanic and a truck driver.

The bell-hole unit follows the firing-line unit and joins the long sections previously completed by the firing-line unit. The bell-hole unit must work in holes dug around the joint since the main line cannot be turned to allow the workmen to work in normal positions.

In power plant and indoor projects the procedure will more or less resemble that described for the field according to the similarity of conditions. Usually the welding organization and equipment will not be as extensive as in outdoor construction because of the smaller size of the indoor projects. Furthermore, a large part of power plant or industrial welding may be fabricated in shops which are especially fitted for such work.

**Strength of Joint Important Factor in Welding Use**

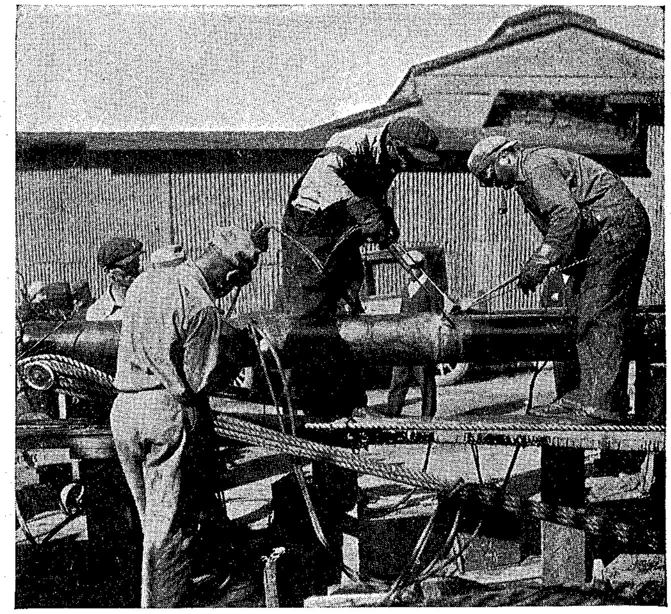
The strength of welded joints is a subject that has received considerable attention lately with the application of welding methods to large projects. Manufacturers of welding equipment as well as the users of the equipment have been intensely concerned with the subject of strength of welds. The result has been that a considerable amount of accurate and valuable data has been published.

Some of the investigations on the strength of welds have been thorough and extensive. A large number of laboratory tests has been made by the American Gas Association who have published the results so found. The American Institute of Mining and Metallurgical Engineers published in October, 1929, a bulletin of results of field tests on a long pipe line.

**Difficult to Test Welded Joints**

One serious disadvantage to the use of welding has been the necessity of making destructive tests in order to be certain that joints had been properly made. In the construction of a long pipe line recently the method of testing, in addition to the selection and cutting of twelve joints from the line, was the coupon method. A special milling machine was clamped upon the pipe and used to cut coupons or narrow slices of material including a small part of the weld from the pipe. The coupons were not used for tensile strength tests but to determine the porosity and penetration of the welded metal and to find other visible indications of the quality of the weld. The coupons were taken at random and therefore gave representative samples of the conditions of the welds.

Tests previously employed were the hydraulic pressure and the hammer methods. In the former hydrostatic pressure of several times the normal working pressure was introduced into the pipe line. Any joints showing a leak were marked and repaired. Apparently, however, this test showed that some of the joints were pressure tight although the weld might be simply an adhesion and not a union of the metal.



**Welding a watertight casing for an underwater cable**

The hydrostatic test may be used alone or in combination with the hammer test, which consisted of repeatedly striking the metal near the weld as hard as possible without denting the surface. The hammer was of the usual machinist's form weighing two pounds or more according to the size and depth of the weld. The hammer blow served to multiply the pressure many times when used with the hydrostatic test and to subject the joint to momentary, impact stresses. Common hydrostatic pressures were 800 to 1000 pounds.

**Welding a header. Special shapes such as this may be welded above ground and then moved into place. This practice is economical**

**Use of Stethoscope for Testing Being Developed**

Messrs. Kinsel, Burgess, and Lytle of the research laboratory of the Union Carbide and Carbon company are developing the use of the stethoscope and X-ray for test purposes. A physician's stethoscope with a gum rubber tip is applied to the pipe or any other welded structure. The sound first heard when the pipe is struck with a hammer at the instant of impact is peculiar to the material and the spot considered. The size of the hammer used for striking depends upon the thickness of the metal tested. Each structure has a characteristic sound. After this sound is established by preliminary tests, the hammer and stethoscope are moved along the weld. The sound that is heard in the stethoscope will bring out any irregularities.

The X-ray is used in conjunction with the stethoscope by taking two photographs of the weld parallel to the respective scarfs machined on the pipe. From the appearance of the film and a knowledge of the plate material and the welding rod, a careful estimate of the strength of the weld may be prepared.

**Experience Shows Welding Practice Safe**

The experience of erectors of thousands of miles of outdoor pipe lines and relatively large numbers of plant and factory installations has been sufficient to make possible successful welds without exception.

Employing welded joints not only brings dependability but greater permanence to pipe lines than any other method of connection. For instance, in the oil industry gas welding has been used for some time on pressure vessels and piping. The results have been a considerable improvement over the riveted joint which on oil stills (for distillation of crude oils) could not be kept tight because of the severe temperature strains and were therefore seal welded. The trouble that gaskets and packings in flange unions and fittings have produced in the power plant and heating projects is well known. This trouble is completely eliminated with leak-proof junctions permanent as the pipe itself. Also the life of the pipe is not dependent upon the depth of the threads exposed to corrosion.

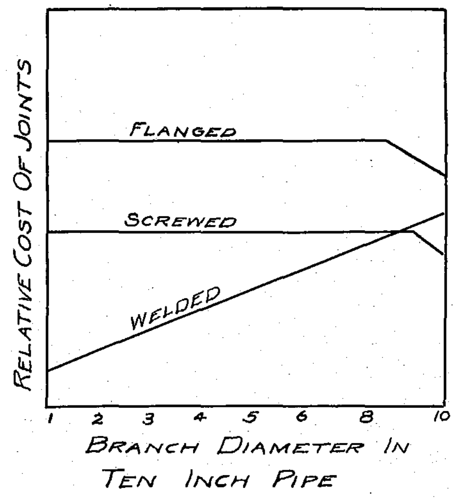
Many engineers consider the subject of appearance an important one. There should be no one to object if better appearance is accompanied with greater efficiency. The stream line appearance of a carefully planned piping layout can not but please such men. The early angular features of welded piping can now be replaced with gradual and symmetrical curves of fabricated fittings. If the pipe is to be covered, the insulation may be applied in an unbroken form of even outline because of the lack of projections of flanges and fittings.

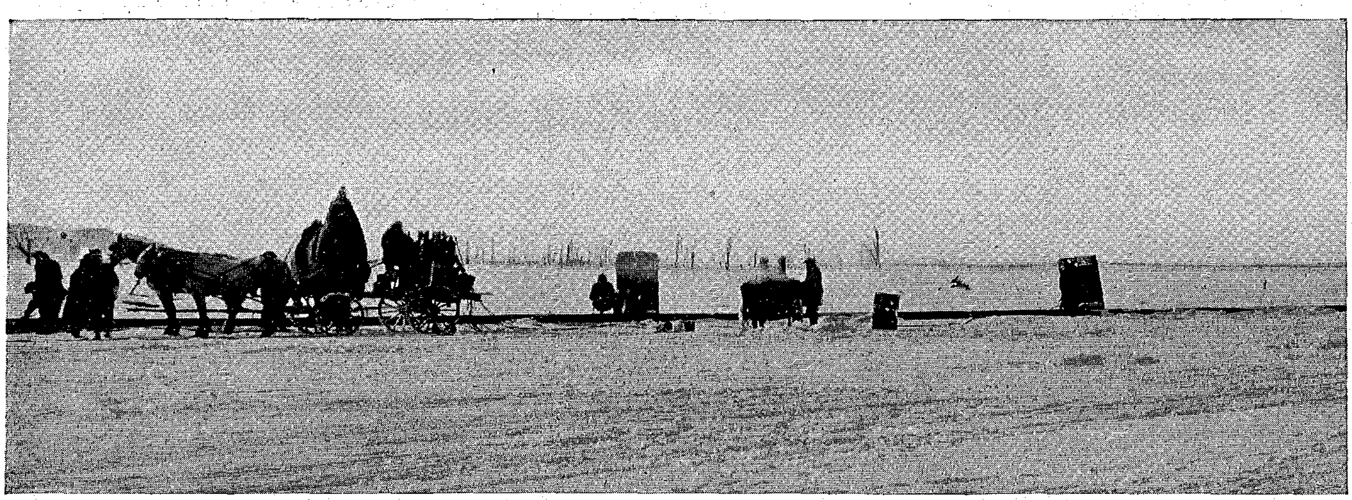
The effect upon the mind of more secure working conditions can only be favorable with workmen and operators. When soundness of welding can be invariably demonstrated and is clearly recognized, men will perform their duties with less restraint and fear of accidents.

**Welded Piping Permits Many Savings**

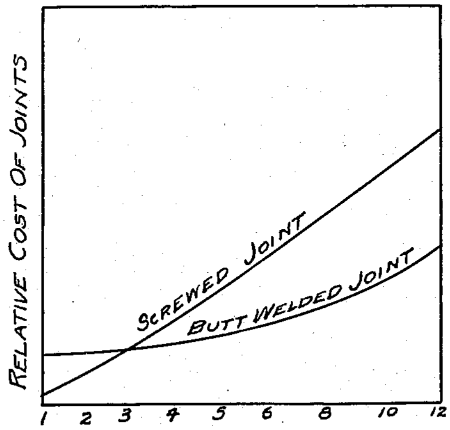
The subject of economic savings, which are the result of applying welded in preference to threaded or other mechanical methods, is one of considerable magnitude. These savings result in both the first cost and maintenance. Items which reduce the costs of making a welded joint below those for a screwed joint are:

1. Reduced fittings and supplies inventory.
2. Economies in buying pipe at the mill in longer lengths because these can be handled more easily for welding. This permits elimination of part of the joints to be made in the field and increases tonnage for transportation advantages.
3. Simplified design permitting the placement of machinery anywhere without using special fittings to avoid interference.
4. Simplified estimating which eliminates the long itemized fittings list and produces a ninety per cent saving in estimating time.
5. Any fitting may be fabricated as needed eliminating the special fittings quotation and delay in securing these specials.
6. Reduced weight because of the omission of heavy fittings resulting in the use of less hangers.
7. Erection equipment not subject to rapid wear and change in accuracy as with dies of a threading machine.
8. Less scaffolding necessary because of reduced weight and because of longer straight sections.
9. Relative ease and consequent reduced costs of applying insulation.
10. Lighter pipe wall thickness than with screwed joints because of the absence of the weakening effect of the threads. The effective thickness of the pipe may be reduced fifty per cent by threading. This saving is sizeable in steel weight considerations.



**The expensive barge and equipment is eliminated where the underwater pipe can be laid on ice in the winter and allowed to sink when summer approaches.**




*Pipe Diameter Butt Welded or Screwed*

11. Decreased internal resistance because of the uniformity of inside diameters allowing smaller diameters to be used. For instance, heating contractors have agreed that circulation can not be maintained in the normal hot water system with screwed fittings with less than 120 degrees water temperature. Yet circulation takes place at 90 degrees with welded piping.
12. Joints are practically all tight eliminating further attention. Recently a railroad placed two similar pipe lines in service, one threaded and the other welded. After the lines were completed only two leaks were found on the welded line, but the screwed line required attention for five weeks before it was made tight.
13. Changes can be readily made without disturbing an old line and without causing leaks.
14. Life and resistance to corrosion are increased.

The summary of all the fourteen items preceding is in a statement made by Mr. Fitzgerald of the Linde Air Products company. Mr. Fitzgerald has said that the welded pipe line is about thirty per cent cheaper than the same line with screwed joints. If this statement is correct for oxy-acetylene welded joints to which it was intended to be applied, the same statement is true with only slight modifications for those electrically welded.

**All Pipe Sizes Can Not Be Economically Welded**

Data which have previously been presented may have caused to be formed an impression that all sizes of pipe can be economically joined by welding. This is not true at present although there has been no absolute lack of application of welding in the small size pipe job and installation.

Mr. Horace Wetzell of the Smith and Obey company has made an analysis of the relative costs of the welded and mechanical methods of joining pipe. The diagrams which were prepared in this analysis follow and are relative only.

The diagram, Branch Diameter in Ten Inch Pipe, demonstrates that for any reasonable size of branch placed in a ten inch line, the welded type of joint is far cheaper than the flanged or screwed joints. For the eight, nine, or ten inch branch, the welded joint and the screwed joint are about the same as to cost.

The second diagram, Pipe Diameter Butt Welded, is more informative showing the economical size to weld or to join mechanically. For sizes of three or four inch diameter and larger, the screwed joint for connecting sections of pipe and fittings becomes increasingly more expensive than the butt or vee joint. The opinions and investigations of several other writers agree with the indications of this chart.

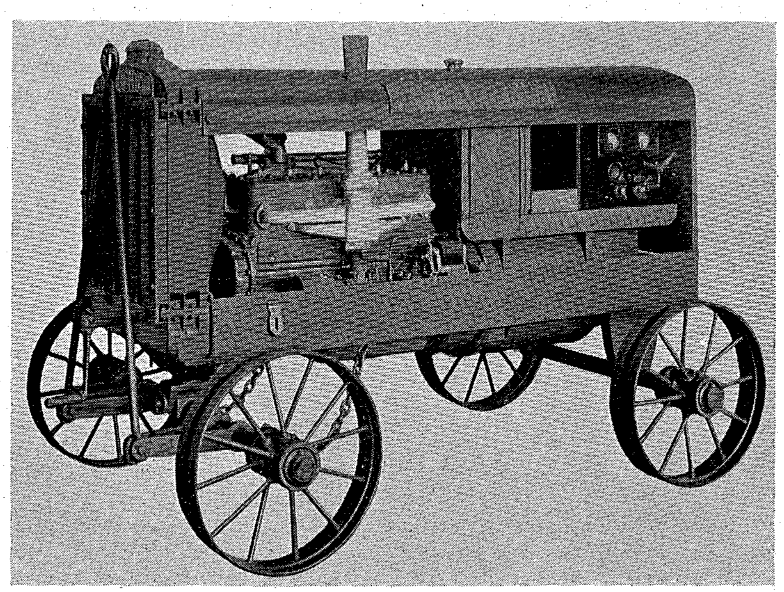
**Low Maintenance Cost Important Factor**

No detailed data for the superiority of the welded over the mechanical joints is available, although the welded pipe line has been shown easy to maintain. One of the features of the welded line is permanent leakproof construction. The welded line requires less replacement materials, such as packings and gaskets, and less attention than the mechanical.

The future appears to be a time of increasing employment of welding methods. Numerous installations of welded piping in all of the usual fields of pipe application have been completed, and the data relating to these have been freely published and discussed. For the uncommon job where exceptional conditions of piping service are required, the welding method is being rapidly introduced. Some of the large utility companies are said to hold unfavorable attitudes toward the welding of high pressure lines; others have employed welding successfully in this way for years.

The problem of those who endorse welding methods is to show how welds may be made uniformly sound. The welding industry is not ignoring this fact as is evident from the large amount of research connected with the promotion of welding by manufacturers of equipment.

The amount of research that the welding industry now promotes is the basis for assuming that the future of welding will be substantial and positive. Mr. H. H. Moss has stated that, "In hardly any other industry is research, both pure and applied, more diligently fostered than in the welding industry; and a large proportion of the progress made is traceable to the appreciation of its importance." The development of the nondestructive testing methods is a current example of this.



**A standard portable motor generator**

austin plant

# Uses Chlorination In Disposal

## of packing wastes

*Faced with a difficult problem in disposal of packing house waste, engineers of the Hormel Packing company devised an ingenious method for its treatment. Richard Nicholsen describes this problem and its solution in this article, winner of the second prize in the 1931 Minnesota Techno-Log Student Article Contest.*

By RICHARD NICHOLSEN
Ch. E., '34

ONE of the biggest problems with which civilized man must contend is that of sewage disposal. For comfort and the protection of his health, man must dispose of all waste materials in a sanitary manner. This problem presents tremendous difficulties whenever encountered, but nowhere are these difficulties greater than in the meat packing industry. The waste from a large meat packing plant contains a large amount of solid meat scraps and immiscible fats and the usual methods of sewage disposal are not very effective with such materials.

Most sewage disposal plants attempt to remove the solid matter from the sewage and then allow the effluent to flow into a nearby river. Now the method of removing the solid material from the liquid is not always very effective. For example a large meat packing company located in a southern Minnesota town was comtinually threatened with lawsuits because it allowed such a large percentage of objectionable material to pass through its disposal plant that the river was badly contaminated. The river for many miles below the plant was covered with a floating, putrid, odoriferous scum, which was a continual source of danger.

The system then in use at this point for sewage disposal was one of sedimentation. By this method only about forty per cent of the impurities was removed from the sewage. The company's staff of medical men and chemists was well aware of the inefficiency of the method, but attempts to improve upon it were unsuccessful. Filtration would prove ineffective because of the greasy and colloidal character of the material. Other methods were impossible either for these reasons or because of the cost of necessary equipment.

But an aggressive research staff would not give up such a problem without a struggle. After years of experimenting, a new method for the disposal of sewage, involving the use of chlorine, was finally perfected. When the effectiveness of the new system had been demonstrated, a full sized disposal plant was immediately built and put into operation. This plant discharged its effluent into the same river that the old plant had discharged into, but within a few days a change in the condition of the river could be seen. The scum from the surface disappeared entirely and the water cleared to such an extent that the bottom became visible for the first time in years. The odor of rotting meat, so objectionable in the past, was gone. In its place was a very faint, sanitary smell such as one notices when passing near a hospital.

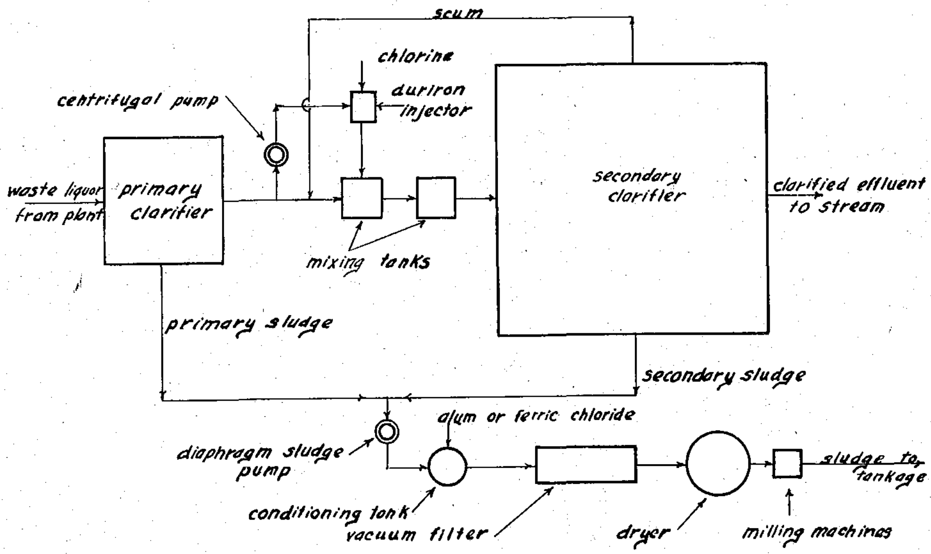
### New Method Increases Fertilizer Yield

These results were observed by the public, but the results seen by the officers of the company were even more pleasing. From the eight hundred thousand gallons of sewage treated daily by the old plant, approximately two tons of solid materials were removed. This substance was converted into fertilizer by the plant's by-product department. After the installation of the new disposal plant, the daily yield of this material was increased to five tons! Three tons of materials formerly emptied into the river were saved by the new process and converted into useful and valuable substances. The actual expenses of the disposal plant were, of course, increased. The initial expense of installation was great and the chlorine used daily is of considerable amount, but by the sale of the by-products produced, the operating expense are easily met and the excess will soon more than equal the initial cost.

The operation of the system can best be explained by describing the experiments which led to its adoption. It was first suggested that chlorine might be used to prevent bacterial action on the material flowing into the river until it had been diluted on a large amount of large amount of water. By doing this it was hoped that the objectionable odor might be eliminated. Samples of the sewage were obtained and treated with chlorine. It was found that a slight increase in the amount of chlorine used would precipitate a portion of the finely divided material from colloidal suspension. These experiments suggested the use of chlorine for the removal of the impurities from the sewage rather than for the mere prevention of bacterial action. Many additional experiments were necessary before the feasibility of this plan could be proved.

But before these experiments are described, it is best that the reader be given an understanding of the nature of the materials with which the chemists were dealing. The packing plant in which these experiments were conducted, butchers on the average day five thousand hogs and four hundred head of cattle. Each animal is washed before being killed and after being bled. These wash waters are drained into the sewers. After the animals have been cut up, each part is washed several times and consequently the waters flowing into the sewers carry scraps of meat and gristle, bits of fat, hair and particles of the intestines of the animals. In addition to these impurities, the usual content of sewers is also present. It was with a mixture such as this that the chemists had to contend. Chloride, of course, is a gas, but it was not introduced into the sewage in this form. It was first dissolved in water at definite concentrations. These concentrations were varied, but accurately measured.

When the solutions of chlorine had been prepared, samples of sewage were obtained as they came from the pipes. These were measured accurately into




**Flow sheet of the plant**

separate glass containers and allowed to remain for an hour undisturbed. As the larger particles of meat settled to the bottom and the globules of fat rose to the surface, the appearance of the liquid changed. It remained clouded and dark in color but appeared to be almost homogeneous, no particles of appreciable size being visible. This material would not settle out on standing because it was actually in suspension. The material floating on the surface was carefully skimmed off and the upper portion of the liquid was stirred, care being taken that the dregs in the bottom were not disturbed. Then a measured amount of one of the known concentrations of chlorine water was added. Very soon an appreciable change took place. The liquid, which formerly had been of uniform appearance throughout, suddenly became filled with a flocculent precipitate which slowly settled to the bottom, leaving a clear liquid above. It is this simple precipitation which is the basis of the entire system that is now operating so successfully on a large scale.

**Experiments Proved Plan Feasible**

Additional experiments were necessary in order to find what concentration of chlorine was needed and how much solid matter could be removed. The tests, of course, were conducted with samples of the sewage taken at different periods of the day and night. Data from each experiment were carefully recorded because all this information was of great importance before the process could be considered for commercial application.

From their calculations, the chemists were convinced that if the process could be carried out as effectively and as efficiently on a large scale as had been done in the laboratory, it would solve the problem of sewage disposal. This could be proved only by constructing an actual disposal plant. The construction of a disposal plant, however, would cost a large sum of money and rather than risk such a sum without more definite proof that the investment would bring good returns, the company authorized its research men to continue their experiments on a larger scale. The experimenters constructed a branch pipe line from the main sewer of the plant and so diverted a portion of the waste material to a tank which they had constructed to receive it. This tank was equipped with apparatus for mixing the chlorine with the sewage in the proportion which they had found to be most effective during their previous experiments.

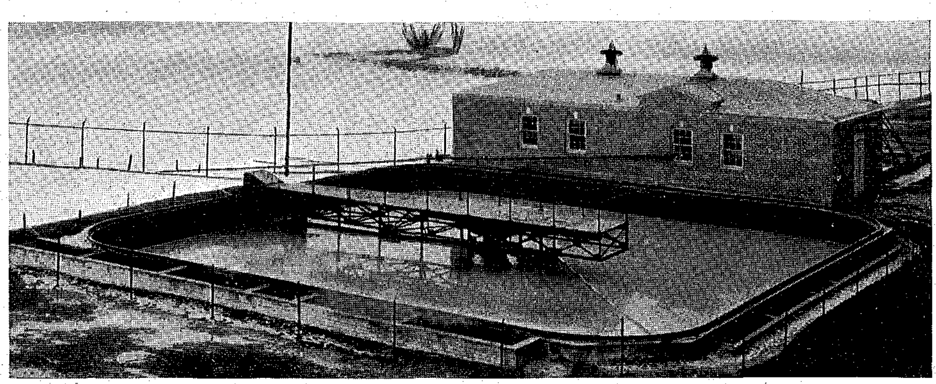
**Handling of Chlorine Dangerous**

Tests with this equipment proved conclusively that the new method was far superior to the old, but they also showed that there were more difficult problems to be solved before a full sized plant could be installed. Everyone knows that chlorine is poisonous and that it was used during the World War because of this property. Two of the men during their experiments were overcome by the gas. Obviously some method had to be devised for conducting the gas into the sewage without permitting it to escape into the air. Another problem which presented itself was that of removing the sludge which collected in the bottom of the tank.

After many additional experiments, these difficulties were finally solved and plans were drawn for the full-sized plant. These plans included the utilization of most of the equipment already in use. The old disposal plant is operated as before, the new plant being used only for removing additional solid matter from the effluent of the older plant. For housing the plant, a new building, twenty-two by fifty-four feet, was built beside the old tank and a large new tank was constructed on the opposite side of the building. This new tank is seventy-five feet square and fifteen feet deep. The building houses the equipment for introducing the chlorine into the sewage, a pump, and two mixing machines.

After passing through the first settling tanks, the sewage flows through an open conduit into the building. The flow of the sewage is measured as it enters the building, after which the chlorine is introduced into it. The injection of the chlorine into the liquid was one of the biggest problems with which the chemists and engineers had to contend. In the first tests, the gas was allowed to diffuse through porous clay tubes, much like Berkfeld filters. This method was satisfactory for experimental purposes, but was not commercially applicable because the gas could not pass through these diffusers in sufficient quantity. Finally an injector was used which made use of the partial vacuum formed by a stream of flowing water. The first installation of this device did not prove very successful for two reasons. In the first place, quantities of the gas escaped into the air, thus endangering the lives of men working near-by. In the second place, the iron of which the injector and pipes were composed was quickly corroded by the chlorine. These two faults, however, were soon remedied without great difficulty. The first was corrected by extending the end of the injector pipe fourteen feet below the surface, thus assuring the complete reaction or solution of the chlorine before it reached

(*Continued on page 99*)



**The building housing the plant is placed between the primary and secondary filters**

## students devise

# A Novel Periodic Classification

## of the elements

**By KEVIN FORDERBRUGEN**
**Chem., '33**

> **A periodic chart, to be of valuable service, should present the elements in such a way as to show clearly the various f a m i l y relationships. It must distinguish the transition elements from the regular ones and must arrange the triads in a logical way. All these have been accomplished by the table prepared by Kevin Forderbrugen and Orville Farestad. Their table also shows that the properties of the elements are periodic functions of their atomic weights—the fundamental idea of the periodic system.**
>
> **—M. CANNON SNEED,**
> ***Professor of Inorganic Chemistry.***



MANY of the early chemists noticed similarities between the elements which they studied. As early as 1829 Dobereiner arranged the elements having similar properties into groups of three. These groupings he designated as "triads." The first really complete classification of the atoms was made by the distinguished Russian chemist, Mendeleeff, in 1869. His table was based upon the atomic weights as related to physical and chemical properties. So complete was his arrangement that he was able to make predictions with remarkable accuracy concerning elements, which at that time had not even been discovered. Later investigations proved Mendeleeff correct in nearly all of his estimations.

The basic idea involved in the arrangement of the atoms into a new type of chart came about quite by accident. Some time ago I was interested in finding some relationship between melting and boiling points and atomic weight. At the time I thought that some formula might be derived by which the melting point could be determined from the atomic weight, or vice versa, and that a chart relating meeting points to physical properties might be constructed.

At the beginning the elements were written down in an arrangement like this, He-H-C, helium being the element melting at the lowest temperature and carbon melting at the highest temperature of any element. In more elaborate charts many relationships which had heretofore been quite difficult to understand became evident. I found that by designating helium as eight and carbon four a rectangle could be formed with hydrogen as a nucleus. The rectangle was completed by inserting elements of proper atomic number. With this as a beginning I soon forgot about melting and boiling points in my enthusiasm to develop this new possibility.

**Prof. Sneed Aids Development of Chart**

Using the pattern described above as a start a new chart was made including other elements arranged in rings about the hydrogen nucleus. About this time the many possibilities and complications led me to seek the assistance of my friend, Orville Farestad. Together we worked out a chart which we presented to Doctor Sneed, head of the Department of Inorganic Chemistry, for approval. Doctor Sneed became quite interested in the possibilities of the new arrangement and assisted in correcting the defects of the system. With his encouragement a number of charts were made, each one having some feature to improve the arrangement. We finally obtained a chart such as the one shown on the opposite page.

The circular chart is in reality quite similar to the system developed by Mendeleeff. However the circular arrangement shows more clearly the general relationships between the atoms.

**Mendeleeff's Table Follows Elements Properties**

The Mendeleeff periodic table now in use consists of an arrangement of the elements under two headings. The vertical classification under the headings group one, group two, and out to group eight gathers the elements according to their physical and chemical properties. The horizontal rows have classified the elements according to their structure.

Thus all the elements in group one are closely related by their properties. Hydrogen, lithium, and sodium follow this classification closely while copper, silver, and gold are not so closely related to the first three elements. This difference is shown by the collection of the long periods into two series, odd and even. Some elements in these two series are more similar to those in the same group but in the short periods. They are all under the letter A. The ones deviating from the strict group classification but closely resembling other elements of the

MENDELÉEFF'S PERIODIC TABLE OF ELEMENTS

Revised, 1925 — By M. C. Sneed and F. H. MacDougall, University of Minnesota

| Periods | | Group I | Group II | Group III | Group IV | Group V | Group VI | Group VII | Group VIII | Group 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Short Periods I | | H (1) 1.008 | | | | | | | | He (2) 4.00 |
| Short Periods II | | Li (3) 6.939 | Be (4) 9.02 | B (5) 10.82 | C (6) 12.000 | N (7) 14.008 | O (8) 16.000 | F (9) 19.00 | | Ne (10) 20.2 |
| Short Periods III | | Na (11) 22.997 | Mg (12) 24.32 | Al (13) 26.96 | Si (14) 28.06 | P (15) 31.024 | S (16) 32.065 | Cl (17) 35.458 | | A (18) 39.91 |
| | | A B | A B | B A | B A | B A | B A | B A | | |
| Long Periods IV | Even Series | K (19) 39.095 | Ca (20) 40.07 | Sc (21) 45.10 | Ti (22) 48.0 | V (23) 50.96 | Cr (24) 52.01 | Mn (25) 54.93 | Fe (26) 55.84, Co (27) 58.97, Ni (28) 58.69 | |
| Long Periods IV | Odd Series | Cu (29) 63.57 | Zn (30) 65.38 | Ga (31) 69.72 | Ge (32) 72.5 | As (33) 74.96 | Se (34) 79.2 | Br (35) 79.916 | | Kr (36) 82.9 |
| Long Periods V | Even Series | Rb (37) 85.44 | Sr (38) 87.62 | Yt (39) 89.0 | Zr (40) 91.0 | Cb (41) 93.1 | Mo (42) 96.0 | — (43) | Ru (44) 101.7, Rh (45) 102.91, Pd (46) 106.7 | |
| Long Periods V | Odd Series | Ag (47) 107.880 | Cd (48) 112.41 | In (49) 114.8 | Sn (50) 118.70 | Sb (51) 121.77 | Te (52) 127.5 | I (53) 126.932 | | Xe (54) 130.2 |
| Long Periods VI | | Cs (55) 132.81 | Ba (56) 137.37 | La (57) 138.91 | Ce (58) 140.25 | | | | | |
| Long Periods VI | | | | Also rare earth metals (59) to (71)* | Hf (72) 179. 7 | Ta (73) 181.5 | W (74) 184.0 | — (75) | Os (76) 190.8, Ir (77) 193.1, Pt (78) 195.23 | |
| Long Periods VI | | Au (79) 197.2 | Hg (80) 200.61 | Tl (81) 204.39 | Pb (82) 207.20 | Bi (83) 209.00 | Po (84) | — (85) | | Rn (86) 222.0 |
| Long Periods VII | | — (87) | Ra (88) 225.95 | Ac (89) | Th (90) 232.15 | Pa (91) | U (92) 238.17 | | | |
| Formulas of Oxides | | $R_2O$ | $RO$ | $R_2O_3$ | $RO_2$ | $R_2O_5$ | $RO_3$ | $R_2O_7$ | $RO_4$ | |
| Formulas of Hydrides | | $RH$ | $RH_2$ | $RH_3$ | $RH_4$ | $RH_3$ | $RH_2$ | $RH$ | | |

| * | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pr (59) 140.92 | Nd (60) 144.27 | — (61) | Sa (62) 150.43 | Eu (63) 152.0 | Gd (64) 157.26 | Tb (65) 159.2 | Dy (66) 162.52 | Ho (67) 163.4 | Er (68) 167.7 | Tu (69) 169.4 | Yb (70) 173.6 | Lu (71) 175.0 |

group are arranged under the heading B. This arrangement, however, does not allow a place for the rare earths, elements with the atomic numbers of 59 through 71. Consequently they are gathered below the table and their relative position indicated.

Periodic tables now in use are arranged in such a manner that to students of elementary college chemistry the division of groups into sub-groups is not exactly clear. The A and B divisions of the groups have proven to many to be a complication, because it is not always evident why such divisions are made. In studying the periodic table it occurred to us that, by arranging the elements according to their atomic numbers with the magnitude of the numbers increasing as the atoms progressed in concentric rings about hydrogen as a center, many difficulties might be overcome.

**Elements Grouped in Periods of Eight**

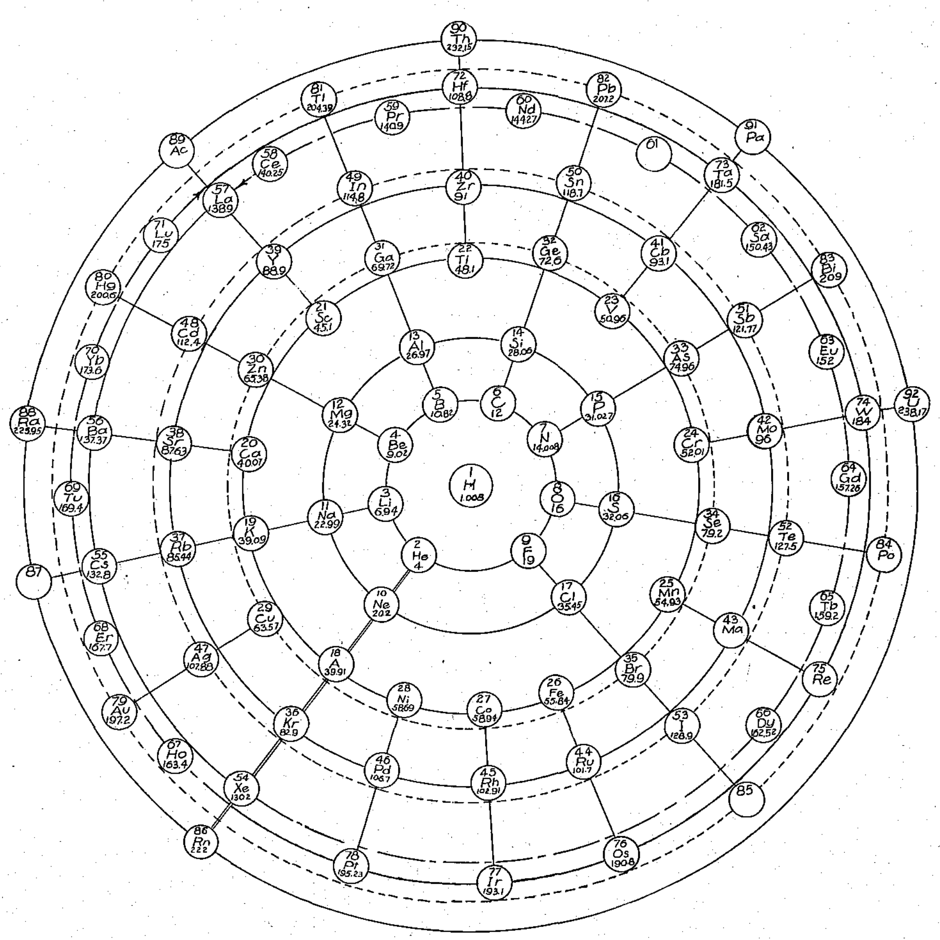
The first two periods, having eight elements each, offer no complications as the elements fall periodically into their correct places, (see diagram). Hydrogen, in this case, is the starting point with its place in the table as the center of all rings. As the atomic numbers increase, the elements revolve about hydrogen as a center and get further away from the center. Helium with an atomic number two begins the first circle or period, and a double line is placed before it to indicate the starting point. Lithium is next and begins the line on which fall the metals with a valence of plus one. As the succeeding elements move around to the opposite side of the circle they grow more and more negative until they reach fluorine which completes the first circle. The next element falls on the double line before the inert gases and begins the second ring. The rest of the elements of the ring fall into line with the families begun by the first ring. Upon completing the circuit the next inert gas drops down the double line and the long periods begin.

Regular elements of the long periods still fall on the solid black circles while the transition or irregular elements revolve on the dotted lines. Therefore, the third ring includes one solid and one dotted circle which together represent the first long period. The irregular elements begin new lines on which new families will form. Iron, cobalt, and nickel form a separate group at the bottom of the chart, and begin family lines of three groups of triads. These triads show up very clearly because they fall on straight lines. It may be noted that all of the periods are begun on the double line by an inert gas. On proceeding around a ring and coming back to the double line, the next element drops down to the next ring. There are three long periods, each containing the same arrangement and the same number of elements excepting the sixth ring which contains the rare earths.

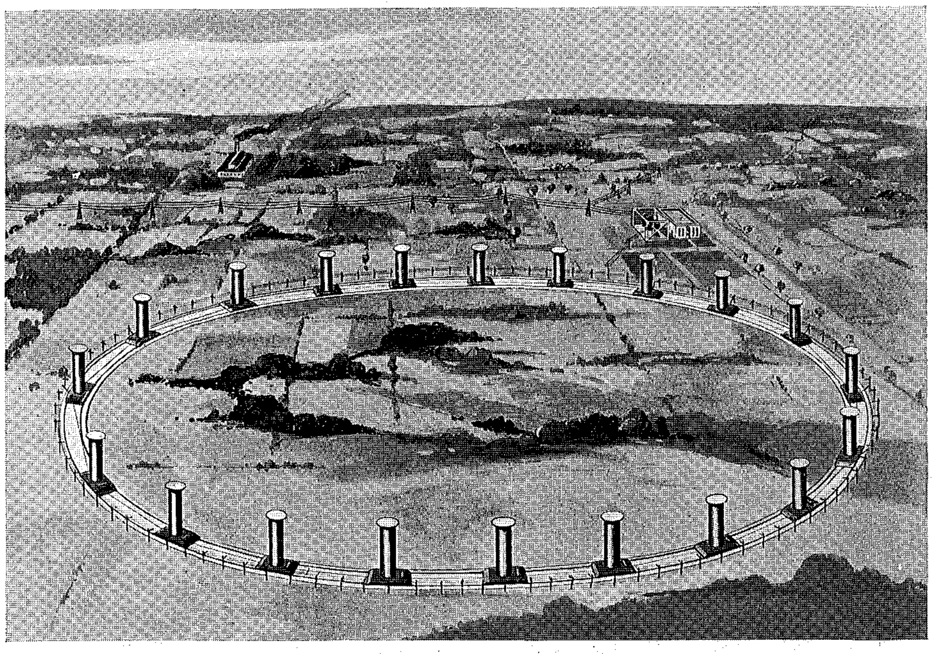
**Rare Earths Given Prominent Position**

The rare earths have no regular position in the existing periodic charts, and therefore their existence is overlooked. To many students a chart seems complete without the rare earths. If placed in such a manner that they would be noticed while the student is studying other elements, students would grow more familiar with the rare earths. In our chart the rare earths form a ring which continues onward from lanthanum and ends with hafnium. This ring, designated by a circle constructed of long and short lines, is arranged in such a manner that the rare earths do not fall into any one family. On either end of this line is an arrow to show that the rare earths are closely related. The rare earths are now in a conspicuous place and yet do not interfere with the periodicity of the other elements.

The family relationship of the elements can, by use of the chart, be clearly understood. All families lie on straight lines which radiate from the center of the rings. All elements along one of these lines fall into a natural family. Families containing the transition elements begin on lines starting in the third ring. All elements falling into a regular group have the valence of the first member of that group. Starting with the inert gases as zero and proceeding around the first circle, the maximum valence increases regularly from one to eight. These qualities of the chart would be of great benefit to the students studying the periodic law and the electron theory.



**In Mendeleeff's table, left, can be seen the irregular or long and short periods and the listing of the rare earths below the chart. In the chart devised by Forderbrugen and Farestad, above, the long and short periods are logically arranged while the rare earths fall in a natural sequence. The double line for transition between rings is in the lower left quadrant of the chart**



Architects' drawing of the Madaras power plant now under construction. The circular track is approximately 3,000 feet in diameter. As many as 40 rotors may be mounted on this track.

# industrial Production of Electric Power from the winds

***Power from the wind—finally the aeronautical engineer conquers that age-long energy source, the wind, in a practical manner. Professor Akerman, who was in charge of the design of the Madaras Rotor Power plant now being constructed, describes the theoretical basis of this first plant and how difficulties in design and erection were overcome.***

By JOHN AKERMAN
Professor of Aeronautical Engineering

FOR centuries the energy of the winds has been harnessed for the use of mankind by means of sails and windmills, but in each case the amount of power has been of a very small magnitude per unit. The latest and largest windmills have succeeded in producing only about 50 kilowatts and for structural reasons they have reached their maximum size.

Only very recently have experiments been made to harness the energy of the winds by large rotating cylinders of 1,000 to 2,000 kilowatts output. Although the power developed by the use of rotating cylinders has been put to other uses, the Madaras Rotor Power Plant is the first experiment in which the force of the wind is used to produce electrical energy in large quantities for industrial purposes, just as steam or water is used now.

It is a well known fact that a wind of given velocity produces a pressure on a rotating cylinder or ball. This pressure is much greater than the pressure exerted by the same wind on a stationary cylinder or on a flat plate of the same cross-sectional area, and the force due to this pressure acts nearly perpendicular to the direction of the wind. This action, known as the Magnus Effect, is manifested in the fact that a spinning baseball or golf ball will deviate from its straight line of flight.

### Circulation Theory Explains Source of Power

The theoretical explanation of this phenomena can be found in any textbook on advanced aerodynamics in connection with the Circulation Theory which can be explained in an elementary way with the help of Fig. 1.

Fig. 1 shows what happens to a horizontal air stream when it hits the rotating cylinder.

Due to the circulation of air with the cylinder, the air travels at a greater velocity on the top of the cylinder (Fig. 2) since the direction of the circulation and the direction of the horizontal wind are the same.

On the lower side, the direction of the circulation is against the direction of the horizontal wind. Applying Bernoulli's Theory we have the following conditions:

On the top, greater velocity, hence lower pressure.

On the bottom, smaller velocity, hence greater pressure.

It is obvious that since the pressure is lower on the top side than on the bottom side, a force is produced which would move the cylinder in the direction of the lower pressure area. This direction is almost perpendicular to the direction of the horizontal wind.

**Cylinder Surface Speed from Three to Six Times That of Wind**

To produce the force on the rotating cylinder, it is necessary to have a horizontal wind, a smooth cylinder of large diameter, and a power input to the cylinder sufficient to rotate it at such a velocity that the peripheral speed is from three to six times as fast as the velocity of the horizontal wind. The ratio of the peripheral velocity to the velocity of the horizontal wind is known as the U/V ratio.

The resultant forces for different U/V ratios on different cylinders have been determined experimentally by tests in large wind tunnels at Goettingen, Germany; at the National Advisory Committee Research Laboratories; at the University of Michigan; and at New York University.

The resultant force on the rotor is the vector sum of the lift and drag, taken at right angles.

$$\text{Resultant Force} = \text{Lift}^2 + \text{Drag}^2$$

Where:

$$\text{Lift} = .00237 \times \text{Radius of Rotor} \times C_L \times \text{Height of Rotor} \times V^2$$

$$\text{Drag} = .00237 \times \text{Radius of Rotor} \times C_D \times \text{Height of Rotor} \times V^2$$

The power required to rotate the cylinder is very small in comparison to the power produced by the Rotor.

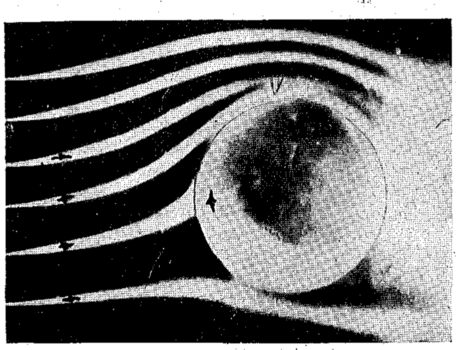


**Fig. 1. The effect of a cylinder rotating in a wind is shown above. The higher the U/V ratio the more pronounced is the effect.**

In 1926 Mr. Anton Flettner of Germany installed a rotor on a freighter and successfully sailed it across the Atlantic. He also constructed a windmill where, instead of four wings, he used four little rotors for producing electrical energy for farmhouses.

Both of these experiments proved theoretically and practically successful, but economically on a freight ship the rotor was found to be of no great value for the simple reason that the power plant is a very small percentage of the total investment in the ship so that the saving due to the difference in cost between rotor power plant and steam power plant was very negligible and would not justify the elimination of power produced by steam or gas engine.

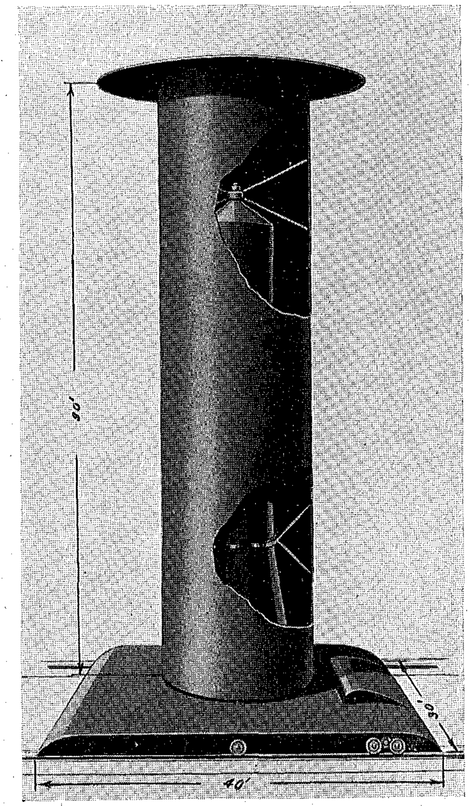
**Rotor Mounted on Flat Cars**

In the Madaras Rotor Power Plant each rotor, 90 feet high and 22 feet in diameter, is located on a large flat car 30 feet square. This car is placed on a circular railroad track of approximately 3,000 feet in diameter. The rotor is rotated by a small electrical motor at approximately 200 R.P.M. In a wind over 6 miles per hour a resultant force nearly perpendicular to the wind is produced and moves the car on the track at a velocity of 20 miles per hour. The resultant force is like a great giant pushing the car and is not only able to push the car but also to drive a generator which is coupled with gears to the wheels of the car. The current from this generator is picked up by a live wire and sent to the power station. A small part of this current is turned back to drive the small electric motor which rotates the cylinder.

As many as 40 cylinders on 40 cars having 40 generators can be put on a track and from very extensive theoretical calculations it has been found that each tower would produce on the average 1,000 kilowatts in any locality where the winds blow from 6 to 30 miles per hour. Reports from the United States Weather Bureau state that any locality has approximately 90 per cent of time per year wind blowing over 6 miles per hour. But there are also many localities where this percentage is much higher.

It is of interest to note that the calculations indicate that, with a 28 miles per hour wind with rotors rotating at 200 r.p.m., the resultant force on each rotor would be approximately 110,000 pounds.

A wind of over 30 miles per hour would produce too large a force and therefore, in that case, the force can be reduced by slowing down the revolutions of the rotors. If a gale starts up, the rotors could be stopped completely and




**This rotor tower, being constructed of high grade steels and aluminum alloys weighs but 5,000 pounds**

a 100 miles per hour wind would produce on a still rotor only about 25 per cent of the force imposed upon the rotor during operation in a 30 miles per hour wind.

**Rotors Change Direction of Rotation Automatically**

In this connection it should be noted that the rotors change the direction of rotation automatically at both ends of the diameter of the track perpendicular to the direction of the wind.

It should also be noted that the cylinders traveling into the wind have the air passing them at a velocity equal to the track speed plus wind speed, and the rotors traveling with the wind have a relative wind velocity equal to the wind speed minus the track speed.

A very extensive study of the theoretical power plant of 20 rotors was made by an engineering committee of seven public utility companies from the standpoint of economy and practical applications of the output of such a plant. Their conclusions were in favor of proceeding with the development of this project. The first step in the development was to make all possible theoretical calculations for individual rotors and for a theoretical power plant.

(*Continued on page 98*)

## One Set of Scales

THERE are many scales by which both value and achievement can be measured. Since every person has a goal, a star, something at which he aims, it is vitally necessary to know the true nature of value.

No one will deny that money has value. With it one can buy food, clothing, shelter, luxury, ease, and to a certain extent authority and prestige. Everyone has an innate desire for these things. They wish to possess, to rule, and to be looked up to; money is therefore a most desirable acquisition.

There is another standard of value, however, which also deserves consideration. It is a personal standard. One of its forms is giving. Anyone who has ever given a Christmas present can understand the joy of giving. In another form it is achievement, that glow of pride at having accomplished a difficult feat. In still another form it is service to our friends and to the world. What is this standard which manifests itself in so many ways? It is joy, it is service, and it is pride; in fact, it is happiness.

Thus there are two fundamental standards by which to measure achievement and success. One within yourself and the other without. Use both standards in setting up your star.

## A Wise Choice of Electives

IT is with a sigh of relief that the average freshman engineer leaves his last English final secure in the knowledge that he is at last out of reach of themes and lyrics and essays. And many of these engineers have gone through an entire year of English without finding any earthly use for all the English they have been compelled to take.

It is not until graduation looms near, when the representatives of the large engineering firms come to the campus for interviews, that English again becomes important. Not until then, for many undergraduates, do English grades, extra English courses, and the ability to express ideas clearly in writing become important again. And how many reams of paper are wasted in the composing of anxious letters of application, as graduation approaches and no position lies in sight. It is a significant fact that the majority of students enrolled in Technical Writing are seniors. Although the number of electives open to seniors is great, these seniors feel that an English course is of highest importance.

We then have the queer coincidence that Sophomores, who are so hard pressed for electives that they take courses of no use to them, shun English courses while Seniors choose these same courses from their wider selection of electives. It might be well for some of the undergraduates to heed the actions of the seniors and ponder a bit on the question of English for engineers before choosing their electives.

## Wanted, Opportunity!

SUCCESS for the present-day graduate engineer is determined by more than just the ability to solve intricate equations and to expound the latest theory of matter. The social and business world of today takes technical knowledge for granted and in addition demands that the engineer has a knowledge of cultural subjects and the ability to express himself.

The lack of non-technical subjects in the curriculum of our modern four year technical course is a notorious fact, and yet some schools have made an effort to alleviate the situation. Attempts have been made to inject certain business, social, and economic studies into the required program. The College of Engineering of the University of Minnesota has followed the general trend of the technical schools in the United States and has made possible the study of a few cultural courses as electives. The Department of Mechanical Engineering has proceeded a step farther by making speech a required subject.

Every undergraduate realizes the value of speech in his future work and desires to spend his days in college in more than just technical scholastic pursuits. In spite of the demand for registration in speech by the earnest students who realize the load that will be placed on them by the business world, it has in every case been denied. The first and only reason being the fact that it is required by the curriculum in Mechanical Engineering.

It is not fair that a student be deprived of a study which his fellow students are allowed to pursue. It is not with the best of fairness that one student should be given an undue advantage over his colleagues who have been graduated from the same college. In addition the business world is being deprived of men who, through no lack of interest on their own part, lost the chance to develop along broader lines than ordinarily prescribed.

The Mechanical Engineering department is to be congratulated on their consideration of the actual facts. It is now time that the course in question be provided with such facilities that it may be made available to every student desiring its advantages. If the College of Engineering does not see fit to provide the facilities in a general way, the separate departments might provide a panacea by placing the hallow of "required" upon speech and as a consequent result make it available to all registered students.

Speech for student engineers would be a fair advance toward a consideration of a few subjects other than technical. The adoption of speech as a democratic elective would mean much more than all the discussion advanced by homilists concerning progressive education in the last two years.

## Advertising—Does It Pay?

WHAT is an advertiser? He is a person or firm offering something for sale — something which he believes to be the best of its kind. He is an advertiser because he wants to make you also a believer in his article.

He is the man behind this publication. For every dollar you place in the now rather lean coffers of the MINNESOTA TECHNO-LOG he places a dollar. And for every dollar he expects, rightly, some returns.

And the advertiser should have his returns. That he is an advertiser proves, rather conclusively, his interest in the readers of the advertising medium. And that interest undoubtedly pays a just reward. But does he realize that fact? Sad to say, not always.

There is but one way to prove the effectiveness of TECHNO-LOG advertising. Tell the store which enjoys your patronage that you saw their ad in the MINNESOTA TECHNO-LOG. Write for that booklet offered by I. Puttem Up Engineering Corporation. But first of all, patronize our advertisers!

WATCH FOR THAT M A P OF THE CAMPUS

## Business, Here's a Tip

FROM North, South, East, West comes the cry, "Science has caused this depression! Let all Science stop for a while! Let the rest of the world catch up!"

Perhaps that lament is true. Perhaps Science is a few steps ahead of the rest of the World. But why should Science halt its army of workers simply because its rear guard, Business, is lagging.

Organization, not for direct control of its products but for advancement of its work, has enabled Science to progress so rapidly. Why not apply some of those same principles to a better organization of Business — to an organization for research in the Science of Business? Then we will probably hear no more cries of "Science is too far advanced. Science . . . Science . . . Science." And probably we will experience no more depressions.

▼

Now that England is on the silver basis, a brisk trade of silver coin for gold coin which is then smelted has started.

## Worry — Worry

INTERNATIONAL aerial transportation has opened many new channels of international contact. As the railroads brought Chicago into close contact with New York, so has the aeroplane brought North America nearer to the South American countries. The entire world is gradually building a mammoth system for the establishment of closer relationships between its various countries. Naturally such an advancement brings to light many important problems.

Perhaps the most interesting problem is that predicted in a recent report of the United States Public Health Service in its annual report submitted to congress. The report reads, "In carrying out the requirements of law with reference to the defence of our territory from invasion by contagious diseases from foreign countries, especially in view of the new problems occasioned by the rapid increase of international aerial transportation, it is important to keep currently advised as to the prevalence of disease, not only in the United States but throughout the world in so far as may be practicable."

This problem seems insignificant until it is seen how many people yearly are admitted into these United States. In 1930 over two million persons were inspected for admittance. Practically all of these persons arrived by boat.

If international aerial communication continues growing at its present rate, the prevention of the infiltration of disease through this channel will become a large and expensive problem. Perhaps in the future we will find the commuter going through health examinations on his way to and from the office. That is, if the aeroplane has not already removed all national boundaries.

## Marks and a Job

CHEAT! What is morally more repugnant than to know that such an epithet can be applied to oneself.

Everyone has probably wondered what incentive there can possibly be which is strong enough to repay a man for selling his honor and his pride. The thoughtless find one reason: they think of marks. "If I cheat, my grades shall be higher." Following the same line of thought they think of the praise of their parents, and of the increased simplicity of obtaining employment.

However they have not followed the thought far enough. A cheat, by the very nature of things, hinders himself from gaining initative, knowledge, and stamina. He receives praise, but he can not live up to it; he receives employment but he can not hold his job down.

Cheating may be good for one's marks, it eventually may get one a job; however the fundamental truth is that a cheat can not stand on his own legs. He must have someone to cheat from!

# AROUND THE WORLD WITH OUR ALUMNI

## *'31 Graduate Leaves for Russian Position*

Another young American engineer has been absorbed by the far-reaching developments of the Soviet government. This time Everet Ostlund, a 1931 graduate of the electrical engineering department, has offered his services to the further development of Russia.

From Minneapolis Mr. Ostlund will go first to Leningrad where he expects to be assigned a job. He is particularly interested in radio work.

"I don't expect much in the line of pecuniary reward," he said before leaving, "but there should be lots of varied experience in electrical work there. The government has increased its appropriation for electrical development this year and I feel pretty sure there will be plenty doing."

In regard to adjusting himself to the communistic mode of life he stated, "I've talked to several people who have returned and they tell me that for a few years anyway one can get along. It looks to me as though it's a good chance for a job and a good chance for a lot of experience. Consequently I'll stay there at least two


years. If I still like it then, maybe I'll stay longer."

Mr. Ostlund will mail an article to the TECHNO-LOG when he stops in Berlin on his way to Leningrad. The article will appear in a future issue of this magazine.

## *Aeronautical Engineering*

'31—Jewett—Robert Jewett is now associated with the Madaras Rotor Power Corporation. Bob is supervising the construction and the erection of an experimental rotor designed to produce power from the wind. Bob's present home is at Burlington, New Jersey.

'30—Kernkamp—Lloyd Kernkamp, who was formerly with the Midwest Refineries, is now with the Texaco Company. Lloyd's new address is Box 1686, Pampa, Texas.

'31—Rodert—Louis Rodert is at present employed in the art of disseminating education. The boys at the Duluth Junior College will certainly absorb their aerodynamics now.

## *Chemical Engineering*

'21—Swart—Richard H. Swart writes, "I have recently taken the position of Research Director for the General Refrigeration company of Beloit, Wisconsin. This was a decided advancement, and I am pleased to have an opportunity to develop a research laboratory of my own." Mr. Swart's Beloit address is 1226 Eaton Avenue.

'25—McKee—John B. McKee writes that he meets a number of Minnesotans

at various technical society dinners in Brooklyn, New York. McKee is with the Valentine Varnish company of Brooklyn.

'26—Tronson—John L. Tronson, who is with the B. F. Goodrich Company at Akron, Ohio, visited in Minneapolis during the Holiday season.

'30—Kay—William C. Kay is now a graduate student in the School of Chemical Engineering Practice, Massachusetts Institute of Technology. He was also a visitor during the holidays.

'30—Windus—Ray F. Windus, formerly test engineer at the Insulite Laboratories, is now associated with the McLaughlin-Gormley-King company of Minneapolis.

## *Electrical Engineering*

'22—Tuve—M. A. Tuve, who is with the Carnegie Institution, Washington, D. C., together with Dr. L. R. Hofstad and O. Dahl, was awarded the $1,000 prize at the Cleveland meeting of the American Association for the Advancement of Science. The subject of their paper was high voltage tubes. Dr. Merle A. Tuve is with the department of terrestial magnetism of the Carnegie Institute.

'30—Garrison—Millard M. Garrison was married to Lessie Boles of Sandstone, Minnesota, December 28. Mr. Garrison is associated with Jansky and Baily, Radio Engineers, with offices at 922 National Press Building, Washington, D. C. Stuart Bailey, '27, came to Sandstone for the wedding and was honored with the position of "best man."

'31—Newman—Morris Newman is now on his way to Russia. In a letter to Professor Springer he writes, "Berlin is doubtless the prettiest and cleanest city in Europe; I like it very much. It could not have changed much since you were here last, except that now many midget cars and little taxis remind one faintly of New York. I am staying over the holidays in Berlin where there is so much of interest, and will then make a swift plunge into the unknown. The little German I had in high-school has been of great value here, but I doubt if I will recollect the Russian language as easily. Also, I wonder if the city of my next stop, Leningrad, once St. Petersburg and considered of the most beautiful in Europe, has remained as unchanged as the capital of Germany.

"Though east is the direction I expect to travel I hope to drop in at the U. of M. within a year or two."

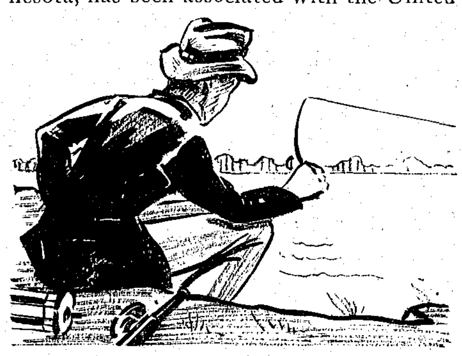
## *Civil Engineering*

The class of '27 Civil Engineers held their reunion during the Christmas holidays. The following men were present to swope stories and tales of engineering experience: Lawrence V. Johnson, Edward J. Witt, J. K. Borrowman, Carl F. Luethi, Douglas M. Campbell, Elmer W. Carlson, C. A. Wentz, Abe. J. Sperling, Francis W. How, C. K. (Nick) Preus, Frederick Carl Teske, Russell I. Riedesel, Stanley D. Lund, Ray C. Edlund, Luerd E. Briggs, Roy W. Kastner, Elmer J. Christianson, Kenneth M. Clark, Floyd O. Borne, R. H. Spantleman.

'30—Cheney—Russel S. Cheney, employed by the engineering department of the Soo Line, is making his residence in Superior, Wisconsin. He writes that he was married February 28, 1931, to Miss Lorraine A. Drake, and that he is not bald as yet, but the forehead is getting higher. He states, however, that marriage and the baldness are not connected. Once in a while he sees Gene Weber and some of the boys with the U. S. Engineers in Duluth.

'24—Johnson—Ray V. Johnson is also with Peppard and Fulton, Wesley Temple Building, Minneapolis. At present he is superintendent on construction work north of Quebec. The work is chiefly on dams, bridges and rock work.

'27—Carlson—E. W. Carlson whose present home address is Comfrey, Minnesota, has been associated with the United



States Engineers Office in Michigan. In conjunction with his work on topographical surveys of Michigan rivers during the last three years, Elner states that he has participated in some very fine fishing. As yet, however, he has not been caught himself.

# NEWS FROM THE TECHNICAL CAMPUS

## *Engineering Registration Shows Slight Decrease*

Registration in the College of Engineering and Architecture and the School of Chemistry showed a decrease of 186 over that of the fall quarter, according to figures released by Dean Leland's office. The total number of students registered for the fall quarter was 1831 as compared to a registration of 1645 for the winter quarter.

The greatest decreases occurred in the architectural and electrical engineering registrations with the first and third year classes showing the greatest changes. The School of Chemistry showed a decrease of 38 in the total registrations and the College of Engineering a decrease of 148.

## *Engineering Graduate Talks Before Seniors*

Louis Schaller, a 1929 civil engineering graduate, discussed the MINNESOTA TECHNO-LOG, the *Minnesota Alumni Weekly,* and other university publications at a meeting of graduating Seniors at the Minnesota Union on December 16, 1931. The merits of the different college publications and the pleasures derived after graduation from the campus news in these magazines were stressed by Mr. Schaller in his talk.

Mr. E. B. Pierce, head of the Extension Division, discussed the importance of carrying on studies after leaving college. The meeting was sponsored by the Union Board of Governors in behalf of the *Minnesota Alumni Weekly.*

## *Dougan Speaks to Civils on Bridge Clearances*

Henry K. Dougan, executive assistant with the Great Northern Railway, discussed bridge clearances over navigable waterways at the fall meeting of the American Society of Civil Engineers in St. Paul.

Mr. Dougan, in his address in St. Paul, said, "I am speaking only of the streams which are not now navigated. I am making no attempt to discuss the desirability of increased use of the Mississippi below St. Paul for, however limited the navigation is at present, there is navigation. Because these streams were once navigated and because it would be theoretically possible to again navigate them, restrictions have been placed upon the construction of bridge crossings which have resulted in greater expense in construction than the river traffic has been worth." An important consideration was brought out when Mr. Dougan said "I have picked as examples railway bridges. Conditions in transportation have changed and it is not likely that the railways will have occasion to build new lines as in the past nor is there likelihood of their having to build many additional bridges across the upper waters of our rivers."

In conclusion Mr. Dougan definitely stated his opinion when he said, "I believe the value of potential future use of these waterways should be determined. Having come to a conclusion the possibility of future navigation other than for pleasure should be cast aside on those streams which, although they may have been navigated when other means of navigation were not available, are not now so used."

***The TECHNO-LOG announces two prizes of fifteen and ten dollars respectively, which will be awarded for the two best student articles to be received at the TECHNO-LOG office on or before April 1, 1932.***

RULES OF THE CONTEST

1. *Articles may be submitted at any time from the date of publication of this issue until five o'clock on April 1.*
2. *Any student is eligible to enter one or more articles in the contest.*
3. *Articles may be on any subject, technical or non-technical, and may be of any length between 1,500 and 5,000 words.*
4. *Photographs or other illustrations submitted with the story greatly increase its chance of winning a prize.*
5. *Judgment will be made by the editors of the* TECHNO-LOG *and their decisions will be final.*
6. *The names of winners will be published in the May* TECHNO-LOG.
7. *All stories submitted will become the property of the* TECHNO-LOG *and if suitable, may be published later.*

## *Joseph Discusses Furnaces for Chemical Engineers*

Mr. T. L. Joseph, director of the North Central Experimental Station of the Bureau of Mines, spoke to chemical engineers on current blast furnace practice on the evening of January 14. His discussion included consideration of heat transfer, reaction zones, and the general chemistry of the blast furnace.

Francis Calton, president of the Minnesota student branch of the American Institute of Chemical Engineers, made arrangements for the meeting. Other meetings of the institute have been arranged to take place later in the quarter.

An article dealing with manganese metallurgy, by Mr. Joseph, appeared in the last issue of the TECHNO-LOG.

## *Prof. Rowley to Attend Heating Convention*

Professor Rowley, vice-president of the American Society of Heating and Ventilating Engineers, will demonstrate a hot plate conductivity apparatus developed in the Experimental Engineering laboratories at the Society's Convention in Cleveland, Ohio, on January 26. The apparatus consists of a number of thick copper plates containing heating elements and thermocouples.

## *Honorary Engineering Fraternities Plan Ball*

Honorary engineering fraternities have united in sponsoring a Tech Ball, to be held at the Glenwood Chalet on Saturday evening, January 23. Members of Tau Beta Pi, Phi Lambda Upsilon, Eta Kappa Nu, Pi Tau Sigma, Chi Epsilon, and their guests will attend.

Winfield Foster, member of Tau Beta Pi and Phi Lambda Upsilon, is in charge of arrangements. He is being assisted by Cledo Brunetti, Forton Christoffer, John Appert and George Weigel.

The Club Royal orchestra has been selected to furnish the music for the occasion.

### *Engineer Dies During Holidays*

Lowell E. Graves, sophomore student in Electrical Engineering, died during the Christmas holidays from pneumonia contracted during the trip to his home at Woodstock, Illinois.

### *Lind Writes Monograph on Ionization of Gases*

"Electrochemistry of Gases and Other Dielectrics" will be the title of a book now in preparation by Dr. S. C. Lind, director of the School of Chemistry, and Dr. George Glockler, associate professor of chemistry. The book is to be a monograph dealing with the chemical effects produced by any type of electrical discharge through gases and other non-conductors.

The object of the work is to organize all of the material obtained by research in the field of dielectrics. This book, the first to be written on the electrochemistry of gases, will coordinate the results of research in this country and Europe. It will be the first of a series of books on dielectrics written under the auspices of the Committee on Insulation, Department of Engineering, of which John B. Whitehead of Johns Hopkins University is chairman.

Dr. Lind expects to have the book completed within a year. It will be published by John Wiley and Sons.

### *Experimental Building Balcony Is Extended*

During the Christmas vacation the Experimental building has been the center of activity on the Engineering campus. The twenty-foot balcony which originally extended half the length of the building has been extended to reach entirely across the building on the east side. The added balcony floor space will be used for laboratory work in automotive and aeronautical engineering classes. In the future it is planned to construct on this new balcony a curving flume which will duplicate as far as possible the actual conditions present in bends of various angles in natural streams in order to study the effect of turbulent flow on erosion in open channels.

The Experimental Engineering building has received a large four cylinder tractor engine from the Minneapolis Moline Power Implement company. It will be used in conjunction with laboratory tests of various internal combustion engines.

A 50 foot wooden flume has been added to the equipment of the hydraulics laboratory. The flume, constructed entirely of wood, is twelve inches wide and eighteen inches deep. It will be used in connection with graduate research work for tests of sediment movements in water under various conditions of open channel flow. The discharge of water through the flume will be measured by a triangular weir through which the entering water passes. Once the coefficient of discharge has been determined for the weir, the rates of water flow through the flume will be determined from Hook gauge readings at the weir.

The construction of a large air filter and related apparatus for testing the efficiency of various ventilating equipment is now almost completed. The apparatus is being assembled on the east balcony and will be ready for use in a short time.

### *Fraternity Initiates Head of Department*

Pi Tau Sigma, honorary mechanical engineering fraternity, recently initiated Professor Du Priest, head of the mechanical engineering department, as an honorary member while five student pledges became active members. Following the initiation ceremony a banquet was held at the Radisson Hotel in honor of those newly initiated. Russel Erickson, president, welcomed the new members and Don Leslie gave the response to the welcome. Professor Martenis, the supreme secretary, and Russel Erickson told of their recent trip to the national convention at Missouri University. Professor Shoop entertained the group with some tricks of magic.

The new initiates are Henry Kanneanan, Don Leslie, Norbert Menglecock, Morris Knight, and Gayle Priester.

### *Shepard, '09, Appointed to Drainage Commission*

George M. Shepard, a 1909 Civil Engineering graduate, received the appointment of assistant chief engineer of the Metropolitan Drainage Commission on January, 1932. His work will include the analyzing and coordinating of the various plans which have been submitted for the sewage disposal plants to be constructed in the Twin Cities.

J. A. Childs, also a 1909 civil, is chief engineer and secretary to the commission. Mr. Childs has been preparing plans for the sewage disposal of the Twin Cities and surrounding territory.

Frederick A. Bass, Professor of Civil Engineering at the University of Minnesota, and A. S. Milinowski, consulting sanitary engineer, were appointed consulting engineers for the commission at the same time.

### *Surveyors, Engineers to Hold Convention*

The Minnesota Surveyor's and Engineer's Society will hold its thirty-seventh annual convention February 25 and 26 in the Nicollet hotel, Minneapolis. Seven speeches are scheduled for Thursday, February 25. Professor Leonard F. Boon of the civil engineering department will speak at the Thursday afternoon session on Problems of Surveying.

The society will hold its business meeting on the same day. The first day's session will close with a stag dinner at six-thirty in the Nicollet hotel. The society will adjourn at noon Friday for a joint meeting with the Minnesota Federation of Architectural and Engineering societies which is holding its eleventh annual meeting in the Lowry hotel, St. Paul, Friday and Saturday, February 25 and 26.

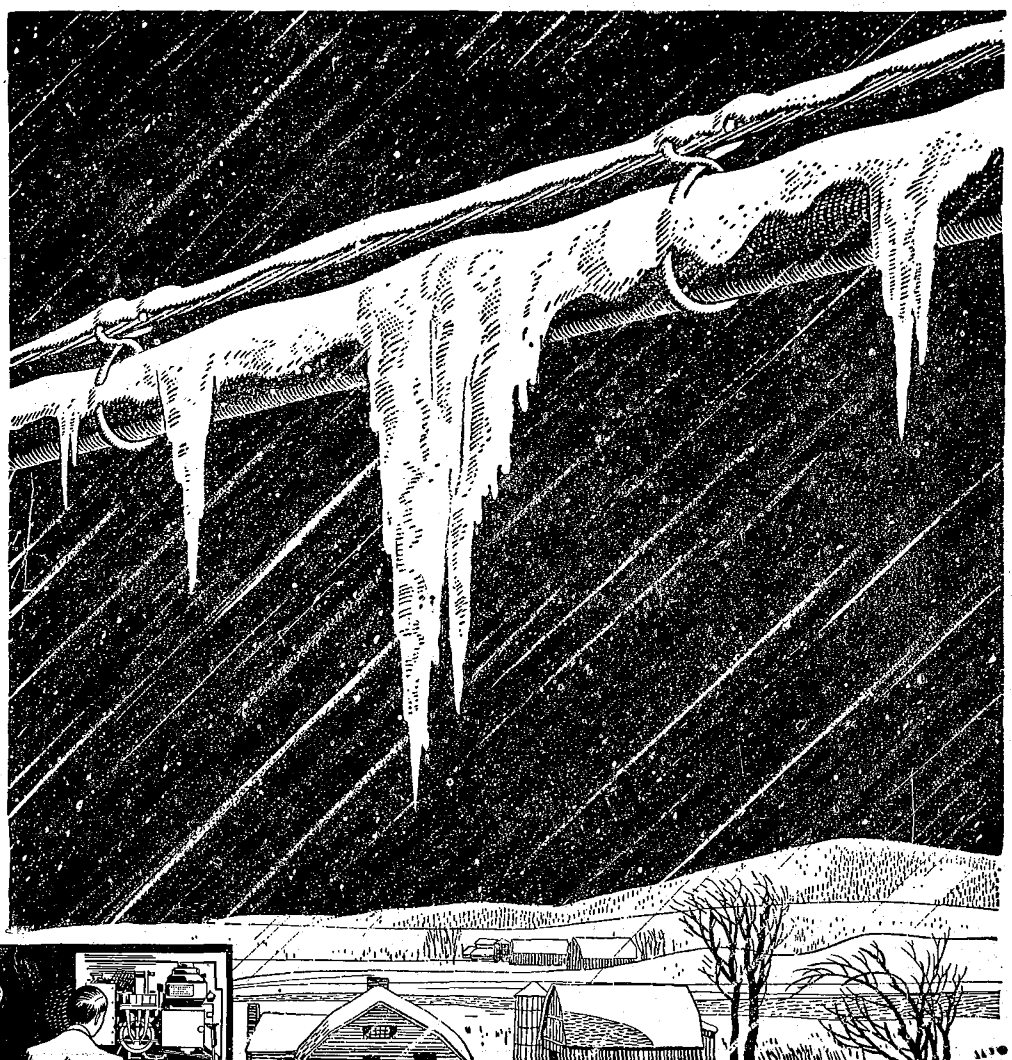
The Minnesota Federation of Architectural and Engineering societies will hear two men from the college of engineering. F. C. Lang of the Minnesota highway department is scheduled to talk on February 26 and Professor J. A. Wise will lead a discussion of building codes at the final session, Saturday afternoon. The business meeting will also be held during the Saturday afternoon session. The convention will close Saturday evening with a banquet and dance in the Lowry hotel.

### *Bass Warns That City Has Low Water Supply*

Professor Frederic Bass, head of the Department of Civil Engineering and member of the Minneapolis city water survey commission, recently announced that the water supply system in the south part of Minneapolis was inadequate for fire protection during the dry summer months.

The commission is recommending the construction of a huge cross town water main in South Minneapolis and of additional coagulation basins at the city water works at Fridley to provide an adequate water supply at all times.

In discussing the need for the recommended improvements, Professor Bass stated that the water pressure available to fight fires has been as low as six or eight pounds per square inch at times during the summer months in some sections of the city. At some points fire engines would pump the mains dry in a short time in midsummer.



# Electricity From the Winds

(*Continued from page 91*)

The next step, which is now under way and nearing completion, is to build one full sized rotor and experiment with that rotor checking the theoretical values and developing ways and means of inexpensive construction for one unit. If the results of the tests on this single unit will be in accordance with the theoretical calculations, the intentions are then to build a power plant of at least 20,000 kilowatt capacity.

**Rotating Large Cylinder Causes Difficulties**

It is one thing to say that such and such an invention will produce such and such results, but it is another thing entirely to make it feasible, particularly if no unit of similar character and particularly of similar size is available for comparison. The question of rotating such a large cylinder at such high r.p.m. and accelerating and decelerating it in a reasonably short time was a big difficulty for many engineers who did not take the trouble to look into the problem deeply enough. Several large concerns tried to investigate the possibility of the construction of such a rotor and they did not see any difficulties as far as the whole unit and mechanism were concerned, except the design of a large, light shell strong enough to withstand the large outside resultant force and the large internal stresses due to centrifugal forces. The latest developments in light and strong aircraft structures were of great help in the solution of the problem.

A staff of aeronautical engineers, one of whom was Robert Jewett, Ae.E. '31, was employed all last summer in the offices of the Baldwin Locomotive Works at Edison, Pennsylvania, on the design of the rotor. Army, Navy, and Department of Commerce regulations for aircraft structures were applied and high grade steels and aluminum alloys used exclusively. The weight of the shell and the cap is only approximately 5,000 pounds.

Although no exact limitation of the size of the rotor plant can be set now, it can be shown that a plant of between 10,000 and 40,000 kilowatts capacity represents a reasonable arrangement. The first cost of any power plant is naturally the important factor in its possible commercial significance. Present estimates indicate that rotor power plants in the neighborhood of 20,000 kilowatts capacity can be built for about $50.00 per kilowatt of rated capacity. This price decreases for larger installations. A modern steam plant of 100,000 kilowatts or more costs an average of $100.00 per kilowatt of rated capacity with increased cost for smaller stations. For hydro-electric plants a characteristic figure might be taken as $200.00 or $250.00 per kilowatt of rated capacity. It is obvious that the Madaras Rotor Power Plant, with a cost of $50.00 per kilowatt, promises a very sound undertaking.

The production cost at the Madaras Rotor Power Plant, compared with the figures from such plants as that at Niagra Falls and large steam generating plants, would be one-half as compared with hydro-electric plants, and one-fourth as compared with steam plants. These are the most unfavorable ratios since the lowest cost of electricity produced by steam or hydro-electric plants are compared with the most unfavorable operating conditions of the Madaras Rotor Power Plant.

It is a natural question asked by everybody, "What happens if the wind does not blow?" As stated before, the wind conditions in the United States are such that only 10 per cent of the time during the year, on the average, is the wind velocity below six miles per hour.

It also should be remembered that modern hydro-electric and steam power plants are interconnected. The Madaras Rotor Power Plant would be an extra link in the hydro-electric and steam power plant system. With the insertion of the Madaras Rotor Power Plant in the steam-hydro-electric system, many steam plants which are not of large enough capacity now to take care of peak loads would be adequate for a long time in the future to take care of emergencies when the hydro-electric and air units could not supply the needed load.

**Plant May Be Used for Energy Storage**

In this connection it is interesting to note that in case of strong winds and no outlet for load, the Madaras Rotor Power Plant may be used as a storage of energy by pumping water in a closed hydro-electric plant reservoir (several such closed hydro-electric plants are now in use in Germany and in the United States).

The present output in the United States in kilowatt hours is 80,000,000,000 annually. It is obvious that if even a small part of this output could be produced at one-half, or lower, of the cost of energy from hydro-electric or steam power plants the project will be of great importance to the industry. The detailed investigation of prevailing winds in certain localities situated far away from a source of coal or hydro-electric project shows the tremendous possibilities of utilization of the electric energy from the Madaras Rotor Power Plant to a very great extent.

# Disposal of Packing Wastes

(*Continued from page 87*)

the surface. The second trouble was remedied by replacing all iron parts by parts made of duriron, a resistant iron alloy.

The chlorine was purchased in tanks containing one ton of the compressed gas. These proved satisfactory except for the fact that they required refilling at frequent intervals. Now the gas is purchased in fifteen-ton lots, shipped in tank cars similar to those used for gasoline and oil. The gas is liquified in these cars and flows through pipes directly to the disposal plant. The liquid is allowed to expand in one of the smaller one-ton tanks and weighed; thus an accurate check can be kept on the amount of gas used. This expansion of the liquid into a gas before being injected into the sewage is necessary for another reason. The expansion is accompanied by a great absorption of heat and if it were allowed to take place in the injector, the device would be frozen solid. As it is, the tank in which the expansion takes place, must be heated to melt the frost which collects in the pipes.

### Two Chlorine Injectors Used

There are two injectors for introducing the gas into the sewage. These are placed very near a large mixing machine which agitates the sewage violently, while a second machine assures even more thorough mixing of the chlorine with the sewage.

As soon as the chlorine has been mixed with the sewage, precipitation begins and provisions must be made for its settling. This settling takes place in the large tank into which the liquid is pumped. The problem of removing the sludge from the bottom of this tank was solved by the installation of a machine for drawing it to the center and a pump for removing it through pipes. This machine consists of a large steel blade, or squeegee, slowly revolved in the tank. This blade is shaped in such a way that when moved along the bottom of the tank, it draws all solid material accumulating ahead of it toward the center. This material is of the consistency of a soft mud and is easily pumped from this point directly to the by-product department.

### Scum Not Removed by Blade

This machine was successful in removing most of the precipitated matter. It was found, however, that a scum formed on the surface of the liquid in the tank which was not removed by this machine and which consequently flowed into the river with the effluent. This scum is caused by the escaping of the dissolved oxygen and carbon dioxide from the liquid. As bubbles of these gases rise from the liquid, they carry with them a small quantity of the solid material, which then floats on the surface. Air, containing these gases, is dissolved in the liquid, during the mixing process, but additional oxygen is also formed by the breaking down of the hypochlorous acid formed by the solution of the chlorine in water.

The removal of the scum was accomplished by attaching a skimmer to the revolving blade. This device moves with the blade but scrapes the surface of the liquid instead of the bottom of the tank. It was so designed that it drew the scum to its outer edge instead of to the center as the squeegee does. At a certain point on one side of the tank its accumulation of material is removed. This material is not in sufficient quantity to be pumped to the by-product department, so it is allowed to flow back to the main sewage line and is then chlorinated a second time.

### Chlorine Sterilizes Effluent But Does Not Kill Fish

The successful installation of this device solved the last of the big problems with which the chemists and engineers had to contend. The effluent remaining after the precipitation of the solid matter, contains enough chlorine to sterilize it but not enough to be odorous or harmful to fish. It actually purifies the water already in the river instead of polluting it. The sludge which is pumped from the bottom of the tank flows directly to the by-product department which was already operated by the company. Here the material is treated in large vats with live steam which extracts all fats and greases. These oils are suited for soaps and tallows. The remaining material is dried and sold for fertilizer. It contains a large percentage of protein matter and when mixed with some of the other by-products of the plant, such as dried blood, is sold for stock food.

The change from the filthy, putrid smelling sewage of a packing plant to soap and stock food is a great one, particularly when the poisonous gas, chlorine, is the principal agent which brings about the change, but it is just another example of the wonders of modern chemistry. The process of the chlorination of sewage is of great value to mankind and will undoubtedly soon be used by many cities and industries which have long been troubled by problems of sewage disposal.

# « « MENTAL TILTS » »

## TWO MARBLE SHOOTERS

Two marble shooters started in to play a game. Sammy, the first, had at the beginning the same number of marbles as Tommy, the second player. Sammy won twenty marbles in the first round and then lost two-thirds of his stock in hand during the second round. That left Tommy with four times as many marbles as Sammy at the beginning of the third round. How many marbles had each at the beginning of play?

## A SIMPLE EQUATION

Solve this equation:

$$2 + x/10 = 1.05^x$$

Once the correct method is found this equation is quite simple.

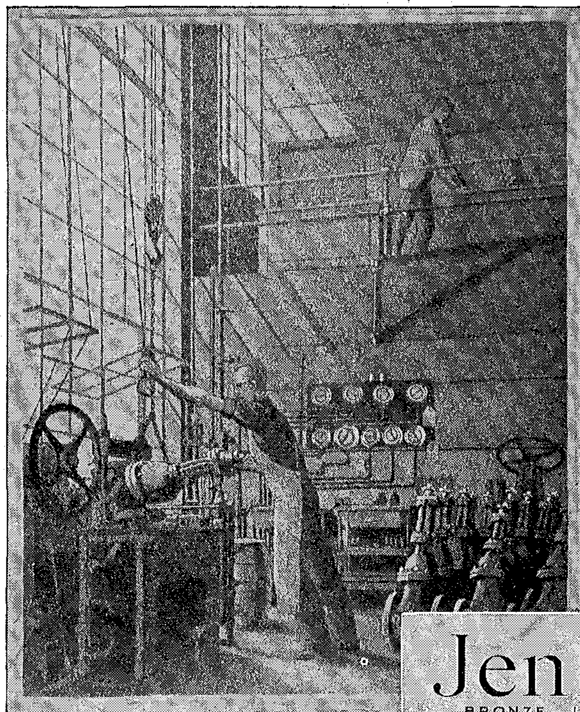
▼

### Answers to Last Month's Tilts

CHESS AND WHEAT. Solving this problem by the use of a series shows that the inventor of chess had received a reward of 46,920,000,000,000,000 grains of wheat. He had the first corner on wheat.

SQUARES AND SQUARES. By rearranging the smaller squares 170 rectangles can be made.

ENGLISH ENGINEERING. Using 23 consonants and 5 vowels 23,250 different words can be constructed each having five letters and consisting of three consonants and five vowels alternated.

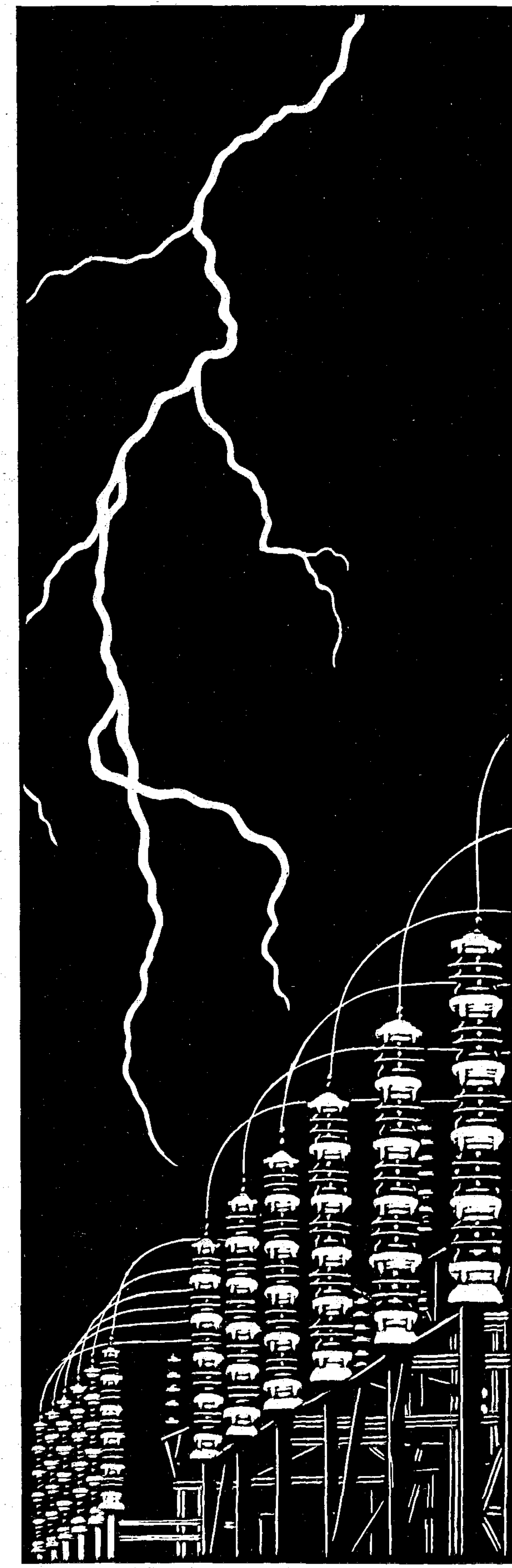


*Testing a Jenkins Iron Body Gate Valve under hydrostatic pressure before shipment from the Jenkins factory.*



X - 20 = X + 20

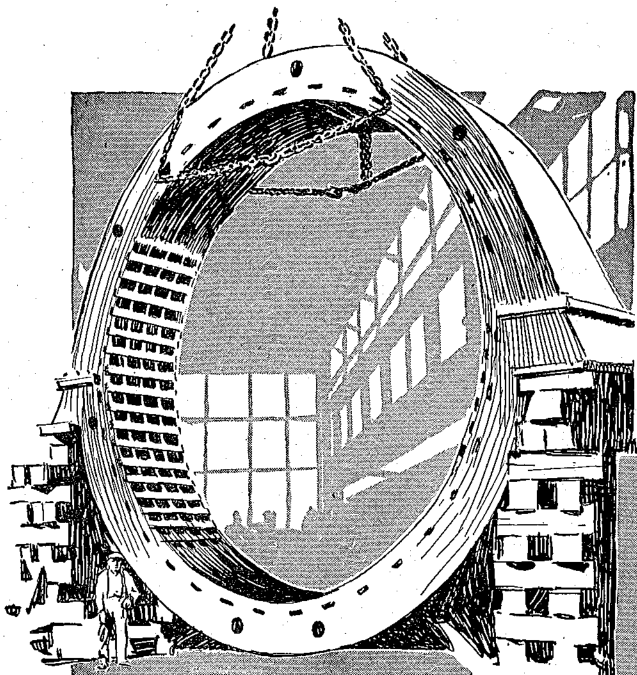
2/3 (X + 20) + X - 20 = 4/3 (X + 20)



# THE MINNESOTA TECHNO-LOG

Vol. XII MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED No. 5

FEBRUARY, 1932



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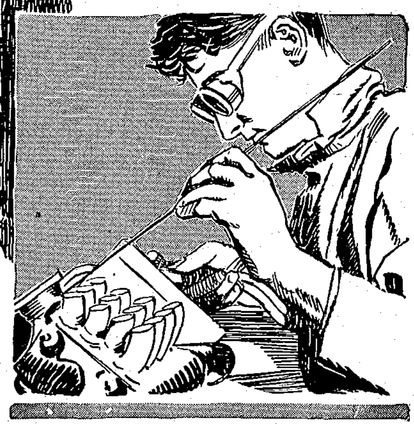

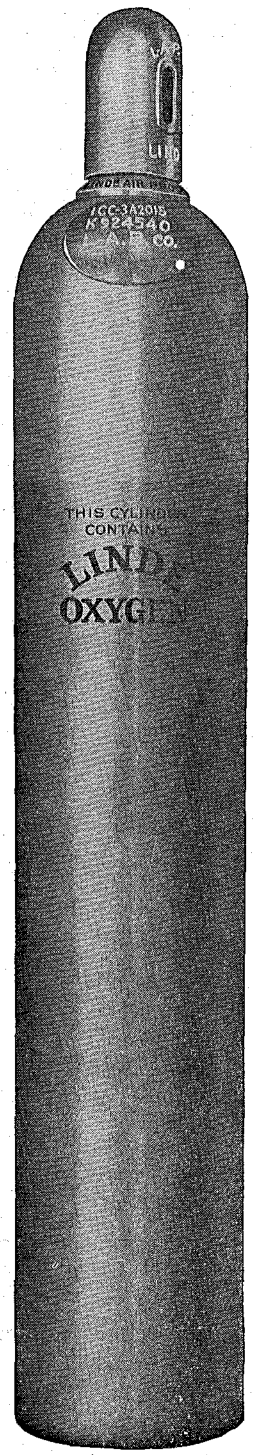

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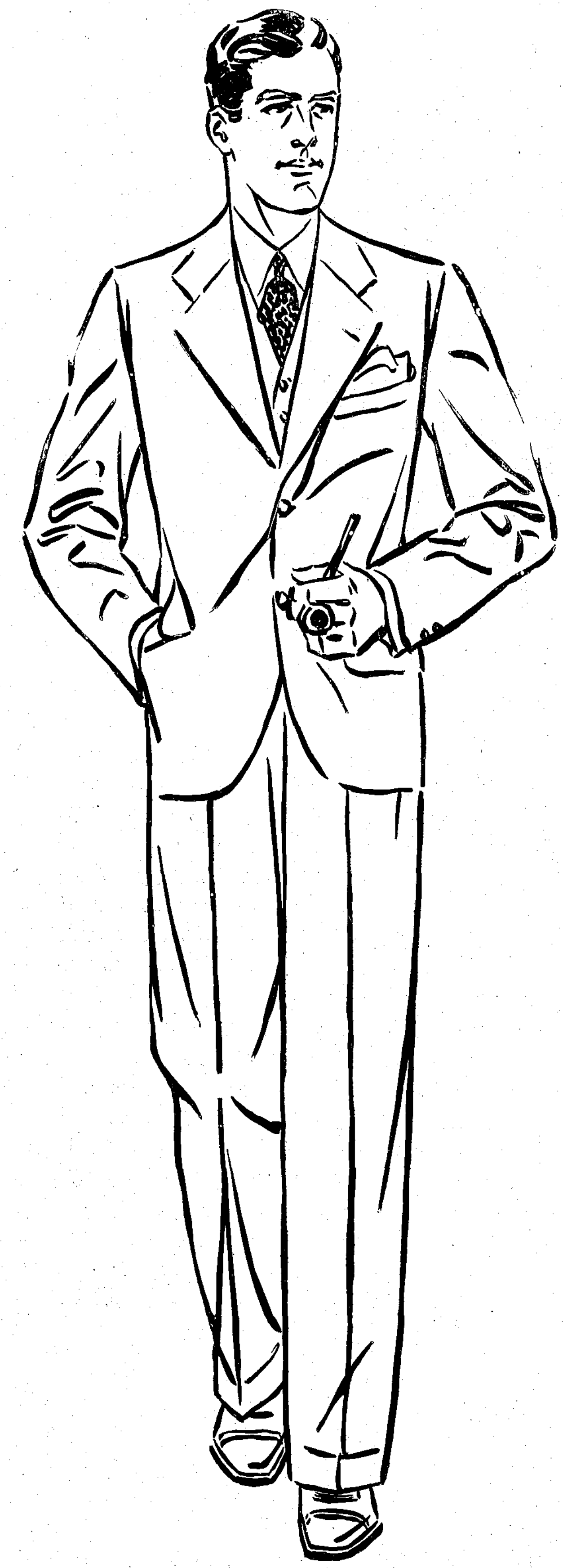

February, 1932

Volume XII, Number 5

# the MINNESOTA TECHNO-LOG

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THE DOMINION'S POWER INDUSTRY *is young, yet large. J. P. Shirley, Jr., presents the salient features of its growth.*

NEON SIGNS—*A student tells about the theoretical and practical operation of this up-to-date advertising mechanism.*

THE YOUNG ENGINEER—*What makes his success?—Brings a character survey in the February issue by a Knight of St. Pat.*

AN ARCHITECT *draws. —Russ Williams presents the* TECHNO-LOG *with a frontispiece and sketches. We should see more of him.*

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| The Cornell Civil Engineer | Marquette Engineer | Penn State Engineer | Tech Engineering News |
| Illinois Technograph | Michigan Technic | The Pennsylvania Triangle | Wisconsin Engineer |
| Iowa Engineer | Minnesota Techno-Log | Purdue Engineer | |

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● TENTH AVENUE BRIDGE
—A CHARCOAL
By Russell Williams

# canada's
# Growing Hydroelectric Industry
## —a survey

*Is Canada an industrial nation? Is Canada capable of great industrial development? J. P. Shirley, Jr., formerly managing editor of "The Minnesota Techno-Log," in a survey of the Dominion's present and potential hydroelectric development elucidates the position and extent of the present enterprises and predicts the location of future industries.*

By J. P. SHIRLEY, Jr.
Ex. '32

IN this review of the available and developed water power resources of Canada, only the salient features of the situation will be given. No effort has been made to include a discussion of any of the several general schemes that have been proposed for the development of the available resources. No effort has been made to illustrate the application of the water power already developed to specialized industries.

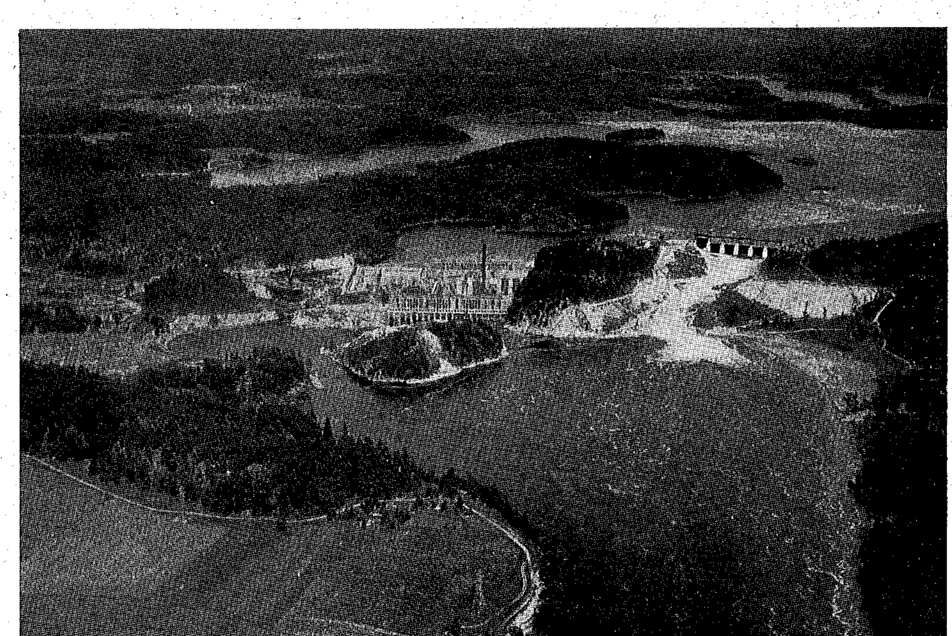
The immediate significance to the Dominion of Canada of water power development is apparent when we consider that water power is the vital force behind the manufacture of pulp and paper, the most highly capitalized manufacturing industry in the entire Dominion. Furthermore, water power is an essential to both the mining and electro-chemical industries as well as those which contribute to the rapidly expanding life of the Dominion.

In addition hydro-electricity is utilized in Canadian homes both urban and rural to a greater extent than in those of any other country, while its use in providing municipal servces such as street lighting and water pumping is quite general. In view of these facts and because of the varied and constantly increasing application of power in the industrial and commercial and also domestic fields, the government has deemed it not only wise but also expedient to continue the aggressive constructional program of former years with the result that new equipment with an aggregate capacity of 377,980 h.p. was brought into operation during the year 1929 alone, and that some 3,000,000 additional h.p. is either in active prospect or under installation at present.

The almost meteoric rise of Canada into a manufacturing country of the first importance is almost directly traceable to its very excellent water power resources. To an increasing degree the low cost power provided by hydraulic development has become a magnet attracting to the country important major or branch industries whose output has had a marked effect in augmenting Canada's export trade. Concurrent with this industrial development the widespread distribution of power for domestic use, not only in urban but also in suburban and rural communities, by the hydro-electric central station organizations has in many different ways affected a decided improvement in the standard of living of a large proportion of the population.

It has been exceedingly fortunate that about 60% of Canada's total water power occurs in the highly industrial but non-coal producing provinces of Ontario and Quebec. Furthermore, it has been the fate of fortune to place ample water power in the neighborhood of the mineral and pulpwood areas throughout the entire country and, strange as it may seem, the principal centres of population have water power within easy transmission distances. These several circumstances combine to provide a power market in which increases in supply must be made at a rapid rate indeed if they will keep pace with demand.

But it can not be said that the government has been slow to realize these facts and avail themselves of the opportunity to advance the cause of industrial Canada. By the end of 1930 there was approximately 6,075,000 h.p. available



**Hydroelectric Power in the East — 204,000 H. P.**
**Paugan Falls Development, Gatineau River, Quebec**

with an active prospect for the installation of an additional 3,000,000 h.p. within the very near future.

**Large Proportion of Power Sold to Public**

It should be mentioned that the installations of the past year have not been confined to any one particular section of the Dominion but extend from coast to coast,—which may also be said of the developments planned for the immediate future. One of the most outstanding features of the present day hydraulic development throughout the world, and this is particularly true of Canada, is the large proportion of the power that has been installed for distribution to the public through the medium of central electric organizations. In direct proof of this statement it might be mentioned that over 98 per cent of the projects installed during the year 1929 were of this nature.

It may be well at this point to pause for a few moments to consider the enormous amount of water power available in Canada today. Although complete information regarding the resources is not yet available, all existing stream flow and power data from federal, provincial, and private sources have been systematically collated, analyzed, and co-ordinated with the object of presenting a dependable estimate of available power. As a result of these investigations it may be stated that from all available sources Canada may realize 20,347,400 h.p. for conditions of ordinary minimum flow with 33,617,200 h.p. ordinarily available for six months of the year.

Now the total installation to date in water wheels and turbines throughout the Dominion is approximately 5,727,000 h.p. In other words the present installation represents only slightly more than 17 per cent of available power. When we consider that machine installation generally shows about 30 per cent greater available power than the figures for ordinary six-month flow, we find that only about 13 per cent of the recorded water power sources have been developed. What an enormous field now exists becomes readily apparent. What stupendous engineering feats the next few decades will witness may only be hazarded. And yet the government is progressing in a manner so definitely scientific, that a man of only mediocre ability may readily predict the rapid industrialization and expansion of the Dominion.

The diversity of utilization of water power, particularly of hydro-electricity, is such as to render extremely difficult any definite classification of the ultimate use of the power from sites other than those developed for specific industries such as the manufacture of pulp and paper or for mining purposes. Even in the special industries mentioned some part of the power is likely to be diverted for domestic or commercial use. Since a very large proportion of the total power developed is distributed through the medium of central electric stations and much of it is sold wholesale to other stations, the difficulty of a complete "use" analysis becomes at once apparent. But it is possible to divide the total installation of 5,727,000 h.p. into three main classes—central electric stations, pulp and paper mills, and other industries—in order to show the distribution of h.p.

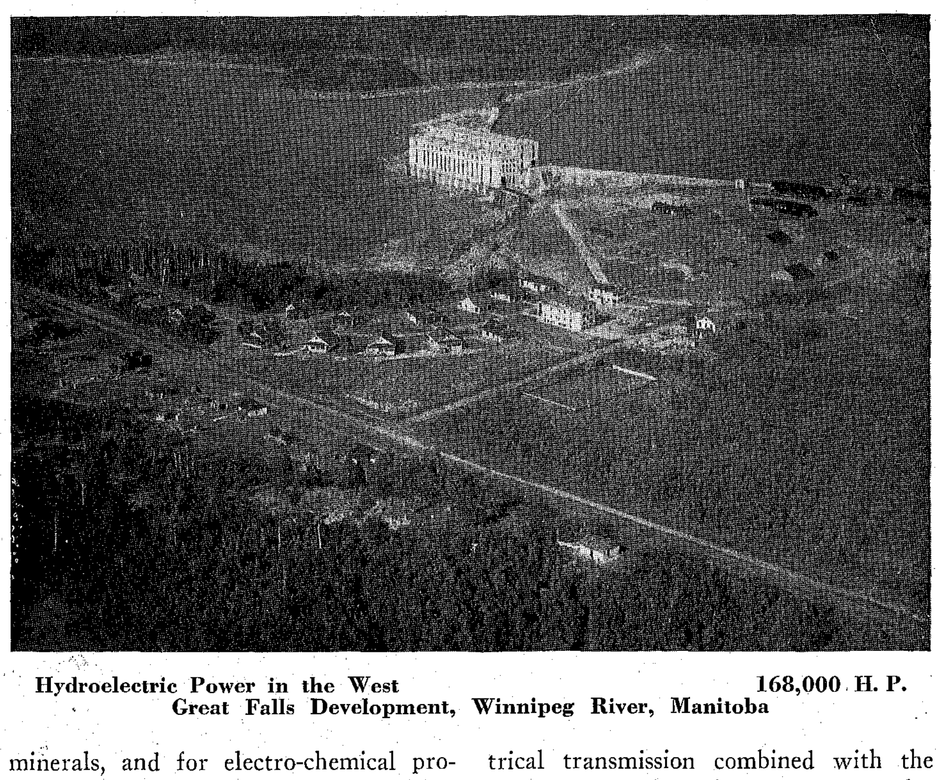
**Central Electric Stations.** It is estimated that 84 per cent of the total given above is installed in central electric stations for general distribution to domestic, municipal, and commercial fields. A considerable portion of the power generated for these installations is sold en block for the manufacture of pulp and paper, for the mining and reduction of minerals, and for electro-chemical processes.

**Pulp and Paper Mills.** Approximately 10 per cent of the total produced at present is installed in power plants for the production of paper and pulp. The industry also purchases some 860,000 h.p. of electrical energy from the central electric stations together with a considerable quantity of off-peak or surplus power for use in electric boilers.

**Other Industries.** It is estimated that 5.8 per cent of the total is installed in general industrial plants such as mines and mineral reduction works, electro-chemical plants, saw, grist and grinding mills, machine shops, and municipal pumping plants.

Because of its vast importance, the use of water power in the central electric station industry will be somewhat expanded at this point. As previously indicated, this field constitutes the leading use to which water power development is put and there is every indication that this proportion will continue to increase. At the beginning of the year 1900, when electricity was just beginning to come into use, 33 per cent of Canada's hydraulic installation was in central electric stations. Ten years later the percentage had almost doubled, while by the beginning of 1920 over 73 per cent was devoted to this purpose.

A number of factors have contributed to this continued growth, notably the extensive economic radius of modern electrical transmission combined with the fortunate location of water power relative to centers of population and industry without adequate fuel supplies. The special adaptation of hydraulic power to central electrical station operations is emphasized by the fact that the last com-



**Hydroelectric Power in the West** **168,000 H. P.**
**Great Falls Development, Winnipeg River, Manitoba**

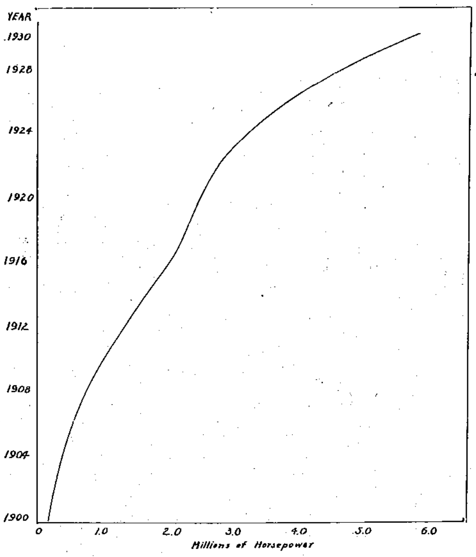



**Diagram of Power Growth**

pleted central electric station census compounded by the Canadian government shows that over 95 per cent of the total main plant equipment is in hydraulic generating stations and that this equipment produces almost 99 per cent of the total electrical output.

At present there are 312 hydro-electric central station plants in Canada with a total installation of 4,817,486 h.p. Of these, 209 stations with an installation of 581 turbines of a combined capacity of 3,520,000 h.p. are owned by commercial organizations while municipal or other public organizations operate 97 stations with 237 turbines having an aggregate capacity of 1,297,000 h.p.

Because it is one of the most conspicuous features of industrial progress in Canada, a few more words may well be said about the use of water power in the pulp and paper industry. As previously stated, the utilization of water power by these industries, or rather the tremendous importance of these industries to Canada, may readily be accounted for by the fact that enormous supplies of water power lie in close proximity to ideal mill sites. The importance of this factor may be brought home when one considers that it takes practically 100 h.p. per ton of daily output of news print. This presents a greedy market.

Generally speaking steam cannot be produced by electricity, as ordinarily sold on the k.w.h. basis, in direct competition with coal. However, when surplus power can be obtained at a low rate, the situation immediately becomes quite altered. And so in Canada it has been found economical by large consumers to purchase blocks of power on a flat contract over an extended period of time to cover their normal or future requirements. Then, on Sunday or when business conditions demand a reduced scale of operation, the surplus can be profitably converted into steam. These mills which maintain their own hydro-electric equipment are provided with an advantageous use for any surplus power they may be able to generate from water at their disposal. It is indeed quite an effective arrangement.

The growth of water power development in Canada has been so striking that a diagram has been prepared to show the expansion. The total installed horsepower has grown from 890,000 h.p. at the beginning of 1910 to 5,727,000 h.p. at the beginning of 1930.

It is surprising, at least to the sophomoric mind, what a stupendous amount of capital is invested in such an industry. According to statistics recently compiled by the Canadian government, the capital invested in water power development in Canada inclusive of transmission and distribution systems is estimated to be almost $1,302,000,000. Of this amount over $1,100,000,000, or 85 per cent has been expended on land, buildings, plant, and equipment. This figure is greater than the capital investment on any other industry in the Dominion and is an investment with a most creditable record of steady earning power as is illustrated by the dividend records of its securities. Furthermore, an examination of charts shows a large increase over a period of years in the output and gross revenue per dollar of investment as well as in the electrical output per installed horse power.

Applying the present investment per installed h.p. to the estimated future growth of hydraulic development it appears that an average of over $90,000,000 per annum of new funds will be required to finance the developments of the next few years.

One of the most fortunate effects of the water power development of Canada has been to reduce the consumption of coal. This is especially significant in view of the fact that the apparent coal resources of Canada are very limited. Although it is very difficult to assign a precise figure to the coal equivalent of developed water power, by taking into consideration all conditions surrounding water power development in Canada and comparing them with somewhat similar conditions of fuel development elsewhere it is reasonable to state that a saving of coal amounting to five and three-quarters tons per annum for each installed horse power is capable of being effected. This means that the total present water power installation of 5,727,000 h.p., if operated continuously, is capable of effecting a saving of 33,000,000 tons of coal per annum.

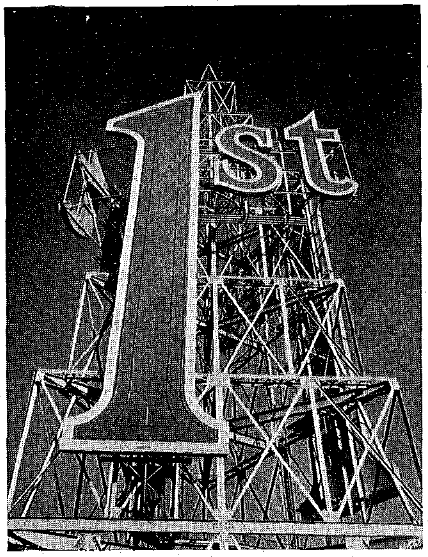
**TABLE 1**

**Available and Developed Water Power in the Dominion of Canada**

| Province | Available 24-hour power at 80% efficiency | | Turbine Installation h.p. |
|---|---|---|---|
| | At ordinary min. flow h.p. 1 | At ordinary six mo. flow h.p. 2 | 3 |
| **British Columbia** | **1,931,000** | **5,103,500** | **559,792** |
| **Alberta** | **390,000** | **1,049,500** | **70,532** |
| **Saskatchewan** | **542,000** | **1,082,000** | **35** |
| **Manitoba** | **3,309,000** | **5,344,500** | **311,925** |
| **Ontario** | **5,330,000** | **6,940,000** | **1,952,055** |
| **Quebec** | **8,459,000** | **13,064,000** | **2,595,430** |
| **New Brunswick** | **68,600** | **169,100** | **112,631** |
| **Nova Scotia** | **20,800** | **128,300** | **109,124** |
| **Prince Edward Island** | **3,000** | **5,300** | **2,439** |
| **Yukon & N. W. Terr.** | **294,000** | **731,000** | **13,199** |
| **Canada—TOTALS** | **20,347,400** | **33,617,200** | **5,727,162** |

But the actual saving in any year is dependent upon the output from the installation rather than the rated installation. Expressed in electrical units of output, for the year 1929 the figure stands at 20,500,000,000 kilowatt hours. Now, by applying to this a conservative figure of 1.76 pounds of coal per k.w.h. (which is a fairly good average coal consumption of various public utility electric power

(*Continued on page 122*)




1st National Bank, St. Paul

# the modern Neon Sign —how it works

*Laddy Markus, electrical engineering Junior, has made the history, development, theory, and use of the neon sign the subject of a practical discussion. Neon, the ultra-modern in signs, has become the feature of our white-ways and its history is as interesting as the light itself.*

By LADDY MARKUS
EE '32

IT IS just twenty-three years since the first commercial neon sign was erected in America and only five years since the first neon installation was made in the Twin Cities, but today the gayly colored luminous tubes, representing the most advanced form of modern illumination, may be seen in every corner of the globe. The blazing slogans of the business world may be seen everywhere; in the great metropolises, in the tiny villages, and in the far-off corners of the Orient. Even gay Broadway, once known for thousands of twinkling electric lights, has turned to neon for colored signs.

The actual production of light by an electric discharge through a gas dates back to the beginning of the world for lightning is an electric discharge through the mixture of gases which make up the atmosphere. In the early days, however, little was known of the reasons for the flash of light and the accompanying crash of thunder, and many ancient civilizations regarded lightning as a supernatural phenomenon.

The northern lights, too, are a form of luminous discharge as static electricity, formed high above the earth through the influence of sun spots, discharges through the rarified atmosphere producing the twinkling luminous discharge so common in the far North.

It was not until the seventeenth century that man was able to duplicate, even in a small way, the glow discharge of nature. Jean Picard, a French scientist, used the ordinary barometric tube to obtain a luminous discharge. A high vacuum containing only a small quantity of mercury vapor was obtained by inverting a closed glass tube filled with mercury. A blue discharge through the mercury vapor was obtained when static electricity was produced by moving the mercury column up and down.

The invention of the Leyden jar in the eighteenth century made available for the first time the high voltages necessary for an electric discharge through a gas under low pressure. Perhaps Benjamin Franklin showed his friends the pink glow obtained in an evacuated flask when brought near a charged Leyden jar. He had only to rub a piece of sealing wax with cat's fur and touch the wax to the Leyden jar repeatedly to obtain the high voltage needed for the glow discharge.

In the nineteenth century many scientists were working on the problem of producing a more convenient light source than the arc light. In 1850, Heinrich Geissler began making gas-filled discharge tubes. His tubes were no larger than the little spectrum tubes so common in laboratories today and were then of little practical use.

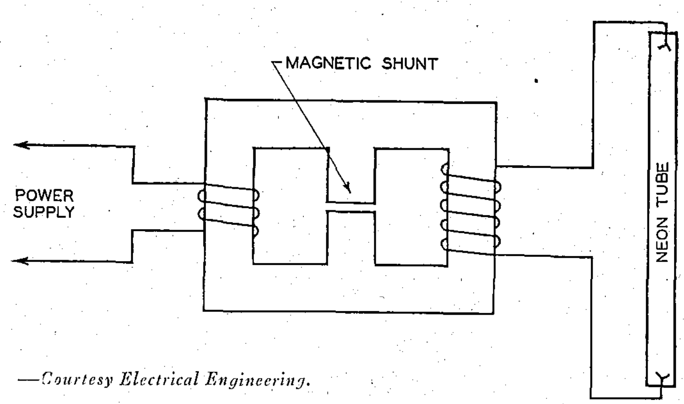
### Carbon Dioxide First Used

Following the work of Geissler, Dr. McFarlane Moore began his researches with gaseous conductor lamps in 1891 finally developing into a carbon dioxide discharge tube which gave an illumination similar to daylight. This gas was first used in a script sign erected at the office of the New York World in 1904. Many other commercial installations were made in this country and Europe before rare gases were obtainable in commercial quantities.

The Moore tube consisted of a glass tube many feet in length and filled with carbon dioxide at a pressure of one-tenth of a millimeter of mercury. The high voltage necessary to operate the tube was obtained from an induction coil. Since carbon dioxide was not an inert gas, it had a tendency to combine with the electrodes and the tubing gradually decreasing the gas pressure in the tube. Additional apparatus was necessary for automatically admitting more gas into the tube as the pressure decreased. The light given off by the tube was entirely satisfactory while it lasted, but the auxiliary apparatus necessary was so complicated that the use of the light in the home was out of question.

With the isolation of neon gas in 1898 by Sir William Ramsay and M. Travers, Moore immediately proposed its use in his tubes. The first luminous neon sign was erected in June of that year at the entrance of Burlington House in London, England.

Neon gas was not available for commercial use until about 1910 when M. Georges Claude, a noted French scien-




—*Courtesy Electrical Engineering.*

**Schematic Diagram of Ordinary Neon Tube Installation**

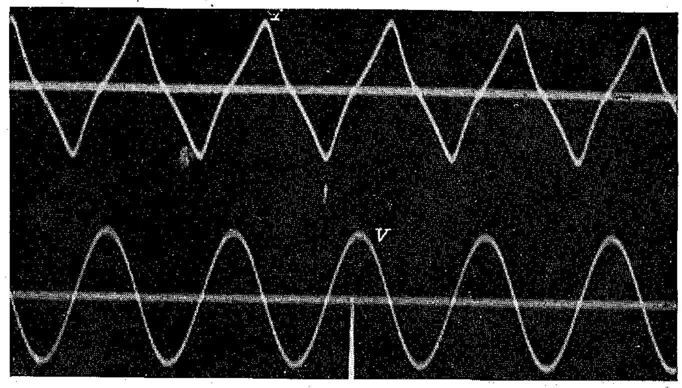
tist, developed his process of fractional distillation of liquid air for separating the gases of the atmosphere.

Claude made extensive researches with gaseous tubes and obtained a number of patents in Europe and America on his methods of manufacturing luminous neon tubes. After many experiments with electrodes of varying sizes he found that long tube life and most efficient operation were obtained with electrodes having an area of at least 1.5 square decimeters per ampere of current flowing through the tube.

A number of manufacturers of neon tubes have infringed on the Claude patents covering the relation between electrode area and current and have been forced out of business. Others, recognizing the patent rights of Claude, have kept the area of their electrodes below that specified by Claude but have adopted many ingenious electrode designs which serve to increase the effective electrode area and the efficiency of the tubes.

In the manufacture of modern luminous tubing signs the design is first carefully laid out on a full sized master pattern. From this design one pattern is made for the sheet metal work necessary for the framework of the sign and a second is laid out on sheet asbestos for the glass bender. Lead or pyrex glass tubing is bent to follow the design on the asbestos pattern. The diameter of tubing to be used is determined by the size of the letter and varies from one-fourth to three-fourths of an inch for ordinary commercial signs. Larger diameter tubing is often used for air beacons where a broader light source is desired.

Electrodes are sealed into each end of the tube and a short piece of glass tubing is welded on for making connections to the pump for evacuation. After the tubing has been bent into the desired shape and the electrodes sealed into the ends, it is evacuated, first with an oil sealed rotary piston pump and finally with the Langmuir mercury vapor pump, to a pressure of approximately one-tenth of a micron or one hundred thousandth of a centimeter of mercury.



—*Courtesy Electrical Engineering.*

**Current (I) and Voltage (V) Waves for Typical Neon Tube**

### Glass Surface Freed of Gases

Proper heat treatment applied to the glass and electrodes while the tube is on the pumping system is the one effective method of removing harmful gases from the metal electrodes and the glass tubing. In bombarding the tube with a high voltage both the metal and the glass are heated by electrical means to a temperature where each releases the impurities and harmful gases most liable to affect the tube in operation. At the same time the tube is connected to the vacuum pump and the released impurities and gases are withdrawn. Water vapor, the gas most harmful to the operation of a tube, is usually introduced while the glass bender is blowing it into shape. Water vapor is a slow moving gas and a great deal of heat is needed to remove it from the tube. Hydrogen, carbon dioxide, and nitrogen are a few of the other impurities which must be removed from the tube.

There are two methods of applying heat treatment during pumping; by internal bombarding of the tube and by external bombarding with the use of ovens.

The internal method of bombardment is most commonly used because of the simplicity of operation. While being evacuated the tube is connected to a high voltage transformer source. When the pressure in the tube has lowered to a definite point, the high voltage will break down the resistance of the gas column in the tube and allow a heavy current to flow. This current agitates and heats the gas molecules within the tube and these molecules in turn heat the glass and electrodes to a high temperature. At this high temperature the glass and electrodes release the harmful gases which they may contain.

In the external method of bombardment the shaped pieces of tubing are placed in an oven and heated to 375 degrees Centigrade. Pyrex tubing must be used with this method for lead glass has a relatively low melting point and high coefficient of expansion. Potassium vapor is usually admitted into the tubes during baking to aid the purification process and increase the life of the tubes. Since potassium does not vaporize at the operating temperature of a neon tube, its presence in the completed tube has no effect on the quality of the emitted light. As in the internal bombardment method, the tubes are connected to the vacuum line during the purifying process.

### Tube Air Washed Under High Voltages

After the tube unit has been completely exhausted it is washed with a small quantity of gas such as air, helium, argon, or neon. The high voltage applied during the rinsing process agitates the gas in the tube and removes any gases which might adhere to the walls of the tube.

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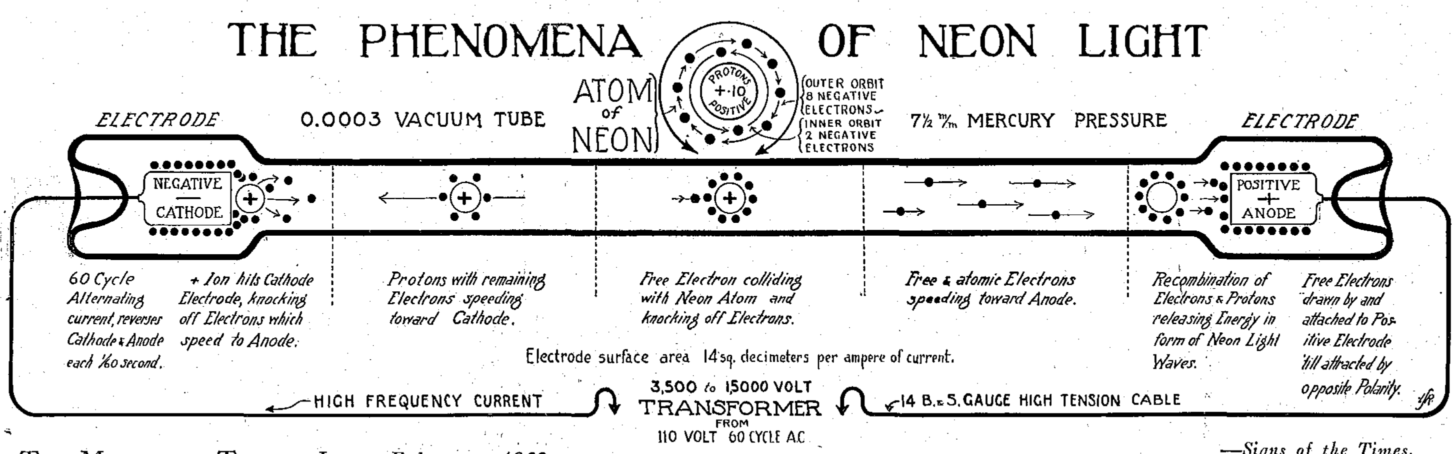



—*Signs of the Times.*

# AROUND THE WORLD WITH OUR ALUMNI

## *Architecture*

'31—Cone—Earle R. Cone, formerly of the Techno-Log staff, is now taking graduate work in architecture at Harvard University. Earle writes: "I must say I never realized how interesting Alumni news could be until I got away from the old school. It certainly is nice to get a little word, or rather news, from them. Perhaps I can give you a little dope that hasn't come in from other sources. As you probably know, I am here at Harvard, (still single in spite of some rumors!) trying to continue this process called education and waiting for the depression to get so depressed it 'busts.' Harold Ekman and Theodore Prichard are among my classmates in the School of Architecture, and Fritz Von Grossmann has just given himself a conspicuous place in the ranks of the unemployed by earning himself a degree. He is probably out in the middle-west now trying to improve upon the situation. During my absence at Christmas I entertained three Minnesota alumni in my apartment. A note I found upon my return indicated that they had a good time. The three men were H. A. Shabaker, J. R. McConnell, and T. A. Petry, three pals from the school of chemistry, class of '29. Shabaker and Petry are with the Vacuum Oil company at Woodbury, New York.


McConnell is here at Harvard with a Ph.D. as his objective.

"Aside from that I might say Paul Eaton passed through here last November on his return from Europe and Walter Huchthausen is expected to arrive here the first part of this week. Walter has been a year and a half across the Atlantic."

Earle's address is 48 Boylston St., Cambridge, Massachusetts.

## *Chemical Engineering*

'26—Rogers—Dr. Marvin C. Rogers attended the fifth annual convention of the professional Inter-fraternity Conference in Cincinnati on November 27 and 28. He was the delegate from Alpha Chi Sigma, professional chemistry fraternity.

'28—Benson—Mons Herman Benson was recently married to Ethel Louise Donohue. Mons has been working in the U. S. engineers office at Grand Rapids, Mich. They will be at home at 745 East University avenue, Ann Arbor, Mich.

Brewer—Dr. Ralph E. Brewer was recently married to Miss Marguerite Brown of St. Paul. After a trip east Dr. and Mrs. Brewer will be at home at 934 Clark street, St. Paul. Dr. Brewer is an assistant professor in the School of Chemistry. He is also a member of Alpha Chi Sigma, Gamma Alpha and Sigma Xi fraternities.

'29—Linden—Carlyle Linden is now associated with the Hercules Power company

as assistant dynamite supervisor at their Kenvil, New Jersey plant. He does not mention any special difficulties in his job.

## *Civil Engineering*

'14—Rockwell—Harvard S. Rockwell, who lectured before the Senior civil engineering class recently, is a member of the Rockwell Engineering company, sales engineers for reinforcing steel and allied products. They furnished the steel for the new Archer-Daniels-Midland elevator of 7,000,000 bushels capacity in South Minneapolis. Mr. Rockwell is married and has three daughters. His home address is 331 Longview Terrace, Minneapolis.

'25—Fulton—E. G. Fulton is Canadian manager of Pepppard and Fulton of Minneapolis and is in charge of construction work in Canada.

'27—Gehring—Lester G. Gehring is working with the U. S. Engineers stationed at Milwaukee. He writes that most of his work has been in Michigan. It consisted of the surveying of the Muskegon, Grand, and St. Joseph rivers. In his own words, "I am just a single man trying to get along." He saw Michigan defeat the Gophers last fall at Ann Arbor.

'28—Rydeen—James P. Rydeen as junior engineer with the U. S. Geological Survey is spending the winter in Mississippi making topographical maps for flood control on the lower Mississippi. The scale is 1:48000, and the contour interval is five feet. The past summer he was in the Pennsylvania gas fields making maps for oil and gas investigation. Jim is not married.

'28—Amidon—Roger Amidon is in Mississippi working with James Rydeen. The location is Clarksdale, Mississippi.

'28—Amidon—Roger Amidon visited his family and friends in the Twin Cities during the holidays. Roger is married and has a daughter two and one-half years old. He is engaged on Plane Table topography of the Mississippi River Valley and is catching airplane photos for base maps.

'30—Carlsberg—E. C. Carlsberg has for the past few months been working at the Experimental building on the campus. He is with the Minnesota Highway department, and during the summer was located at Redwood Falls.

'30—Johnson—Dropping into the office for a chat Wally Johnson told us of his experiences on his job down in Barbertown, Ohio, with the Columbia Chemical company. As research engineer he has been working a great deal on the company's new million dollar caustic soda plant.

According to recent rumors, Wally is just about ready to "settle down."

'30—Alderson—A. D. Alderson is in Marquette, Michigan, with the South Shore Dock Company. He is associated in the construction of a new ore dock for the Duluth, South Shore, and Atlantic Railway. Lee McNally, '28, is also on the same job, and Peter Berg, '23, is in charge of the construction.

'28—Mohr—Daniel F. Mohr writes that he has been with the Minnesota State Highway department for the past three years. From April to November 1, of last year he was at Elbow lake as draftsman on a paving job. Since November 1 he has been working at Alexandria on a series of swamp-fill jobs. He was in the Twin

Cities on a two week vacation during January and has now returned to Alexandria. While here he intimated he was not married.

'31—Anderson—Don Anderson is with the W. P. Roscoe company, contractors of Billings, Montana, and is employed on the construction of the Burlington railroad bridge at Bridger, Montana. He enjoys boxing and is keeping in practice.

## *Electrical Engineering*

'09—Walling—Ben B. Walling, Minneapolis realtor and a specialist in business and industrial property in the city for 18 years, has joined the organization of Thorpe Bros. as head of its business property department. Walling is a director of the Minneapolis Real Estate board and has served on several of its major committees.

'16—Simons—Walter W. Simons who is associated with the Electrical Research Products corporation as installation supervisor, writes: "Coming in on the advanced guard of the 'cold-snap' reminded me of the good old days when I used to plow through the snow to the old electrical engineering building. I note that the class of '16 doesn't have much to say for publicity, so that I will have to put in a word of appeal for more news from the crowd. In Chicago, 910 South Michigan avenue, the latch is open to anyone who wants to call."

Walt's home address is 7300 South Shore Drive, Chicago.

'03—Dibble—Barry Dibble, whose home is at 120 East Palm avenue, Redlands, California, has just made the interesting discovery that its twenty-nine years since he was a "slipstick tooter" on the campus.

It is now Barry Dibble and Son, consulting engineers. Mrs. Dibble was formerly Belle Butler, '03, University of Minnesota.

'19—Marshall—Donald E. Marshall is now living in Long Beach, California, where he is associated with Procter and Gamble as the superintendent of their new plant. Donald originally worked for Procter and Gamble in New York. He came to the California position via a job in Kansas City with the same company.

'24—Anderson—Fayette Anderson is the father of a daughter, Betty Lee, born in October. Fay who formerly lived at 510 W. 123rd street, New York city, is now located at Westfield, New Jersey.

'26—Lewis—Lloyd W. Lewis was married on December 28 to Miss Ruth Alvina Kaiser of Missoula, Montana. They will be at home at 1104 Yakima avenue, Tacoma, Washington.

'27—Barton—James P. Barton is at present associated with the General Motors Radio Corporation of Dayton, Ohio. He was formerly with the Westinghouse Electric Company.

'30—Bugenstien—A. A. Bugenstien is pursuing a course in the graduate college in electrical engineering. Art's address is 703 Emerson avenue north, Minneapolis.

'30—Elmstrom—R. E. Elmstrom is taking a course in the graduate department of the School of Business.

'30—Rudman—M. J. Rudman and Mr. and Mrs. M. E. Knudson spent the holidays in good old Minnesota. They drove from East Pittsburgh. Mirko Rudman is with the Westinghouse company in East Pittsburgh as is Manches Knudson.

## *Societies Offer Grads Fellowships, Scholarship*

The New York Chapter of the American Institute of Architects recently announced the Le Brun traveling scholarship while the National Research Council has announced several fellowships in physics, chemistry, and mathematics.

The Le Brun traveling scholarship provides for travel and study abroad for a period of not less than six months. The scholarship, which carries a $1,400 stipend, requires that the applicant be between the ages of 23 and 30 years, a resident and citizen of the United States, must have practiced architecture or served an architectural draftsman for three years, and must not have been a beneficiary of any other traveling scholarship.

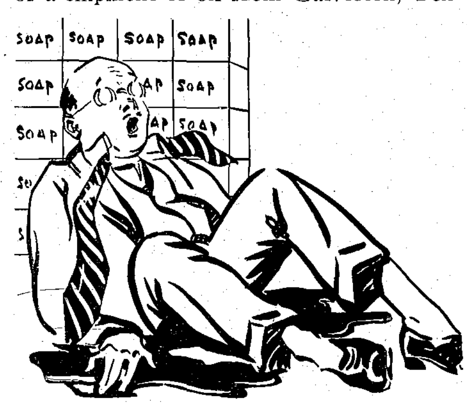
Each competitor must be nominated by a member of the American Institute of Architects. Further information regarding the scholarship may be had by applying to the Le Brun scholarship committee, room 530, 101 Park avenue, New York.

The fellowships offered by the National Research Council require a training equivalent to that of a doctor's degree and a high order of ability in research along the lines of physics, mathematics, and chemistry. They carry a remuneration of $1,440 yearly without dependents and $2,184 with dependents.

Further information is available from the secretary, Research Fellowship Board in Physics, Chemistry, and Mathematics, National Research Council, Washington, D. C.

## *Mechanical Engineering*

'31—Honey—Paul Honey is learning the soap business with the Procter and Gamble company in Texas. Recently Paul was cleanliness superintendent of the loading of a shipment of oil from Galveston, Tex-




as. Although the greatest care was taken for the oil, Paul was on the job for thirty-eight hours and very much in need of some soap. Working for a soap company did not seem to help the situation.

'23—Amidon—Lee L. Amidon writes: "I am still located here at West Virginia university as instructor in the department of steam and experimental engineering. Hard times have somewhat hit this state so that one forgets about the matter of salary increases. In these conditions, however, those with a job seem fortunate so why should we complain."

'26—Pierce—Walter H. Pierce is now director of the department of engineering, National Association of Laundry Machinery Manufacturers. Walt is located in Montreal, Canada. Mr. Pierce formerly was a resident of Joliet, Ill.

'27—Hutchinson—Edward T. Hutchinson writes: "Ralph Evans, '27, and John Boyce, '28, were both married recently, just twelve hours elapsing between the weddings. They are both with the Fairmont Railway Motors at Fairmont, Minnesota, on design and test work.

"Leroy Schulze, '27, is now living at 630 Library Place, Evanston, Ill. He is with the Electric Machinery company in their Chicago office."

'29 — Freeman — Frank S. Freeman writes: "I recently lost two roommates. Hakenjos married and Saxhaug is now with his mother in Washington. I am making the best of it, however, and am still working for Ingersoll Rand."

'31—Anderson—C. J. Anderson is at present associated with the Butler Brothers company at Cooley, Minnesota.

'31—Bailey—C. N. Bailey is producing the shekels at the Northern Pump company, Minneapolis, Minnesota.

'31—Bjorklund—E. E. Bjorklund is with the Cambridge Woolen Mills located at Cambridge, Minnesota.

'31—Brokke—H. E. Brokke is in the railroad business now. His present position is with the Northern Pacific railway at Brainerd, Minnesota.

'31—Clysdale—E. G. Clysdale is still on the campus. He is engaged in graduate work of the most imposing character.

'31—Edman—John Edman is associated with the K. C. Lee company of Aberdeen, South Dakota.

'31—Grant—Irving Grant is still staying at the Triangle fraternity house. He is with the Northern States Power company.

'31—Giese—Howard Giese is in Mitchell, South Dakota, on heating and ventilating work.

## *Alumni Service Offers Positions to Graduates*

Professor A. S. Levans, chairman of the Alumni service organization, announces that lists of Fellowships and Assistantships available at the various engineering schools of the United States are now posted on the official bulletin boards of the Main Engineering building and the School of Chemistry. These fellowships include study in all branches of engineering, chemistry, physics, mathematics and mechanics, architecture, and architectural engineering. The stipends with these fellowships vary from free tuition to allowances of up to $1500 per year.

A more comprehensive list of positions open in various colleges and universities to graduate students majoring in chemistry is published in the Journal of Chemical Education of February, 1932.

The Alumni Service Fund was organized three years ago to aid graduates in securing positions. The membership fee of $5 includes a one year subscription to the MINNESOTA TECHNO-LOG.

# THE MINNESOTA TECHNO-LOG

## UNIVERSITY OF MINNESOTA




## Valuable—Your Library

THE knowledge of today is the cumulative result of centuries of human progress. Scientific wonders of today and scientific achievements of other days are built upon the acomplishments of a seemingly obscure time. Hence, it is evident that the seat of real learning lies in the libraries—the home of the records of the accomplishments of the ages.

Our library contains many volumes which are used every day for research and general study. Every student deserves an opportunity to use the books of the library and should take the best care of them when they are in his custody. When books are mutilated a fellow student is deprived of a means of ready study and in addition the record of months and even years of work is destroyed.

Technical magazines register the pulse of the scientific world and record all developments and reactions in the minutest detail. Much practical and interesting study depends on magazines in a library and therefore it behooves every student to see that these magazines are given the same consideration as the books in the library. Make it a point to see that volumes from your library are neither destroyed or permanently loaned.

Engineers, it is to your advantage to see that the volumes in your library are taken care of in a manner which will provide you, with the most valuable, useful, and ready elucidations.

## Make Your Opportunity

WE wish to pass this idea on to you not entirely from altruistic motives, but because the idea has our enthusiastic approval.

Two Senior engineers have secured a job upon their graduation in June. These two men did not wait for opportunity to knock, but they made their own opportunity by demonstrating to one of our advertisers that they were wide awake and had more than interest that begins and ends in the class room. How did these men achieve the impossible if they did not have the necessary inside route at their command?

Many national and local firms use the Minnesota Techno-Log as an advertising medium, and these two men being wide-awake read the ads which prompted them to write for booklets and descriptive material. They followed up their first contacts with requests for additional information on the interesting subject no matter whether it was "Thyrite," "why clothes help a man," or "optical instruments." Thus, they brought their well-founded interest to the attention of the companies, and as a result they both have jobs.

Neither one of these two Seniors have achieved outstanding scholastic success nor are they campus leaders, but they were wide awake and that, Engineers, coupled with a bit of intestinal fortitude gave these men their chance. Large corporations and smaller organizations are looking for men that are awake to the needs and the developments of the times.

Remember, your mind may be well trained in technical considerations, but its intrinsic value is destroyed if it is dead to life and life's values. This situation demands an examination and deserves your attenton.

## Persistence In Success

ONE of the fundamental and necessarily an almost inherent quality of every engineer should be persistence. The desire to complete a job started, in spite of all obstacles should be in the heart of every engineer. The student who has this quality is almost surely a success in his studies and the engineer who is striving against the vicissitudes of life will reach his goal if he has that dogged persistence that conquers all obstacles.

Every year many students try for positions on the staff of the Techno-Log. It is not known whether they are really interested in the journalistic work or whether they desire to be in the "lime-light," but it is a fact that many quit for no other reason than ordinary laziness. These fellows lack that quality they should cultivate while in school. Explanations are offered by the would-be writer for not turning in his few assignments, but these are more often than not a superficial method of saving his "face." The Techno-Log needs men who are persistent in their work; men who desire to gain as much from college as possible; men who appreciate the value of experience in technical writing.

The finest chance for building character exists while in school. Therefore, every student-engineer should delve into his thoughts concerning every project that he undertakes. If his introspection reveals that he is quitting because of the difficulties involved, he should remember that persistence is a good part of success in life and that no man is a real engineer until he is persistent in his work and endeavors.

# « « « SLIP STIX » » »

## growl and grunt

Suggestion for the next Razz Banquet—A little Razzlin match.

## these practical jokers

To the "cellar gang" came the other day a mysterious card from Des Moines. One side had a picture of a rare mess of fish on display in a hotel lobby. On the reverse side were inscribed the words, "Almost as good a collection as you have in the office."

## embarrassing moments

Two young collegians, after spending the evening out, thought they should imbibe a wee bit of sustenance. After partaking of a very early morning repast in a downtown cafe, both discovered they had no more money than a jackrabbit has pants. Mental pictures of a jouncing ride in the "hurry up wagon" soon formed. Spying a small beetle in one corner of the room, they captured it and established its presence in a lettuce leaf on a salad plate. Stepping up to the gentleman at the till, they indignantly refused to pay for food that was *full* of bugs and worms, all the time pointing to the undeniable evidence a few tables away.

They were soon home, thankful that Noah did not forget to preserve specimens of a coleopterous insect with four wings.

## society

Guests at the Inter-Pro ball numbered various notables, various not-so-notables. 'Mongst those on the official (?) list in the world's largest daily was, to wit, no less than one Lizzie Stupnagle.

Regards to the Colonel, Liz.

## how about another donkey?

Yea, verily, the elite of this great institution of learning have trod mightily in stately lines at the M. B., J. B., and S. P. History has been made, and but one thing remains to settle a final matter, weighty as the rest. Who, brethren, will lead the Common Peepul's Ball?

## it would make a hit

Lieutenant Erickson strode into the classroom as a moving picture machine was being removed. Gazing at it thoughtfully he remarked to his class, "Sorry I haven't any moving pictures to show you fellows. Maybe I could do a little tap dancing or whistling though."

Probably.

## aw nerts

To Slipstix has come the following bit of consoling advice: Try writing your next page with the ribbon extracted from the typewriter. I've seen worse columns, but I can't remember where.

Thank you, kind sir. I'd like to write your obituary, and right away wouldn't be too soon.

## seen in a scientific laboratory

Four strapping gentlemen boiling a beaker of water.

## had it coming

Your bad but faithful servant, namely, your bad but faithful servant, on oversleeping one morning, conceived the brilliant idea of being excused on account of a bad cold. After I skipped gaily into the doctor's office, the M.D. grabbed my head viciously and squeezed till the ears could easily have been buttoned behind. "Do you feel anything?" he hissed. Thinking he wanted to see how tough I was, I faintly gasped, "No." "Aha," he chortled, and grabbed my face between his fists, all the time pressing till I could have joyfully kicked him in the shins—and would have too, but he was standing on my feet. Then he thumped me roundly on the cheek bones with his fist and pushed in my eyes. "Does this make your head ache?" he inquired in the pleasantest of snarls. By that time there was no telling if I ached any more anyway, so I lithped, "No." "Then there's nothing wrong with you," he said, shoving me out the door.

And I was halfway to the P. O. before remembering I hadn't got any excuse.

## putting it across

*Dr. Montonna:* And a theory like that wouldn't be worth two hurrahs in hell.

*Dr. Straub:* Now in this vessel we have—.

## 'twas gala, no less

Future campus high lights, dim bulbs, etc., came from city high schools one snowy afternoon to view "Julius Caesar." And a right snappy looking bunch of purty gals, too. Stick around, boys, stick around.

## in the mail box

A committee of one sends in the following: Did you know that the flooring on the new balcony in the Experimental Engineering building is equal to any dance floor in the Twin Cities? Great care has been taken to alternate light and dark maple in the flooring so as to obtain a very artistic effect. Now why on earth do Engineers need a dance floor?

Mebbe they don't. Anyway, some could do just as well in a rock quarry. Tsk, tsk.

## figure it out

Seen on the menu of a campus eat shoppe along with faces and other parts of pretty girls' anatomy: "That which is not that which is not that which is not is not that which is."

Yes. Oooooie, esk me, em I dizzy?

## what price larceny

Last month two hundred TECHNO-LOG were filched in the post-office. Only one reason could possibly have precipitated such action. Everybody wanted a copy of Slipstix. But lo and behold, TECHNO-LOG head man, high mucky muck (g-!!?**—:&c%?? d— him!!) had ditched magazine's finest page.

▼

Whoops! My tyPewriter's gOing bAd.

(Thank gawd—*Editor.*)

# NEWS FROM THE TECHNICAL CAMPUS

## *City Buys Piping Recommended by Bass*

The Minneapolis city council, in accordance with the recommendations of Professor Frederick Bass, head of the department of civil engineering, has approved the purchase of 30,000 feet of 42, 36, 30, and 20 inch diameter piping to be used in a crosstown city water main. The 42 and 36 inch pipes will be riveted steel with lock-bar joints. Those of other diameters will be ordinary cast iron piping.

The installation of this water main will mark the first step in the water works reconstruction program made necessary by lack of adequate fire protection in many parts of Minneapolis during seasons of drought. The next step will be to build a 1,000,000 gallon reservoir in the neighborhood of France avenue and 42nd street, and install a pumping station capable of delivering 75,000,000 gallons of water per day to the city water system.

## *Architects' Society Hears Talk by Richardson*

Projecting and discussing some snapshots made on a recent trip through Italy, Harlow C. Richardson spoke at a recent meeting of the Architects' Society in the engineering auditorium, on the subject "Impressions of European Architecture." The talk, given during convocation hour on January 28, was an informal travelogue rather than a lecture on architecture, and covered his trip last summer through Como, Florence, Milano, and Pisa.

Mr. Richardson showed a number of pictures of the important buildings in the places he visited. He told of his experiences and impressions at each of the places and discussed the history and details of construction of the various buildings.

Mr. Richardson told of the wonderful view of the valley of Arno which he obtained from the dome of the Duomo Cathedral in Florence. This cathedral has a double dome, one inside the other, and the ascent is made by going half way around inside the inner dome and then climbing a stairway between the domes. The tour from one side of the dome around to the other must be made along a narrow gang-way high above the street level. This gang-way is protected only by a small hand-rail. Richardson told of his fear of high places inside and of escaping it here in the Duomo by keeping his eyes firmly fixed on the wall, all the way around.

Another place he mentioned was the Monastery at Milano which has a glass dome and a glass arcade covering a whole street for a block. The Giotto bell tower at Florence and the leaning tower of Pisa were other places of interest visited by Mr. Richardson.

## *Eta Kappa Nu Offers Scholarship Prize*

Omicron chapter of Eta Kappa Nu, honorary electrical engineering fraternity, is sponsoring a new scholastic award. The prize, which is a suitably engraved Electrical Engineering Handbook, will be awarded each year at the Tri-Honorary banquet held in the spring. It is offered to the sophomore registered in electrical engineering who has maintained the highest scholastic standing during his first five quarters at the university. If this student received the Tau Beta Pi prize at the end of his freshman year, this prize will go to the next in the class.

## *Chemistry Students Work for University*

At the present time sixteen undergraduate students in the School of Chemistry hold positions in the various departments which enable them to partially defray the expenses of their education. Most of these positions are held by seniors. Only those students who have maintained a good scholastic average and are in need of financial aid are granted undergraduate assistantships.

Many of the reagents and solutions used in the laboratory courses are prepared by students. Quizzes and examinations in the inorganic courses are graded by another group. Still others are engaged in clerical work. A few act as assistants to professors engaged in research work.

Besides the actual financial aid which these students receive from these part time positions they obtain experience which will prove valuable in later years.

## *A. I. E. E. Hears Talk on Electricity as Medicine*

Dr. Paul Luckenbach entertained members of the A. I. E. E. January 21, with an illustrated lecture on electricity as applied to medical engineering by transforming electrical energy into radiant energy in the form of X-rays and the healthful ultra-violet rays. He used slides to show by comparison the effect of these rays upon animals. The comparison of animals subjected to radiant energy and those deficient in these health-giving rays was shown.

Fred Suhr, formerly with the General Electric company and now taking graduate work, talked on the problems confronting students after graduation and described the student course of the General Electric company. In conclusion, Cledo Brunetti gave a membership pep talk and Harold Sanderson discussed the future programs.

## *University Press to Offer Unusual Radio Programs*

Attend a party and educate yourself is the twentieth-century way to disseminate knowledge according to the University of Minnesota Press. A series of intellectual "after dinner" parties over WLB, the university's broadcasting station, have been scheduled for every Tuesday evening at 8 o'clock during March by the University Press as a means of giving the elucidation of important topics the "essence of modernity."

Four characters—a hostess, a college professor, and two other guests—will engage in informal discussions of a number of current topics.

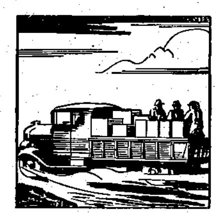
The dates and the subjects planned are as follows: March 1, Can a Third Party Survive in American Politics?; March 8, The Prairie Pioneers—Heroes or Ne'er-Do-Wells; March 15, Should College Students Earn Their Expenses?; March 22, Are the Classics Dead?; and March 29, How Can Minnesota Birds Be Saved?

The four characters will be played by students from the department of speech and trained and directed by the head of the department, Professor Frank M. Rarig, and A. Dale Riley, campus dramatic director. The programs will be based on material contained in books published by the University Press.

# Engineering skill.. on trial at the old courthouse

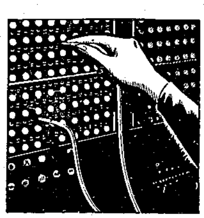
*While the ashes were still smouldering, Western Electric was already in action.*

That afternoon fire had raged, wiping out much of the business section, reducing the telephone building to smoking ruins. That night, Western Electric men were at work converting an old courthouse into a telephone exchange. The next day both local and long distance communication was restored in the stricken town...



*Men and materials were rushed to the scene from miles around.*

¶ Western Electric accepts many such challenges as this. Challenges that put to the test the engineering skill of its Installation Department, that call into play the resources and facilities of its nationwide system of distribution. ¶ Backing up a far-flung line of communication is only one phase of Western Electric's responsibility to the Bell System. Equally important is the purchasing of supplies and materials and the manufacture of telephones and telephone equipment.



*Day after fire, local and toll service was restored.*

# *Western Electric*

Manufacturers . . . Purchasers . . . Distributors

SINCE 1882 FOR  THE BELL SYSTEM

## Architects Dance at Beaux Arts Ball

On February 5 the architects danced at their seventeenth annual Beaux Arts Ball which was sponsored by the Architectural Society. An exhibition of student architectural designs on the third floor of the Main Engineering and an exhibition of faculty and student freehand work and sculpture in the North Studio opened the day. In the afternoon tea was served to guests and alumni in the Architectural Library. The evening brought the Architect's Jubilee, "Fete Moderne."

The traditions of the Jubilee date back to 1915 when architects waltzed in what was called then, a "costume ball." After the war the present name of Architect's Jubilee was adopted. An Egyptian theme marked the Jubilee of 1920, when freshmen played "Izzy Ded?" or "If Not Why Not?" a play with the scene laid in the court chamber of the Temple of Karnak on the afternoon of the Ides of March. The next year a Roman theme was adopted as the motif of the ball and was called a "costume ball hic jassarium bandus." In 1922 when knighthood was in flower, a medieval theme was used. Two years later the motif was an imitation of the Parisian "Bal des Quartz Arts."

South sea island scenery and a Congo art theme were employed to typify "A Night in Cannibal-Land," seven years ago. In 1926 characters from fairy stories danced at the ball "Arkitex in Fableland." The next year a "Trip to the Moon" was reached by having dances in the program miles up in the log book. The trip started three miles in the air, the intermission was 238,573 miles up, but the dance ended with the guests returning to earth.

In 1932 the "Fete Moderne" did well in adding to the interesting history of this traditional ball. The main theme of the decorations pictured a revolution in the interplanetary relations. Mural designs picturing zeppelins cruising in and out among skyscrapers and planets lined the walls of the auditorium. Skyscrapers of immense scale were intermingled with large floral designs, and winding bridges.

The entertainment consisted of the traditional freshman playlet which originated on the night of the first jubilee and also a group of impersonations of several faculty members and students by Hillis Arnold. The playlet was entitled "Wind in Her Window" or "The Fuss of Mrs. Fussbody," a fussy and designing client. Duane Dickey as Mrs. Fussbody had as his rival Roger Lehmann, Polychrome Runnawash, whose falsetto voice amused the audience.

Rivalling any Junior or Senior Ball lineup was the grand march. The humorous and unusual attire of the couples as two by two they circled the room was certainly unique. It was difficult for the members of the faculty to choose the prize winning costumes from the array of Buck Rogers and their partners. Modern evening dress fifty years hence, modern summer dress, and all types of futuristic costumes were represented. The two prizes, an etching by Chatwood Burton and a linoleum cut by Elmer Young, were presented to Frank Skillman and his partner. The prize-winning costumes were respectively representations of the Empire and Chrysler buildings. Ingenuity and design were characteristic of these two original costumes.

**The architects of 1982 as they danced in 1932. Take particular notice of the scenery that will be before you in Buck Rogers' time.**

## Practical Mathematics Available to Engineers

There is one course being given in the engineering school this quarter which is not following staid old lines. The course is practical mathematics and the reason it is not following staid old lines is that there aren't any. The course is taught by Mr. Sadowsky and its purpose is to improve the engineer's knowledge of the practical applications of mathematics.

Some unique experiments are being planned for the laboratory work. Since no definite plans have been made for the course, the class is free to experiment on any fitting subject. They are now collecting equipment to be used in finding the length of time it takes a camera shutter to close. The actual determination of the time will be made by measuring the length of a light streak on a piece of camera film. This will necessitate the use of many accessories which will be difficult to obtain since the laboratory for the course is not subsidized by university appropriations.

## Instructor and Student Rebuild Radio Station

Radio station W9YC, short wave transmitter located in the electrical engineering building, has been completely rebuilt by Carl Swanson, mathematics instructor and Lyman Swendson, a graduate student, and is again working on a regular schedule each night. Captain Rex Minckler is the faculty advisor for the station.

The new set is crystal controlled operating on a wavelength of 160 meters. A vacuum tube, used as a master oscillator for the crystal, works into two intermediate 50 watt amplifying stages. These two amplifying stages may also be used as frequency doublers to enable the station to operate on 80, 40, or 20 meters. The output stage of the transmitter uses a 204-A tube which delivers 250 watts to the antenna system.

Fifteen students now have regular watches at the station and keep it in communication with other amateur stations throughout the nation. Regular communicating schedules are being made with other stations as rapidly as possible.

Messages are relayed without charge to any part of the country and to many foreign countries by the station. Messages may be left in the electrical engineering office or given to any of the station operators.

# The Modern Neon Sign

*(Continued from page 109)*

When the gas pressure in the tube has been sufficiently lowered and a high degree of purity within the tube obtained, the valve to the pumping apparatus is closed and a valve to the desired gas reservoir opened to admit the final charge of gas into the tubing. The tube is then sealed off and is ready for the testing bench. Here normal operating voltage is applied to the tube until the gas assumes a uniform color throughout the tube.

The extraction of the inert gases from the air for use in discharge tubes requires a highly developed technique for the gases must be absolutely pure before they can be used to obtain glow discharges. These gases are obtained as by-products of the refrigerating process in which nitrogen and oxygen are separated from the air. Compression, followed by expansion, lowers the air temperature causing liquidation. Since the different components of air have different boiling points, fractional distillation may be used to separate the various components. The gas having the lowest boiling point is separated first and the temperature then carefully raised to the boiling point of each of the remaining components until vaporization takes place and the individual gases can be collected. Final purification is obtained by passing the gases separately over chemicals which absorb the impurities.

The fundamental principles underlying the phenomena of neon light form a fascinating branch of theoretical physics. Although many noted physicists have been studying for half a century the theories of electrical discharge in gases, it is still unwise to dogmatically assert that such and such an action takes place in a luminous tube. Enough information is at hand, however, to give a basis for a very reasonable theoretical explanation of the mysterious phenomena of luminescent tubing.

### Electricity Carried by Ionized Gas

Neon gas consists of atoms which exist by themselves. Each atom contains, at its center, a small massive body called the nucleus, which carries a minute positive electrical charge. Outside the nucleus are various groupings of electrons carrying negative charges. Each atom normally has an equal number of positive and negative charges, but there are always a few ionized atoms which have lost an electron. When a high potential is applied to the electrodes of the tube, the positive ions are attracted to the cathode or negative terminal of the tube and the negatively charged particles or electrons are attracted to the anode. The electrons are very light and therefore move through the tube at a high velocity. When a moving electron collides with an atom, it often ionizes the atom by forcing an electron from its atomic orbit. A progressive ionization of gas molecules then takes place as the electrons move to the anode. When the heavy positive ions strike upon the cathode and lose their charges, electrons are liberated from the electrode material to move through the tube to the anode. Thus there is established a flow of charged particles which accounts for the conduction of electricity through the gas filled tubes.

Inside the tube is a continual tendency for the free electrons to combine again with the positive ions. It is this recombination of ions which gives off the characteristic glow of light in discharge tubes.

The high potential gradient present near the negative electrode of a cold cathode tube greatly accelerates the positive ions so that their momentum, as they reach the cathode, is very much greater than that of the lighter electrons reaching the anode. When metallic electrode particles are knocked off the electrodes by the impact of ions, enough heat is generated to open the pores of the metal in the particles and allow gas to enter. As these metallic particles deposit themselves on the tube walls, their closing pores lock in some of the gas of the tube. In this manner, as electrode sputtering continues, more and more of the gas in the tube is taken out of circulation or occluded, and the gas pressure in the tube is lowered. This lower pressure speeds up the action of the ions through the gas and causes them to hit the electrodes harder increasing the amount of sputtering. If this process continues long, the tube will get exceedingly hot at the electrode and may crack.

### Tube Failure Due to Pressure Loss

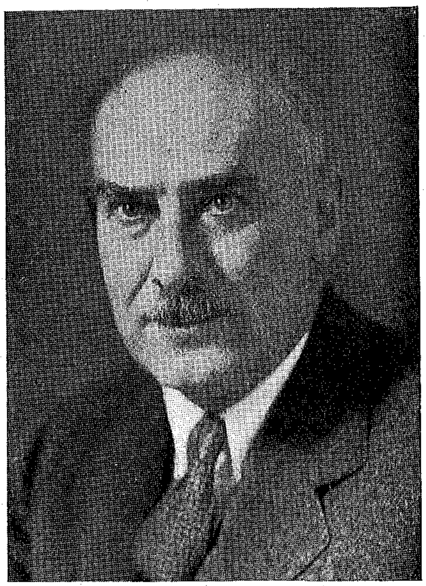
The most common cause of failure in a tube is due, however, to the decrease in gas pressure. With a lowering of pressure the cathode voltage drop becomes greater and a higher voltage is needed to operate the tube. Finally the voltage required becomes higher than that supplied by the transformer. At this point the light begins to flicker, finally going out.

Since alternating current is used with

*(Continued on page 120)*

# FACULTY SKETCHES

HEADS of departments are sometimes rather terrifying beings, but Dr. Charles A. Mann, chief of the chemical engineering department of the University of Minnesota, is a highly educated man, human and well liked by everyone who knows him. Besides being a chemical engineer, he is a musician of note. He is interesting to meet and is himself interested in many things.



**Professor Charles A. Mann**

Born in Milwaukee, Wisconsin on June 5th, 1886, he attended the public schools there, being graduated from the West division high school in 1905. He then attended the University of Wisconsin receiving a B. S. degree in chemical engineering in 1909, an M. S. in 1911, and a Ph. D. in 1915. He taught seven years at the University of Wisconsin in chemistry and chemical engineering, three years as a professor at Ames organizing a chemical engineering course and laboratories, and has been here at the University of Minnesota thirteen years—eleven as head of the chemical engineering department.

Dr. Mann's interests are: chemical engineering, his profession; and education, his work. His hobbies are golf, music, and billiards.

He was a professional musician when fourteen, playing cello, violin, and trombone; and was active in several high school and amateur orchestras. He played in the Milwaukee municipal band, a theatre orchestra, and was associated with a symphony orchestra for three years before entering the University. At the University he played in theatre orchestras and gave music lessons to pay his way. During his senior year at the University of Wisconsin and for seven years afterwards he was conductor of the University band. Under his direction this organization grew from a thirty-piece band to two bands of sixty pieces each. In 1915, they took a trip to the Panama and San Diego expositions, playing at many places throughout the West and covering more than ten thousand miles on the trip. He was conductor of the University of Wisconsin symphony orchestra for five years and of the First regiment band of Wisconsin state militia for seven years. At Minnesota his music had to give way to his profession of chemical engineering although he was for some time a member of the symphony orchestra here. He is still interested in music, and is a member of several campus musical organizations.

It is in chemical engineering, however, that Dr. Mann's real genius shows. He was an assistant and instructor in the department at the University of Wisconsin for seven years and, after receiving his Ph. D., he went to Ames as an associate professor. At Ames he organized the complete chemical

(*Continued on page 124*)

## The Modern Neon Sign

(*Continued from page 118*)

high voltage tubes, neither electrode can be called cathode or anode. Both electrodes therefore show the same effect of disintegration.

Manufacturers of neon tubes have adopted a process of coating the electrodes with alkali metals such as caesium or potassium. By this means they have greatly reduced disintegration of the electrodes, and have made their tubes last about four times as long as those using plain copper or iron electrodes.

Although the most efficient operation is obtained at a gas pressure of one to three millimeters, tubes originally filled at this pressure would not last long as there is then little margin between the initial pressure and the pressure at which the tube fails. In actual practice gas pressures of 8 to 25 millimeters of mercury are used. The average life of a well constructed tube varies from 3,000 to 20,000 hours. Many specially constructed tubes have given over 40,000 hours of uninterrupted service before flickering.

As much as 65 feet of tubing can be used with a single 15,000 volt, 25 milliampere transformer. Shorter lengths must be used for blue light because of the higher resistance of krypton and mercury vapors.

The transformers generally used are of the magnetic shunt type having a high leakage reactance. The magnetic shunt is necessary because a gas column, having practically zero resistance when luminous, acts as a dead short on an ordinary transformer.

The transformers are assembled in compact units mounted within the framework of the sign to eliminate any high voltage leads outside the sign itself. Large power transformers are used only for large diameter tubes where a larger current is required at the same high voltage.

Although the neon tube has practically unity power factor, the magnetic shunt type transformer brings the power factor of the unit down to 35 or 40 per cent. Condensers are often connected across the primary of the transformer to raise the power factor, but, after around eighty per cent has been reached, further increase becomes impractical because of the increasing costs of condensers.

#### Unity Power Factor Obtainable

Recent research workers at Iowa State college have developed a method of obtaining unity power factor with no added cost for equipment. An ordinary constant current transformer is used instead of the magnetic shunt type. In one power supply line are placed two series inductive reactances with a capacitative reactance between the junction of the two and the second supply line. The values necessary for the different reactances may be determined for each tube by means of Steinmetz's equations for non-sinusoidal waves.

Any desired color may be obtained in a glow tube by using different gases and combinations of gases and vapors. Various shades of green are produced by mercury vapor in an amber or uranium glass while yellow or gold is produced by helium in a yellow glass tube. In a clear tube helium has a dull white color, a brilliant white resulting when mixed with certain other gases in a clear tube. The well known orange-red color is obtained by placing neon gas in a clear tube.

Blue is best obtained by using mercury with krypton in a clear glass tube. When a voltage is applied to a tube of this type, conduction first takes place through the krypton. The current passing through the gas raises the temperature high enough to vaporize the mercury. Conduction then takes place through the mercury vapor for, with a mixture of two gases, the gas having the greater atomic weight carries most of the current and therefore produces most of the color.

In the early days neon was used with mercury to obtain blue. It was found, however, that when the temperature fell to 25 or 30 degrees below zero the mercury would not vaporize and the tube would glow red instead of blue. The use of krypton has entirely eliminated this source of trouble.

#### Hot Cathode Reduces Voltage Drop

The costly insulation and the danger accompanying high voltage tubes has caused the development of a discharge tube operating directly on voltages available in the home. This is the hot cathode tube using a thoriated tungsten filament heated by current obtained from a stepdown transformer. The cathode drop is reduced to a few volts and cathodic disintegration is practically eliminated. The glow is due to an arc discharge having a negative resistance characteristic very similar to that of a carbon arc so a series resistance must be used for stability. At the present time, the hot cathode tube has little advantage over the common high voltage tube now used for advertising purposes as the same amount of auxiliary equipment is necessary with both types.

Research is now being conducted with a view towards eliminating the series resistance and simplifying the auxiliary equipment of the hot cathode tubes. Very high intensities of illumination have been obtained from the hot cathode tubes.

The deep red light of neon has a greater visibility and more far reaching penetration than any other known light

(*Continued on page 123*)

# « « MENTAL TILTS » »

## WINE, IF YOU FIND IT

One tumbler is half full of wine and another tumbler is half full of water. A teaspoonful of wine is taken from the first tumbler and put into the other one. After stirring, a teaspoonful of the mixture is taken from the second tumbler and put into the first. Is the quantity of wine removed from the first tumbler greater or less than the quantity of water removed from the second tumbler?

## BUG-VELOCITY

A chain of mass m and length 2L hangs in equilibrium over a smooth pulley when an insect of mass M alights gently at one end and begins crawling up with uniform velocity V relative to the chain. Find the velocity with which the chain leaves the pulley.

▼

### Answers to Last Month's Tilts

TWO MARBLE SHOOTERS. When Sammy and Tommy started their grim duel at marbles they were provided with 100 each.

SIMPLE EQUATION. The only solution available for the equation involved a graphical approximation. X=39.4.

## Hydroelectric Industry

*(Continued from page 107)*

plants in the United States), it is indicated that an actual saving for the year 1929 of 18,000,000 tons of coal was made.

These figures clearly demonstrate the extent to which natural resources may be conserved by a country slightly deficient in one type of resource by the development and utilization of a type of natural resource, such as water supply, that does not tend to deplete itself. The Canadian government and engineers in particular are to be congratulated on their farsighted approach to this problem of power and the truly scientific method in which they have planned their attack.

In order to more clearly represent the relation between available and developed water power in Canada Table 1 has been prepared.

The figures of available water power listed in Table 1 are based upon rapids, falls, and power sites of which the actual existent drop or head possible of concentration is well authenticated and in most cases definitely established. Many rapids and falls of greater or lesser power capacity are scattered on rivers and streams of the Dominion which have not as yet been recorded. This is particularly true in the relatively unexplored northern districts such as the Flin Flon and all the land adjacent to Hudson's Bay. In brief, then, the figures represent the minimum water power possibilities of the Dominion and are based on definite rapids, falls and power sites.

#### Two Bases Used in Estimations

The power estimates have been calculated on the basis of 24 hour power at 80 per cent efficiency for conditions of "ordinary minimum flow" and "ordinary six months flow." The former is based on the averages of the flows for the two lowest periods of seven consecutive days in each year over the period for which records are available. The latter is based upon the continuous power indicated by the flow of the stream for six months in the year.

In actual practice, the flow has been determined by arranging the months of each year according to the day of the lowest flow in each, the lowest of the six months then being taken as the basic month.

It has been the opinion of many investigators that estimates of power on the basis of ordinary six month flow are of exceptional practical value. They are based on the assumption that it is good commercial practice to develop wheel installation up to an amount the continued operation of which can be assured during six months of the year with the deficiency in power during the remainder of the year provided by storage or other expedients. But in the final analysis, the correctness of this assumption for any particular site can only be definitely settled by a careful consideration of all the circumstances and conditions pertinent to the particular development. The method, however, enables a fairly satisfactory overall estimate of the maximum hydraulic power available.

Now the figures listed in columns 1 and 2 of the table represent 24-hour power and are based upon rapids, falls and power sites, of which the actual existent drop or head possible of concentration are definitely known or at least fairly well established.

The figures in column 3 represent the actual water wheels installed throughout the Dominion, but it is not possible to deduct from them and columns 1 and 2 the percentage of available water power resources that has been developed to date. This is caused by the fact that the actual water wheel installation throughout the Dominion averages 30 per cent greater than the corresponding maximum available power figures calculated as in column 2. The figures quoted above, therefore, indicate that the "at present" recorded water power resources of the Dominion will permit of a turbine installation of about 43,000,000 h.p. And it is upon this basis that the present turbine installation represents only a little more than 13 per cent of the present recorded water power resources. In other words, the data used in the table 1 may be said to represent the minimum water power possibilities of the Dominion.

To conclude we quote the following paragraph; "A potentiality for incalculable blessings—or for wide spread destruction! With water the engineer fills reservoirs and canals, turns huge turbines, irrigates deserts, sustains vast industries, and floats the shipping of the world. Against it he raises levees, dams chasms, builds artful sanitary devices, and erects massive walls. Uncontrolled it is the foe—controlled it is the friend of progress—an implacable enemy to those who do not understand it, but an untiring servant of those who take pains to learn its ways."

## The Modern Neon Sign

(*Continued from page 120*)

source. It has been used successfully throughout the world for air beacons and signal lights. Even when clouds or fog encircle the beacon, aviators can always see a pink glow just above the light source.

Luminous tubing does not readily adapt itself to moving designs because of the increase in the number of electrodes and consequent higher cathode voltage drop with shorter tube segments together with the difficulties encountered in designing high voltage flashing switches. A very ingenious method of obtaining action in neon signs has been developed recently in this country. The apparatus is connected between the secondary of the transformer and the different tubes and operates on the principle that an electric arc, when formed between properly arranged vertical electrodes, will move upward at a definite speed. This speed may be regulated by adjustment of the gas path of the moving high voltage arc. This upward movement of the arc, recurring at regular intervals, is used to switch the current to various sections of neon tubing.

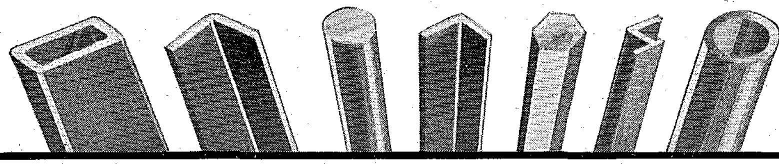
# FACULTY SKETCHES

(*Continued from page 119*)

engineering course and directed the installation of the laboratories. Leaving there in 1919, he came to the University of Minnesota where, after two years, he was promoted to head of the chemical engineering department. Under his direction the course has grown to be one of the finest in the country and has now 315 undergraduate students and 22 graduate students.

Dr. Mann and his students have carried out over one hundred important researches, some of which are: utilization of agricultural waste by producing gas, hydrocarbons, tar, and charcoal from such materials as straw and corn cobs; electroplating from nonaqueous solutions, to make possible electroplating of such metals as tungsten, aluminum, and beryllium; improvement of lignite as a fuel, making lignite as good and as economical a fuel as bituminous coal.

Dr. Mann is listed in "Who's Who in America," "Who's Who in Engineering," and "American Men of Science." He is a member of the following organizations: Campus Club, Minneapolis Kiwanis, Scottish Rite Masons, American Institute of Chemical Engineers (faculty advisor, Minnesota branch), American Chemical Society, American Electro-Chemical Society, Society for Promotion of Engineering Education, American Association for the Advancement of Science, Wisconsin Academy of Science, Crotchets and Quavers (a campus music club); and the following fraternities: Sigma Xi, Tau Beta Pi, Phi Lambda Upsilon, Alpha Chi Sigma, and Scabbard and Blade.



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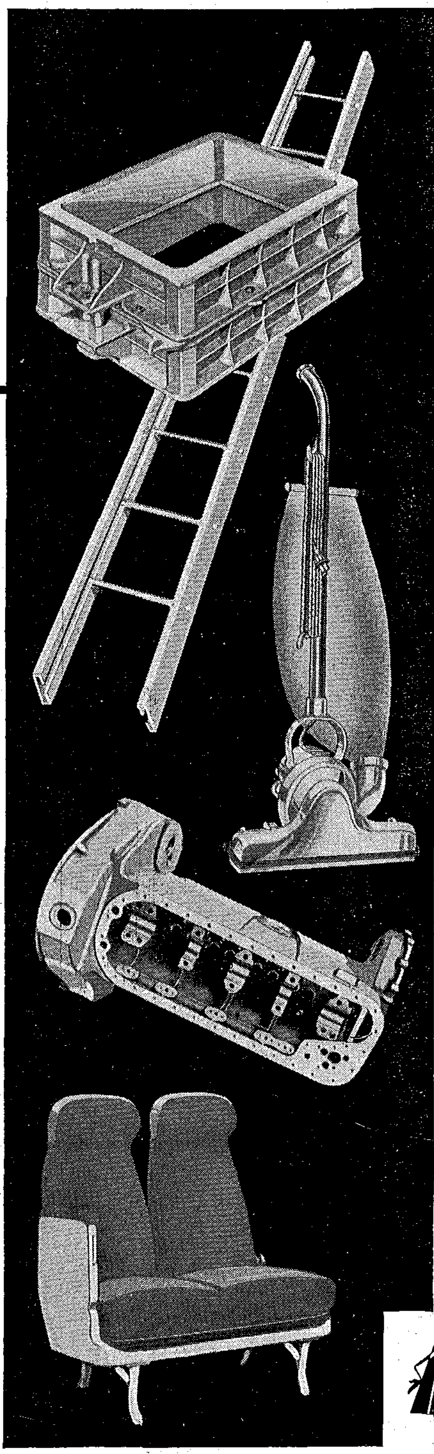

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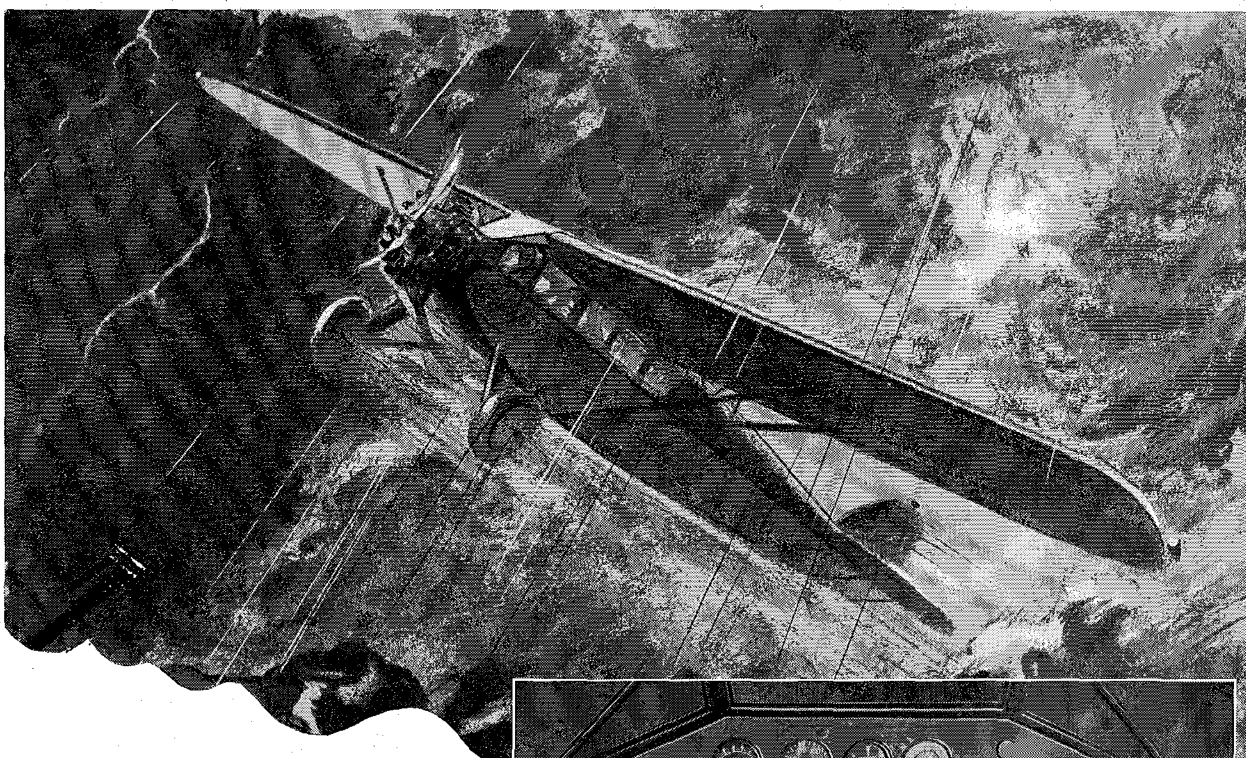

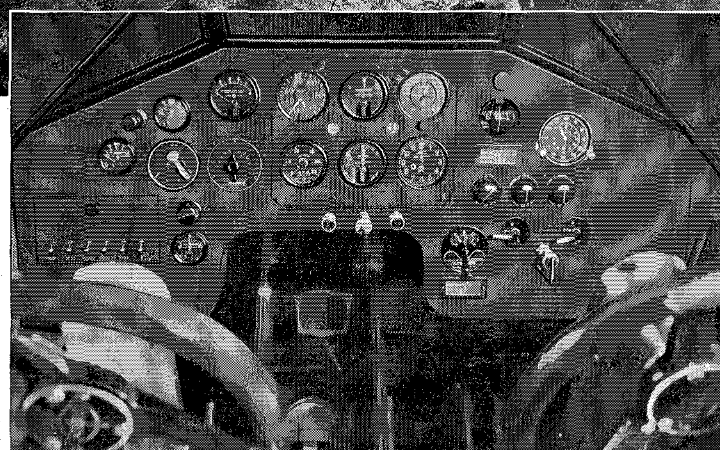

# "EYES" THAT GUIDE AIRCRAFT

SPEED with safety and dependability is the essence of airplane service. To-day's ship is safer in fog and darkness. Its "eyes" are in its instruments, and the equipment of a new monoplane recently purchased by General Electric is unique in that the instrument panel is almost completely electrified.

The ship is equipped with many electric devices: automatic steering, radio apparatus for communication and contact with directional radio range beacons, and a sonic altimeter to give accurate indication of height above the ground, regardless of visibility. The 300-horsepower engine is equipped with a G-E supercharger.

Other General Electric apparatus on the ship includes an electric engine-temperature indicator and a selector switch, a magneto compass, a card compass, a drift indicator, a turn indicator, a tachometer, an oil-temperature indicator, an oil-pressure indicator, a voltammeter, control pulleys, landing lights, and an oil immersion heater.

These developments in air transportation were largely the accomplishments of college-trained engineers who received preliminary experience in the Company's Testing Department. Hundreds of college graduates join the ranks through this department, which trains them for electrical leadership on land, on sea, and in the air.

95-925DH

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

# THE MINNESOTA TECHNO-LOG

Vol. XII MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED No. 6

MARCH, 1932

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FARMS AND ENGINEERS—*H. H. Shepard points out a new need for technical men in the insect control field.*

NORTHWESTERN ENGINEERS *should know the requirements for successful grain handling. Howard Helgerson tells us about the world's largest storage bins.*

WHY APPRENTICES? *Knox Powell, graduate, relates some of his acquaintances and experiences in one of these training courses.*

A CARVING IN SOAP *by Richard McCarthy, architect, is the result of days, yea nights, of work—fast and furious.*

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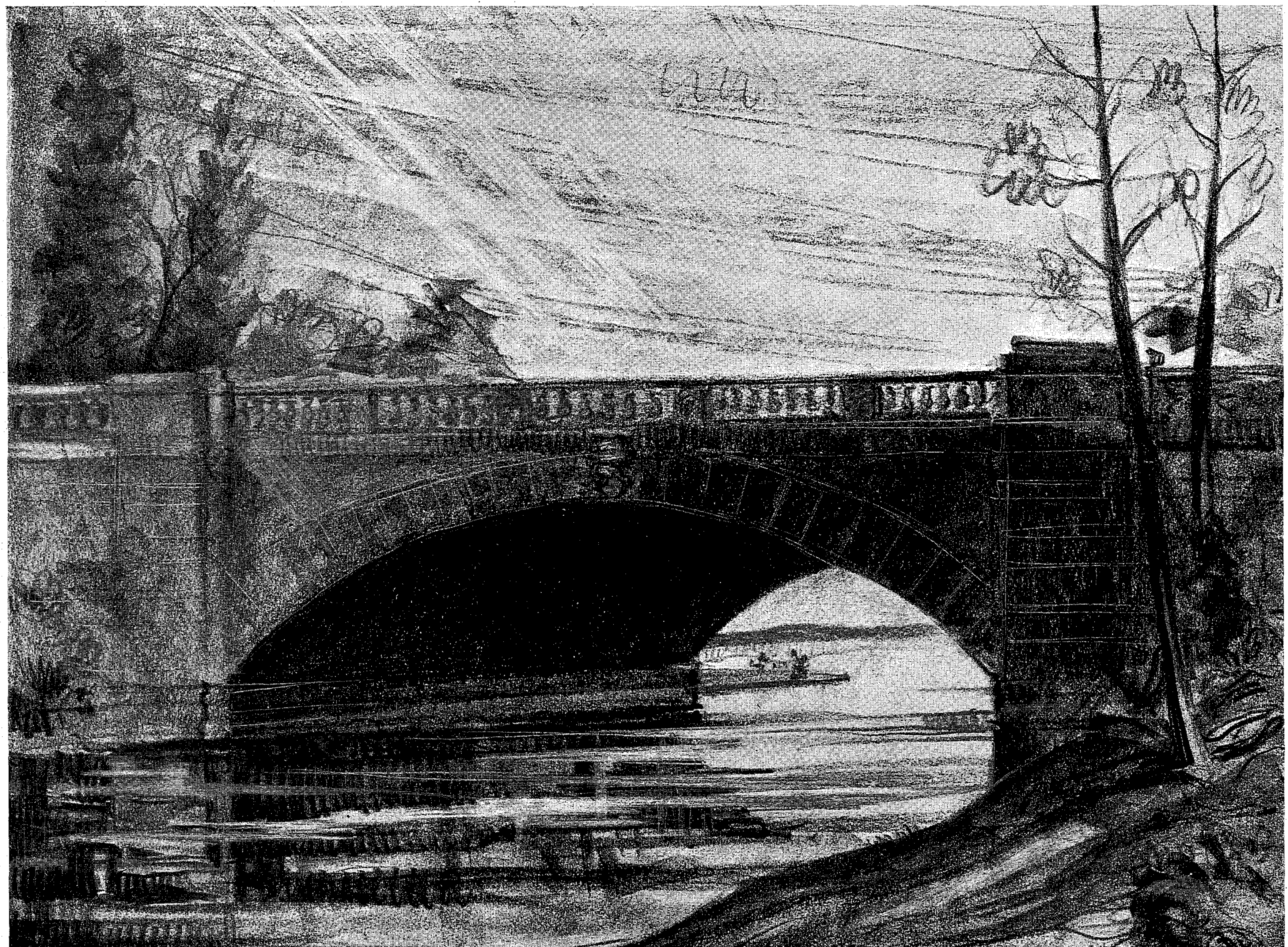


**Bridge Near Lake of the Isles**
—A Lithograph by Russel Williams

electricals

# Install New Generating equipment

*Needing more equipment to care for a sudden increase in enrollment the electrical engineering department has designed and constructed in the school a motor-generator set as easy and safe to operate as the common telephone.*

By SAM LEVY
E. E. '33

SEVEN unique new motor generator sets have been installed in the balcony of the main electrical engineering laboratory in order to provide compact units for the study of alternating circuits by junior electrical engineers. The increased enrollment in the electrical department during the winter quarter necessitated this additional equipment.

In order to combine a maximum of utility with absolute safety in each set, it was decided that only the different parts of each set would be bought, leaving the assembly to be done in the machine shop of the electrical engineering building. Professor F. W. Springer of the department of electrical engineering was placed in charge of the design of the set and the assembly work.

Each set consists of a five horsepower shunt wound direct current motor mechanically connected to a special sine wave alternating current generator and mounted on a structural steel frame equipped with casters. A flexible fiber coupling connects the shafts of the two machines and takes up any vibration due to changes in the alignment of the two shafts.

A control rheostat mounted above the direct current motor regulates the field current and thus varies the speed of the set. A starting box using the customary magnetic holder is mounted just in front of the direct current motor, and is used only for starting the set. Mounted above the alternating current generator is a second rheostat which regulates the voltage output of the generator.

While the ordinary range of frequencies delivered by each set is from 40 to 80 cycles per second, provisions are made for inserting added resistance in series with the armature of the direct current motor for further lowering the speed of the set. In this manner frequencies as low as 5 cycles may be obtained.

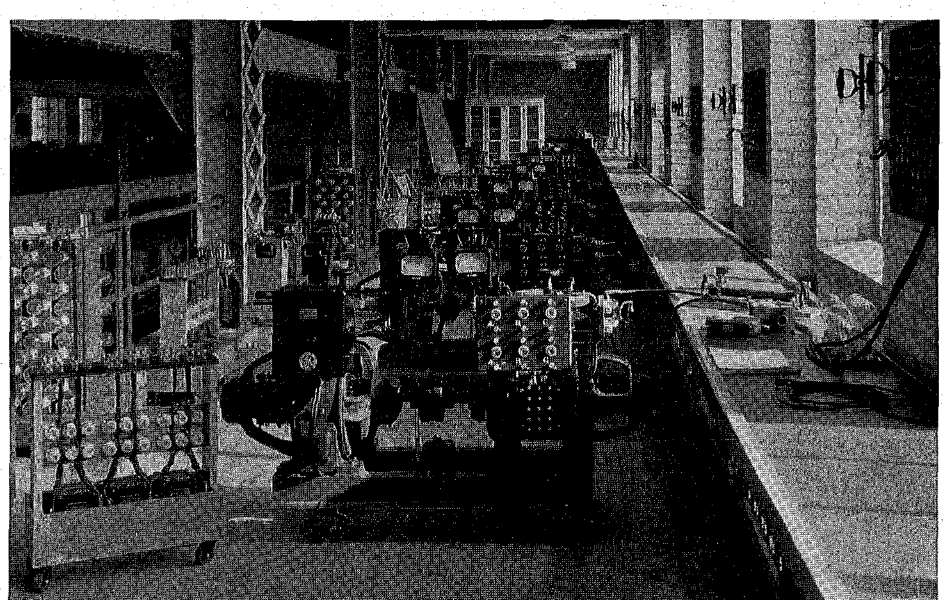
A wide range of voltages in various phase relations may be obtained by making the proper connections to the output panel board in the right hand side of the set. Fuses are placed in all the circuits before they reach the panel board, to protect the machine against short circuits. All wiring is behind the panel and out of the way, so it is practically impossible for anything to go wrong within the machines as long as they are oiled regularly.

Two meters mounted on the machine indicate the voltage generated and the speed. Some difficulty was experienced at first in keeping the pointers of the meters from vibrating, but this fault was completely overcome by mounting the meters on short coil springs. These springs take up all vibrations leaving the meter pointers absolutely stationary.

A small direct current generator connected to the large motor shaft through a flexible spring belt generates a current which is proportional to the speed and therefore to the frequency of the alternating current generator. The output of this small generator is connected to a six volt voltmeter previously calibrated to read speed in r.p.m. and frequency in cycles per second. By this method the frequency of the output may be read directly without making the usual tachometer measurements and computations. The output voltage is measured with an ordinary 150 volt alternating current voltmeter.

During the fall quarter work on the sets was pushed as rapidly as possible in order to make the sets available for the

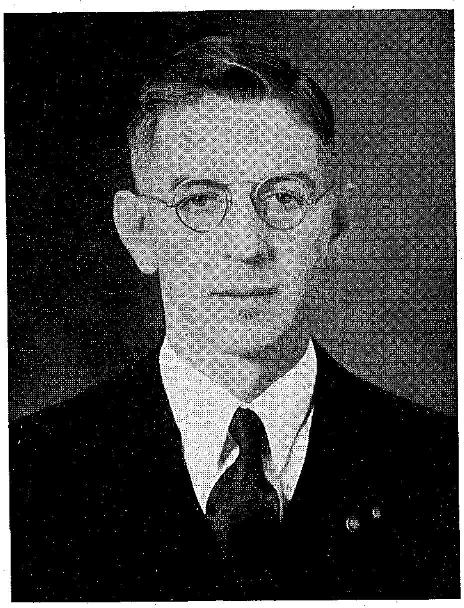
(*Continued on page 144*)



**The method of mounting the motor and generator on the same base and the control panel of the generator can be seen in the photo above. The rheostat on the right controls the output; that on the left the motor speed.**

# 'I Hereby Dub Thee....'

By KNOX A. POWELL
M. E. '20



**Newly knighted Knox Powell left Minnesota in 1920 to enter a technical apprentice course. Returning to the University of Minnesota campus to pursue advanced studies he relates some of his experiences as a graduate.**

**As a member of the Engineering Student Council in 1916, Mr. Powell assisted in establishing the Engineers Bookstore. He is now a member of the American Association of Engineers, the American Society of Mechanical Engineers, and the American Legion.**

THE emissary of the good St. Patrick, patron saint of engineers, had dubbed me knight of that famous verdant order and sent me forth in search of worthy exploit. The court of Alma Mater had fortified me with a scroll of introduction to whom it may concern in the form of a diploma. Preceded by anxious arrangements and followed by words of profound advice, I had set out in quest of great industrial adventure.

No one need be reminded that the council chambers in industry are not open to whatever technical graduates may choose to enter them. The certification of Alma Mater did, however, gain me entrance to a graduate apprentice course, a sort of anti-chamber or vestibule to an industrial career. There I met as motley a crowd of fellow adventurers as ever set out to test fortune.

First to introduce himself was a graduate of a two year technical college. He assured everyone that all that was valuable in a four year course could easily be covered in two years; and that, in fact, any bright youth merely wasted two years of his life by dawdling around with a regular four year course. He was perfectly familiar with everything that any one else had ever heard of, even when it happened to be maliciously fictitious, and could explain the most abstruse mathematics or the most profound philosophy with equally voluble assurance and finality of judgment.

Once in extreme confidence, however, he informed me that most valuable thing college had taught him was that nobody really knows anything. "Great men have been great only as they ventured into the unknown," said he, "so why bother too much with mere knowledge." His watch case contained a much thumbed list of men who had, doubtlessly, bluffed their way to fame and fortune. His motto was: "Keep a stiff lower lip and bluff." Poor chap, his methods were all too miraculous to apply to modern industry.

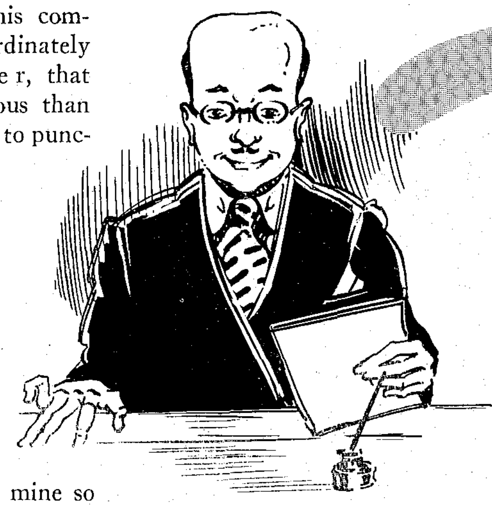
Then there was a graduate of a famous old northeastern university. A certain reserve attracted my attention as soon as I saw him. He was affable without being forward and proved to be a pleasant and, at times, even a brilliant conversationalist. His thought like his manners, however, had attained a polish of self-sufficient maturity which I could never quite penetrate.

At times, the man seemed to cast an appraising eye over us all as if to pass sophisticated judgment on his foolish fellows. In an unguarded moment he stated that in twenty years not one in fifty would be above the bare tread-mill grind for bread and butter. "Fools", he exclaimed, "to pursue their work so eagerly when only those with the inside track and a pull will ever get anywhere." Alas, he tugged at his own "pull" so vigorously that it came out by the roots.

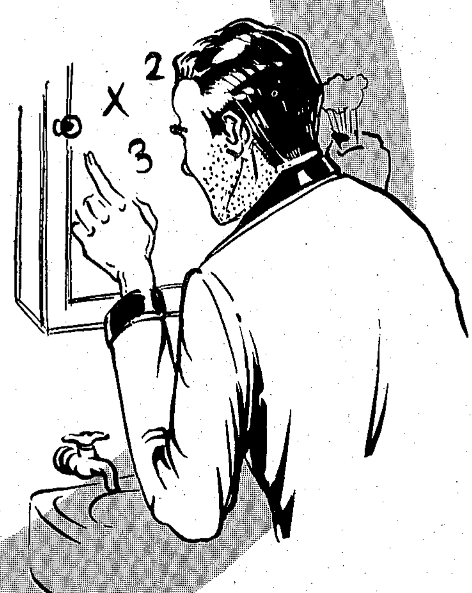
A curly headed go-getter from a southeastern college amused us all with his mercenary ambitions. He made the rounds in quest of opinions as to the possibility of a technical apprentice failing to attain within three years to a job at a mahogany desk with a stipend of five hundred dollars a month. He was greatly disappointed with the lowly monetary ambitions of most of us and evidently derived little statistical comfort from a mental tabulation of our opinions as to his own chances for such success.

He availed himself of every opportunity to quizz the company officials about rapid "recognition", as he called it, and even, so they say, told a vice-president that he was a fool to accept such a low salary.

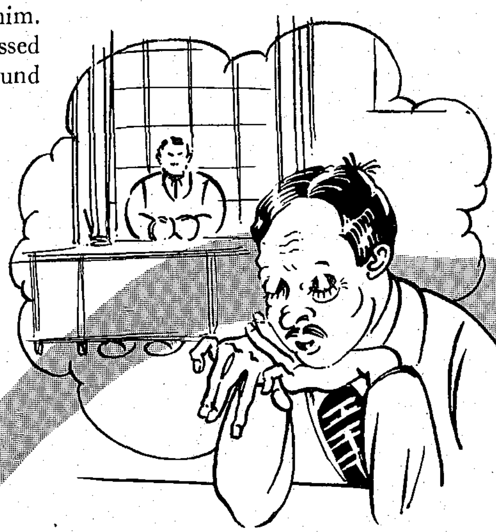
Later when he renewed his statistical search for opinions, some of us took pity on the lad and revised our candid judgment in most liberal fashion for his comfort. He was so inordinately overjoyed, however, that some one less generous than the rest was tempted to puncture his mental dilation. He subsided ignominiously and was never heard from again.



The graduate of a great northwestern university was a most curious human specimen. His room was just across the hall from mine so I saw much of him. He was an indefatigable worker. An ill-dispositioned shop foreman with a strong dislike for college men once assigned him to mop the heavy oil from a large gear case and wash it out with a half dozen buckets of gasoline while the regular hunky rested, only to have him appear in a couple of hours smeared from head to foot by his energetic efforts to ask where the next case was.



He solved all the problems in the apprentice literature and also most of those his mates thought up for him. The morning he missed his breakfast, we found him still standing just as we had left him a half hour before, with collar in one hand and tie in the other, reciting the solution of a difficult problem in hyperbolic functions which had occurred to



him at that point in his dressing. Another time we discovered him half shaved, spreading lather on the bath tile and drawing graphical solutions with his finger.

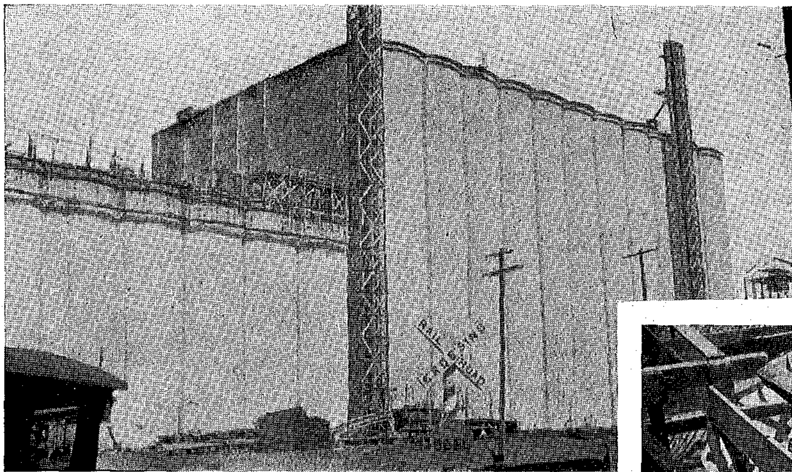
He pursued the unknown so hotly and relentlessly that soon nobody but his room-mate could make any contact with him at all. The management of the industry was, evidently, equally unable to follow his mental excursions or to evaluate his findings for they put him in a research room up on a hill with plenty of paper and pencils but no money to spend and let him ramble.

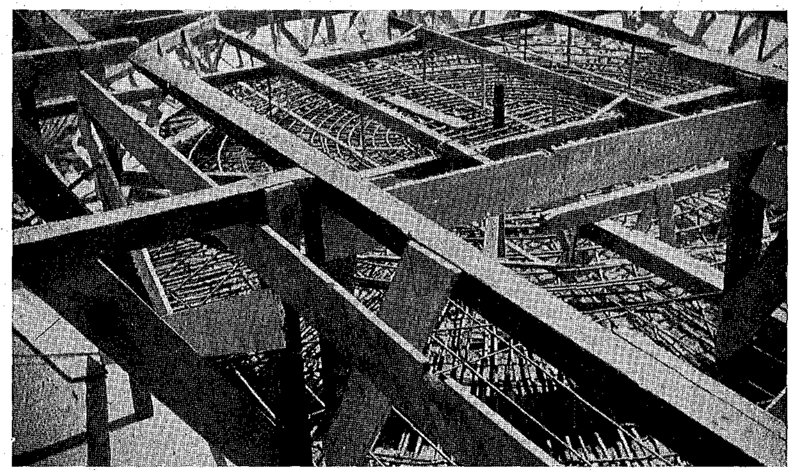
A graduate of southwestern technical college succeeded, as success can be seen, far better than any of the rest of us. His curious accent and quaint expressions set us all smiling, nor was he unaware of his own peculiarities. His spirits were always buoyant yet never effervescent, and a native curiosity overcame any possible diffidence though it never carried him beyond the bounds of good judgment and proper restraint. He was interested in everything and everybody, in fact so much so that everybody was interested in him.

He became known as a wizard for the solution of difficult problems and a solomon for excellent judgment not only because of his own abilities which were indeed superior, but also by the voluntary efforts of others who delighted to exercise their wits under the magnetism of his personality. A perplexed official once confided a very baffling situation to him because, as the officer afterward told me, he would then be assured of the best assistance of every man on the apprentice course toward a proper result.

The man just floated to the top wherever he happened to be. He had risen to be division manager when I saw him last and everyone still felt that magnetic reciprocal interest which had always characterized him. Everyone from bell girl to the first assistant was alert to help him. The efficiency man who made up the department progress reports said, "Nobody can beat such an aggregation of wits. That man will be president of the company some day if the stockholders are lucky."

Such were a few of the outstanding knights errant who entered the technical apprentice course with me to stand in that ante-chamber of industry awaiting a summons to enter the inner precincts and an assignment of a task worthy the jousting.





Above can be seen the completed first unit and the partially finished second unit with the movable forms in place. In the picture to the right the saucer shape of the circular and radial rods in the background can be seen by comparison with beams in the foreground. This is the base of a tank before placing of the concrete.

# engineers use New Methods In Elevator construction

***Howard Helgerson, sophomore civil engineer, shows some of the unique methods of construction and design employed in the recently completed grain elevator for the Archer-Daniels-Midland Company. In erection of this world's largest storage bin electric motors furnished all the power. Designing a new type of bottom for the bins effected a radical change in modern elevator construction practice.***

THIS discussion is a presentation of the salient features in the progress of elevator construction and in the design of the modern elevator as exemplified by the new 7,500,000 bushel storage-terminal constructed for the Archer-Daniels-Midland Company. It is well before describing the new innovations incorporated in the modern elevator to indulge in a résumé of construction development and the creation of the demand for new and more efficient methods of grain storage.

Concurrent with the mechanization of the agricultural industry and the development of its distribution system, storage methods of bulk agricultural produce have advanced to an efficient and economical stage. The industry has not only found it expedient to employ larger and more modern means of grain storage but also has realized the value of engineering in the design and the construction of storage-terminals.

Three decades ago the principal type of construction employed in the terminal elevator field consisted of what is known as the "crib" structure. The elevator was erected on a slab foundation and provided with walls consisting of layer upon layer of 2x6 or 2x8 inch timbers. They were placed in much the same manner as bricks, but, since the separate timbers were much longer, some variation was necessary. The partitioning of the elevator into bins was also accomplished by this method, and in most cases the partitions were made an integral part of the whole building. The capacity of this type of storage house is limited to approximately 750,000 bushels.

Soon, however, the rapid increase in acreage under cultivation in the middle western states necessitated a new design in elevators. Engineers, as a result of this prodding, produced a storage elevator consisting of a number of brick tanks approximately twenty-five feet in diameter and one hundred feet high which were used in construction with a "work-house," which contained all the handling and processing equipment.

From experience the engineer had found that reenforced concrete construction was ideal for many types of structures, hence only a short time intersticed with experimentation elapsed before the first concrete elevator was "going-up" in a race against time to provide increased storage for the fall influx of grain from the wheat-belt. The new concrete elevators were of approximately the same size and shape as the older brick style. The advantage of this new building material, however, was soon enhanced by more practical designs in the arrangement of the reenforcing steel. This allowed an increase in the capacity per storage tank and an increase in capacity per dollar invested.

The new storage-terminal for the Archer-Daniels-Midland company, built by the MacKenzie Hague Engineering company, is the ultimate result of the cumulative experience in elevator design. The new elevator consists of 120 concrete tanks which, with the bins occupying the interstices between the tanks, give a total storage capacity of 7,500,000 bushels. This enormous capacity places the new unit in Minneapolis as one of the largest in the world. The length of the structure is 427 feet; the width 155 feet. The tanks are 148 feet high, but the head houses, which provide for the receiving and handling of the grain, rise 66 feet above the top of the tanks so that a portion of the terminal is 214 feet high.

The preparation for the construction work entailed sufficient excavation to provide a position for the conveyor housings. Two of these housings, which are built of reenforced concrete and are of square cross section, run the entire length of the elevator below the bottom of the tanks to provide means of removing the grain from the tanks. Conveyor belts, which travel 850 feet a minute and handle 10,000 bushels of grain per hour, were installed in the completed housings.

**Devise New Methods of Placing Steel**

The designers, in order to secure a maximum capacity of storage per square foot of space, evolved a unique method of placing the reenforcing steel in the foundation of each tank. It is a familiar fact that an inverted saucer (for example: the tea party variety) can withstand a much greater compression load than one in the upright position. It is also evident from a consideration of the stresses involved that a circular form, such as an inverted saucer, can withstand a larger steady load without shifting much more safely than a square or round formation of constant cross section. These facts were cleverly made the basis for a new arrangement of steel work. Steel rods in the geometric design of concentric circles were placed so that each succeeding circle was of smaller diameter and placed a little higher than the preceding circle. Connected with the rings were radial cross members of steel which gave the whole a character much resembling that of the analogy. A matrix of concrete was placed in such a manner as to fill the entire space surrounding the steel work. A large portion of the 2,000 tons of reenforcing steel used in the elevator together with 11,000 cubic yards of concrete was placed in the foundation in order that each square foot of tank bottom could support a load of approximately one-ninth of a box car of wheat.

The raising of the tank walls necessitated the building of movable concrete forms. Lumber was cut by the use of an electric mill into pieces which were arcs of a circle 25 feet in diameter. These boards were laid upon one another to secure a laminated effect which provided a rigid circular beam as a foundation for the sides of the concrete form. Upright pieces of lumber three and one-half feet long were fastened to the circular beam to make the body of the form. The whole, which included special forms for the bins in the interstices, was connected to a steel truss passing diametrically across the tank and providing a means of raising the whole molding structure by the use of many jacks. The elevator was built in two units; the first raised was made up of 66 tanks while the last unit consisted of 54 tanks. The molds and placing platforms of the tanks in each unit were interconnected and raised almost simultaneously as the demand for more form space arose.

The orthodox method of placing the reenforcing steel was used in the side assembly in spite of the unique method adopted for the foundation. This steel work consisted of vertical rods whose rigidity and strength was further augmened by circular rods tied to the upright members. The assembly was made from the placing platforms as they were raised for the concrete.

**Electric Motors Furnish Power**

The utility of the head houses built above the tanks lies in the need for "heads" or unloading positions for the "legs" or vertical conveyors above the storage elevator proper. The operating equipment of the houses, which are of covered steel frame construction, consists of one electrically driven 16,000 bushels per hour capacity leg each. Double power shovels with individual motor drives place adequate facilities for the unloading of the railroad cars at the disposal of the operator. Conveyor belts of the same capacity as those provided for the unloading of the bins carry the grain from the "leg head" to the individual bins. Although a total of 407.5 horse power in electric motors is provided for operation, the elevator is not equipped with processing machines as it was designed primarily for storage and as the adjacent units of the company, to which grain may be taken from the new storage house by means of belt conveyors, are provided with adequate processing facilities.

An interesting feature of construction is that the only motive power used was electric motors. Electric motors drove all the machinery that manufactured and placed the 27,250 cubic yards of concrete in the walls and fashioned the 18 carloads of lumber used on the job into their proper shape.

**This form under construction shows the steel truss across the center and the method of placing the circular beams and of fastening the sides of these beams.**

# a new field—

# Correlating Agriculture

## and engineering

By H. H. SHEPARD
Assistant Professor of Entomology

*Hordes of insects ravaging Minnesota fields last year impressed upon both country and city peoples the importance of insect control. A definite need was revealed for cooperation of engineer and agriculturist in research and development of insecticides.*

IT is said that "an ounce of prevention is worth more than a pound of cure." The adage applies as well in the struggle of man against insects as in that against diseases. Preventive measures are as relatively little studied in the field of insect control as in that of medicine. By the time a cure is demanded the insect menace is so great that promptly effective measures are required to provide relief. It is here that the chemist may be called upon to furnish information through which the farmer may avail himself of cheap and appropriate insecticidal materials. The substance of this service may belong either to the field of production or to that of utilization of insecticides.

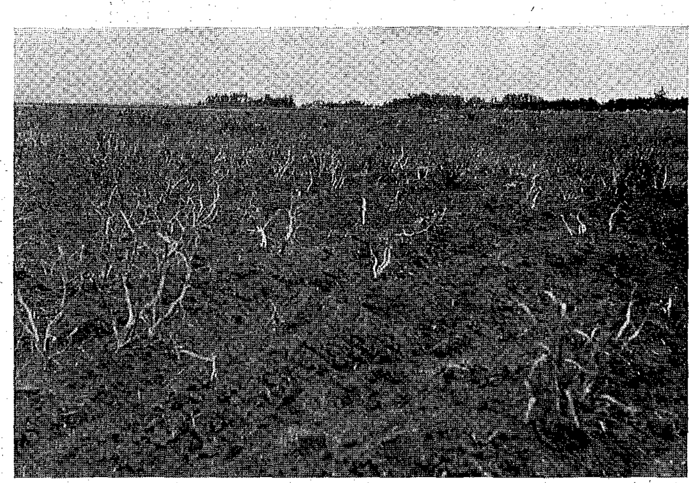
A large share of the profits of chemical manufactures are often derived from the sale of by-products. Some of the latter, which were allowed to go to waste a few years ago, are now extremely valuable to commerce. Formerly a use for waste materials was discovered by accident rather than by organized research as is usually the case at the present time. This is as true in the field of insecticides as in other branches of the chemical industries.

In the early days of the chemical control of insects, substances known to be poisonous to humans were first tried. Naturally, arsenical compounds were amongst these. A green pigment on the market about 1865 for use in shutter paint and known as Paris Green was found to be effective against the Colorado potato beetle. This compound is a copper aceto-arsenite. London purple, another arsenical and a by-product of magenta manufacture, was tried in 1877 but its arsenical content was too variable to give consistent results as an insecticide. Moreover, the use of arsenic acid as an oxidant in the manufacture of rosaniline was discouraged by medical authorities. The use of nitric acid for this purpose was favored, thus eliminating arsenical residues from textiles dyed with rosaniline colors.

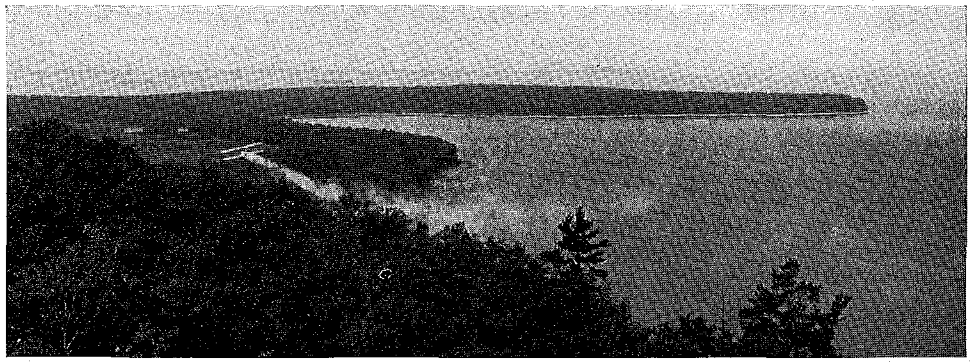
**Cotton Dusted by Plane**

Other arsenicals have superseded Paris Green to large extent because of their greater effectiveness and improved physical and chemical properties. The gypsy moth, imported into Massachusetts from Europe in 1868, caused the first important investigation of insecticides by chemists. As a result of their experiments, lead arsenate was first made in 1892 for use as an insecticide. Before 1910 calcium arsenate appeared on the market in competition with lead arsenate. The calcium salt is generally cheaper than the lead because of the difference in value of lead and lime. This fact drove lead arsenate almost entirely off the market during the World War. Another major advantage of calcium arsenate is its lightness. The increased bulk of the powder due to recent improvements in methods of manufacture make it economically possible to dust large areas by airplane, the arsenical dust falling like a drifting cloud over the foliage. As a control against the cotton boll weevil, large areas of southern cotton fields are treated in this manner.

The more important arsenicals may now be manufactured for insecticidal use by electrolytic processes. In this connection may be related an experience of the Alabama Power company. In early 1923 a shortage of calcium arsenate was expected in the South because of the large areas threatened by the cotton boll weevil. This company, operating in the heart of the cotton belt and dependent on its prosperity, decided to make a study of electrolytic processes for producing calcium arsenate. They were successful in developing a method in which a basic sodium arsenite solution was oxidized to the arsenate by electrolysis. After oxidation the calcium arsenate was precipitated by treatment with lime. By this process the cost of production was lowered and a local source of calcium arsenate provided. Incidentally the company secured additional power consumption.



**Hordes of grasshoppers invaded Minnesota potato field last season with these results. Proper use of insecticides would have prevented this.**



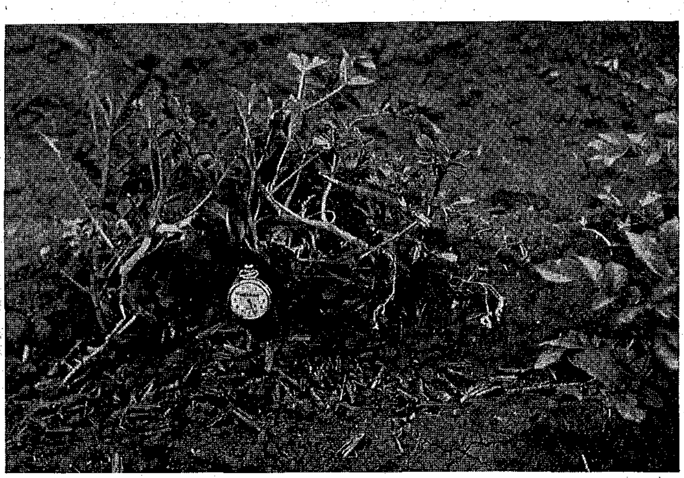
**Dusting the powdered insecticide over the field by plane is an effective method. Here the plane is dusting a Wisconsin woodland with calcium arsenate.**
*(Photo Courtesy A. A. Grenovsky)*

A few statistics relative to the use of arsenic in insecticides will give some idea of the extent of the industry in this country. Of the annual consumption of 75,000 tons of white arsenic in the United States about 60 per cent is used in insecticides. The user of white arsenic, second in importance, is the glass manufacturer who requires about 25 per cent of the total used. It is necessary to import some white arsenic, nearly 11,000 tons coming from abroad in 1930, while about 15,000 tons of lead arsenate and a similar quantity of calcium arsenate are produced in the United States annually. Paris Green is still used in the control of some insects and is produced to the amount of 3,000 tons a year. It was estimated in 1920 that ten to fifteen times as much calcium arsenate as then in use could be applied profitably in the control of the cotton boll weevil. This estimate would require over 26,000 tons of white arsenic to be used annually on the cotton crop alone.

**Arsenic Was Formerly Curse to Smelters**

Arsenic is derived mostly from the ores of iron, silver, nickel, and some other metals. It is sublimed in the course of smelting the ores and collects within the smelter flues. According to Patten arsenic was formerly "a curse to the smelting industry but because of the rapid increase in the use of arsenical spraying materials, it has risen to a place of great importance."

A second group of materials, certain by-products of the natural gas industry of West Virginia, are of interest for their insecticidal value. Ethylene is formed in the cracking of natural gas under certain conditions. Such a compound as ethylene dichloride can be manufactured without difficulty by direct addition of chlorine to ethylene. The problem here is to find suitable outlets for such compounds. Some are excellent solvents. Others are useful as intermediates in the synthesis of other compounds. In the case of ethylene dichloride and ethylene oxide a decided value as fumigants for use against the insect pests of stored products was reported in 1928 by the United States Department of Agriculture. It is of interest to note the commercial development of ethylene dichloride. It was first offered in 1923 at thirty-five cents a pound and with a rather limited supply available. In November, 1926, it was quoted at six cents in tank car lots, thus bringing it into competition with carbon tetrachloride, a common fumigant of much less effectiveness.



**Comparison of the watch with the grasshoppers shows the large number of these insects which destroyed the potato field on the opposite page.**

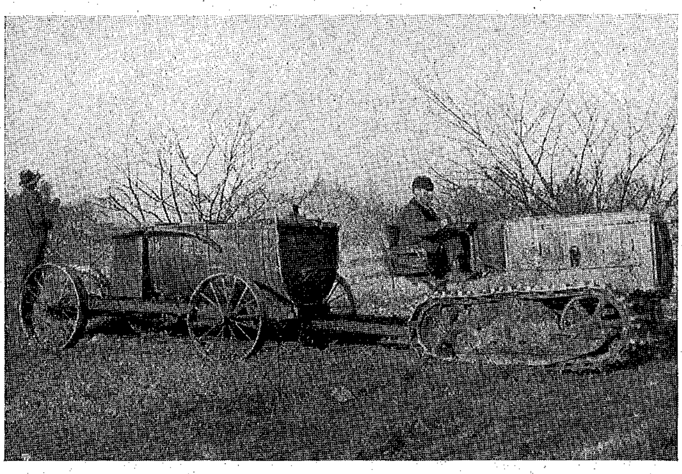
A third instance of the use of by-products as insecticides is the result of a study by the United States Department of Agriculture of the possible insecticide value of compounds closely related to nicotine. This alkaloid is known chemically as beta-pyridyl-alpha-N-methylpyrrolidine. It is more toxic to insects than most other compounds. Government entomologists and chemists thought that the joining of two pyridyl radicals, rather than one pyridyl and one pyrrolidine, might produce a toxic compound showing physiological activity similar to that of nicotines. This was found to be the case when a crude dipyridyl oil was sprayed on plant lice. On the other hand, gamma-gamma-dipyridyl, the chief component of the oil, was found after purification to be only slightly toxic to these insects, showing that a much more highly toxic constituent was present in small quantities in the crude compound.

By varying the physical conditions or the original chemicals of the synthetic method various isomeric dipyridyls and their derivatives were made. After several years of investigation it was found that the highly toxic constituent of crude dipyridyl oil is a derivative in which the heterocyclic rings were joined in the same relative positions as in nicotine, namely, as beta-pyridyl-alpha-piperidine. The hydrogenated, or piperidine, ring has the same location as the hydrogenated ring (pyrrolidine) in nicotine. Moreover, the new compound, now known as "neonicotine," is empirically isomeric with nicotine ($C_{10}H_{14}N_2$). Both are water soluble, basic liquids, having about the same toxicity for insects. Neonicotine has since been reported, under the name of "anabasine," as an alkaloid occurring naturally in *Anabasis* sp. (Chenopodiaceae), perennial weeds growing in Africa, Armenia, and Russia.

Pyridine, the raw material in the synthesis of dipyridyl compounds, is a by-product of the distillation of bones for animal charcoal and also of the purification of coke oven gases. It was used formerly as a denaturant of alcohol. After many persons had died from drinking the pyridine denatured product, its use was discontinued. There followed a sudden drop in the market value of pyridine and a new outlet for it was sought. One manufacturing company attempted to commercialize a rather crude dipyridyl oil as an insecticide. Apparently due to a lack of technical force the company is having difficulty in controlling the conditions of commercial synthesis and it has not yet placed on the market a product of desirable quality.

**By-Product Sulphur Recovered from Gas**

Another important commercial by-product utilized as an insecticide is sodium fluosilicate and the fluorine compounds, such as sodium fluoride, derived from it. In the production of acid phosphate for fertilizer purposes two or three million tons of phosphate rock are mined annually in the United States. The rock contains about three per cent calcium fluoride, depending upon the locality from which the rock is obtained. When the rock is treated with sulphuric acid in the process of making acid phosphate, fumes of silicon tetrafluoride are produced. Formerly these fumes were allowed to escape but, as they are injurious to vegetation, laws were enacted requiring that the gas be disposed of in some other manner. The fumes were then conducted into absorption towers where the tetrafluoride reacted with dripping water to form a weak solution of fluosilicic acid. This acid was at first allowed to drain away but later was put to use as an insecticide in the form of sodium fluosilicate, the acid being precipitated with sodium chloride. It is possible to make over 50,000 tons of fluosilicate annually in the phosphate industry. This amount is more than the demand at present in insect control but some is consumed by the laundry industry, in the manufacture of cement-hardening preparations, and in the production of iron enamel ware and opalescent glass.



**Tractor drawn equipment affords a cheap but effective means of dusting orchards.**
*(Photo Courtesy A. A. Grenovsky)*

Although most of our sulphur supply comes from deposits of elemental sulphur, there is a considerable quantity of by-product sulphur obtained for insecticidal use. In the purification of manufactured illuminating gas it is necessary to remove hydrogen sulphide. A colloidal "gas sulphur" results from oxidation of the sulphide. Although the recovery of gas sulphur is a recent development it is likely to prove much less important than if natural gas were not rapidly replacing manufactured gas.

All of the materials discussed thus far are by-products of industries not particularly interested in the production of insecticides. A number of insecticidal materials are producted, however, as the chief products of certain industries, although their values as insecticides may be less than for other uses. Elemental sulphur is mined and prepared in various degrees of fineness for different uses. Amongst these is its use in agriculture for killing insects and plant diseases. Lime is also used insecticidally, mostly in combination with other more active materials. Probably bentonite clay, present in large deposits in some localities, will eventually have an extensive use in insecticide combinations when more is known regarding its powers of absorption of toxic liquids. It is already in use to some extent to control the settling of heavy particles in spray suspensions.

Peace time use for war gases has been actively sought by military agencies who found themselves with large stores of gas at the end of the war. Edgewood arsenal, in Maryland, was producing 1500 tons of chloropicrin a month although less than twice that amount (2,776 tons) had been produced when the armistice was signed. Naturally most of the war gases originally intended for the destruction of human lives are rather hard for the agriculturist to handle. However, chloropicrin, one of the tear gases, has found considerable use as a fumigant of stored grain. It was first investigated as an insecticide by William Moore, formerly of the University of Minnesota, although an Italian worker studied its properties in this connection at about the same time.

Besides being interested in the commercial production of insecticides, the chemical engineer is ready to apply his training to increasing the value of such materials for the farmer. A few notable examples of the latter type of project will be described briefly.

**Adhesion Important Factor**

It is desirable that poisonous particles of an insecticide adhere well to treated foliage, resisting the forces of wind and rain until the need of protection is over. Soap, glue, or other sticking and emulsifying compounds are often added to sprays to promote adhesion of the toxic particles to the waxy surfaces of leaves. Some of these increase hydrolysis of insoluble arsenicals or are precipitated by hard water or are undesirable for other reasons. At the University of Minnesota a few years ago it was decided to approach the problem of adherence from the standpoint of the electrical charges residual both in the particle and in the leaf. With an apparatus for demonstrating cataphoresis, migration of insecticide particles in the electric field was observed. Most of the arsenicals used as insecticides bore negative charges. A like charge was also demonstrated on the surfaces of wet leaves. Naturally, then, the arsenicals usually applied are repelled to a certain extent by plant foliage. It was found possible, however, to produce certain arsenicals bearing a positive charge. They were shown to be highly efficient, adhering to foliage far better than the ordinary negatively charged arsenicals.

The chemical engineer, furthermore, may undertake investigations of the physiological action of insecticides. Some of the work of the United States Department of Agriculture is outstanding in this direction. Entomologists have in the past employed a simple cage test in the estimation of the toxicity of chemicals to insects. The method consists of applying to foliage a certain known concentration of insecticides, either in solution or in suspension. Test insects are then allowed to feed freely on the poisoned leaves, the results being noted from time to time. Although the concentration of poison in the original spray is known, the amount which finally adheres to each unit of leaf surface cannot be estimated. Furthermore, no record of

*(Continued on page 146)*

# « « « SLIP STIX » » »

## battleship

It might be the reputed reports of Oriental pop guns, or it might be just plain softening of the brain—but in either case the fact is that everyone is playing this nautical game of "battleship." Even your old guardian of literature was inveigled into a marine engagement and promptly lost his navy. To say nothing of getting terribly seasick.

## it can't fail

Chemical engineers being instructed on preparations for their annual spring inspection trip were cautioned about being late on the morn of departure. Resourceful Dr. Mann, never caught without the proper method for making an impression, hit upon the correct procedure for insuring promptness. Said he, "Go say goodbye to your girls the night before instead of the morning we leave."

## show me the way

According to a certain family carpenter, a house under construction was at that stage where the bedrooms were being built. Very early one morning a gentleman, well lubricated, called up from the sidewalk—and a lamp post, "Whach you building there?"

"A bedroom," was the answer.

"How longsh it take to build a bedroom?"

"About two weeks."

"Aw shucksh (hic), ta 'ell with ya bedroom. I'll go home."

## cause for suspicion

Between stations in Pennsylvania a certain train came to a sudden stop with a tremendous grinding of brakes. Immediately a worried-looking man rushed down the track and demanded of the brakeman the reason.

"What is it?" he asked. "An accident?"

"Somebody pulled the bell rope," was the reply. "The engineer put on the brakes too quickly, and one of the cars went off the rails. We'll be tied up about four hours."

"Four hours!" exclaimed the passenger. "But I'm to be married today!"

Instantly the brakeman turned on him with suspicion.

"See here," he ejaculated, "you aren't the guy who pulled the bell rope, are you?"

## oh for yummy

Personal idea of the month's catchiest expression: Such fun—more people killed, more babies born, and the cutest undertakers.

## before "final" dawn

Can anyone lend credence to the rumor that members of the great fraternity, School of Lost Ambition, are brushing up on their thrice annual theme song "Just a Little Closer"?

## to arms

A bulletin was posted for Volunteers for the Chinese war. Two phoney yet likely enough sounding names were tacked on. Soon a few real volunteers were sucked in on the hoax. The farce was discovered shortly, and brave gentlemen immediately de-volunteered themselves.

We're not mentioning the names of any buildings, but we think this is the lousiest sign the anatomy building has had posted on its grim walls.

## something should be done

Our espionage system has solved the riddle of who whisks away TECHNO-LOGS. And it's not difficult to believe the culprit guilty of such kelptomaniacal proclivities. Acting on a hot tip from an anomymous hat, our six sleek sleuths (try that in a hurry) intercepted the following message in code (deciphered):

Oh boy ohboyohboyohboy! Am I having fun! Stealing TECHNO-LOGS out of P. O. boxes and making everybody mad. Ohboyohboyohboy—am I having fun!

(Signed)
MR. BOP.

## how would you say it?

Anybody:
A Nigger in the woodpile
An engineer:
A Darky in the kindling
A forester:
An African in the lumber
A chemist:
An Ethiopian gentleman in the cellulose

## a chemist proposes

(Being the first of a series of the proper way to win your future Missus. Watch for your turn.)

Oh wondrous creature, lighter than helium, rarer than hafnium, nobler than platinum, my zenith of rare elements, let us form a combination, even as do hydrogen and oxygen. Let us evaporate into the stratosphere, a subliming as it were. Let our lives be a utopia of ionic equilibrium. Let anger never be precipitated, but filtered out of existence. Let harmony and love be an irreversible reaction, even unto the millenium. In other words, baby, will you marry me?

## skum boomeranged

Worthy (?) Ski-U-Mah-sters wisecracked—"you can 'poduck' an engineer on two bits and a beer."

Aftermath—entire skum staff found cracked—" you can 'poduck' an engineer those still conscious)—one skum-er sniffed the breath of a "poducked" engineer. Others sniffed his. All laid out cold.

Breathes there a man with soul so dead
Who never to himself hath said
As he cracked his dome on the foot of the bed
****—&%—!!÷(;!!!**&&???£££

"Hey, hay," said the old cow as the farmer tossed her a bundle of straw.

And so away to a joyous vacation.

See you all in new bonnets.

So long, you mugs.

# THE MINNESOTA TECHNO-LOG

## UNIVERSITY OF MINNESOTA




## Babel

IN the bible there is a story with which we are all familiar, but of which few of us have learned the significance. The story is that in which man tries to build a tower to heaven, but God circumvents him by confounding his language so no can can understand what another is saying.

From this beginning comes the idiom, "babel", which simply means to speak uselessly. You are probably now asking yourself, "What has this to do with me?" The answer is pointed, "What have you said during the past day, the past month, or even the past year, which is not 'babel'?"

It is amazing, when we stop to consider, how little of our speech is necessary; how little is worth the breath spent. In the final analysis, one should not do things without cause. If we have nothing to say; silence is golden. "Babel" is only a mediocre means of saving ourselves from the enigmatic reality of existence.

## Why English?

ENGLISH is again brought to the foreground. In a recent editorial appearing in the *Saturday Evening Post* the results of a survey as to the practical and theoretical value of courses studied in college were introduced. In addition a statement regarding the value of a college education was made by Owen D. Young. Owen D. Young is probably the best known business administrator associated with primarily engineering corporations in America and as a result his words should have a special significance for the engineer.

"In his opinion the objective of an American college should be to assist a student to develop his character, to stimulate his intuition and emotions, to discover his mental aptitude and to train it, to learn enough about our organized machinery of society to apply his gifts effectively, and to acquire skill in his communication with others. Mr. Young amplifies his last specification by explaining that it means languages, both oral and written, and manners too."

"The alumni who assisted in the survey previously referred to found English far and away the most important subject they had taken in college, both from the utilitarian and from the cultural viewpoint. Mathematics was their second choice for utility, and philosophy for cultural value."

"The three things their college training gave them as determined by their answers to elaborate questionnaires—were broad intellectual interests, ability to reason and to analyze facts, and ability to distinguish the important things in life from the unimportant."

The need for a liberalization of the present technical courses is more than apparent and, of course the introduction of another year of English or a year of speech would do much to alleviate that present situation.

Cognizance of the fact that a change in the present curriculum will not be made immediately must be taken by every engineer. Therefore the prospective engineer should give cultural studies his earnest consideration and should fill the interstices of his technical curriculum with courses and extra-curricular reading that will prepare him for a position in the business, engineering, and social world.

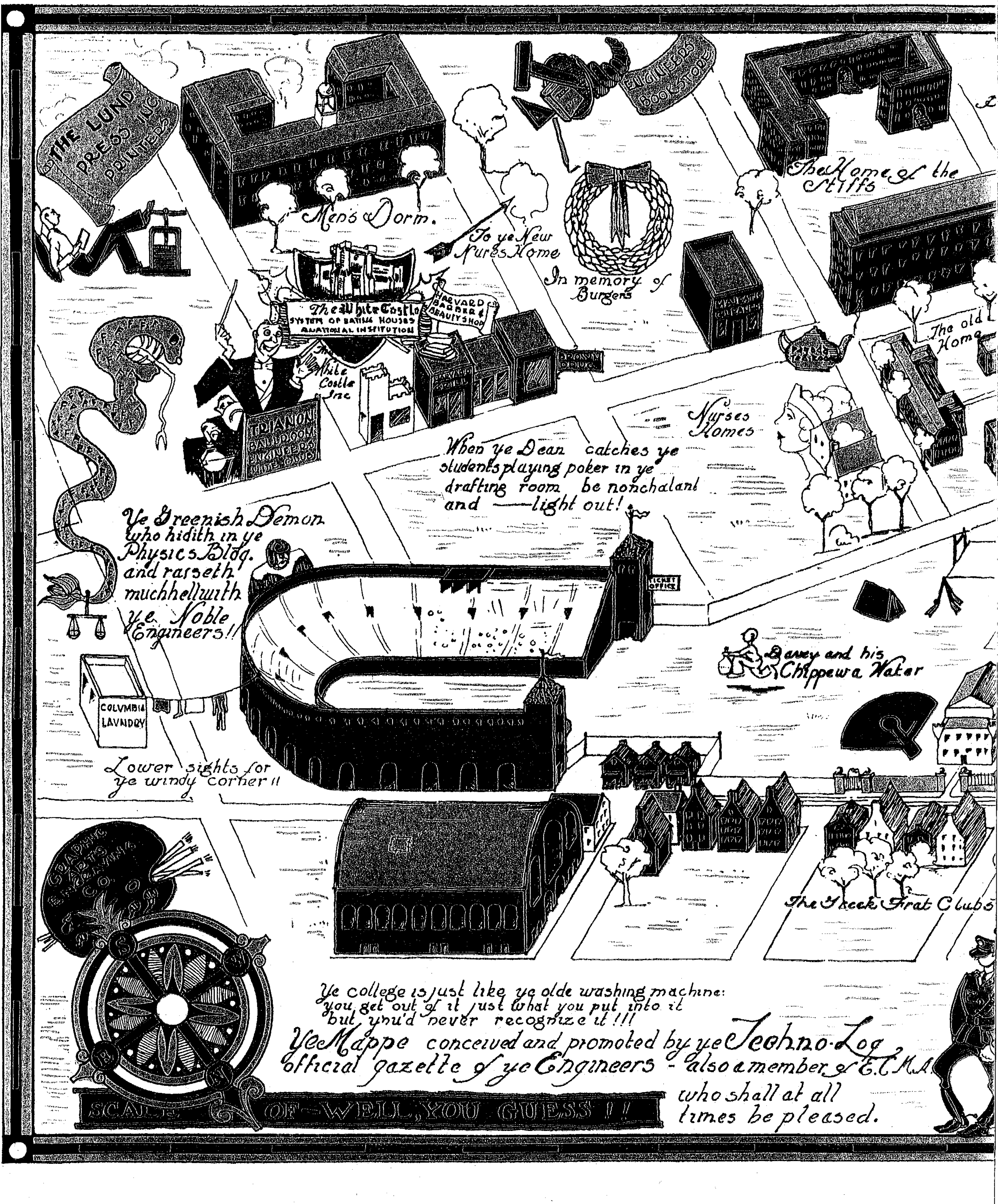
## Does Easy Do It?

IN life, we find that man has a natural tendency to follow the easiest path. So it is with engineers in college; they usually choose to do their easiest assignments first, and to spend the greatest part of their study time on the easiest subjects. Courses requiring charts and diagrams offer the greatest temptations, for who can resist the urge to turn in a perfectly inked and lettered masterpiece when no especial mental effort is needed to do the work? There seems to be a natural tendency within all engineers to linger over easy assignments that they have completed, putting in fancy drawings here and there, and painstakingly typing out intricate equations.

We must, however, stop for a moment at times to weigh the apparent value of each of our courses against their actual value to us in our chosen life work. It may be that the time we are spending on a certain subject is all out of proportion with the actual value of the subject.

If an undue amount of time is given to any one subject, the others must of course suffer. The basic courses in any branch of engineering usually are the hardest, but they are of maximum importance and should be given the greatest portion of the engineer's time.

The present age is one of specialization. Success can be attained only by keeping our chosen goal always in mind; by planning our courses of study in such a way that each evening our goal is just a little nearer.



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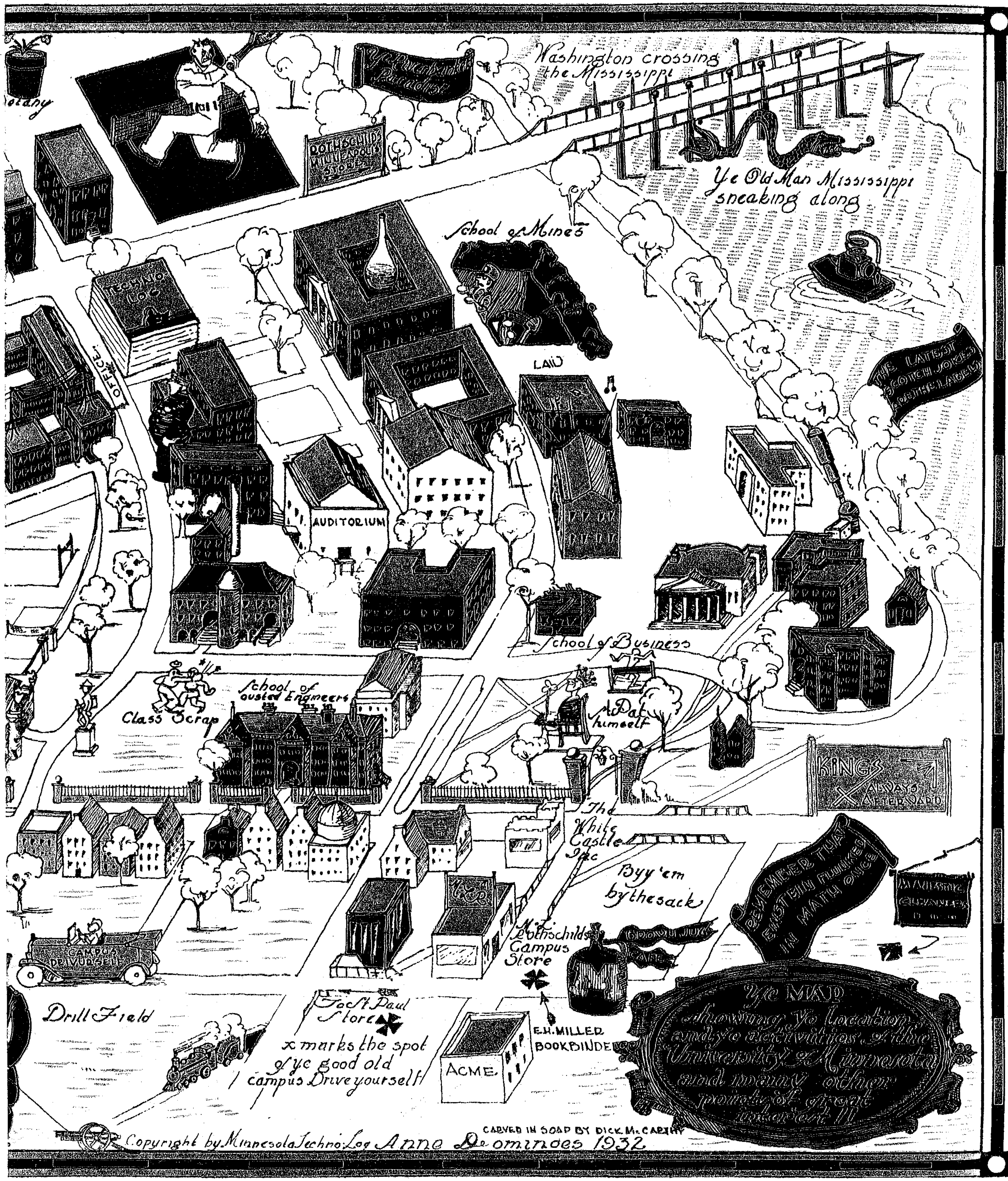
When ye Dean catches ye students playing poker in ye drafting room be nonchalant and —— light out!
Ye Greenish Demon who hidith in ye Physics Bldg. and rasseth muchhellwith ye Noble Engineers!!
TICKET OFFICE
Davey and his Chippewa Water
COLUMBIA LAUNDRY
Lower sights for ye windy corner!!
GRAPHIC ARTS ENGRAVING CO.
The Greek Frat Clubs
Ye college is just like ye olde washing machine: you get out of it just what you put into it but you'd never recognize it!!!
Ye Mappe conceived and promoted by ye Techno-Log official gazette of ye Engineers - also a member of E.C.M.A. who shall at all times be pleased.
SCALE OF—WELL, YOU GUESS!!



Washington crossing the Mississippi
ROTHSCHILDS MINNEAPOLIS STORE
Ye Old Man Mississippi sneaking along
School of Mines
TECHNO LOG
OFFICE
LAW
AUDITORIUM
School of Business
School of ousted Engineers
Class Scrap
The White Castle Inc
Buy 'em by the sack
KINGS ALWAYS AFTER WARD
REMEMBER THAT EINSTEIN FLUNKED IN MATH ONCE
CAMPUS DRIVURSELF
Drill Field
To St Paul Store
x marks the spot of ye good old campus Drive yourself!
ACME
E.H. MILLER BOOKBINDER
Campus Store
Ye MAP showing ye location and ye activities of the University of Minnesota and many other points of great interest !!
CARVED IN SOAP BY DICK McCARTHY
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1932

# NEWS FROM THE TECHNICAL CAMPUS

## *Chemistry Students to Sponsor "Chem" Show*

At a recent meeting of students in the school of chemistry, plans for a Chemical Show as a feature of Engineers' Day were discussed. The show is to be sponsored by the Minnesota student branch of the American Institute of Chemical Engineers. Heretofore no project of the sort has ever been presented at Minnesota.

Equipment and apparatus used in the school of chemistry will comprise part of the exhibits. Students will operate and demonstrate apparatus used in testing, analyzing and manufacturing chemical products. Exhibits of working models and products will be sent from a number of the large chemical companies to demonstrate some of the newer devolepments in the chemical engineering industry.

## *Swedish Architure Displayed in Art Exhibit*

There is at present hanging in the engineering auditorium an exhibition of contemporary Swedish architecture in drawings and photographs. These are largely reproductions of drawings of some of the new buildings in Sweden, and a large group of enlarged photographs of the architecturally noteworthy edifices in Stockholm. There are 231 of these photographs, the group including pictures of the Town Hall of Stockholm, the home of Professor Carl Milles, the Architects House, and a large group of the churches and theatres of Stockholm.

This collection is being circulated by the American Federation of Arts, a national organization for the culture of taste and art appreciation, from Washington, D. C. The pictures in this group were collected by the Swedish-American Foundation in cooperation with the Association of Swedish Architects and the American-Scandinavian The exhibition has the patronage of His Royal Highness, the Crown Prince of Sweden.

Three pictures in the group are aerial photographs of the city of Domnarvet. These are part of a city planning project, and show in one plate the city as it now is. The other plates are plans for the future of the city, being the same pictures of Domnarvet, but they have been retouched to show what it is desired to have the city be in the future.

Another picture in the group is of the doorway of the "China Cinema" in Stockholm. The face of this door is decorated in the real Chinese manner, with the traditional dragons and fantastic figures in ceremonial garb.

Another group of these pictures is of the home of Professor Carl Milles, a noted Swedish architect, whose home is just outside of Stockholm. These are views of both the building and the grounds about the home, and also some pictures of the interior of the house. Other pictures include a group of pictures of the "Architects' House", a house designed by a group of architects to embody their ideas of the best features of home design.

## *Chemical Engineers Make Inspection Trip*

Thirty five senior chemical engineers are at the present time completing an inspection trip of a number of chemical plants in and around Chicago. The trip comprises a part of the chemical engineering course and is taken every spring by the graduating class.

Together with the practical course in chemical manufacture taken in the summer just previous to the senior year, the inspection trip furnishes a broad background in the applications and possibilities of chemical science in engineering projects. Observations are made of new and unique processes, and records are taken which are later developed into a complete report of all the plants visited.

Doctors Charles A. Mann and R. E. Montonna of the department of chemical engineering are accompanying the group this year.

## *Changes to Be Made In Chemistry Department*

According to reports from a recent faculty meeting in the School of Chemistry the department of technological chemistry may be dropped. Courses in technological chemistry have been required of chemical engineering students in the past. If the department should be dropped parallel courses will be introduced in the departments of chemical engineering and analytical chemistry.

## *A.I.E.E. Inspects Plant Of Electrical Company*

Student members of the American Society of Electrical Engineers made an inspection trip through the Minneapolis plant of the Electric Machinery Manufacturing Company on the afternoon of February 18th.

Professor Kuhlman went along, of course, to keep his gang from blowing every fuse in the place, and Martin Swanson, president of the society, had to be there to count the number present for the minutes of his next meeting.

Guides from the company took small groups of students through the plant and pointed out the many features of interest to electrical engineers.

The assembly room, where large and small alternating current generators were being assembled and tested, was the first department to be visited. The coil winding and forming department was then inspected. Here forming machines turned out stator windings of various shapes and sizes and huge dipping tanks and ovens placed high quality insulating material on the shaped windings.

All punchings and laminations for the magnetic parts of the machine are made in the sheet metal department. Large paper condensers are wound by machine and combined in oil filled containers in the condenser department. These condensers, which are rated at 220 volts for continuous service, are used for correcting power factor of induction motors in industrial plants.

## *Architects' Fraternity Initiates New Members*

David Anderson, Eino Jyring, and Gordon Wall, seniors in the school of architecture, were initiated into Tau Sigma Delta, honorary fraternity in architecture, at a banquet held at the Skylight Club in Minneapolis on the evening of February 3. Following the ceremony Professor Mann gave an illustrated lecture on his recent trip through France and Italy.

Anderson is a member of Tau Beta Phi, honorary engineering fraternity; and Wall received the school of architecture faculty prize in 1930, and the prize offered by the Minnesota chapter of the American Institute of Architects in 1931.

## Electrical Laboratory Receives New Equipment

The newest addition to the equipment in the electrical engineering laboratory is a 40 k. v. a. three-phase induction regulator. The regulator, which was formerly used to maintain the voltage constant in a lamp factory in Minneapolis, has been donated to the electrical engineering department by the General Electric Company.

The apparatus has incorporated in it relays which automatically control the output voltage at 240 volts. If desired the relays may be disconnected, and the regulator manually operated. During the spring quarter two groups of senior electricals will make a study of the machine. These men will determine how the regulator may be used to the greatest advantage, and whether its utility will be enhanced by modifying the machine to make its operation adjustable, that is, so that it will automatically maintain the voltage constant for any of several voltages within its range.

The electrical engineering department has just completed the mounting of stroboscopic devices on six synchronous machines. The purpose of the stroboscrope is to measure the phase shift of the rotor when the machine is operated either as a motor or as a generator under different loads and power factors.

## Aeronauticals Hear Talk On Anti-aircraft Guns

Lieutenant R. A. Ericson of the military department discussed the effectiveness of anti-aircraft guns at a senior aeronautical society luncheon held in the Minnesota Union February 9.

The Army now has three types of automatic guns, used as anti-aircraft artillery, all of which are quite effective against normal targets, that is, attack planes. The 30 caliber machine gun is possibly the best known of the automatic guns due to its large use in the World War. It can fire 500 rounds per minute with an effective range of 2000 yards. Tracer ammunition is used to provide a method of aiming. The newest of type is the 50 caliber machine gun. This gun, which fires 600 rounds per minute, can penetrate the armor of a light tank. The gun is aimed by the use of a director or by tracer ammunition. The largest of the automatic guns is the 37 mm. gun. It uses either a director or tracer ammunition for direction finding. These guns are fairly effective at 1000 yards, and average about 8 hits per gun per minute at moving aerial targets.

There are two guns of large caliber in use as anti-aircraft artillery, a 3 inch and a 105 mm. gun. The normal targets of the 3-inch type are heavy bombing and observation planes. On either straight line or maneuvering flights this gun is fairly effective making hits with about 10 per cent of its shots. The 105 mm. gun is only used on straight line flights as it is difficult to aim quickly. These have the same effectiveness as the 3-inch guns and are a match for the heavy bombers provided the planes can be seen.

## Rotor Power Inventor Speaks to Mechanicals

Julian D. Madaras, inventor of the rotor power plant, described one of the rotor power units and discussed the economic possibilities of such a plant at a joint dinner meeting of the St. Paul, Minneapolis, and student branches of the American Society of Mechanical Engineers, held on February 8, in the Minnesota Union. Mr. Madaras announced that the first unit, including the tower and its car will be completed and ready for tests within the next month.

The theory of the rotor cylinder and details of construction of the plant were given in Professor Akermann's article published in the January issue of the Minnesota Technolog.

Clifford Anderson, president of the student branch of the society, presided, and Roman Arnoldy was in charge of entertainment. Several dancing acts, clog dancing, some saxaphone solos, and a few songs made up the lighter part of the evening's program.

## Koepke Shows Films

Two motion pictures were shown last week by Professor Koepke of the mechanical engineering department to members of the American Society of Mechanical Engineers. One Film, "The Thirtieth Part of a Hair", concerned the operations and manufacture of machine grinders. It depicted the methods involved in obtaining a high degree of accuracy in the process of machining large castings.

Another film, "Tungsten Carbide Milling", showed how tungsten carbide is made up into milling cutters and made a comparison of the cutting speed of tungsten carbide and high speed steel.

## Tau Beta Pi Discusses Changes in Curriculum

A dinner meeting of Tau Beta Pi, honorary engineering fraternity, was held in the ballroom of the Minnesota Union March 2. After the election of new members, proposed changes in the freshman curriculum were discussed by the members. Harlow C. Richardson, head of the engineering English department and chairman of a committee appoint by the faculty to investigate and revise the freshman curriculum, was a guest at the meeting.

All freshman courses were criticized, with the majority of comments applying to the mathematics department.

Although the shop courses have already been removed from the freshman program, many members asserted that shop work should be removed entirely because of its relative unimportance.

The drawing courses, which have been slightly reduced this year, also were the object of comments. The relation of drafting to different engineering fields was brought out by one of the faculty members present.

## Engineering Library Adds Vibration Text

Vibration has long been recognized by engineers as a powerful though little understood force, and structures have often been reinforced against failure from abnormal stresses resulting from it. A recent addition to the engineering library, "Noise and Vibration Engineering" by S. E. Slocum, presents a practical rather than theoretical treatment of this subject, blazing a trail into the new field of noise and vibration engineering and its relation to the comfort of man.

The book opens with a study of the characteristics of elastic ground waves and a discussion of the various seismographs used in analyzing transmission of waves through earth and rock.

Results of the author's studies of vibration dampers and insulation, and a description of modern methods of vibration insulation of tall buildings follow. One chapter develops in an elementary manner the fundamental mathematical relations which characterize simple vibration.

The control of street traffic vibration and subway noises receives treatment; and the vibration insulation of machinery together with related topics of noise abatement and sound deadening are also taken up.

# —and that's what the statistician does for industry

Definite knowledge of "where we are" and "what lies ahead" is as vital in business as in flying. For this expert navigating, the Bell System has long relied upon statisticians.

These men study present and prospective industrial, economic and social conditions in all parts of the country. They gather facts—analyze them, correlate them, discover their significance to the telephone business, draw guidance from them. They study and forecast the changing requirements of the public for telephone service. They estimate the probable future demand for new services, such as radio telephony to foreign lands and ships at sea. They keep the executives advised as to current progress towards the objectives thus carefully determined.

Only by plotting a course scientifically can the Bell System continue to develop along sound lines.

## BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

## *Engineers Arrange University Band Formal*

Positions on committees in charge of the annual Formal ball given by the University band every spring and to be held this year in the Grand Ballroom of Hotel Lowry, St. Paul, on April 8th have been given to several members of the Technical schools.

The chairmanship of the Alumni committee is held by Francis Calton of the School of Chemistry. William Sears, Aero. E. is chairman of the decorations committee and promises that the decorations will be the best yet produced at any party given by any campus organization. The chairman of the finance committee is Harold Shipman, Chem. Eng. He reports that the party is financially sound in every respect. Elmer Foskett, Chem. Eng., is serving on the ticket committee and Ross Green and Richard Brown hold places on the committee of invitations. Edwin Kelm of the School of Mines is chairman of the committee in charge of guests and Gayle Priester, chairman, with George Stefanich and Paul Sanders direct the Grand March. The publicity for the affair is being handled by Herbert Jensen, chairman of the School of Chemistry and Ralph Monson, Aero. E. It is planned to have the general theme of the Formal center around a "parade of the Big Ten," with the music, decorations and favors appropriately chosen to carry this out.

## *New Dentistry Building Has Unusual Clinic Room*

The main clinic room of the new Dentistry building, now being completed on Washington Avenue by the Standard Construction company, is believed to have the highest glass-to-floor ratio of any room of its character and size in the United States. There will be one square foot of window area for each three and one-half square feet of floor space. The north wall is almost half glass, the windows being carried so high that light can reach the working level four feet six inches above the floor, even at the innermost side of the room forty-three feet back, from an elevation of twenty-six degrees.

The light requirements created a difficult problem of exterior treatment to avoid the lifeless, staring aspect which is apt to characterize large glass surfaces. The problem was the more difficult, declared Professor Mann of the School of Architecture, because the massiveness of Millard Hall and the Anatomy building, which flank the new structure, tended to accentuate the vacant appearance of large glass areas in the new building.

Because the windows extend up into the facade and are out of proportion with other windows of the building, cast iron is being used to replace the brick and woodwork commonly used for window sash. The contrast between the brick and the shop black of the iron as it now stands is too great and will have to be reduced. By painting the iron more nearly to match the adjoining woodwork, the necessary value to offset the change from standard sash to the larger windows will be obtained. The exact color will be determined next summer by painting trial areas.

## *Eta Kappa Nu Entertains General Electric Men*

Eta Kappa Nu, honorary electrical engineering fraternity, entertained representatives of the General Electric Company at a business meeting held on February 23, at a campus tea shop. Guest speakers were Mr. M. M. Boring, head of the personnel department of the General Electric Company; Mr. Klass, local representative of the company; and Professor Bryant, head of the department of electrical engineering.

Mr. Boring told of various experiences he has had as contact man with the company, and Professor Bryant related some of his early experiences at the General Electric Plant in Schenectady.

# AROUND THE WORLD WITH OUR ALUMNI

## *Chemical Engineering*

'08—Walker—George W. Walker has returned to Minneapolis, and is now working with the Al Johnson Construction company. His new address is 308 Busch Terrace, Minneapolis, Minn.

'11 — Maney — Professor George A. Maney of Northwestern university was in Minneapolis recently. At present he is Professor of Structural Engineering at Northwestern university.

## *Electrical Engineering*

'05-'06—Magnuson—Carl E. Magnuson, director of the Engineering Experiment station of the University of Washington, has just written for a five years subscription to keep in touch with the boys. He may be addressed at any time at the university in Seattle, Washington.

'06—Mowry—Harry W. Mowry, who is with Western Electric company as installation development engineer, writes, "Regarding interest of old classmates, you probably know we had a reunion at Cass Lake in June of this year. About half the members of the class attended and had a chance to 'check and double check' everything. We also have a 'Round Robin' letter which has been circulating practically continuously for the past twenty-five years." Harry has moved recently and is now located in South Orange, N. J., at 275 Richmond Ave.

'24—Greene—Alfred B. Greene, of Glen Lake, was elected president of the Northwestern Society of Radiographers. You will remember him as the All-Senior president in 1924.

'28 — Froberg — Harold E. Froberg writes, "I am still located in Chicago with the American Telephone and Telegraph company. For the past three months I have been assigned to the long lines commercial department selling leased wire services and also the new teletypewriter service, and I find the work very interesting. I have met a number of classmates during by travels about town." Harold's present address is 4130 N. Keystone, Chicago, Ill.

'29—Ginnaty—Jack R. Ginnaty, former editor of the Techno-Log, dropped into the office recently and reports that he is not married yet; in fact, not even engaged.

'30—Edgell—Ernest E. Edgell is still working with the Electric Blue Print Company in St. Paul. He was recently engaged to Miss Harriette Davis, also of St. Paul. Congratulations, Ernest. Ernest is at present living at 196 Midway Ave., St. Paul.

'30—Johnson—Edward L. Johnson informs us that he is the father of a seven and a half pound boy. The Johnsons are living in East Pittsburgh, Pennsylvania.

'30—Punkari—H. V. Punkari, who is at present associated with the American Telegraph and Telephone company in their long lines department, visited the campus recently. In spite of the fact that he noted no changes in the laboratory of the Electrical Engineering building, there have been some remarkable additions. The balcony of the lab has received a great deal of new equipment recently, Helgi, and we hope you'll see it all in place on your next visit.

## *Mechanical Engineering*

'05—Gerrish—Harry E. Gerrish, president of the Morgan-Gerrish Company of Minneapolis, was recently elected president of the Minnesota chapter of the American Society of Heating and Ventilating Engineers. His present address is 808 LaSalle Ave., Minneapolis, Minn.

'05—Clipfell—Carroll D. Clipfell is still living in Redwood Falls. At present he is the president of the Scenic City Coop. Oil company and also the superintendent of the Redwood Falls schools, which takes care of his time quite fully.

'20—Powell—Knox A. Powell has recetly returned to Minneapolis from Lester, Pennsylvania, where he has been employed by the Westinghouse Electric company as a manager. His present address is 1008 18th avenue S. E. Minneapolis. He is now taking post graduate work at the University of Minnesota.

'31—Jordre—W. S. Jordre who formerly was located at Barberton, Ohio, is working with the Babcock and Wilcox company.

'31—Kindseth—Harold Kindseth is with the Kullberg Mfg. Co. of Minneapolis.

'31—Larson—Stanley J. Larson is associated with the Metropolitan Drainage Commission in Minneapolis.

'31—McNeil—Lawrence McNeil is in New York with the Babcock and Wilcox company.

'31—Myres—Robert Myres is in Minneapolis with the Bell Telephone company.

'31—Nichols—F. A. Nichols, as an aspiring engineer, is polishing locomotives for the Northern Pacific Railway in St. Paul.

'31—Nordeen—Harold E. Nordeen is the self-appointed photographer of the Employment Stabilization Survey which has offices in Northrop auditorium here at school.

'31—Olson—Melvin Olson is with the Straw Products Company in St. Paul.

'31—Sawyer—T. P. Sawyer is also with the Industrial Survey at the University of Minnesota.

'31—Thayer—Russel Thayer is taking graduate work at the Massachusetts Institute of Technology, Cambridge, Massachusetts.

'31—Toogood—L. S. Toogood is with the United States Bedding company in St. Paul.

'31—Watson—H. Duncan Watson is engineering with the Cargill Elevator company in Minneapolis.

'31—Whaley—F. J. Whaley is in South St. Paul with the Armour Packing company.

'31—Wiggins—O. J. Wiggins is working with the Industrial Survey at the University of Minnesota.

## *Civil Engineering*

'90—Burt—John L. Burt, owner of a sugar estate in Mexico, is now to be found at Ganadalojara, Jaliscor, Mexico, at Apartado 82.

'14—Ott—Leonard E. Ott is at present associated with the Merritt Whitney company as assistant superintendent in charge of construction on the United States Lock and Dam number 15 at Rock Island, Ill. This is part of the project that is at present being placed by the government as part of the development of interior waterways transportation.

Ex '29—Graves—Robin C. Graves is at present engineering superintendent for Foley Brothers of St. Paul, contractors who are at present constructing the St. Paul city hall.

## *Advance Courses Offered Graduate Electricals*

Beginning next year four new courses are to be offered in the department of electrical engineering. These courses are offered by associate professors Webb and Hartig due to the request of the graduate students and to follow the trend in changing the type of graduate work in the school.

Mr. Hartig will give a course of three quarters on electromechanical vibrating systems and engineering acoustics. It will cover a theoretical discussion of production of sound by electrically driven vibrating systems, sound transmission, reflection, and absorption; also a laboratory study of vibrating systems, pipes, horns, absorbing materials, sound pressure, articulation, reverberation, resonance, and sound filters.

Three new courses will be introduced by Mr. Webb; a three quarter course on electronics and one quarter each of radio transmission and radio receiver design. The electronics will be a theoretical and laboratory study with aspects of their engineering applications of the following subjects: electron emission from hot bodies, Richardson's equation, Langmuir-Childs equation, secondary electron emission, ionization and resonance potentials, external and internal photoelectric effect, positive ion emission, shot effect, discharge of electricity through gases, "getter" action, Barkhausen-Kurtz effect, ionization due to radioactivity, heavyside layer as a reflecting and refracting medium, long period echo effect, electron waves, vacuum gauges, and vacuum technic.

The radio transmission course will cover the design and operation of modern transmission equipment, with special emphasis on broadcast transmission. This course will be offered in the fall quarter to graduate students, and seniors by permission. Radio receiver design will include a detailed study of the problems arising in broadcast receiver design. This will also be offered in the fall quarter to graduates and seniors by permission.

Mr. Hartig's course, Electromechanical Vibrating Systems and Engineering Acoustics, will carry two credits per quarter and will be numbered EE. 272, 273, 274. Mr. Webb's course, Electronics, will also be a two credit course and will be EE. 215, 216, 217. His other two courses on radio transmission and radio receiver design are two credit courses but have not as yet been assigned numbers in the curricula.

## *Forge Shop Receives New Arc, Spot Welders*

The forge shop recently acquired several new arc and spot welders and exchanged an arc welder which has been in use for some five years for a later model. The equipment was added to meet the needs of the students in chemistry and chemical engineering and was requested by the faculty of the school of chemistry. Improvements have been effected to provide for work in soldering, brazing, piping, and arc and spot welding. For these purposes, a bench equipped with vises and gas furnaces has been installed across the east wall of the forge shop and five booths have been erected on the north wall for the welders. Gas, air, and electric connections were installed along the east wall for the bench furnaces, brazing torches, and soldering bits. Equipment will also be added for testing joints and pipe assemblies. Familiarity with this work will more fully enable the graduate chemist to build up his own apparatus when undertaking a research problem.

# St. Patrick

*—Parade . . . . Dansant . . .*
*. . . Brawl . . . and the*

**Minnesota Techno-Log**
**of**
**May, 1932**

*Alumni, Reserve*
*Your Copy Now!*

# Elevator Construction

(*Continued from page 127*)

winter quarter. Much experimenting was done in order to find the most advantageous arrangement for the different units of the set. Early in the fall quarter, one set was assembled with a wood framework for tests. From this and one other model the best design for the sets was decided upon.

Three transformers mounted on a portable rack are used with each set in studying transformer characteristics. The primary and secondary windings have been wound in sections, and leads brought from each section to the panel board just above the transformers. Practically any desired transformer connection may be obtained if this panel board is connected up with the motor generator set.

The sets are now in daily use by not only the junior electrical engineers for whom they were primarily purchased, but also by many other classes which use only the more common electrical circuits in their laboratory work. During the mornings classes of chemists, mechanical engineers, and others taking courses in electric power use the machines while in the afternoons junior electricals make constant use of them.

The completion of these sets fully substantiates the promise of Professor Springer that the equipment would be as easy and safe to use as a telephone, for even a high school student, after studying for a short time the simple circuit diagrams accompanying each set, could have the motors connected and running in a few minutes.

Before the new equipment was available, students were forced to spend a great part of their laboratory time in connecting up the individual units now so conveniently assembled in each motor-generator set. The elimination of this preliminary work gives the students more time to run their experiments, thereby increasing the value of the laboratory courses to them.

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All students fall in these categories—Those who think they receive what they deserve, those who think they received less than they deserved, and those who didn't think.

—*Topics in Ten Point.*

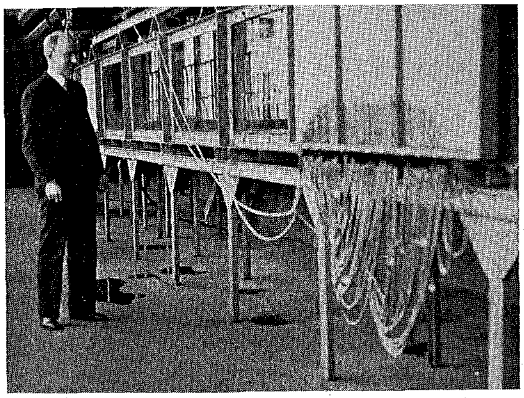
## *A. S. M. E. Hears About Ventilating Problems*

On Thursday evening, January 14, Mr. Forfar, associated with the Grinnell company of Minneapolis, gave a talk to members of the A. S. M. E. on the heating and ventilating systems used in the Minneapolis auditorium. His talk was illustrated with about a hundred slides showing the various parts of the installation. Mr. Forfar discussed the many difficult problems which had to be overcome before the project could be completed. Studies of the best auditoriums in the world were made before any work was begun on the design of the equipment for the Minneapolis Auditorium.

At a business meeting recently plans were begun for a week end trip to Duluth and Cloquet industrial plants. Arrangements are being made so that the trip will be made the first part of the spring quarter. Transportation will be by automobile.

A second meeting took place Wednesday, February 3. Mr. Bayliss, field engineer of the National Tube company, spoke on the process used in making seamless pipe.

# FACULTY SKETCHES



**Professor Straub watching the action of water in a channel through the glass sides of the flume constructed in the experimental engineering building.**

ANOTHER of our well known professors is Dr. Lorenz G. Straub of the Experimental Engineering Laboratories, who is internationally famous for his work on the hydrostatics of the Missouri river. Dr. Straub is associate professor and head of the hydraulics division of the University of Minnesota, and has done most of his work in the field of hydraulics and structural engineering.

Dr. Straub was born in Kansas City, Missouri on June 7, 1901, and received his grade and high school education there. He attended the University of Illinois and was graduated in 1923, with a B. C. E. degree, receiving the college of engineering scholarship. He continued his studies and received an M. S. in Structural Engineering in 1925, Ph.D. in Engineering in 1925, and a final degree of C. E. in 1930.

He did research work in 1923 and 1924 at the University of Illinois, and in 1924 and 1925 for an engineering company, working on reports and the design of waterworks and other municipal plants, including underground reservoirs, filtration plants, bow string arches, hollow and gravity concrete dams, and many other projects. From 1925 to 1927 he was an engineering fellow at the University of Illinois.

From 1927 to 1929 Dr. Straub traveled in various European countries, making hydraulic engineering investigations as the first "Freeman Traveling Scholar" and the auspices of the American Society of Civil Engineers. On this trip he went all over Europe visiting the larger cities and seeing something of every European country. Returning from Europe he was with the United States Engineering Department two years as head of the "Special Studies Department." This work was in the Kansas City district, dealing especially with investigations of the regimen of the Missouri river and its tributaries. Since this he has been head of the Hydraulics division of the University of Minnesota.

Dr. Straub's interests or hobbies are: music, hiking, birds, flowers, and photography. He likes travel in general, and especially hiking through the woods watching birds or flowers and perhaps making a few pictures. He is traveling more or less now with the government on river work, studying the relation of stream flow to transportation of sediment, and the effect of dams and other obstacles in changing the characteristics of a stream.

As a youth Dr. Straub's ambition was to be a pigeon

(*Continued on page 147*)

# Agriculture and Engineering

(*Continued from page 134*)

the area of leaf surface consumed by each insect can be made.

When the lethal action of chemicals is determined with respect to mammals, a measured quantity is given to the experimental animal, administered by mouth or by injection into the blood stream or beneath the skin. Then the minimum lethal dose is computed in terms of unit body weight. To provide a similarly exact method the government entomologists used leaf disks of uniform area and evenly dusted with particles falling from a dust cloud in a belljar. The amount of dust on the disks was determined at each dusting by weighing that which fell on glass circles of the same size. Two leaf disks were pasted together, enclosing the poison dust on one of them and so forming a poisoned leaf "sandwich" readily eaten by test insects of the leaf-eating type. A planimeter method was used to measure the area consumed out of each sandwich. By inspection of the calculated doses, sublethal and lethal, it was possible to estimate with considerable accuracy the "median lethal dose"; i.e., that dose from which the insect is as likely to recover as to die. This type of end-point for statistical reasons is considered the best upon which to base comparisons. It is interesting to note that on a weight basis the lethal dose of various arsenical compounds is practically the same for an insect as for a mammal, taking for purposes of comparison data for the silkworm and for the rabbit.

In a recent study of the speed of toxic action of lead arsenate in an insect, a gold-leaf electroscope was used. Thorium B is a radioactive isotope of lead and therefore may be inseparably mixed with that element. An unknown but extremely small quantity of thorium B then becomes an indicator when mixed with relatively large, known amounts of lead. The electroscope was used to determine the relative amounts of radioactive lead (thorium B) in various minute samples of insect material after the insects had been fed with a mixture of arsenates of lead and of thorium B. Of course such a study could only indicate the fate of the lead-thorium B mixture in the insect, for arsenic does not necessarily remain attached to the metal after insect digestive juices dissolve the poison.

The application to the problems of insect control of such fundamental principles of chemistry and physics as govern the fields of colloid chemistry, radioactivity, organic synthesis, and others as important, is bound to develop this aspect of agriculture. The entomologist should have a working knowledge of the basic sciences, chemistry and physics. But more and more the entomological workers of this country are calling upon trained chemists, physicists, and others to be their co-workers, mingling knowledge of the fundamental sciences with the biological experience of the entomologist to develop a higher understanding of our insect enemies and their control.

## *Chemical Honorary Initiates*

The new men honored with membership in Phi Lambda Upsilon included Marshall Ruley, Edgar Piret, Ralph Peck, Henry Yutzy, Einer Michaelsen, and Arthur Hibbard.

## FACULTY SKETCHES

(*Continued from page 145*)

fancier, and he had one of the largest pigeon cotes in Kansas City. He had a very great variety of pigeons of every kind and was the envy of all the other kids in the neighborhood who raised pigeons. He is still interested in this work, and even now would like to start in again and gather a group of pigeons together. As an amateur photographer Dr. Straub has also done a great deal and has an immense collection of snapshots made in various places.

At present Dr. Straub is working on a problem in the hydraulics laboratory, trying to reproduce in the flume he developed certain conditions found in the Missouri river. He has several of his classes working on this problem. They are trying to obtain in a model the same sort of sedimentation as the river is observed to give.

Dr. Straub is a member of the following fraternities and societies: American Society of Civil Engineers, Verein Deutscher Inginieure, American Concrete Institute, Society for the Promotion of Engineering Education, American Association for the Advancement of Science, Kansas City Engineers Club, Sigma Tau, Sigma Xi, Gamma Alpha, Chi Epsilon.

**COMING UP!**
**—The Second Annual**
**TECH BANQUET!**

# « « MENTAL TILTS » »

## NUMBER, WHO HAS IT?

What is the number which multiplied by three, then increased by three-fourths of the product, divided by seven, diminished by one-third of the quotient, multiplied by itself, diminished by 52, by extraction of the square root, addition of eight, and division of ten gives the number two?

### Answer to Last Month's Tilt

WINE. The amount of wine taken from the wine vessel is one teaspoonful. The amount of water returned to the wine vessel is one teaspoonful minus the small fraction of wine. Therefore, the amount of wine left in the water glass is one teaspoonful minus the small increment removed with the water. But the amount of water moved to the wine vessel is one teaspoonful minus the same increment of wine. Therefore, the amount of water removed is the same as the amount of wine.

# THE MINNESOTA TECHNO-LOG

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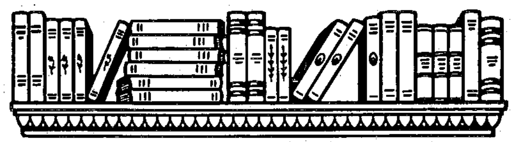
APRIL, 1932



April, 1932

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# the MINNESOTA TECHNO-LOG

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SMOKE *not only destroys or injures living matter but also shows a waste of fuel.*

RECENT EXPERIMENTS *show Professor Springer's KIT method of calculating synchronous generator regulation to be accurate.*

HIGH TEMPERATURE *heating presents many difficult problems which the ingenuity of chemical and mechanical engineers is slowly solving.*

GALA, *no less, will be the coming May issue. Watch for it!*



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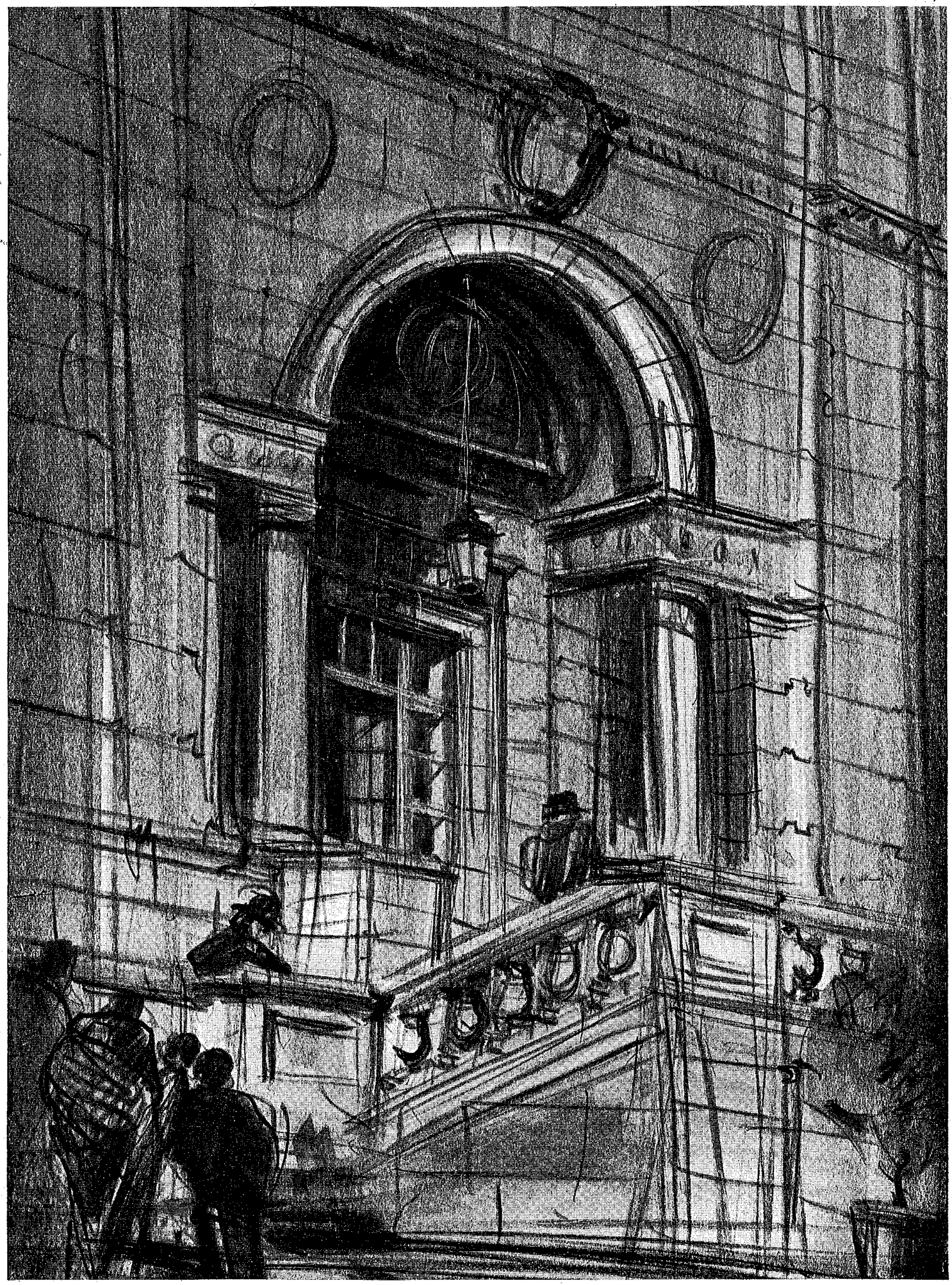


**The Hill Reference Library, Saint Paul**
—A Lithograph by Robert Cerny

# Smoke nuisances can be Prevented

By CHARLES F. SHOOP
Professor of Steam Engineering

THE Mellon Institute presents a bibliography that lists over 1500 books, bulletins, and articles on the subject of combustion as it relates to smoke abatement. In perusing this digest of material covering as it does all phases of the subject in hand, one is likely to say, "What new is there?" and feel that another contribution must of necessity be a repetition. This captious feeling receives further substantiation after contact with the voluminous treatise on Smoke Abatement, an investigation, compiling statistics for the City of Chicago.

Nevertheless, information regurgitated, having previously been only partially digested and then re-digested may be presented in such form as to bring to one's attention a concept never before grasped or thought through, a real contribution to our present knowledge. Aside from this source of constructive information and research data, now public property, there is available the means employed in recent progress in the attempt to increase efficiencies of combustion and the decrease of smoke. That success has crowned these research efforts is evidenced by the apparent confidence they have established in the minds of the management of certain power and industrial organizations by the incorporation of these processes in the attainment of greater economies.

Practically all authorities agree, excepting the English, that it is possible under certain maintained conditions (these conditions are definitely known and established) to burn high volatile coal without the production of smoke. The English combustion engineers believe that they cannot possibly prevent black smoke unless smokeless fuel be used; the reason for this attitude will be considered later. There are many plants burning a wide variety of fuels in ordinary hand-fired furnaces, in extension furnaces, and automatic stokers that are operating without smoke. It is safe to say, however, that no plant will operate smokelessly under any and all conditions of service, nor is there a plant in which the degree of smokelessness does not depend largely upon the intelligence of the operating force.

Even though authorities agree that smokeless combustion is possible, they further agree that, in many cases where proper conditions and equipment are at hand conducive to smokeless combustion, the human element does not "conduce" but "produce" and smoke is the product. The number of installations which are burning coal smokelessly is in the minority when compared with those producing smoke, where either the installation or human element is at fault. This statement, however, may not apply to certain densely populated districts of our large cities, where enforcement is imperative and rigidly maintained.

The products formed from fuel burning are solid particles of soot, charcoal, dust, ashes; visible gases of tar and condensing water vapor; invisible gases of carbon monoxide, carbon dioxide, various hydrocarbons, nitrogen, sulphurous vapors; and some negligible quantities of other gases.

The characteristics of the particular fuel, with the degree or percentage of complete combustion secured in burning, will vary the proportions of the above enumerated products.

In general, all the products of incomplete combustion may be termed "smoke" and are so considered in this article.

The deleterious effects of smoke may be grouped under four headings:

The effects on health;
on buildings, clothes, and household furnishings;
on vegetation; and
on general municipal cleanliness and beauty.

Healthful living embodies the elements of pure water, pure air, pure foods, clean environments, clean living.

All cities have large health and water departments to protect the milk supplies, food stuffs, drinking water, and to dispose of sewage. Their budgets run into millions. But to clarify a vitiated atmosphere often one smoke abatement officer heads up the division with a budget not much larger than his salary. If we so zealously guard the purity of our water, milk, and food supplies, why not the purity of the air we must have all the time, whether asleep or awake?

Nature apparently did not intend that the respiratory tract of man should breathe in products of combustion or incomplete combustion, although it has provided a wonderful system of moistening and filtering the air that goes into the lungs. The air we breathe is filtered through the narrow and tortuous channels of the nose where it impinges upon the mucous membrane which is moist and sticky and endeavors to take out of the air solid particles in suspension, but it cannot completely do it when the atmosphere contains an excess and over-abundance of the products of incomplete combustion.

For the impurities and non-assimilative material we eat and drink, nature has supplied a method of elimination. Our stomach is provided with two openings; an inlet and an outlet. Our lungs, however, have no outlet; the inlet must serve as both, so that foreign material in solid form must be expelled by coughing, not a normal body process. Our stomach is sturdy; our lungs are composed of delicate tissues. We consume, normally, only about five pounds of food and liquids per day, while we breathe in about thirty-five pounds of air during a like period.

A post mortem on a city resident will reveal a brown colored pair of lungs; a miner or local coal shoveler, a pair of black lungs; a farmer's lungs, a dirty pink; an Eskimo's lungs, a healthy pink. Perhaps city residents should organize a nose air-filter club.

Investigators attempting to determine accurately the effects of smoke on health have encountered, perhaps even more than others, the difficulties of eliminating such conditions as have like effects. We, therefore, find a good many conflicting conclusions, especially among the earlier investigators. The net conclusions of several hundred investigations seem to be about as follows: (1) that smoke in the ordinary quantities has no direct harmful effect on a normal healthy individual; i.e., it cannot be shown to be a direct cause of ill health; (2) smoke is seriously detrimental to persons suffering from diseases of the lungs, throat, and nasal passages; (3) long continued breathing of smoky air lowers the general physical tone; (4) the effect of smoke on the sanitary surroundings is very undesirable both because it excludes sunlight and because the grime it deposits tends to produce carelessness in other directions; (5) the most objectionable personal effects are the psychological ones. Smoke, as we know from our own experience, tends to make us irritable; it also increases fatigue and depression and produces various aggravating local irritations which reduce the capacity for work.

Dr. E. E. Free, consulting engineer, New York City, states that on the clearest day one cubic foot of New York city air contains 50,000 particles. This may increase to 3,000,000 on the smokiest day. For the past five years in New York city the average has been 500,000 particles per cubic foot. This is equivalent to one ounce of soot per 12,000,000 cubic feet of New York air.

Contrary to popular opinion, Dr. Free stated that rain and snow have little effect in clearing the atmosphere of smoke particles (other than cinders). The small smoke particles (1 micron in diameter) fall only thirty feet in ten hours during which time they would have been blown 100 miles by a moderate breeze.

Smoke clouds limit the amount of available sunlight. The filtering out of ultra-violet radiation or ordinary sunlight is influenced not only by the actual weight of smoke but by the flocculation of small particles into large ones.

We believe that ultra-violet light does have an important effect upon health, but the many factors involved in checking up causes of death and death rates makes it impossible, with our meager statistics, to lay the same directly to the lack of ultra-violet light.

It is reported that the atmospheric condition at the lower end of Manhattan Island, where the air is very smoky, was such as to show an average loss of daylight on sunny days of 42 per cent at eight o'clock in the morning and of 18 per cent at noon. Observations were reported as of January, 1927. In Pittsburgh it is estimated that 30 per cent of the artificial lighting is due to atmospheric conditions for which smoke is responsible. One factory head ventures to state that a disagreeable day yields 10 per cent less labor returns than an agreeable day.

Smoke deposits tarry matter and ashes over everything exposed. With a short stack and raised windows the furnishings of residental property are greatly damaged. To permit the liberation of free acids which expend their devastating effects upon building materials, paint, and clothing is an economic waste.

Practically all coal contains sulphur; if it averages 1 per cent sulphur and above 75 per cent of this escapes into the air, mostly all as sulphuric acid, then every chimney would discharge about one ton of sulphuric acid into the air for each 133 tons of coal burned. This is why sheet iron and sheet tin roofs are eaten out so quickly and why limestone in buildings deteriorates. There are about 50 billion cubic feet of deluged gases discharged into the atmosphere every day in Chicago; a reason for the washing of white buildings.

If Chicago did not have a high average wind velocity (14 miles), the air conditions would be almost unbearable. One reason why Pittsburgh is so smoky is that it is almost enclosed by high hills, and has a very low wind velocity. Salt Lake City is another city surrounded by high hills with a lack of wind velocity; as a result fog, smoke, dust and soot clouds hang over the cities.

In an average day Minneapolis belches forth at least 5,000,000,000 cubic feet of stack gases to vitiate the atmosphere.

In the fall some years back the Park Board planted at the gateway a number of linden trees. In the spring these trees developed splendid foliage. By the first of July most of the foliage was gone and the trees were almost leafless the remainder of the season. After three years these linden trees had to be replaced by the more hardy Carolina poplars.

***Gas, coke, bituminous and anthracite coals, lignite, peat—any fuel—is a potential smoke producer.***

***Smoke analysis and classification, determination of causes of smoking, and means for preventing or remedying smoke producing conditions are necessary tools for smoke prevention. In a coming issue Professor Shoop explains means of smoke elimination by use of these tools through proper engineering practice and good government regulation.***

The soot that floats through the air lodges on the foliage of the trees and plants and clogs the life cells of the foliage producing disease and a lingering death. Cleveland reports that soot gathered from leaves analyzed two to three per cent sulphuric acid. Rain will not wash the plants free from the soot. Soot produces stagnation upon vegetation of all kinds. In some locations the soil becomes so acid that it is difficult for any vegetation to grow.

One of the most discouraging effects of smoke is its effect upon municipal beauty and cleanliness. This effect discourages artistic expression in respect to architecture, statuary, paintings, and even dress. Smoke is deposited on all things exposed, reducing them all to the same somber color.

The U. S. Steel corporation, the National Cash Register company, and many other industries have long ago recognized what clean surroundings mean to both skilled and unskilled labor. The spending of enormous sums of money by these organizations was not merely humanitarian — it was business. It resulted in increasing output; it was a paying investment. The continued sight of withered vegetation, dirty buildings, and a black smoke smudge hanging over a city is sure to decrease any special enthusiasm for work.

What is municipal progress? Does the smoke from factories persuade other manufacturers and institutions to settle in a given city? Will it drive present manufacturers out and prevent others from coming in if the strong arm of the law enforces rigid compliance to the smoke ordinance? This has not been the finding of cities that have abated the smoke nuisance successfully. There are truly other civic problems aside from the purely industrial and commercial.

Minneapolis has an average soot fall of about 540 tons per square mile per year. If this soot were ground in oil, there would be sufficient black paint to cover fifteen square miles with two coats. Your residence lot, 50 by 150 feet, receives seventeen bushels of soot per year.

Mr. G. Murphy of the Midwest Air Filter company places Minneapolis eighteenth in a list of twenty-three cities as to air density; i.e., dust or soot count in the air.

That the dirt and haze in London are due almost entirely to coal smoke was proved by the remarkable cleanliness of the streets and clarity of the atmosphere during the coal strike of 1921. London has the most smoke of any city in the world, with four hundred tons of unconsumed matter going into the atmosphere each day.

***Truck, train, and barge bring coal—fuel—to a city. Some of this fuel leaves as part of a finished product, some is dissipated through the air as heat, and some is allowed to go up the stack as smoke.***

***Besides being a definite waste of fuel smoke many times contains corrosive acids. Engineers have begun to realize these evils in smoke and are taking many precautions to prevent its appearance. In this article Professor Shoop shows some of these points.***

Residence smoke, which normally constitutes 25 per cent of that emitted, is especially undesirable to the householder, as it is emitted at low levels. The low temperature furnaces burning high volatile coal are productive of that thick yellow smoke laden with sulphur compounds which form sulphuric acid fumes on being brought into contact with moist air. These fumes are highly destructive to both living and dead matter.

Dr. Free states that in New York city the utility steam and electric plants and large factories are not the primary offenders and that more than 90 per cent of the smoke nuisance comes from apartment buildings, houses, and other small users.

Colonel Eliot H. Whitlock has been studying the smoke problem of the New York metropolitan area, particularly from the New Jersey shore, under the auspices of the Stevens Institute of Technology since June, 1930. He disagrees with Dr. Free that the larger plants are minor offenders.

The Mellon Institute gives the following averages for the distribution of smoke sources for various cities:

| | |
|---|---|
| High pressure and industrial plants | 45% |
| Large heating plants | 12% |
| Railroads | 18% |
| Residences | 25% |

Dr. Free contends that he proves his point by identifying plants from which certain smoke particles have originated. He states he did this by studying the shape and character of carbon and ash particles at given plants and at distant air sampling stations. Using this system of identification he was able to tell what proportion of smoke collected at a distant station originated at the plant under question. Even Sherlock Holmes, according to Sir Arthur Conan Doyle, tracked criminals by the analysis of their cigar ashes.

While the complete abolishment of smoke is in many cases not economically feasible, there are at present a number of forms of treatment of the problem which can be used. These methods may be divided into two groups; the remedial, where smoke is treated after its formation, and the preventable, where methods are used which prevent the formation of smoke.

The method of cleansing smoke by washing has been used successfully by a number of railroads and industrial plants, but the difficulties encountered in maintaining these plants in the presence of the corrosive action of acids developed by the process make the repairs and operating costs abnormally high.

In the electric precipitation method the smoke is passed through a series of grids carrying an electric current. The very small particles of carbon upon coming into the electric field about the grid become sensitized and form themselves into nuclei or aggregations of particles. These condensed centers of carbon are carried forward in the smoke stream until they are brought sufficiently close to the grid to be snatched from the passing gases. At intervals the electric current is cut off and the grids cleaned.

The removal of smoke producing plants to locations outside of the city limits can do much towards reducing the smoke problem of the cities.

Central power and heating plants may be placed under rigid restrictions and supervision. Many such plants are operating smokelessly; hence it is possible for all to do likewise.

Smoke drains, i. e., artistically constructed tall chimneys which bleed centrally located plants, emitting the smoke at such height as to carry it beyond the belt of thickly populated districts, may also be used to eliminate smoke in cities after its formation.

Few industrial plants use large quantities of manufactured gas, a smokeless fuel, so its consumption at present is principally limited to domestic or household use.

Burning of natural gas transported through pipe lines from distant states can also be considered. Natural gas from the Oklahoma gas fields has been piped to Rochester, Minnesota, and if inducements were forthcoming, the 18 inch pipe line could be extended from Rochester to the Twin Cities in less than nine months. The gas fields of the North have penetrated to Sioux Falls, South Dakota. We may expect that, in a comparatively short time, natural gas will be sold to the domestic consumer and industrialist in our Twin Cities, as three sources are now in evidence. It is a smokeless fuel.

High temperature coke is a smokeless fuel with not more than two per cent volatile matter. It is not well suited to power and large heating boilers on account of its lack of ability to respond quickly to change of steaming rate on load demand. There has been considerable trade developed in the consumption of this fuel for domestic use. It is a smokeless fuel.

(*Professor Shoop concludes his smoke prevention discussion in the May number of the* MINNESOTA TECHNO-LOG. *—Editor*).

# calculating the Regulation of Synchronous generators

*An empirical formula developed by F. W. Springer, professor of electrical engineering, offers a simple method of regulation calculation. Mr. Kendall, who describes this method, is now a graduate student working under Professor Springer.*

By D. B. KENDALL
E. E. '30

THE most common form of synchronous generator has a rotating direct current field of such form that the resulting field in the air gap generates a voltage in the armature coil-sides resulting in a sine wave terminal voltage in properly connected armature coils. In the case of a pole-pitch armature winding the poles will be under the respective coil sides when the induced voltage is a maximum. If the armature current be in phase with the voltage, as is the case with a unity power factor load, then the pole axis and pole magnetomotive force will be 90° ahead of the armature axis and magneto motive force.

In case the current in the armature is 90° lagging, the load being of zero power factor inductive, then the pole and armaturemagneto motive forces will be in the same line and in opposition when the armature current is at peak value. With the armature current leading by 90°, as with zero power factor on condenser load, then the two magnetomotive forces will lie in the same line and be in the same direction. In this case the machine tends to become self-exciting.

The above covers the extreme ranges of armature reaction as affecting the poles and it is evident that the exciting current in the field coils must be increased very considerably as the current in the armature varies from 90° leading to 90° lagging, or from direct magnetizing to direct demagnetizing action on the poles.

A number of equations have been developed by calculation and experiment in order to calculate the above demagnetizing effect of the armature. They give somewhat different results and evidently must be applied by expert designers to correctly compensate for the variations in structure and design practice.

Professor Franklin W. Springer of the electrical engineering department has proposed an empirical formula for calculating the armature reaction in salient-pole three phase alternators which seems to have some pedagogical as well as practical advantages. In the development of this formula he proposes to start with the maximum or peak current of one phase and then to introduce an empirical constant to determine the average effect of the three phases on a pole. Considering the maximum or peak value of the current, the magnetomotive force per pole of one phase of the armature would be proportional to $I_mT$, where $I_m$ is the maximum value of the phase current and T is the number of armature turns in series per pole per phase. It must be true that for a given machine there is a definite ratio between these real and definite maximum or peak ampere turns for one phase per pole and the average magnetic effect of the three phases per pole. This ratio will be called K′ and has been found by tests on ten machines made by the Electric Machinery Manufacturing company to be approximately 1¼ for the average machine. Then for the average machine the armature reaction, or demagnetizing effect (KIT) of the armature, when the current lags 90° behind the voltage, is 1¼ $I_mT$.

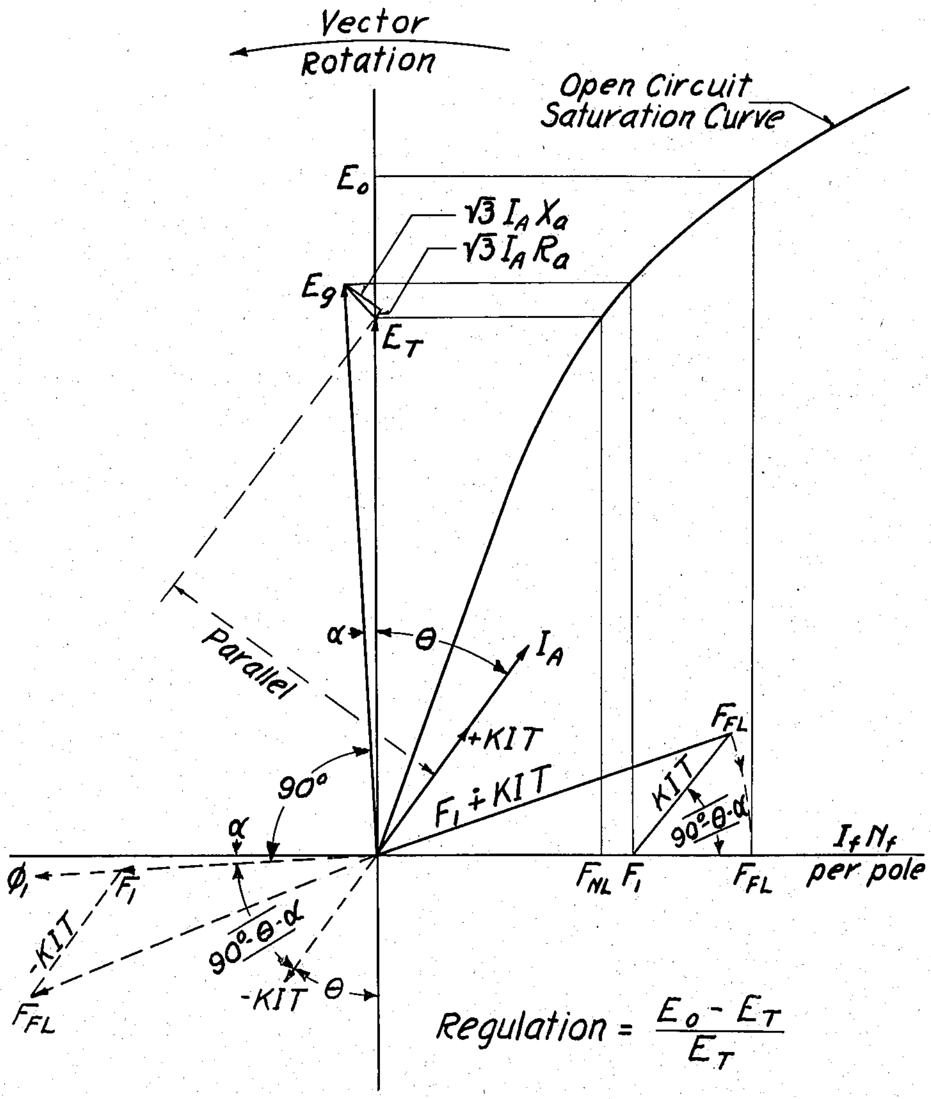
The armature reaction, $(K'I_mT)$, will be somewhat different for different machines, depending upon the amount of chording of the armature winding and upon the pole span or pole width and distribution form of the flux produced by the field pole. It is a commercial practice to use windings with a span of two-thirds to full pole pitch of 180°, or an average span of 150°. The form of flux distribution is affected by pole width, pole shape, and the relative length of the air gap. Ordinarily the pole width varies in practice from 65 to 75 per cent of pole pitch.

Professor Springer proposes to use K′ for the average machines such as those having 150° chording and 70 per cent pole width and then to correct the empirically derived armature reaction ampere turns, $(K'I_mT)$, per pole, for variations in chording either way from 150° and for variations in either direction from 70 per cent pole span.

The chording correction is found to

**SYMBOLS USED IN DIAGRAM**

| | | |
|---|---|---|
| $E_T$ | = | Terminal voltage. |
| $I_A$ | = | Armature current per phase. |
| $\theta$ | = | Power factor angle ($\cos\theta$ = .8) |
| $R_a$ | = | Armature effective resistance per phase. |
| $X_a$ | = | Armature reactance per phase. |
| $E_g$ | = | Generated voltage at full load ($I_a$). |
| d | = | Angle between terminal and generated voltages. |
| $F_{NL}$ | = | Field ampere turns per pole to generate $E_T$ at no load. |
| $F_1$ | = | Field ampere turns per pole to generate $E_g$. |
| KIT | = | Armature reaction in ampere turns per pole. |
| $F_{FL}$ | = | Field ampere turns per pole required to maintain rated $E_T$ at full load (.8 power factor). |
| $E_0$ | = | Open circuit voltage with field excitation $F_{FL}$. |
| $\phi_1$ | = | Air gap flux required to generate $E_g$. |




**Professor Springer's Solution may be Clearly Shown Graphically**

be approximately one per cent for each 5° variation from 150°; hence, a full pole pitch or 180° winding would require ($K'I_mT$), as derived, to be increased 6 per cent, while in case of the 120° winding ($K'I_mT$) should be reduced 6 per cent.

The second correction is for the variations of pole width or field flux distribution from the average value assumed. It is found that ($K'I_mT$) should be increased approximately 1 per cent for each per cent less than 70 per cent. Similarly ($K'I_mT$) should be decreased about 1 per cent for each per cent that the pole span exceeds 70 per cent.

The extreme cases would be combinations of the extremes of the above two corrections, namely: first, a wide pole having a long concentric air gap combined with a short-chorded armature, all resulting in large leakage and the necessary reduction in ($K'I_mT$) of about 11 per cent; second, a narrow pole with a short air gap and a short radius pole face with full pole pitch armature coils. In such a case ($K'I_mT$) would be increased about 11 per cent because the armature magnetomotive force of each coil would embrace all the flux of the pole over a considerable angle of action.

For numerical convenience the root-mean-square current (I) may be used instead of the peak value ($I_m$) with a corresponding change of K′ to K as indicated:

$$K'I_mT = 1\tfrac{1}{4}\, I_mT = 1\tfrac{3}{4}\, IT = KIT$$

The regulation of an alternator is the percentage rise in voltage when the rated kv-a load is thrown off, the excitation and frequency being maintained constant. The regulation depends on the magnitude of the armature reaction and armature impedance, and also upon the power factor of the load.

As an example of a common method of determining regulation, consider a 200 kv-a, 2400 volt, 16 pole, three phase, single circuit, Y-connected alternator having 120 slots, 2 coil sides per slot and 6 turns per coil, winding chorded to 66.7 per cent pitch (coil span of 120°), pole span being 73 per cent of pole pitch. The armature resistance ($R_a$) is .576 ohms (2 per cent) per phase and the armature reactance ($X_a$) is 2.30 ohms (8 per cent) per phase. The open circuit saturation or magnetization curve of this machine is shown in the figure, terminal volts being plotted against field ampere-turns per pole. Assuming full load and 0.8 power factor, current lagging, the first step in calculating the regulation would be to determine the generated voltage, $E_g$, by vectorially combining the armature impedance drop and the terminal voltage, $E_T$. The phase current will be

$$I_A = \frac{200{,}000.}{\sqrt{3} \times 2400} = 48.2 \text{ amperes,}$$

lagging the terminal voltage $E_T$ by the angle $\theta = 37°$ as shown in the figure. The armature resistance drop per phase is $I_AR_a$ and the reactance drop per phase is $I_AX_a$. Since the saturation curve is given in terms of terminal voltage, these drops must be multiplied by $\sqrt{3}$. Then

$$\sqrt{3}\, I_AR_a = \sqrt{3} \times 48.2 \times .576 = 48 \text{ volts}$$

and

$$\sqrt{3}\, I_AX_a = \sqrt{3} \times 48.2 \times 2.30 = 192 \text{ volts.}$$

The resistance drop is in phase with the current and is drawn parallel to it as shown in the figure. The reactance drop is at an angle of 90° with the current and is so drawn. The generated voltage, $E_g$, is thus found to be 2560 volts, displaced by the angle $\alpha = 3°$ from the terminal voltage $E_T$. To determine the armature reaction (KIT),

$$I = 48.2 \text{ amperes}$$

$$T = \frac{120 \times 6}{16 \times 3}$$

$$= 15 \text{ turns per pole per phase.}$$

The armature reaction would ordinarily be 1.75 IT = 1.75 x 48.2 x 15 = 1264 ampere turns per pole. However, since this machine has a coil span of only 120°, the reaction should be decreased by 6 per cent, or 76 ampere turns. Also, the pole span is 73 per cent of pole pitch so the reaction should be further decreased 3 per cent or 38 ampere turns for this factor. The actual value of armature reaction, or demagnetizing effect of the armature if the current lagged the voltage by 90°, would thus be 1264-76-38 = 1150 ampere-turns per pole. These ampere-turns are in phase

(*Continued on page 168*)

# better, cheaper High Temperature Heating with organic fluids

***Lowering pressures and increasing temperatures the use of organic substances for indirect heating purposes is gradually advancing. Easy design of equipment and close temperature control are important factors in their increasing usefulness.***

By G. H. MONTILLON
Professor of Chemical Engineering

IN the good old days "Boiling in Oil" was a favorite way of roasting one's enemies and strange to say, this method is still in great favor for high temperature heating. The bearded alchemist with mystic powers ground and mixed his potions while by devious ways of calcination, lixiviation, filtration, and distillation, he continually sought a way to turn the base metals to gold. In those times chemical change brought about by heating was a mighty tool in the bag of tricks of the seeker of the world's secrets. And though centuries pass and times change, the useful tools of man still remain—with the new developments leading us on in a fascinating manner.

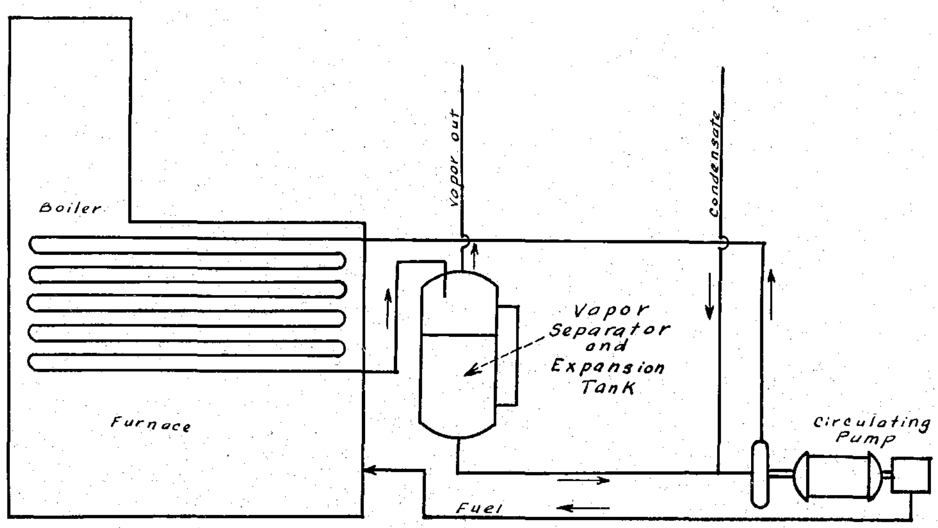
Of the many methods of heating which might be employed in the chemical industries, mention may be made of direct fire, hot water or steam, hot oil, pipe still heater, electric heaters, and vapors of organic compounds.

Before one can get a clear picture of this group of methods he must recall the desirable features needed for an idealized but nevertheless practical unit. Such a unit might involve a minimum of hazard to the operator, be readily controlled in temperature, be easy to start and stop preferably with low heat losses, have ample heat-carrying capacity, and be economical in operation.

The use of direct fire applied to a container partly filled with liquid being heated was no doubt one of the earliest and simplest methods in use. Where quite large volumes of material are to be heated to relatively high temperature, this method has disadvantages. It is liable to be quite wasteful of heat and close temperature control is often difficult if not almost impossible. This results in overheating of the product nearest the hot flue gases with the consequent danger of burning the product and even ruining the containing vessel.

The use of hot water or steam for heating has also been in use for a long time. However, the ordinary jacketed kettles designed for pressures of 150 to 200 pounds per square inch, can be used for temperatures up to about 375° F. By the use of specially designed vessels employing higher pressures, temperatures up to 660° F. may be obtained. Such an apparatus, employing the Frederking construction, is described by S. O. Solt Ind. and Eng. Chem. 19, 697 (1927) and embodies the unique feature of having the steel tubes through which the heating medium circulates cast integrally within the walls of the containing vessel. The added strength obtained in this way is a necessity because at the temperature of 660° F. the corresponding pressure of water is 2,450 pounds absolute. The operation of such high pressure equipment may cause some apprehension, but the makers assert that the dangers are minimized by using a small boiler which at any one time stores only a relatively small amount of hot water with its equivalent total energy. This system eliminates many of the disadvantages of direct fired equipment and gives high rates of heat transfer, ease of temperature control, and good thermal efficiency.

A third method of industrial heating by oil circulation has been successfully used and is described by A. B. McKechnie, Ind. and Eng. Chem. 19, 691 (1927). In this system a petroleum oil of high flash point and low vapor pressure is heated in an absorber and circulated through pipe lines by means of a positive pressure pump through the jacket of the vessel to be heated. Temperatures up to 550° or 600° F. can be closely maintained by this system. The oil, which has a specific heat of about 0.48 at 150° F. and about 0.68 at 550° F., is circulated rapidly enough at the temperature desired to supply heat as needed. The cooled oil, which is only a few degrees lower in temperature than the oil leaving the absorber, is continuously heated and recirculated in the sys-




**A Typical Oil Heating Installation. Oil Heated in the Furnace is Circulated through the Expansion Chamber to the Heater.**

tem. Only low pressures are necessary in the circulating lines and the petroleum oil acts to prevent corrosion and lengthen the life of the unit. The thermal efficiency of the absorber compares favorably with the best results found in steam boiler practice for units of equivalent size and greatly exceeds the actual efficiencies which usually exist under direct firing methods. The primary source of heat for the absorber may be fuel oil, gas, or electricity, depending on local conditions.

In some industries the ideas involved in the oil circulating system of heating have been utilized in the so-called pipe still method of heating. In this system the material to be heated is circulated by a pump through a series of pipe coils arranged similarly to the absorber just discussed. In principle the same ideas are involved as are brought into play in a water tube boiler—hot flues gases outside the tubes heat the rapidly flowing product being processed. By employing rather high velocities good overall rates of heat transfer and a high thermal efficiency can be obtained. For many products, however, it is not always feasible to actually circulate a product and make it serve as the primary recipient of the heat required. For this reason this method is particularly useful in those industries where temperatures need not be controlled within extremely narrow limits and where large quantities of bulk liquid materials are handled as in the petroleum refining and the asphalt processing industries.

The use of electric heaters for chemical equipment is only economically possible where power costs are low and where close control of temperature is a necessity. Many varieties of strip heaters are on the market which, when properly installed, can readily be used for heating antoclaves, stills, sulphonators, and similar pieces of equipment. Where pipe lines are to be heated the use of resistance wire or ribbon properly insulated will give reliable service. The use of suitable resistance units in conjunction with these heaters assures a positive temperature control.

One of the newer methods of heating which is causing considerable speculation and discussion as to the limits of its field of usefulness is that of the use of vapors of organic compounds as heat carrying mediums. As J. J. Grebe points out in "Diphenyloxide for Preheating Air," Mech. Eng. 719,22 (1931), "The field of high-boiling organic heat transfer agents has been so enticing that many proposals have been made and a considerable amount of experimental work has been done to determine their applicability."

The organic compounds which have been used for this purpose are diphenyloxide, $C_{12}H_{10}O$; diphenyl, $C_{12}H_{10}$; and naphthalene $C_{10}H_8$; which have the following properties:

| | Melting Point F° | Boiling Point F° |
|---|---|---|
| Diphenyloxide | 81° | 496° |
| Diphenyl | 156° | 495° |
| Naphthalene | 176° | 424° |

From this table it is seen that these hydrocarbons may be used as heat carriers at quite moderate pressures for high temperature processes. Regarding the single hydrocarbons it is seen that diphenyloxide, which has the lowest melting point, melts at 81° F. Fortunately, a mixture of 85 per cent diphenyloxide and 15 per cent napthalene melts at 65° F while a mixture of 74 per cent diphenyloxide and 26 per cent diphenyl melts at 56° F. so that either mixture would be fluid at ordinary room temperature. These compounds are all non-corrosive and non-poisonous so that they may readily be used in standard steel or iron vessels designed for ordinary pressures. A general idea of the properties of diphenyloxide may be obtained from the accompanying table.

| Temperature | | Pressure | Heat Content Btu per Lb. | | Density-Lb. per Cu. Ft. | |
|---|---|---|---|---|---|---|
| F° | C° | Lb. per Sq. In. abs. | Liquid | Latent | Liquid | Vapor |
| 496 | 258 | 14.7 | 208 | 120 | 54.8 | 0.26 |
| 550 | 288 | 25.0 | 243 | 114 | 52.8 | 0.48 |
| 600 | 315 | 42.0 | 277 | 108 | 50.9 | 0.88 |
| 650 | 343 | 68.0 | 310 | 102 | 49.1 | 1.29 |
| 700 | 371 | 100 | 343 | 95 | 47.3 | 1.70 |
| 750 | 399 | 146 | 377 | 86 | 44.8 | 2.50 |
| 800 | 427 | 210 | 412 | 76 | 42.0 | 3.50 |

This table shows that a temperature of 650 F. can be obtained at a pressure of only 53.3 lb. gauge, quite a difference in pressure as compared to water at the same temperature.

From a practical standpoint the design of diphenyloxide boilers seems to involve few difficulties. According to J. J. Grebe Mech. Eng. 719,-22 (1931), there are two types of boilers recommended for use with diphenyloxide. The first is a boiler with natural circulation designed to give very free circulation of liquid with a minimum resistance to flow in the tubes. Advantage is taken of the air lift effect of the vapor in helping to increase circulation and a high head must be maintained between the vapor, separating drum, and the furnace.

The second type of boiler is similar to the first except that a circulating pump gives a positive movement to the liquid diphenyloxide through the boiler tubes, thus assuring maximum heat transfer rates and high capacity.

Experimentally, diphenyl vapor has been used to concentrate caustic to 98 per cent by weight by Badger, Monrad, and Diamond, Ind. and Eng. Chem. 22, 700-707 (1930), and for heating asphalt by Montillon, Rohrbach, and Badger, Ind. and Eng. Chem. 23, 763(1931). Commercially it has been used at the Indian Refining company's plant at Lawrenceville, Illinois, for oil refining.

Diphenyloxide has been used in connection with a steam power plant for superheating and re-heating high pressure steam as described by H. H. Dow, "Diphenyloxide Bi-Fluid Power Plants," Mech. Eng. 48, 815(1926); and for preheating air as described in Power Plant Eng. 35, 486-499 (1931).

Considering the information at hand concerning these compounds and the favorable properties which they possess it seems very probable that their uses may soon be extended to include heating processes in the manufacture of varnish and special waxes, dyestuffs and intermediates as well as for the processes of high temperature distillations and sublimations.

# THE MINNESOTA TECHNO-LOG

## UNIVERSITY OF MINNESOTA




## The Honorable Chemist

VERY seldom does humor fall into the classification of editorials. However, the following sketch, titled *Essay by a Japanese Schoolboy* in a recent issue of the *Crucible,* is undoubtedly worthy of study by future chemists — and engineers.

"The chemist are wonderful humor beeing. It is found looking like other men, sometime. Other people such as gentlemen look like Honorable Chemist but not so long in face. Long face significant of learned mind.

"Long, white coat which are worn by doctors, bakery men and chemists mean nothing. Such pristine whiteness of Chemist coat only keep shirt clean — if have one. Holes made by raw acid show who chemist and who baker.

"Baker smells like essence of gods, Honorable Chemist like fumes from Satinic reguns.

"All chemists were early liars. They is still numerous prevabricators among freeborne or leggitimate Chemists.

"The Honorable Chemist work like beavers in stink house likened to Laboratory.

"Some people fooled by advertising picture of chemist. Real chemist no look longingly through test tube while stand-in palatial laboratory. Real chemist is man of great brains but not look he had any. Laboratory is place of great mess. Odors of bad eggs and colors of many suns everywhere. Evil and smelly smoking pipe droop from lips of perspiring chemist.

"Maybe chemist he pretend he bigger man, keep shirt clean and talk lot, silly world wake up and think him better yet.

"Chemist, he honorable man."

## Engineer Selling

ONE characteristic common to practically all young engineers is their inability to communicate to others in a convincing manner the facts which they have collected through long study, experience, and research. The courses of study offered in the engineering schools of this country, in which the technical aspects of engineering are stressed, have much to do with this deficiency in engineering graduates, but perhaps the engineering students themselves are at fault. Every college freshman, and a great many engineering graduates, today have the false idea that only the ability to handle the technical aspects of their chosen work is needed for success in engineering.

Selling is a proposition which faces every individual in ths world. Each person must sell himself, his personality, his education, his training, and his experience before he can ever obtain a position. This is especially true in the case of engineering graduates who have to compete with experienced persons for positions in a field which already has an excess of men.

Even after a position is obtained, the engineer has to sell the employer on his actual ability to do the work for which he was employed. He has to sell his ideas, his studies, and his recommendations if he is to be an important cog in the machine of industry.

The only really effective selling scheme for man is the personal interview and the public address. Letters and reports can do much to advance a person in his chosen field, but the ability to put things over before an audience is perhaps the final criterion of success in the engineering profession.

## Two Men — One Choice

TWO men go out into the world to earn their living. Both have equal qualifications and both obtain similar employment with a wage of $150 per month.

One of these men spends his total wage each month and partly satisfies his innate desire for beauty, luxury, and pleasure. He spends, and he has joy in spending for he is young; but he dies a "poor" man.

The other man has methods which are somewhat different. He stints and saves and is miserly. Of his $150 wage he spends only $100, and thus saves $600 a year. His savings he invests and, when opportunity offers, starts a business of his own. In time he becomes a "rich" man.

In the world there are only two classifications for all men; they who possess wealth and they who do not. You may become either of these men. Look carefully before you choose, but make a choice and live up to it.

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ST. PAT signifies an important change in the engineering schools. The juniors will take the reins from departing seniors. Let us hope they "carry on" well.

# « « « SLIP STIX » » »

## and double check

Neatly etched in the edge of a table in a corner nook of a nearby cafe are printed the words "Look to Your Left." On the wall to the left are the words, "Ha ha, fooled. Now look behind you." And there is the inscription "Haw, fooled again." After which some sucker has put a mark which, when pronounced out loud, sounds like "check."

## shed a tear

Certain class of senior engineers on spring inspection trip paused a few days in Wisconsin's biggest beer city, also windy city of Illinois — decided to cut loose and see the town — went to brightest burlesque shows in both cities — returned home and viewed far famed burlesque of mill city — saw nothing more than work of cross eyed censors — strayed home murmuring sadly, "Give me the *good* old days."

## scratch

She came forward, all pretty and shining
And kissed him as if she were pining.
Honest, 'twas too good really to be.
Then she dived for a pocket
And dropped like a rocket,
For she was only a billiard ball. See?
You call it so bad, but I call it verse,
Ta-Ta,-De-Um-Do.

They poured acid down the villain's throat,
They poured it on his face;
But he neutralized it to a salt,
Because he was so base.

## skill—only skill

The *New Yorker,* nationally known Manhattan journal, recently published an engineering bit of news.

"Clock people have a story that they tell about a jewelry concern in Indianapolis. The firm's engineering department had been experimenting with steel wire, drawing it out very fine. They finally produced a piece of 120-gauge wire—practically invisible. The boys were proud—so proud, in fact, that they cut off a strand and sent it to a rival jewelry concern in Switzerland. 'Just to show you what we are doing in Indianapolis.'

"Weeks went by. A few weeks before Easter a package bearing a Swiss postmark arrived. The boys opened it with great care. Inside was a steel block; mounted on the block were two steel standards; strung between the standards was the same piece of 120-gauge wire. At one end of the block was mounted a small microscope delicately focused on a certain spot on the wire. One by one the engineers placed an eye to the microscope and examined in silence the work of their foreign rivals, who had bored, in the wire, a rather handsome little hole."

## gwan home

With all the new rulings in football and restrictions of the boxing commission, our baseball reporter suspects that soon they will not even allow any chickens on the "foul" line.

## scandal

Wily engineers some time ago intercepted a certain note written by one of their colleagues to his moll. (Don't you just *love* this dirt?) Would that Keats could get a load of this:

*Dear Betty:*

The sun is shining brightly
The birds are singing sweet.
The leaves are swinging on the trees
As though they'd like to meet.
I can see the clouds of white
Against the sky so blue.
Maybe you can see the same bright clouds,
At least I hope you do.

When night at last as black as tar,
Shuts out the light of day,
I turn my eyes to the Northern star
That twinkles up your way.
But still this steady world of ours,
Which stays the same each year,
Causes you to work up there
While I must work down here.

## words—just words

No end of giggling was precipitated between two students in a machine design class one day when the elderly professor was explaining various types of pipes. His lecture was well seasoned with the expression, "I have seen—." After one particularly spicy rendition of the phrase by said professor, student A leaned over to student B and muttered in a shaky whisper, "Hmmm, the old boy has been around, hasn't he?"

## an e. e. proposes

(Being the second of a series. Are ya readin?)

Mazda darling, be mine. Watts life without you? Ohm is not ohm without the light of your presence. My heart is a transformer that steps up at every thought of you. I would lay my head alongside your switch; the touch of your hand is like a live wire. Marry me and let us have a little meter in our home.

## with the dawn

A very strict and prim lady in St. Paul was called out of bed one morning at 5 A. M. The following dialogue ensued:

"Hello."

"Hello."

"How are you this morning?"

"All right."

"Then I guess I must have the wrong number."

"Here's where I cut a good figure," said the chorus girl as she sat on a broken bottle.

Yes, and who can deny Africa's contention that playing with dice is shaky business?

For Sale: One good job. Yours for the asking.—*Tech. Comm.*

Well, that's nicely taken care of.

# AROUND THE WORLD WITH OUR ALUMNI

## *Aeronautical Engineering*

'30—Larson—Karl O. Larson is now with the motor engineering department of Northwest Airways of St. Paul and is living at 312 Harvard avenue in Minneapolis.

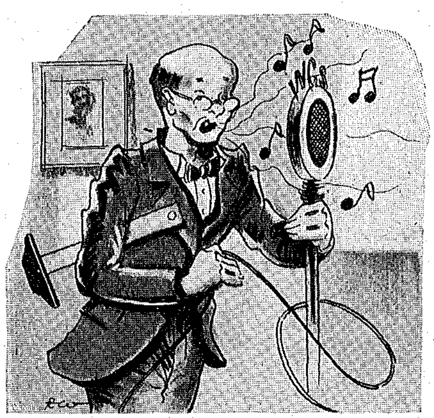
'30—Dawson—Ivan Richard Dawson is now working in the research department of the Aluminum Company of America and is living in Cleveland, Ohio.

'31—Bowker—Walter Bowker, taking the Navy flight training course, is staying at the Navy dormitories in Pensacola, Florida.

'31—Hill—Ralph Hill, now working for Professor Akermann, is staying at 324 Walnut S. E. Ralph is still single, rather unusual for an aeronautical.

## *Architectural Engineering*

'23—Sutherland—Samuel Sutherland is doing architectural work with the Board of Education in Milwaukee and as a side-



line is doing some singing and announcing over a large radio station. Sam is married and has one possible engineer.

## *Mechanical Engineering*

'20—Tuve—Professor George Tuve has been extremely busy for the last month as he was in full charge of the symposium on Air Conditioning sponsored by the Case School of Applied Science and the Cleveland Engineering Society on March 17 to 19. The six sessions, at which well known professors and chief engineers of large air conditioning companies presented studies of the various factors involved in air conditioning, were attended by almost five hundred engineers from the United States and Canada.

Professor George Tuve is now beginning his second year as professor of Mechanical Engineering at Case. He was an assistant professor in steam engineering at the University of Minnesota for about four years after he obtained his professional degree. After three years as full professor at the University of Western Texas, he was appointed to the faculty of Case School.

He is the co-author with Professor Shoop of the mechanical engineering department of a textbook on mechanical engineering laboratory practice. He plans to go to Europe soon to study the attitudes held there towards laboratory work before he revises his text.

'11—Barnum—Marvin C. Barnum is now working for himself in New York City as a sales engineer in the air conditioning and ventilating field. Marvin was formerly sales manager in the humidifier division of the Wilcolator company of Newark, New Jersey. Believe it or not, Marv is still single.

'13—Buenger—Albert Buenger of St. Paul was chairman of the committee on arrangements for the convention of the Minnesota Federation of Architectural Engineering Societies recently held in St. Paul. Al is now living at 1666 Stanford Avenue, St. Paul.

'25—Backstrom—Russell Backstrom recently prepared a bulletin on house insulation which was published by the Department of Commerce. Russ is engineering specialist for the National Committee on Wood Utilization, Department of Commerce, Washington, District of Columbia. He is married but has no children.

'30—Chloupek—William Chloupek was with the Al Johnson Construction company engaged in bridge construction work but is now back in Minneapolis.

'30—Shepard—Raymond Shepard is still with the General Electric company at Schenectady. Ray expects to pay a visit to the old homestead in about ten weeks when he has his annual vacation. Ray was married last summer to Miss Marjorie Shepard of Minneapolis. His present address is 1422 State street, Schenectady, New York.

'12—Clark—William Clark, chief lubricating engineer with the Pure Oil Company of Chicago, is living at 331 Sherman avenue, Evanston, Illinois. Bill visited the campus in March, leaving this note for his classmates: "This is my first visit to the campus while school was in session since 1922. It certainly has changed and

I find difficulty in locating the old haunts. Am very glad to get back and find a few familiar faces among the faculty. I'm married and have a daughter twelve years old who does not display any engineering propensities. Am an ardent would-be golfer who will never get beyond the dub stage."

> ***The editors wish to apologize to both the civil and chemical engineers for an error in the March issue. George Walker, '08, and George A. Maney, '11, were listed as chemical engineers whereas, according to Professor Cutler, they have been graduated from the Department of Civil Engineering.***

## *Civil Watches Tornado Sweep Alabama Town*

Charles Prior tells of his "grandstand view" of the recent tornado which swept through Tuscaloosa, Alabama, in a letter to his parents, Mr. and Mrs. J. H. Prior of Minneapolis. Charley is working with the United States Geological Survey and has an office on the third floor of the postoffice building in Tuscaloosa. He describes the storm as follows:

"It had been raining lightly all day and was quite warm. At three o'clock I went out to get a cup of coffee and noticed how oppressive the air seemed to be. At 3:30 it started to thunder and lightning, and the rain poured down for a quarter of an hour. When the rain stopped I noticed that the clouds which had been rushing north were now going south at a high rate of speed. My window faces southwest and I noticed that the clouds in that direction were growing very black. I went to the window to see better, and soon saw that a tornado was forming and was approaching very rapidly. It was soon at the west end of town, whirling at a great rate, and the air around it was full of everything. We waited to see if it was going to hit the postoffice building. It started to come down the main street, but turned at the west end of town and went across the river into Northport. As soon as we saw it would not come directly our way, I rushed up on the postoffice roof to get a grand stand view. I would say that it passed within 2500 feet of where we stood. I saw parts of houses, roofing, lumber and a little bit of everything in the air. It made a great roaring noise and was the most exciting thing I ever saw.

"We did not realize the full extent of the damage until a little later, when we attempted to cross the river into Northport and were stopped at the bridge. From where we were stopped we could see that the damage was terrible. Coach Burneem and his football squad of the University of Alabama did wonderful work getting out the dead and injured. All night long the dead and injured were being carried past my house. The news traveled fast, for one woman here, who was not in any way injured, received a telephone call from her relatives in England that same day. The negroes suffered most as the storm seemed to center in their quarters."

Mr. Prior was graduated in 1928 with a civil engineering degree.

## Civil Engineering

'08—Lang—Fred C. Lang, engineer in the department of tests of the State Highway department, spoke at the afternoon session of the Minnesota Federation of Architectural Engineering Societies convention which was held in St. Paul during the first week of March. Fred is still staying at 1246 University avenue in St. Paul.

'21 — McLean — Milton McLean is teaching religion and psychology at Macalester College, St. Paul. Milton received his B. D. from the McCormick Theolog-

ical Seminary and last year reecived his Ph. D. in psychology from the University of Chicago. He was general secretary of the Y. M. C. A. at the latter institution.

'23—Nelson—Glenn Nelson is now manager of the Harriss theatre in Findlay, Ohio, for Warner Brothers, Incorporated. He has temporarily digressed from the engineering field, but expects to get back pretty soon.

'23—Peck—Lloyd Peck is now general manager of the Laundry Owners National association, an organization which operates throughout the entire United States and Canada. A telegram the other day announced the cheering news that a seven pound baby boy arrived at Lloyd's house on March 2. Joliet, Illinois, is the home town.

'23—Swanson—Paul Swanson is now with Hoeppner & Bartlett, general contractors at Eau Claire, Wisconsin. Paul came to St. Paul last December for the reunion of the class of 1923 held at the St. Paul Athletic Club, and admitted that he was the father of a little girl.

'23—Maiser—Walter Maiser is helping to build the $4,000,000 Ramsey County Courthouse and City Hall for Foley Brothers, general contractors of St. Paul. Walt is married and is living at 1815 Wesley in St. Paul.

'23—Flindt—Richard Flindt is with the Schuett-Meire company, structural engineers, and is still able to design the most complicated concrete and structural steel construction members. Dick is still single, and can be reached at 574 Baker Arcade Building, Minneapolis.

'23—Dindorf—Edward Dindorf is estimating and buying for Heffron and Fitzgerald, general contractors of Rochester, Minnesota. Eddie is married and has just recently become a father.

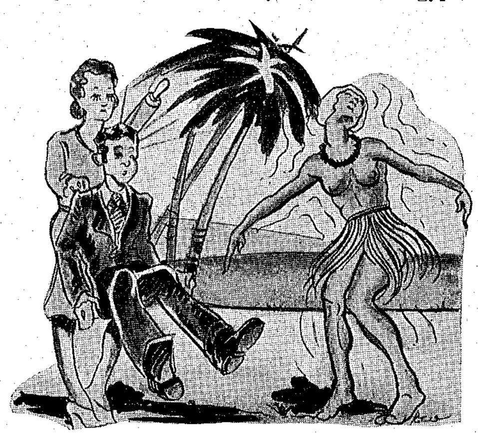
'23—Olson—Elmer J. Olson has been with the Oliver Iron Mining Company of Ishpeming, Michigan, ever since his graduation, working at their various mines throughout the Northwest. Some time ago Elmer took a couple of month's leave of absence for gold prospecting in Oregon but apparently didn't find what he was looking for. He had a little better luck after he got back as he is married and has a two year old daughter.

'24—Powell—Louis Powell, curator of the St. Paul institute, is now living in St. Paul at 26 South Dale street. He is giving lectures for children on "Mother Nature's Workshop" regularly at 4:45 Tuesday afternoons over radio station WCCO.

'24—Stoddart—Hugh Stoddart writes in with news of Oregon: "I have been located on the Coast Highway in Oregon for the Bureau of Public Roads in charge of one of the last sections of this highway to be completed. The entire length of the Coast highway will be open to travel about the middle of next summer. Its scenic attractions are at least the equal of the widely known Columbia River highway." News of the Civils of '24 can be sent to Hugh at Box 3900, Portland, Oregon.

'25 — Donahue — Stephen Donahue is with the Bates and Rogers Construction company of Chicago doing grade elimination work and some construction work with double track railroads. A two year baby girl is in the family now. Steve's home is in Spring Valley, Wisconsin.

'23—Aslakson—Carl Aslakson has been located at Perryton, Texas, in charge of a large triangulation party. He had with him three officers and twenty men and used a lot of high toned instruments in his work. Carl has been in Florida, all along the Atlantic seaboard, in Alaska, along the western coast, and was even in the Philippines for two years. He has done surveying in the Sulu Sea but was handicapped on this trip as regards Zulu girls inasmuch as he had his wife with him. They came back to the States via Singapore, Penana, Ceylon, Suez, Egypt,



Italy, and France. Carl was married in 1925 and has a son three years old who was born in Manila, Philippine Islands. Life with the United States Coast and Geodetic Survey can't be so bad for Carl, after all.

In the March, 1931, issue of the MINNESOTA TECHNO-LOG Carl described his experiences in the Philippine Islands. Quite a change from the waterways of the Philippines to the trails of Texas!

## Electrical Engineering

'08—Schoepf—Alfred W. Schoepf, who was working for the Emprezos Electricas Brasileiras, Sao Paulo, Brazil, is now back in the States. His address is 2514 Argyle street, Butte, Montana.

***'25—Brossard—Henry Brossard died of spinal tuberculosis in Glen Lake sanatorium on January 11 of this year. He was with the Northern States Power company from the time of his graduation until his health failed working in the department of rural electrification.***

'31—Johnston—Dorance Johnston has been fishing through the ice at the Lake of the Woods during the winter. He

says that the ice is over four feet thick there during the cold snaps, but the fish bite nevertheless.

'09—Robinson—Archer Robinson visited the campus recently and was astounded at the changes in the campus buildings in recent years. Professor Brooke took Archy in tow and together they called on Dean Leland, Professors Shoop, Springer, and Martenis. Archer hasn't changed much, for Professor Shoop still recognized him after twenty-three years' absence. Things have been going well with this old grad, for he is now general manager and vice president of the Central Ohio Light and Power company, one of the large public utility companies of the East, with offices in Findlay, Ohio.

'14—Irwin—Vincent H. Irwin is visiting in the Twin Cities. His most recent work was the superintending of the construction of a powerhouse built in Death Valley for a large borax company. Vincent says it was 115 in the shade down there, but there wasn't any shade. Mr. Irwin is associated with the D. P. Robinson & Co., designers and constructors of power houses.

'27—Barton, James P.—James P. Barton, who has been with the General Motors Radio corporation, is now without a job as the work of his branch has been discontinued. He was here at the University on registration day with his brother and says he is interested in finding a teaching position. He is now staying in Milwaukee.

# NEWS FROM THE TECHNICAL CAMPUS

## *Engineers to Select Boards, St. Pat April 26*

Casting ballots Tuesday, April 26, seniors will chose a St. Pat to rule over Engineers' day, May 13, while all engineers will vote for candidates for the TECHNO-LOG and Engineers Bookstore boards.

Candidates for these positions must have petitions signed by at least 25 engineering students in Dean Leland's office by 5 o'clock Thursday, April 21, according to Martin Swanson, head of the technical commission.

Eligibility of candidates filing will be determined by the technical commission. All candidates for the TECHNO-LOG or Bookstore boards must have completed five quarters in the College of Engineering while the candidates for St. Pat must be last quarter seniors. The rules of the All-University council will govern all other points of eligibility.

Positions to be filled on the TECHNO-LOG and Bookstore boards are representatives from the departments of civil, electrical, and mechanical engineering, the School of Chemistry, and department of architecture. Aeronautical engineers will cast their ballots with the mechanical students.

## *A. I. E. E. Sponsor Communication Lecture*

The Minnesota branch of the A. I. E. E. sponsored a lecture given in Northrop auditorium Thursday, April 4, by Sergius P. Grace, assistant vice president of the Bell Telephone Laboratories.

The title of Mr. Grace's lecture and demonstration was "Play-O-Feen Grink-A-Nope." These cryptic words, when spoken through the "scrambled" speech apparatus, became two recognizable English words. This demonstration was given as an indication of the advances made in the telephone laboratory toward the goal of truly private telephone and radio communication.

As a further means of showing the dependability and development of modern communication, Mr. Grace established connections by radio and wire with an airplane high over New York City, with steamships in all parts of the world, and with cities in Europe and the United States.

By means of a battery of amplifiers the beating of a man's heart was magnified until the thunderous noises reverberating through the auditorium resembled the distant booming of artillery. The program was completed with a series of research development demonstrations.

## *Commission Choses Japs Engineers Day Chairman*

Following a newly devised method for the selection of Engineers day chairman the technical commission chose Archie Japs, junior chemical engineering student, head of arrangements at a meeting Tuesday, April 12. The selection was made by the commission from a list of candidates who presented plans for the arranging of St. Patrick day festivities.

The method of election replaces the old elections. The change was made with the belief that selection of the chairman could be removed from student politics.

The selection of Japs was made from a list of eight applicants. Those filing were Archie Japs, chemical engineering; Gayle B. Priester, mechanical engineering; Charles W. Britzius, civil engineering; William C. Budge, architectural engineering; Thomas Rogers, mechanical engineering; Alva E. Kaliher, electrical engineering; Henry W. Rahn, chemical engineering; and James Stoddart, electrical engineering.

## *Former Student Issues Insulation Bulletin*

Russell E. Backstrom, a 1925 mechanical engineering graduate and insulation specialist for the United States department of commerce sub-committee on wood utilization, recently issued a booklet, "House Insulation, Its Economics and Application." The first portion of the report deals with the advantages of insulation in houses. It is pointed out that the saving in fuel resulting from insulating will pay for the cost of insulation in a few years. The advantages of insulation with respect to the comfort of the home in summer and winter are fully discussed and the manner in which the insulation may be applied to buildings is demonstrated for the different classes of materials.

## *Chemists Plan Engineers Day Show—Exhibition*

Four campus groups have decided to unite and jointly sponsor the "Chem" Show which is to be presented on Engineers day. Plans were originally developed by the Minnesota student branch of the American Institute of Chemical Engineers but interest in the project prompted the cooperation of Alpha Chi Sigma, professional chemical fraternity; Phi Lambda Upsilon, honorary chemical fraternity; and Iota Sigma Pi, women's honorary society.

Doctors R. E. Montonna and G. B. Seisig are acting in the capacity of faculty advisors.

Those serving on comittees are:

GENERAL ARRANGEMENTS: Francis Calton, Iver Kinneberg, William Von Fisher, Edgar Piret, George Flanagan, Kenneth Johnson, Robert Conary, Winfield Foster, Milton Ryberg, Charles Winding, Caroline Chamberlain, Maxine Burmeister, Alice Croze.

PUBLICITY: George Flanagan, George Taft, Cecil March.

FLOAT: Leonard Reiter, William Crawford.

DECORATIONS: Russel Miller, Raymond Karpen.

FAVORS: Maurice King, Julius Katz.

STUNTS: Clinton Macmullen, Fred Beyer, Samuel Yuster, Wallace Cornell, Donald Gernes, Sidney Miller, Romund Moltzau.

INDUSTRIAL EXHIBITS: Edgar Piret, Winfield Foster.

GUIDES AND SIGNS: Earl Ruble.

HISTORICAL: Milton Ryberg.

## *Engineers Neglect Slide Rule Studies*

Recent reports indicate that the engineer is going non-technical. This quarter there are 42 engineers registered in a speech course under the direction of Mr. Ramsland while in addition many embryo engineers are studying language and business courses.

The fields of endeavor now filled by engineering students are German, French, Spanish, economics, statistics, psychology, sociology, political science, journalism, and geology.

## *Technical Societies Hear Unemployment Talk*

Mr. W. H. Kerry, city engineer of St. Paul, gave a comprehensive survey of the unemployment situation in the Northwest before a joint session of the four student engineering societies held in the electrical engineering auditorium Wednesday, April 13. The meeting was sponsored by the American Society of Civil Engineers.

Mr. Kerry has made a study of unemployment conditions in this locality and presented some very interesting details and explanation regarding the position and the relationship of conditions in the Northwest to those in other parts of the United States.

## *Electrical Professors Conduct Motor Tests*

Professors Ryan and Kuhlmann of the electrical engineering department have been asked to witness tests to be made on the electric motors which the city of San Francisco has contracted to buy from the Electric Machinery company of Minneapolis. The group of motors, which include nine 1000 h.p. and three 900 h.p. synchronous machines, will be installed in several of San Francisco's pumping stations to serve as motive power for centrifugal pumps.

An unusually high efficiency is guaranteed for the motors by the Electric Machinery company and if the motors do not attain this efficiency in the tests to be supervised by Professors Ryan and Kuhlmann, the company is enjoined to forfeit a penalty acording to the stipulations of the contract.

## *A. I. Ch. E. Offers Prize For Engineering Ability*

A contest involving the solution of a modern chemical engineering problem is being sponsored by the American Institute of Chemical Engineers. Three prizes are being offered amounting to one hundred, fifty, and twenty-five dollars.

The interesting feature of the contest is that the solution of the problem is to be presented in the form of a report to a technical executive. Proper execution of the problem must take into account good assumptions, judgment, and accurate computations. Those entering the contest are expected to gain valuable experience in the coordination of technical and economic principles.

**George Taylor Plowman**

## *Chemistry Faculty Attend National Meet*

Three members of the faculty from the School of Chemistry presented papers at the national meeting of the American Chemical Society held at New Orleans during the first week in April. Doctor I. M. Kolthoff read a resume of his investigations upon the volumetric determination of nitrates with ferrous sulfate. Results of research studies upon the action of radon on propylene and cyclo-propane were presented by Doctor G. B. Heisig. Doctor Donovan Kvalnes explained a new method for the study of reversible oxidation and reduction reactions.

Other faculty members attending the convention were Doctors Lillian Cohen, Charles Mann, Murray Sprung, Nelson Tayor, L. I. Smith, and Mr. J. L. Maynard.

## *A. S. C. E. to Present "The Span Supreme"*

"The Span Supreme" a film story of designing and spinning of the cable for the new George Washington Bridge across the Hudson River at New York is to be presented by the Minnesota student chapter of the A. S. C. E. Thursday evening, April 21, in the main engineering auditorium.

"The film, which describes in the most interesting and in the most minute detail the spinning and the handling of great cables, will be explained by one of the professors of structural engineering," William Hill, president, said.

## *George Taylor Plowman Etcher and Lecturer Dies*

George Taylor Plowman, celebrated etcher and lecturer, and one of the two first graduates of the school of architecture at the University of Minnesota, died at his home, 9½ Madison Street, Cambridge, Massachusetts, on March 26, 1932. He was born at Le Sueur, Minnesota, October 19, 1869. He is survived by his wife and three sons, George Taylor Plowman, Jr., of Chicago; Professor Edward Grosvenor Plowman of the University of Colorado at Denver, and Lawrence Carrington Plowman of New York City.

Mr. Plowman and Leo Goodkind, now treasurer of Schunemans and Mannheimer's department store in Saint Paul, registered at the University of Minnesota in 1891 for upper class work leading to the degree of Bachelor of Science in Architecture. Although a course in architecture had been catalogued for several years, the work had not been offered. Dean Pike of the Mechanic Arts College persuaded Harry W. Jones, the well known architect who had come to Minneapolis from the Massachusetts Institute of Technology in 1884, to organize a course for the registrants and to conduct it as part time Professor of Architecture. Under Mr. Jones was developed much of that superb draftsmanship which characterized Mr. Plowman's later work. Mr. Plowman also studied under Douglas Volk, noted artist and portrait painter, who was then conducting the Minneapolis School of Fine Arts.

After graduation from college in 1892, Mr. Plowman began a successful career in architecture which he continued until 1910. In 1895 he married Miss Maude H. Bell of Mardin, Turkey. She shared her husband's art enthusiasm and, in 1931 when his health was known to be failing, wrote an article on covered bridges for the American Magazine of Art describing some of his last work. Mr. Plowman supervised the installation of the exhibits in the mining building at the St. Louis exposition. Later he was supervising architect associated with John Galen Howard, Dean of Architecture at the University of California, in charge of the erection of the beautiful Hearst Memorial Mines building of white marble on the campus at Berkeley.

Not until his fortieth year did Mr. Plowman become actively interested in the engraving and etching for which he is famous. His interest in the youthful graphic arts movement in America was aroused, it is said, by the articles and illustrations in the International Studio magazine to which he himself later contributed. He took up work under Eric Pape, well known painter and, until 1913, head instructor of the Eric Pape School of Art in Boston. He studied in Paris and spent the two winters of 1911 to 1913 in the etching department of the Royal College of Arts, South Kensington, London, where he was the only American pupil of Sir Frank Short. The summers were spent making etchings in England and France.

Mr. Plowman has produced over three hundred plates since 1910, the main ones of which fall into five groups; the Oxford series, the London series, the Paris series, the three plates of American whaling ships and his last, the American covered bridge series. His architectural training shows in his choice and masterful execution of structural subjects. The twenty-two plates of the Paris series are devoted almost entirely to buildings in quaint out-of-the-way corners that travellers rarely see. Probably the most outstanding of the artist's works is the Rue des Pretes, St. Severin, which hangs in the Luxembourg gallery in Paris. The whaling ship and the covered bridge series are historical and were undertaken to record some of the charm of those fast vanishing subjects.

A number of the finest plates of the covered bridge series are reproduced in "Covered Bridges of New England" by Clara E. Wagemann, a copy of which is in the university engineering library. The "Whaler Morgan at New Bedford" and the "Charlemont Bridge" are included among the eighteen representative etchings, dry points, and lithographs which Mr. Plowman presented to the Minneapolis Art Institute at the time of his last lectures in the city in January, 1931.

Mere execution did not, however, occupy Mr. Plowman's entire attention. He devoted much time and energy to the educational side of the graphic arts awakening in America, for which he published a greatly needed illustrated treatise on etching and other graphic arts in 1914, and a manual of etching for beginners in 1924. He was a divisional secretary of the Y. M. C. A. in France in 1918 and organized and conducted the art department of the Y. M. C. A. university at Coblenz in 1919.

Mr. Plowman has exhibited at the Royal Academy in London, the Paris Salon, and in many other cities in England and the United States. Permanent collections contain his works at the Congressional library in Washington, the Public library and the Metropolitan museum in New York City, the Museum of Fine Arts in Boston, the Public library in Newark, the California State library in Sacramento, the British museum and the South Kensington museum in London, the Luxembourg museum in Paris, and the Art Institute in Minneapolis.

Mr. Plowman's wide interests were attested by the many associations and clubs with which he was connected. He belonged to the Brooklyn Society of Etchers, the Boston Society of Etchers, the Chicago Society of Etchers, the California Society of Etchers, the Print Makers Society of California, and the Print Society of England. He was a Fellow of the Royal Society of Arts in London, and a member of the London Authors club, the Boston Authors club, the National Arts club in New York, the Faculty club at Berkley, California, the American Federation of Arts, and the famous Salmagundi club of New York.

## Synchronous Generators

(*Continued from page 157*)

with the armature current $I_A$ and exert a demagnetizing action on the field.

The field must be strengthened sufficiently to overcome this demagnetizing action of the armature if the terminal voltage is to be maintained. Since the ampere-turns needed to overcome the armature reaction are at an angle of $(90° - \theta - a)$ with the field ampere-turns $(F_1)$ needed to generate the voltage $E_g$, the strength of the field required to maintain the rated terminal voltage under full load is obtained by combining vectorially the above two components of field ampere-turns, thus obtaining $F_{FL}$ as shown in the figure. The actual vector diagram is shown in dotted lines, but it is not necessary to construct this diagram to determine the full load excitation, $F_{FL}$. Since $F_1$ is obtained from a point on the magnetization curve corresponding to $E_g$, the armature reaction KIT may be added directly to this value of $F_1$ by drawing it at the proper angle as shown. $F_{FL}$ is then rotated down to the axis so that the open circuit voltage $E_o$ corresponding to this field excitation can be determined. $E_o$ is found to be 3020 volts. The regulation is then

$$\frac{3020 - 2400}{2400} \times 100 = 26 \text{ per cent.}$$

For a unity power factor load the procedure would be the same, except that $\theta$ would be zero. The angle $a$ between the terminal voltage $E_T$ and the generated voltage $E_g$ would then be larger than in the illustration.

On sustained short circuit, it should be noted that the armature reaction, KIT, limits the generated voltage $E_g$ and that the armature impedance IZ absorbs this generated voltage.

If the angle $a$ between the generated and terminal voltages is neglected, then the addition of the armature reaction is somewhat simplified. At unity power factor the full load field excitation would then be

$$F_{FL} = \sqrt{F_1^2 + (KIT)^2}$$

and for 0.8 power factor, current lagging, the full load excitation would be

$$F_{FL} = \sqrt{F_1^2 + 1.2\ F_1 \times KIT + (KIT)^2}.$$

Neglecting the angle $a$ in this way makes very little difference in the regulation at 0.8 power factor but may give an error of 10 per cent in the excitation at unity power factor if the armature reactance is as high as 20 per cent.

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# FACULTY SKETCHES

ANOTHER member of our faculty who is well known in his profession is Professor Fredrick Maynard Mann, of the department of Architecture. Evidence of his reputation among the architects of the country is shown in his recent election to the rank of Fellow in the American Institute of Architects. This is an honor conferred on only a few men each year and represents some noteworthy contribution to the profession.

Professor Mann was born in New York City on the first of May, 1868. His interest has always been in architecture, and in 1888 when he came to the University of Minnesota he registered in the School of Architecture, after the first year transferring to civil engineering because, as he said, "There was no one here who knew anything about architecture at that time." He was graduated in 1892 with a degree of B.C.E.

After graduation he worked for the Northern Pacific railroad on construction and design in order to make enough money to continue his studies in the line of architecture. He went to the Massachusetts Institute of Technology receiving a B.S. in architecture in 1894 and a M.S. in architecture in 1895.

From 1895 to 1899 Mr. Mann was an instructor in architecture at the University of Pennsylvania. At Pennsylvania he taught design but also had classes in construction, strength of materials, and graphical statics, so that his teaching experience was in several different fields.

In 1898 Mr. Mann won a competition in which many of the countries' best known architects were entered. He was the only unknown who entered the competition, but his design of a memorial church won the prize. The results of this competition was that Mr. Mann got more work and so practiced architecture in Philadelphia from 1898 to 1902. Among the work he did in this time was a bachelor apartment building. At this time there was no such structure in Philadelphia, so that his design was an innovation. He also designed a church at Lansdowne, a suburb of Philadelphia.

When Mr. Mann was called to Washington University at St. Louis in 1902, he had to organize and start the department of architecture there. He was interested in the school because Washington University was the first school in the country to use the collegiate Gothic style of architecture in its buildings. This style had caused much interest in architectural circles.

In 1910 Professor Mann was called to the University of Illinois to take the place of Dr. Ricker, who had been at the school for forty years. This represented a change from one of the newest schools of architecture to one of the oldest. Professor Mann served at Illinois for three years, coming to the University of Minnesota in 1913. He has been here since that time as head of the department of Architecture.

In 1923 Professor Mann was appointed to the Minneapolis city planning commission and has held that position since that time. He is now the oldest member of the commission in terms of service and was president of the commission for the years 1927 and 1931.

Professor Mann's office is one of the most interesting in the college. Besides the usual array of books and references he has several good colored drawings on the walls, some pure art as well as those that are architectural in import. He has

(*Continued on page 172*)

## FACULTY SKETCHES

(*Continued from page 170*)

a leaded glass plaque in the window and standing on his filing cabinet is an old Chinese statuette of one of the seven household gods of the Chinese. At one time Professor Mann was much interested in Japanese and Chinese art and says now, "The modern art is very similar to the old Chinese and Japanese art in its approach to expression of fundamental ideas." In this he means the neglecting of formal geometric perspective and favoring a more symbolical perspective of impression.

Professor Mann's great interest outside of the field of architecture and art is in the wild outdoors; he likes fishing and canoeing or any sport in the open.

Mr. Mann is a member of the American Institute of Architects, Tau Beta Pi, Sigma Xi, Psi Upsilon, Alpha Rho Chi, Scarabs, American Civil association, National Economic League, the Minneapolis Engineers club, Skylight club, and the Six-o'clock club.

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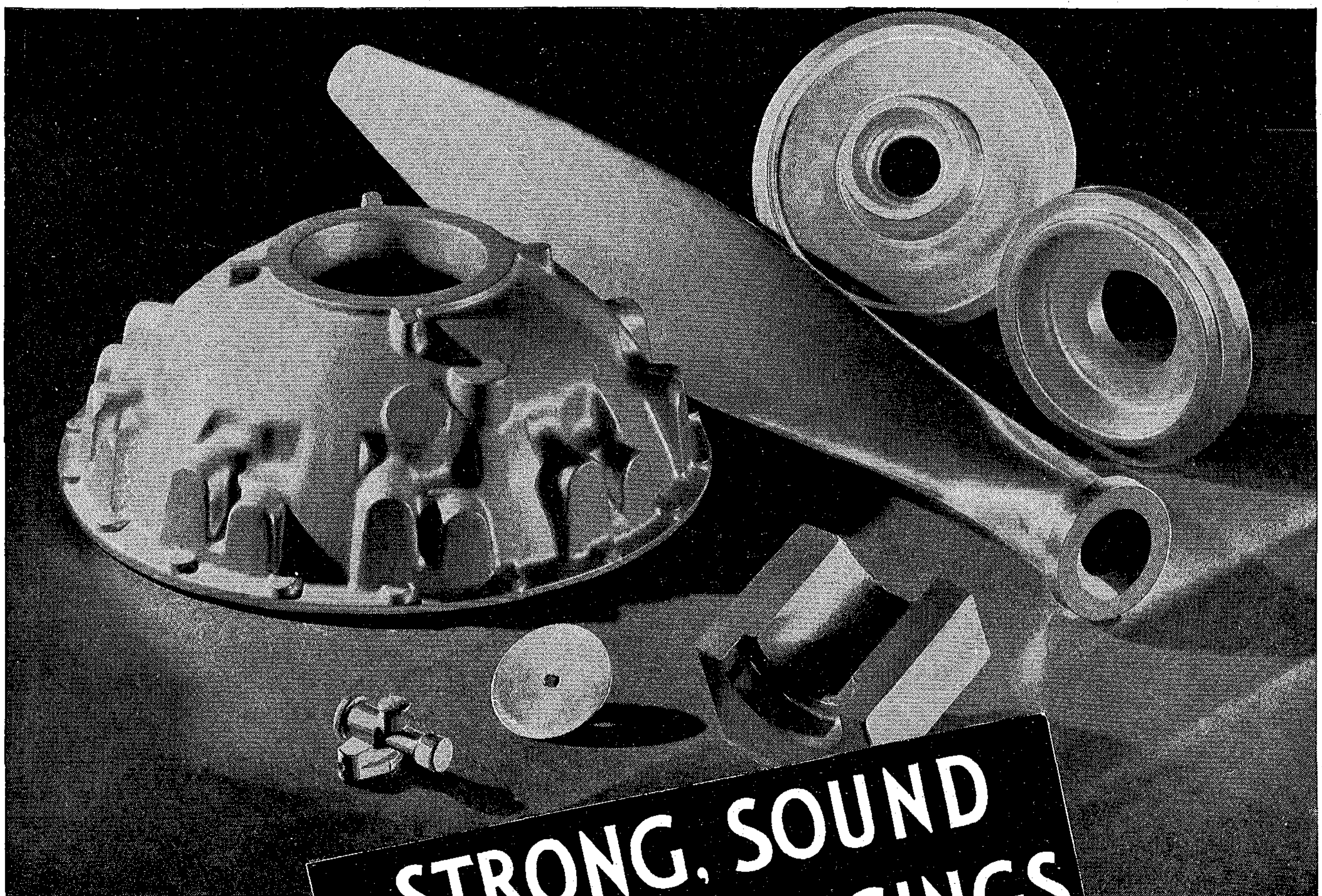

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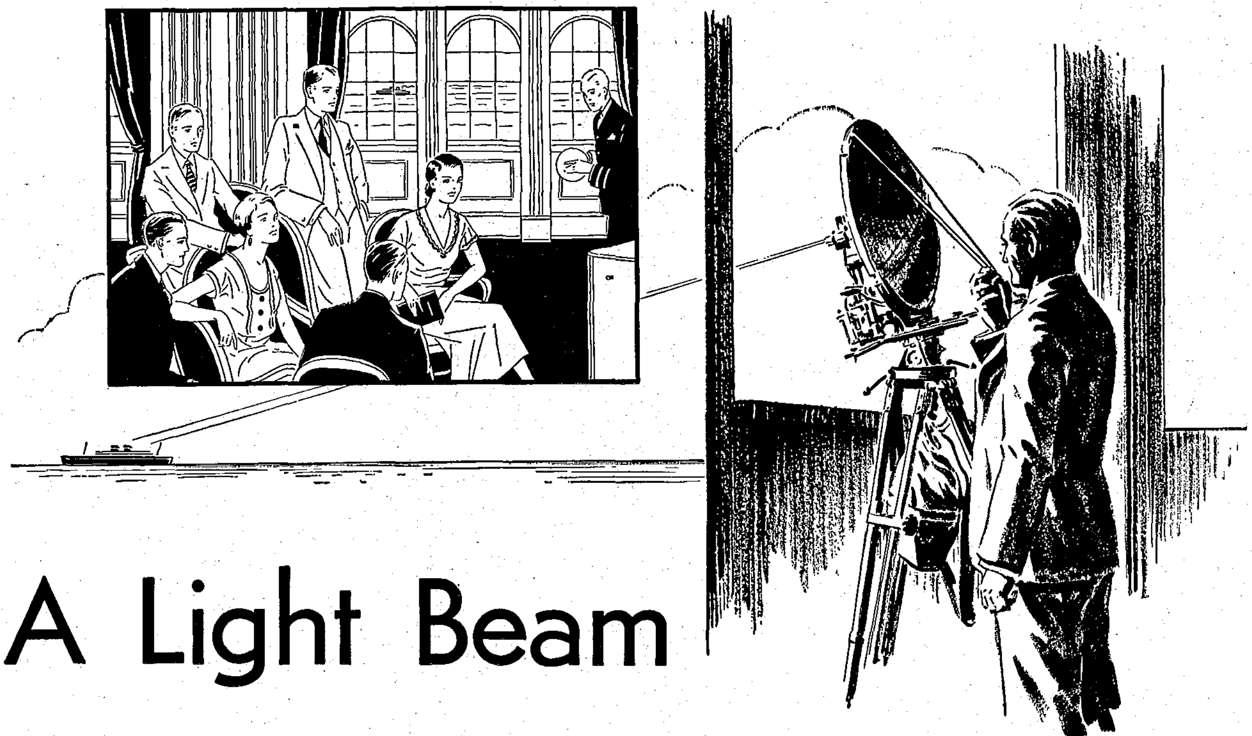
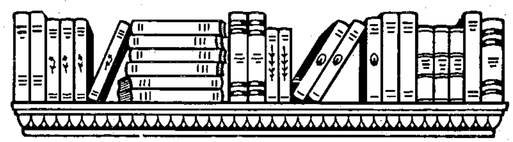
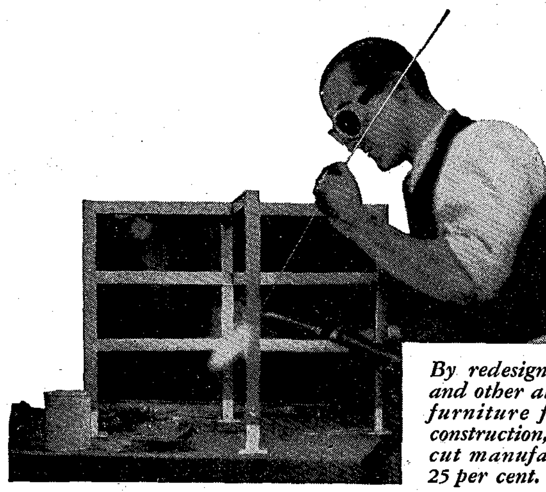


# THE MINNESOTA TECHNO-LOG

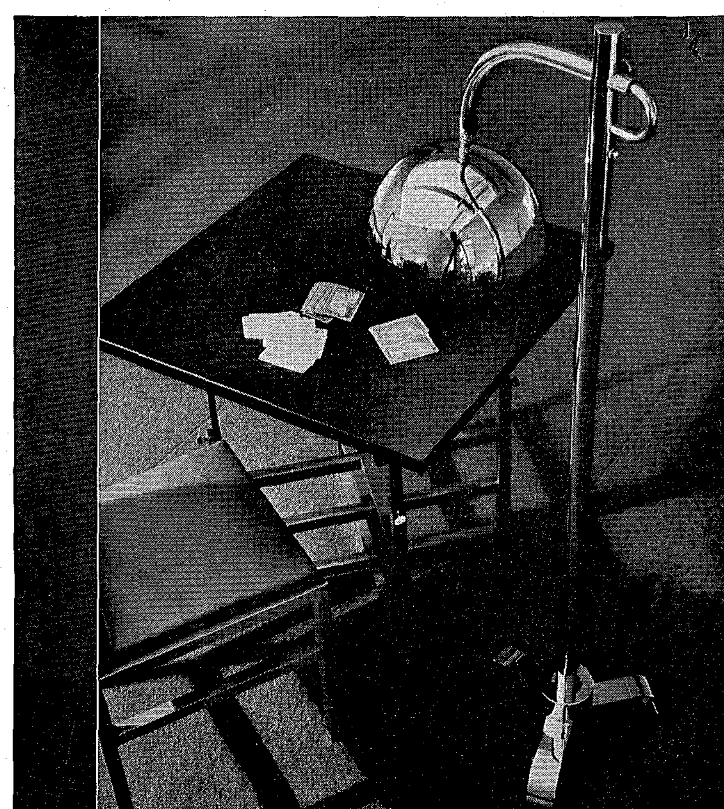
Vol. XII MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED No. 8

MAY, 1932









May, 1932

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APPRENTICESHIPS *are an age-old form of introduction to an industry. Mr. Powell gives some inside information on how these courses are conducted by modern industry—and why.*

MODELS, *suprisingly like the natural structure in both appearance and action, aid the engineer in design. Many times their erection proves profitable in savings in construction of the final product.*

SMOKE *is both a civic and an industrial detriment. Professor Shoop shows a number of methods for preventing this loss.*

ST. PAT AND HIS QUEEN *mark the last issue of the staff of 1931-32. But one more issue, June, will be published—and that under our indirect supervision.*

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The Basilica of St. Mary, Minneapolis
—By Russell Williams

# industry renewed

# That Apprentice Idea

# —why?

***Graduate apprenticeship plays an increasingly important part in adapting college trained men to industry. Mr. Powell, who has spent several years with a large manufacturing company, tells the purpose of such apprenticeship.***

By KNOX A. POWELL
M. E. '20

OUR fathers, if they were technically educated, probably went to commencement with the advice to sprint for the end and jump off precipitately into the welter of industry to sink or swim. They probably discovered at once that they were not immediately prepared to accomplish anything. Then, if the truth were known, began a fierce battle to get onto the "ropes" before the cramps of complete discouragement should overtake them. Employers and fellow workmen tried to help as best they could, but swimming lessons are difficult in deep water and the volunteer trainers sometimes lost patience with the heroic but blundering attempts to "make good." This method of induction into industry did not always produce the strongest possible swimmers and the professional mortality in the learning was very high.

The technical graduate of today cannot plunge directly into organized industry as of old. Every approach is guarded by some more or less formal graduate apprenticeship, a vestibule course through which he must pass to receive instruction regarding the sea of production in which he will live his professional life.

**Doing Is Final Goal**

The great problem of engineering is "how to do." Formal education centers its attention on the how, but industry is chiefly concerned with the doing. Schooling is merely potential, but production is kinetic. Education is preparatory, but only accomplishment is actual realization. The first is just the means, and the latter is the real end.

The eighteen years that the average college graduate has spent in formal schooling, however, is a long time for youth to keep the ultimate object of production plainly in view. Few engineering graduates, in fact, have escaped all haziness of outlook and managed to maintain steadfastly and clearly before them the second step in the great problem of engineering. Many technical graduates, somewhere along the line, have even lost the vision altogether and come to feel that somehow education should be its own reward.

In college, as soon as a man knows how to do a thing it is time for another assignment, but just the opposite is true in industry. Effective production cannot start until the method is well established. For that reason, the man fresh from college, although possessing clear perception, is ill fitted to stand the grind of routine. He knows well the value of variation in analysis, but he rarely appreciates the essential worth of uniformity to production. He is accustomed to scrutinize each move with intelligent judgment to prove its correctness, but he is unskilled in the use of repetition to avoid error. He fears monotony lest it have deadening effect instead of welcoming it as a conserver of energy in emancipating the wits. He delights in each new problem, but finds no joy in the hundredth solution of an old one.

So insidiously damaging is this false point of view that prolonged schooling may engender, and so inevitably one sided is the average technical graduate's experience, that some industrial executives even consider college to have no intrinsic value. They hold that college is merely an extended aptitude test for sorting out the most suitable men. Even executives who concede other worth to technical schooling almost invariably place first emphasis on the selective value. Some actually refuse to consider men below the upper twenty-five per cent in scholastic rating of the graduating classes.

Industry, whether it considers college training inherently valuable or not, has had to find a way of adapting university men to its work. The low average of success when mere chance was trusted to bring about the transformation from student to producer could no longer be tolerated in this age of increasing efficiency. Moreover, the continued rapid development of scholastic education on the one hand, and of industrial specialization on the other, has steadily widened the gap between technical studentship and professional practice. Industrial leaders have resurrected the apprentice idea of the old guild craft in a much abbreviated form to solve the difficulty.

The first object of the technical apprenticeship is to impress college men with the necessity for uniformity and, hence, conformity. Discipline some call it. Without uniformity predetermination is impossible. By it, all the glories of modern social and material well-being have been attained.

The danger of blind conformity, however, must be avoided. Just as the man who obeys the civil law intelligently is a citizen while the man who adheres absolutely to the legal letter is a slave, so the man who consciously conforms to rules is a craftsman while the one who never takes an exception is a mere drudge. Some technical apprentice courses have even installed special officers whose sole duty is to administer a maze of rules which, while they must not be flagrantly violated, are purposely so subtly inconsistent as to give practical demonstrations in intelligent conformity.

The problem of repetitive work is more difficult. The technical apprentice must be so initiated in routine that he will realize that only by that means can

(*Continued on page 199*)

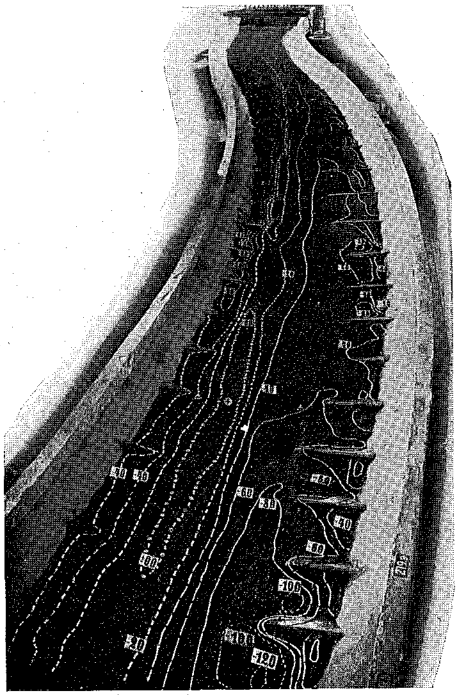


Figure 7. A view of a model of low water channel corresponding to a stretch of the Rhine river downstream of Karlsruhe, Germany.

# models aid in Studying Hydraulic

By LORENZ STRAUB
Associate Professor of Hydraulics

WITHIN recent years hydraulic engineering has been undergogoing an interesting stage of development which promises to provide a unique and rapid evolution in the design methods of hydraulic structures. The use of models for analyzing the more complex design problems confronted in modern hydraulic engineering including river control in its various aspects, such as the design of harbors, docks, flood control works and the like, is at the threshold of what appears to be a remarkable stage of development. However, the application of the theory of models is not limited to works of this nature; one may apply the principles to the design of air craft, submarines, ships of various types, pumps, and motors. It is possible to make experiments with water as a medium and predict occurrences which will be obtained with air, oil, or some other medium.

Investigations may be made on miniature rivers, harbors, and dams modeled to resemble the mighty hydraulic structures in nature. Floods, tides, waves, and winds may then be produced at will. A cycle of occurrences requiring several years in nature may be reproduced in the laboratory in a precisely similar fashion on a small scale in a few days or possibly even in a few hours if the scale of the model is sufficiently reduced.

**Economic Factors Show Models Success**

Although many poorly designed hydraulic works in the past have withstood the forces to which they were subjected, they are not to be considered satisfactory, because great economies could have been effected by more thorough studies. It is virtually impossible to predict all of the complicated flow occurrences which are likely to obtain in connection with overflow spillways, harbors subjected to tides, river moles, and the like, by purely theoretical analysis. Thus, for example, the Wilson dam at Muscle Shoals, although very carefully designed, was subjected to very serious erosion at the bottom of the overflow spillway, notwithstanding the fact that the dam was constructed on bed rock. Here individual boulders weighing as much as 200 tons were torn from the stream bed and transported considerable distances downstream, thereby seriously endangering the toe of the dam. Such damages are extremely costly and may be avoided by experimental design of the spillway.

Experimental studies based upon the laws of similitude facilitate the correction of various shortcomings in the original design of projected installations. In the case of off-channel river harbors and sea harbors, the location and type of entrance may be revised so as to reduce sedimentation and resulting dredging costs to a minimum; ship locks may be improved to allow the maximum possible speed of operation with the simplest and therefore most inexpensive design; headraces, penstocks, and tailraces of hydroelectric plants may be improved to reduce energy losses to a minimum and materially increase the plant efficiency; studies may be made of localized conditions of scour incurred in stream beds in consequence of artificial or natural obstructions. These and many other economies are possible by means of model experiments. Purely mathematical treatments thus far have proven in-

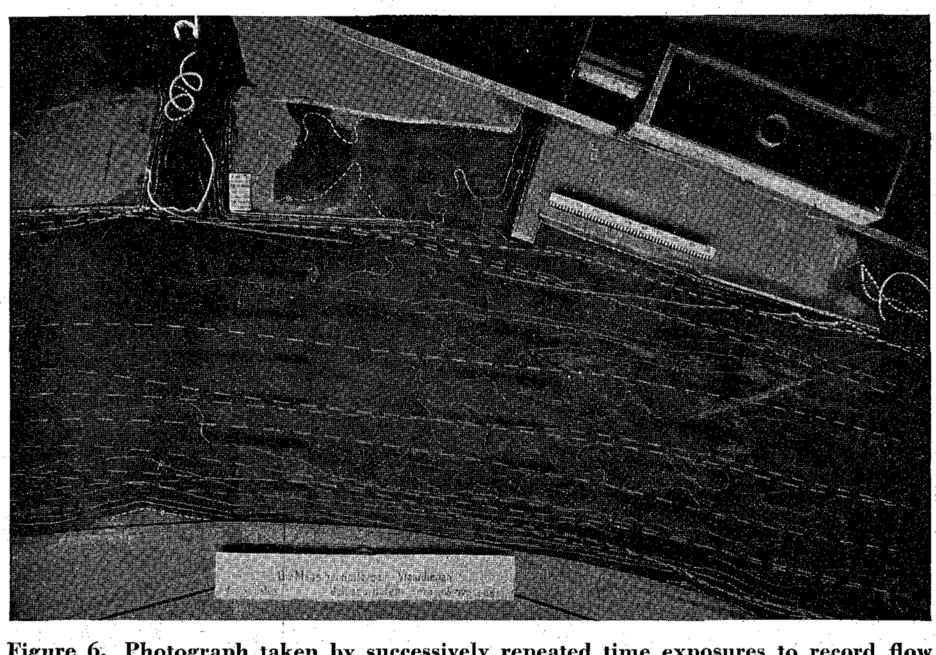
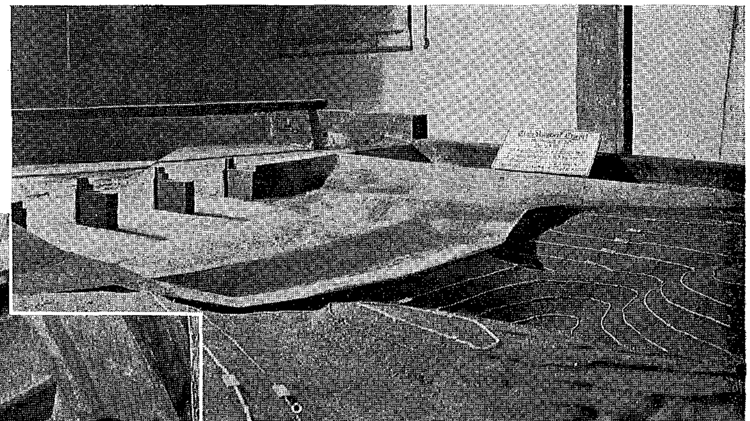


Figure 6. Photograph taken by successively repeated time exposures to record flow phenomena in the model of the Maas river estuary. Note the paths of light in the bays at top of picture.

# Structures



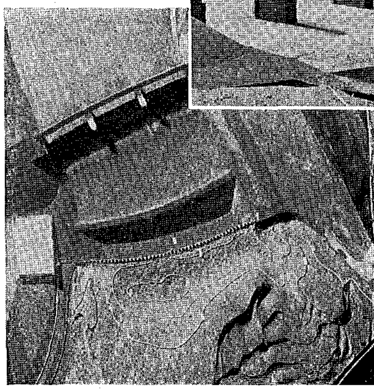


**Figure 2 (above). A second picture of the model of the Cricort floodway showing how the flood waters caused deep scour downstream of the spillway apron.**

**Figure 3 (left). The white contour lines show the improved scour conditions below the apron of the model Cricort floodway after the model had been revised.**

adequate in the study of many of the complicated flow conditions here enumerated.

Furthermore, the model has the advantage that the most unfavorable cycle of flow occurrences may be brought about at will; the conditions obtaining in nature may be even exaggerated if desired so that the worst possible occurrences may be readily observed. The time required to observe the cycle of events in the model is only a fraction of the time required in the case of the prototype, and the costs are correspondingly reduced.

All of these circumstances are favorable to great economies in the cost of hydraulic structures, and may frequently result in the elimination of very serious mistakes in design. The cost of an important river, harbor, or hydroelectric development often amounts to many million dollars; hence, very slight improvements in design will be accompanied with huge financial savings.

**Engineers Lack Training in Laws of Similitude**

A thorough knowledge of the mechanics of similitude is indispensable in the solution of practical hydraulic problems by means of models. Although the usual mechanics is practically unlimited in application to pure dynamic phenomena, the applicability of the mechanics of similitude has certain limitations. It is important to recognize that not all motion occurrences can be imitated by means of a model, and therefore not all dynamic problems met with in practice can be solved by means of the mechanics of similitude. Extremely careful analyses must be made to ascertain whether the motions concerned may be strictly subjected to the requirements of similitude; frequently the laws of nature act against such possibilities and permit only approximate similarity. A knowledge of the fundamentals of similitude is not uncommon among mathematicians and physicists but is usually lacking among engineers. This is possibly the outstanding reason why the advantages of models have not been fully recognized or appreciated.

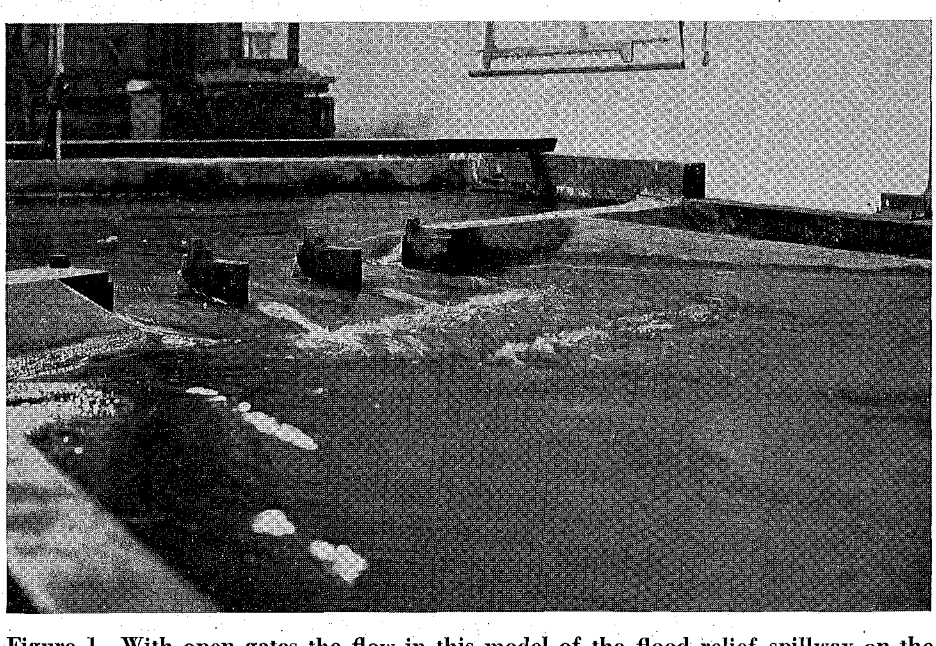


**Figure 1. With open gates the flow in this model of the flood relief spillway on the lower Oder river at Crieort, Germany, is 0.65 cubic feet per second corresponding to a flow of 7500 cubic feet per second in nature.**

For mechanical similarity between a model and the prototype the two must be geometrically similar and the movement of homologous particles in the two systems must take place in a similar fashion under the influence of natural forces. The forces coming into consideration in particular are those which cause movement. These, for convenience, are called physical forces. Forces which have no effect upon movement, in contradistinction, will be termed nonphysical forces. Physical forces are those which are ordinarily defined by a coefficient. In general they may be classified into five groups; namely, earth's gravitational force, general attraction forces between masses, internal liquid friction, capillarity or surface tension in liquids, and elastic forces. Each one of these types of forces governs a different "model law." The model law defines the time, length, mass, and force relations between the prototype and model.

In case only one physical force influences the motion occurrences—this being the gravity force in the case of a pendulum—perfect similarity may be had with any one of an infinite number of scale ratios for the model. However, if the motion occurrences are influenced by more than one model law, there is only one possible size model which will provide perfect similitude; in most instances this is the prototype itself. Hence there are relatively few instances in which it is possible to obtain perfect similarity between the model and the prototype. This does not mean that the model is to be used except for the very few cases in which only one physical force influences the motion occurrences, but it necessitates discrimination in order to avoid serious error in the deductions based upon experimental results.

### Two Model Laws Illustrated

Considerable space is required for adequate description of the various model laws; it will suffice here to give examples of the two model laws most frequently dealt with in experimental hydraulics. As an example in which the force of gravity governs the flow occurrences, a dam will be considered which is to pass a given quantity of water; the relative linear dimensions of the prototype and model will be taken as 10: 1. Likewise, for the purpose of comparison, a smooth pipe line will be considered, the homologous lengths of prototype and model being related as 10: 1 just as for the dam. Then, in order to transfer the results of the respective models to the corresponding prototypes, the factors which must be used are as given in the accompanying table.

**Coefficient by Which the Quantities Observed in the Model Must Be Multiplied for Application to Full-size Conditions, Assuming Prototype Ten Times as Large as Model**

| Item | Flow Over Dams (The same model law holds for pendulums, falling bodies, some types of wave motion, some types of open channel flow phenomena, etc.) | Flow Through Pipe Line (The same model law holds for motion of submarines and air craft, resistance of smooth surfaces to fluid flow, etc.) |
|---|---|---|
| Time Periods | $T_n : T_m = 3.16$ | $T_n : T_m = 100$ |
| Velocities | $V_n : V_m = 3.16$ | $V_n : V_m = 0.1$ |
| Accelerations | $B_n : B_m = 1$ | $B_n : B_m = .001$ |
| Forces | $F_n : F_m = 1000$ | $F_n : F_m = 10$ |
| Stresses | $S_n : S_m = 10$ | $S_n : S_m = .01$ |
| Discharges | $Q_n : Q_m = 316$ | $Q_n : Q_m = 10$ |

Similar relations may be set up for work, energy, and other factors dealt with in mechanics; here also there is a wide variation in the two laws concerned. Thus it is evident that a clear conception of the controlling law must be had if the engineer is to successfully interpret the results of his experiments as applied to the proposed structure. If it should be attempted to apply the model law for gravitation (which is applicable to the flow over dams) to the case of flow conditions where internal fluid friction is the controlling force (flow through pipes), it is quite obvious that serious mistakes would result.

If the fluids are of different viscosities, for example, if in the model water were used while in the prototype oil is to be considered, the transfer coefficients must be varied from the above for internal fluid friction occurences. Still other complications are introduced when bed sediment transportation is involved, such as takes place in rivers. Other laws govern elastic forces, mutual attraction, and capillarity forces.

From the above comparison it is obvious that a thorough knowledge of the mechanics of similitude is indispensable in connection with the experimental method of design of various types of structures. However, the fact remains that highly efficient and economical designs are possible by the intelligent use of small scale models. Their limitations must be thoroughly understood.

The application of the mechanics of similitude in the complete numerical solution of a practical problem involves the following steps:

**1.** Preliminary study on the basis of mechanics with a view of ascertaining whether it is at all possible to treat the problem by the method of similitude.

**2.** Determining the "model law" governing the particular occurrence.

**3.** Performing experiments with due consideration of the limits of the applicability of the model law involved.

**4.** Evaluation of the magnitudes resulting in the model in connection with their transfer to the prototype.

**5.** Where possible, the performance of an experiment on the prototype as a check on the relative magnitudes in the prototype and model. (This is particularly important if more than one physical force produces the occurrences.)

Continual comparison between the model and prototype, wherever possible, eventually leads to a firmer basis for determining the limitation and reliability of models in the solution of engineering problems.

A few examples with which the writer was associated are here cited briefly for the purpose of indicating the general procedure of analysis of intricate hydraulic problems by means of models. The experiments, for the most part, were performed under the direction of Dr. Th. Rehbock of Karlsruhe, Germany.

### German Work Shows Savings

Figures 1 to 3 are of a model of a flood relief spillway designed for the lower Oder River at Crieort, Germany. The problem consisted in providing a suitable by-pass to relieve the Oder River of excess flood waters when the levees are endangered. The model was constructed to a scale of 1: 50. Figure 1 shows a flow of 7500 cubic feet of water per second passing the flood gates, which in the model actually amounts to only 0.65 cubic feet per second.

Figure 2 shows the resulting scour occurring in a period of seven hours—one hour in the model. The white lines indicated are strings representing contour lines (lines of uniform elevation) spaced at a vertical interval of 3.28 feet (1 meter), which is only 0.066 ft. in the model. In the original design (figure 2) there is evidence of very serious erosion just below the apron of the spillway. Figure 3 shows a bird's-eye view of the same model but with a slight revision which has resulted in practically complete elimination of the serious erosion condition. The revision consisted simply of the addition of a dentated sill at the end of the spillway apron. The model was built within a steel tank approximately 10 feet wide, 40 feet long and 2 feet deep. The spillway was made of cement, the remainder of the model of sand.

A model was built to a scale of 1: 200 of the high water relief and hydroelectric plant on the upper Rhine River where the model is carrying an amount of water corresponding to approximately 200,000 cubic feet per second. The

(*Continued on page 196*)

# designing Furnaces to fit the Fuel eliminates Smoke

By CHARLES F. SHOOP
Professor of Steam Engineering

**Smoking chimneys show a definite loss of coal and cause a tremendous amount of expense due to soot deposition in clothing and merchandise. This smoking may be prevented by the use of either smokeless fuels or correctly set furnaces. Professor Shoop concludes his article on smoke control with a discussion of these factors.**

THE advantages claimed for oil over many other fuels are: no dirt or ashes, no smoke if burner is properly adjusted, higher maintained efficiency, automatic operation, and freedom from continuous attendance. Oil for both domestic and industrial use has greatly reduced the consumption of coal.

Low temperature coke is char or carbonized coal containing fifteen per cent volatile or less, manufactured under low temperature distillation. The object of low temperature distillation of coal is to obtain a coke-like material high in carbon and containing not more than fifteen per cent volatile in the form of stable hydrocarbons that will burn without smoke. This product is suitable for briquetting into smokeless domestic fuel of anthracite character. It is considered a smokeless fuel, as any coal having less than eighteen per cent volatile is classed in the state of Minnesota as smokeless fuel.

Anthracite coal possesses the same burning characteristics as high temperature coke. But the amount of this fuel available is limited. A mixture of anthracite slack with liquid tar has been successfully burned free from smoke by the Consolidated Gas and Electric company of Long Beach, New Jersey, at ratings up to 225 per cent. Anthracite is classed as a smokeless fuel.

Lignite, a fuel that the West will soon know more about, must eventually replace the costly Eastern coals in this region. The lignite deposits furnish the most extensive reserve fuel resources in the world and those deposits are thick and near the surface. The U. S. Geological Survey estimates the North Dakota and Wyoming fields as containing 1,200 billion tons of this fuel.

Lower grades of lignite disintegrate and crumble when heated. On burning, this packing of finely divided fuel on the grate increases the resistance of the fuel bed to the flow of air; hence, a high draft pressure is required for even moderate rates of combustion. The Cochran manual states that this crumbling causes intense combustion at the point where the air enters directly above the grate. This high temperature with the low fusion point of the ash results in the formation of clinkers.

As the moisture and volatile content exceeds that normally found in bituminous coal, the difficulties in burning lignite are correspondingly greater. There must be a long combustion space, the gases requiring a long furnace travel. Smokelessness with hand firing is exceedingly difficult in present designed furnaces.

The Mining Experiment Station of South Dakota is alive to the lignite issue. The results of an extensive series of tests covering the use of lignite in dust form, both dried and undried, for steam generation, has been issued in bulletin form by this Station. This research has been carried to a degree that recommendations for burning lignite smokelessly are being made relative to the installation of unit pulverizers for central heating stations and small power and industrial plants. Many of the inherent difficulties attending the burning of raw lignite are overcome when it is burned in the pulverized form.

Lignite has a tendency to break down into fine particles and partially pulverize on air drying. This dust is an almost ideal substance to start with as it pulverizes easily. The South Dakota Station reports that lignite with a 17 per cent moisture content was readily pulverized and burned in dust form.

The Journal of the American Society of Mechanical Engineers reports for the Dakota station that, after the furnace had been brought to a high heat, it operated successfully when fed with undried lignite having a moisture content of 31.9 per cent. It is believed that this is the first record of the burning in dust form of crude lignite slack containing the original moisture content as received.

A further study of this fuel is not required, as its sale in this locality has been practically discontinued. It is not a smokeless fuel.

Peat is the product of vegetable matter in the first stage of conversion to coal. No serious consideration need be given to the study of peat at present as it is reasonable to suppose that lignite should receive first attention.

If the method and conditions of burning raw coal as we have them now are to continue to prevail, we will have the same problem of smoke abatement to combat in the distant future, as our present worked bituminous coal fields under our present rate of consumption will last at least 400 years.

Smoke is due to incomplete combustion, which is brought about by either cooling the distilled products below their combustion temperatures or through lack of oxygen when the gases are at their combustion temperatures. Incandescence must be attained before a union with oxygen will occur.

In the first case, what cools the gases below their combustion temperatures? The principal source is the chilling of the gases by coming into contact with cold surfaces before combustion has been completed. In the second case, sufficient air is not present at the place and time to complete combustion and the burning is snuffed out.

Again, many boiler installations are found where the furnace is too short and the flame way or combustion chamber lacks sufficient volume to provide for slowing down the progress of the gases to give time for completion of the combustion. A longer flame way is needed for Indiana and Illinois coals than for Pennsylvania and Ohio coals. Therefore, a furnace which operates satisfactorily with Pennsylvania coals may produce smoke with Illinois coals which have a higher volatile content.

Just as the interposition of heat absorbing surfaces in close proximity to the burning distillate tends to cool the gases, to suppress combustion, and to produce visible smoke, just so does the interposition of refractory walls, piers, and arches serve to radiate heat at points where needed and in addition break up stratification and induce the mixing of the gases. The U. S. Bureau of Mines state that in the burning of bituminous coal, tar vapor is distilled off at the surface of the fuel bed and either burned or broken up into soot and fixed gases before it has traveled a foot, i. e., in about one-tenth of a second. The need of refractory walls at a high heat is therefore evident. These aids are hard to maintain under severe heats and in addition reduce the volume of the combustion space.

As a rule, the better method of treatment is to adopt the Monnett setting with its brick roof suspended from the lower line of tubes directly above the fire, its horizontal baffles, and curtain wall. Mr. O. Monnett states that in solving the smoke problem in Chicago, he was often forced to employ horizontal baffling. Tests proved that neither the efficiency nor capacity were lowered by the change; however, a greater draft was required. Mr. H. Kreisinger of the Combustion Engineering corporation states that horizontal over vertical baffling gives better results for high volatile coal.

No bituminous coal can truly be classed as smokeless when burned in the raw state.

The *Blackhills Engineer* states that a cubic inch of coal after pulverizing contains 125,000,000 particles, assuming that each of these particles is also a cube. Then, by use of simple mathematics, we find the superficial area has been increased over 500 times. When it is realized that each of these particles is surrounded with a jacket of air, it is evident that almost ideal conditions for rapid and complete combustion are present.

The combustion of pulverized coal is characterized by a total absence of smoke, even with cheap grades of coal. Impurities in the coal up to approximately twenty-five per cent have no apparent effect upon the efficiency, and the capacity of the installation can be maintained by injecting more coal. Coals which carry as low as five per cent of combustible matter furnish sufficient gases for ready ignition and maintenance of combustion.

With a pulverized coal installation the operator has direct command over a sensitive and responsive control of the rate of combustion, and can extinguish the flame instantly if he desires. There are no losses from clinkering or cleaning of fires, and the resultant smoke stream is eliminated. If the plant is properly designed, less trouble with ash will be encountered than in the modern stoker plant.

The horizontal return tubular boiler, a persistent smoker with raw coal, need cast no smoke shadows after changing to pulverized coal. In addition, it may be said that the discharged particles from pulverized coal burning are finer and lighter, not being laden with tarry compounds; hence, they may be carried great distances under slight air disturbances. These particles are free from the grit and grime of the ash produced from raw coal burning and are less damaging to the lungs because the furnaces operate at a high temperature which fuses the sharp particles into round globules.

Many English authorities are of the opinion that to prevent smoke a smokeless fuel must be used. This smokeless fuel is to be secured through carbonization, thus guaranteeing smokeless operation under the most careless handling and improper furnace conditions, which are surely furnished by the English domestic fireplace. American engineers are not of the English persuasion; while they accept the fact that carbonized fuel would solve the problem, they believe other methods under our conditions would be more desirable. In the solution of this complex problem the mechanical engineer is indeed the focus. Proper combustion is the solution.

Antiquated court traditions make it difficult to get at smoke offenders, however. The courts hold that it is unconstitutional to say what shall or shall not be used as fuel. The law, according to the courts, can only forbid the resulting nuisance.

The Minnesota Supreme Court states, "It is not easy to see how dense smoke can be regarded with toleration or found acceptable to the sense of ordinary humanity, particularly in the residence portions of a community."

The majority of the best ordinances have incorporated the following conditions in their text, which apply to both stationary plants and locomotives:

**1.** No smoke be allowed of a density which exceeds the standard of density, at any time, except when cleaning or building new fires, and then for 6 minutes in 1 hour only.

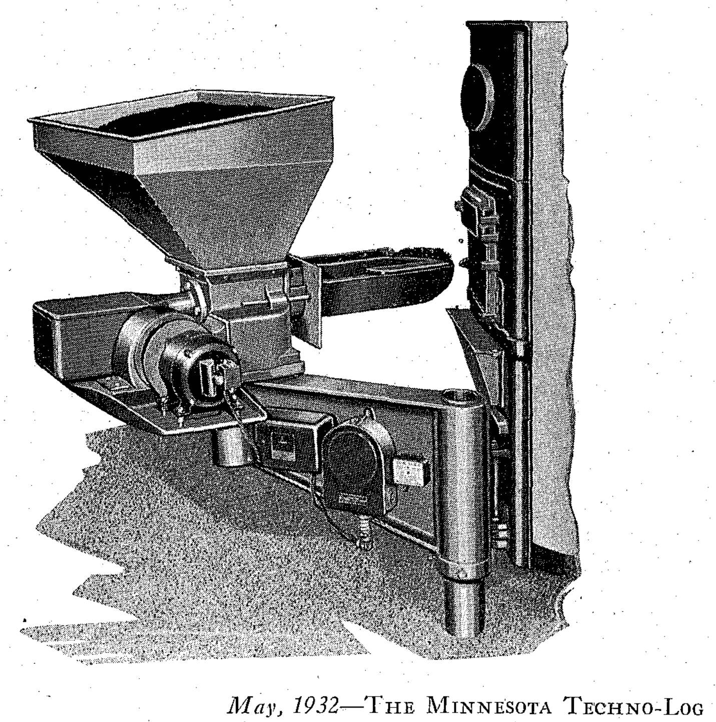
**2.** The standard of density is to be number 3 Ringleman.

**3.** A smoke inspector is to be appointed with as many assistants as shall be found necessary, all with pay.

**4.** In the event that the ordinance is not obeyed, provisions for the prescribing of suitable penalties are to be made.

The smoke abatement officers' position in many cities is politically controlled, and much pressure is brought to bear conducive to leniency in the prosecution of offenders.

Smoke suppression and abatement is a campaign of education. The average public spirited citizen has yet failed to



grasp the fact that smoke abatement is vital to health and public economy. He places the smoke problem alike in the category of other public nuisances. He learns that his neighbors are sending their clothes to the dry-cleaners so why should he not be content to send his also? In other words, the average citizen is a follower and not a leader.

In the St. Louis campaign to secure the reaction of the householders and apartment managers, a city block was selected where every family or apartment in the block used soft coal. The smoke density was obtained for the chimneys of this block without the knowledge of the occupants. An expert instructor then visited from door to door, offering free firing instructions and asking co-operation in the smoke abatement campaign with the following results: five per cent refused absolutely; five per cent gave practically no cooperation; ninety per cent fully cooperated. After three days, the smoke densities were again observed, and it was found to have decreased fifty per cent; by leaving out the bad smokers, the reduction was seventy per cent.

The following table enables the citizen to visualize what has and may be done by the supervision of technically trained smoke abatement officers:

| | Per cent of total prob. | Unrestricted density, % | Highly Restricted density, % | Reduction possible, % |
|---|---|---|---|---|
| **High pressure indus. plants** | **45** | **40** | **2** | **95** |
| **Large heating plants** | **12** | **20** | **3** | **85** |
| **Railroads** | **18** | **49** | **6** | **85** |
| **Residences** | **25** | **10** | **4** | **60** |
| **Total** | **100** | | | |

Mr. H. E. Meller, chief of the bureau of smoke regulation of the City of Pittsburgh, states that in the past fifteen years smoke regulation by law has decreased the emission of smoke by eighty per cent. Dr. Free estimates that to get completely rid of the smoke nuisance in New York city would add twenty-five per cent to the cost of living. Kansas City's smoke inspector estimates that six dollars per capita is the loss in damage created by the smoke nuisance. Professor A. W. Cole, Purdue university, places the loss due to smoke damage and unburned fuels at $17.00 per capita. The presence of smoke is an indicator of inefficiency and waste.

Mr. Osborne Monnett states that the minimum required for an effective abatement requires $50,000 per year per 1,000,000 population, or about .3 per cent of the sum of the unconsumed fuel plus the actual damage done by the soot and smoke. That means Minneapolis would require $25,000 per year for at least a three-year period. The campaign cannot be an over-night venture; it will take a year's time to initiate a workable program and make a survey of every industrial, apartment, and residential smoker.

The plan should arrange for at least three divisions: the technical division, the educational, publicity, and promoting division and the financial division.

The technical division should be in charge of trained engineers who can demonstrate that all objectional smoke, regardless of fuel, can be absolutely prevented by means which are both feasible and practical. There are three ways of stopping smokers; by shutting down the plants, by burning smokeless fuels, and by burning ordinary coals smokelessly. This third method is the one the technical division will have to handle.

The educational, publicity, and promoting division must educate the business men and legisltors and administrative branches of the city government to the need of abatement.

A desire only will not succeed; it must be fortified by a determination to see the thing through. The subject quickens every minute after a smoke abatement campaign is initiated, but emanation first begins, and, as the summer comes along, the agitation dies out. In the fall, the committees usually find themselves again at the same starting point.

Practically all of the important cities have smoke prevention departments and ordinances to combat the smoke problem. The methods employed by these city departments are effective in preventing the emission of objectionable smoke where favoritism, special privileges, or political influences are eliminated, provided sufficient expert smoke inspectors are employed. These men must, as stated, be experts. These experts know that simply trying to force results through court action brings about only temporary relief.

The education of the fireman is an absolute essential if permanent results are to be obtained. It is surprising to learn of the large percentage of firemen who do not know the simplest rudiments of combustion. Again there are old types of furnace installations and crude devices for burning coal which require the intelligence of experts to properly manipulate in order to maintain comparatively smokeless operation. The fireman must be instructed in methods having their basis in facts. The expert, therefore, is needed.

The city must have a fair and reasonable anti-smoke ordinance. It must be free from political interference in enforcement, have a corps of trained experts with assistance, and lastly, the financial division must furnish means for the complete budget. The savings per year are almost sufficient to pay for the complete overhauling of all plants that smoke and the installation of smoke preventing devices. A change from a poorly set, smoky furnace to one meeting the ordinance may save on the average of twenty per cent of the fuel bill.

**Methods of Determining Condition of City Atmosphere**

**1st method.** The precipitated soot and dust are actually caught in special containers, the contents weighed, and the soot fall computed for unit time per unit area in, usually, tons per square mile per annum. This method was used in determining the dust and soot fall for Minneapolis over a twelve-month period.

**2nd method.** The results of several carefully worked out experiments which show the per cent of soot freed per unit of coal burned are used in conjunction with the tonnage of coal burned per unit time. The percentage of soot freed from coal has been determined by various experimenters. Their estimates vary from .1 to 6.5 per cent. An average value for domestic fires may be placed at 6.5 per cent for fireplaces, 4.5 for stoves, and .5 per cent for industrial plants. Assuming 2,000,000 short tons of coal as the Minneapolis consumption, and 540 tons per square mile per annum deposited as soot, we arrive at 1.5 per cent as the average of the weight of coal burned that is carried into our atmosphere as soot.

From 1 to 20 per cent of this soot is tar, the percentage depending upon the kind of coal burned and the method used in its burning. The actual amount of soot put forth into the air above any large city is tremendous, and the layman usually questions the exactness of figures given because of their magnitude, but the fact that the results of carefully conducted experiments agree so closely speaks well of their accuracy.

**3rd method.** By special instruments that draw in samples of air from various stations the number of particles or their so-called density may be determined. Direct comparison may

(*Continued on page 198*)

# starting the First Chemistry Show —a novel project

By GEORGE W. FLANAGAN
Chem. E., '32

FOR a number of years the idea of a Chemistry Show has been a topic of interest and speculation among the students of the School of Chemistry. However, through some lack of an initial driving force, the wheels of organization were never set into motion. It remained for a group in the present senior class to finally overcome the inertia of the idea and transform it into a fast moving project.

In the early part of the fall quarter senior members of the Minnesota student branch of the American Institute of Chemical Engineers occasionally met in some of the more remote corners of the Chemistry building to discuss plans of action for the coming year. By some unexplainable means the conversation always dropped into that tempting and speculative idea of a Chemistry Show. At these early meetings interest in the show grew from musings and dreams into an enthusiastic desire to present a display that "would knock the public for a row." Francis Calton, president of the institute, was the most enthusiastic champion of the idea and due to his spirit and hard work the project finally was launched. During the course of the following general meetings of the institute mention of the scheme met with instant approval. Upper and lower classmen alike agreed to the promotion of the show as the feature event of the school year.

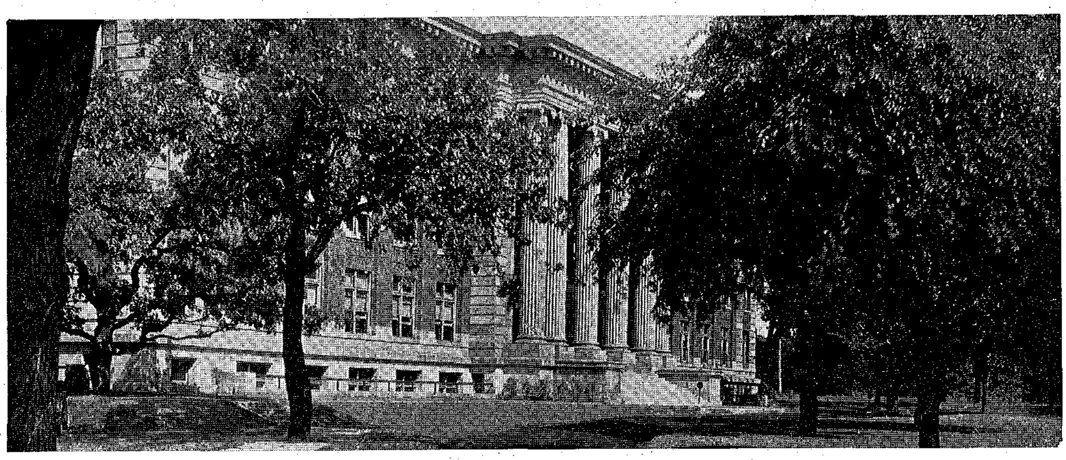
Early in the spring quarter a committee of general arrangements was organized to investigate the possibilities of such a show. Doctors Ralph E. Montonna and Gladstone Heisig joined this group as faculty advisors. Their suggestions and goodwill did much in the way of setting the ball rolling. Soon after the first meetings graduate students became interested in the project. Their interest prompted the committee of general arrangements to appoint the older men as chairman of the "stunts" which would constitute a great part of the show. This move proved to be wise because the greater fund of experience and the more mature judgment of the grads made way for the presentation of a large number of intensely interesting and perfectly safe "stunts."

A wave of interest in the show now swept the entire school. Three organizations expressed their wish to become joint sponsors of the affair. Acceptance was granted to each and at the following meeting of the committee representatives from Alpha Chi Sigma, professional chemical fraternity; Phi Lambda Upsilon, professional chemical fraternity; and the girls of the School of Chemistry were present. From this time on plans for the show advanced at a rapid pace.

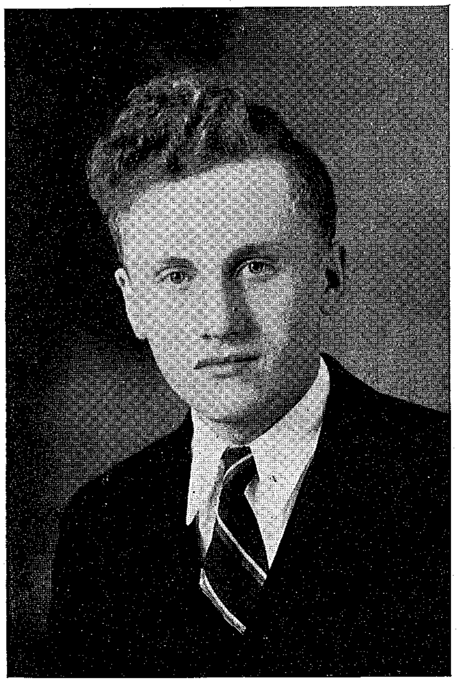
After some consideration the joint committee adopted the plan of presenting the show in four divisions, to include the demonstration of chemical equipment and apparatus, industrial exhibits, historical exhibits, and, finally, "stunts." It was believed that a demonstration of the tools used by chemists and chemical engineers would give the lay visitor a better understanding of the type of work undertaken by these technicians. Industrial exhibits from a number of commercial plants were intended to show the applications of chemical engineering practices.

At the present time most people are aware of the work of the ancient alchemists but few know of the methods and means the alchemists had at their disposal. For that reason it was decided to present an authentic demonstration of the type of laboratories our predecessors used. "Stunts" were planned chiefly for entertainment, but many of those proposed are also interesting from the educational point of view.

Immediately following the presentation of the plan of the show, a large number of committees were formed to draft and execute each detail. Weekly luncheon meetings were held in the Minnesota Union. An invitation was extended each week to a prominent faculty member to attend these meetings and offer criticism. During the last month the committee has enjoyed the spirited and enthusiastic comments of Professor Elmer Johnson, faculty advisor on past Electrical Shows; Doctor Charles A.



**The chemistry building holds exhibits which will reveal the chemists' secrets during the first Chem Show.**



**ARCHIE JAPS**
*Engineers' Day Chairman*

Mann, head of the department of chemical engineering; Dean Leland, chief of the engineering college; and Doctor S. C. Lind, director of the School of Chemistry. All of these men have shown a keen interest in the affair and have since used their influence as staunch backers of the Chemistry Show.

The past few weeks have been a bustle of activity for those engaged in the preparation of stunts and exhibits. Liquid air has been splashed about, eggs have been plated with a coat of gleaming copper, strange pieces of glassware have made their appearance, an ancient alchemical laboratory has sprung into existence, industrial firms have supervised the construction of their exhibits, and any number of stunts have been perfected and tried out. These preparations have brought the show into a practical realization; the dreams of those senior chemicals are at last a reality.

Students have also installed a public address system, with loud-speakers scattered throughout the building. Announcements of the demonstrations in the various laboratories will be made from time to time for the visitors.

Saint Pat's day will prove the success of the Chemistry Show. If the interest shown by the newspapers and other outsiders is any indication, the success of the venture is assured. Those who by their hard work have made possible the Chemistry Show have a sincere wish that the idea will continue and become a tradition in the School of Chemistry.

# Engineers and their Blarney Stone

THE rivalry between the engineers and miners of today is very tame as compared to the mighty struggles of the past. It was back in 1915, on the day before the second engineers' celebration, that the famous engineer-miner battle roused the campus. Engineers had borrowed Professor Rowley's Ford to transport the Blarney stone from its hiding place in the stone quarry below the Franklin avenue bridge to the campus. In those days Fords didn't behave a bit nicer than they do now, so this group of engineers had rather a trying time getting down to the river and dragging the heavy stone into the car. They finally did persuade the balky chariot to move the 300 pound Blarney stone and themselves back to Professor Rowley's garage just back of his house, which stood right where the new library is today, but were so tired that they left the stone in the car, with a few engineers staying behind as guards. In some unexplainable manner the miners learned of the hiding place and marched en masse upon the precious stone, taking a wheelbarrow along to move the stone. The few guards fought valiantly to keep the stone, but the miners greatly outnumbered them. One of the guards finally escaped and rushed over to the engineering building for help. The alarm was spread, and an immediate exodus from every available door and window in the engineering building took place. The reenforcements were not a second too soon, for every single guard was hugging the ground. The miners had the Blarney stone in the wheelbarrow, and were just getting ready to move off. Fists began to fly anew, but the miners held their own against the first group of engineers, and even moved the Blarney stone across the street. The engineers had no intention of giving up their precious stone, and as more and more loyal followers of St. Pat rushed to the scene, the miners were driven back. In triumph the engineers carried the Blarney stone to the steps of the Main engineering building, but here the miners charged again, and almost succeeded in getting the stone. The fighting was fast and furious, with the Blarney stone bumping up and down the steps as each group got hold of it. It was not long before the miners were driven back into the street, however, for more engineers had by now joined in the fray. At last the precious Blarney stone was safe—the miners had been repulsed and properly chastised, and peace again reigned over the campus.

## THE PROGRAM

9:30 OPEN HOUSE
Shops and laboratories are open to the public. The first Chemistry Show will be held in the Chemistry building with feature exhibits at 2:00 and 8:00 p. m.

11:00 PARADE
The parade starts at the experimental engineering building, going on Washington to Church street, past the engineering buildings to University, west along University to 10th, north on 10th street to 5th, then east on 5th to 15th, and back to the knoll.

12:00 KNIGHTING CEREMONIES
All good engineers will be at the knoll for the knighting of the seniors by Saint Patrick.

2:30 DANSANT—GREEN TEA
The afternoon dansant to be held in the engineering auditorium will be open to everyone. Tea will be served in the architectural library on the third floor of the building. Carrol Carpenter will play.

9:30 THE BRAWL
Bud Struck's orchestra will provide music for the big event of the day at the Minnesota Union ballroom. Admission will be $1.50 a couple.

ST. PAT . . .

WILFRED DARLING

# Blarney Stone

ON returning to his native country from a short sojourn on the continent St. Pat found the natives under the influence of the heathen Druids. With true engineering ingenuity and skill he performed miracle after miracle to win over his peoples to his faith.

For a starter, St. Pat constructed with the crudest of tools that long famous rocky road to Dublin—to an engineer a tremendous task; to the heathen Irish a product unusable because of roughness. Then came the miracle; St. Pat designed a wagon which could be used on the road! Truly, a masterpiece of engineering.

A short time later St. Pat saw the need of a bridge across the river Shannon. Years of work proved to him that Coopers E-60 loading was superior to the old Coopers E-25. He then invented influence lines to save time wasted on the loading calculations.

While placing the concrete in this bridge St. Pat became interested in snakes. They persisted in climbing over the super structure causing

. . . HIS QUEEN

CHEFFE MARX

# and Blarney

considerable trouble to the workmen because of the poor footing they afforded. These snakes also took great pleasure in sliding down the cement troughs. It is here that St. Pat became worried as the snakes prevented the concrete movement.

Shutting down all operations St. Pat started means for removing this pest. First he constructed a trough leading to the sea. Then he removed all other troughs and sent his concrete down the new chute. The snakes, sensing a new thrill, rode the path joyfully seaward. Imagine their surprise on feeling the clammy sea water close over their backs. And then heavy concrete poured over them securing them forever to the bottom of the sea!

To this day can be seen massive rocks around Ireland's shore. Each is of St. Pat's endurable concrete; each contains a snake. And the Blarney stone, later used in the construction of that world famous castle, contains the last snake to leave the Emerald Isle.

# THE MINNESOTA TECHNO-LOG

## UNIVERSITY OF MINNESOTA




## Fight! Fight!

MINERS, Lawyers, Engineers and Foresters—bitter enemies to the occasionally very bitter end. And why? Simply because they are Miners, Lawyers, Engineers, and Foresters. Practically every student in either one of these schools would consider his education incomplete without the other three colleges with which to wrangle.

But let every professional student beware of this haggling relationship becoming a yearly warfare. President R. S. Shaw of Michigan State college was recently forced to ban all "scraps" of this type from his campus. And largely because of the brutality exercised in the annual class rushes.

True, here we have no recognized competitions between colleges. But where is the Miner, Lawyer, or Forester who wouldn't care to bomb the annual Engineers' Day parade with slightly aged eggs?

And he should. That bombing is a very important incident in every St. Pat's celebration. But, Engineers should not exercise too much brutality in dealing with such bombers.

## 'Flunk' Seniors?

THE majority of engineering students probably give very little thought to the standards of scholarship of our college until they become seniors and are confronted with the problem of employment. With many graduating groups it happens that some of the students do not secure positions. When a severe business slump exists the reason for this is evident. In normal time, however, the few men who do not secure positions are often students who, either due to inability or other causes, have difficulty in learning more than enough to "get by." If these men lack the ability to master an engineering education or lack the interest in engineering which urges them to industrious study, what chance have they of success as engineers? Who will be willing to place responsibility upon their shoulders?

These stragglers cannot create a favorable impression of our school; they merely lower our standards of scholarship; they reflect unfavorably on the methods of instruction, on the administration of the engineering college, and on the competence of our professors.

The engineering college has been criticized for "flunking" too many freshmen. This is a debatable contention, but it seems inconsistent when the "stragglers" are considered. The answer we propose to the question of how the stragglers survived is: the instructors give too few failures to upperclassmen, especially to juniors and seniors. An instructor may fail a great number of freshmen without being criticized, but he cannot fail any upperclassmen without injuring his reputation.

Would it not be well to raise the standards of scholarship for all classes and to eliminate from the engineering graduates of the University of Minnesota those students who are just getting by?

With higher standards here, our graduates will be more and more in demand by the engineering industry, and the prestige of the engineering college will be raised.

## College Friends

A LEXICOGRAPHER defines nascent as "a term applied to an element that at the instant of being set free from a compound, possesses unusual energy and combining activity." Nascent, then, are the young men who have just been set free from their high school associations, and, being alone in a big university, possess unusual ambitions and friendship-making propensities. Perhaps in the very first days of campus life, a group of these nascent engineers, bewildered by the red tape before them, will band together and pour out their woes. Acquaintance leads to friendship, and the new engineering class is soon composed of many little friendly groups.

The level in scholarship of any group will be that of the majority of members in the group. Those few students who originally possessed greater ability will see their best friends loafing along, and soon these better students will drop to the level of their group of friends.

Of course the reverse may happen, and a few mediocre students having friends in a group of high standing men will strive continuously to better their scholastic work and reach the level of their friends. It is these average students who, choosing friends above them, are really getting all they can out of their college career.

Friendship of a certain kind can make our college career a pleasant and profitable one; some friendships, however, can seriously hinder our education. Let us now, perhaps at the risk of being a little selfish, think things over and ask that friendship give us a bit more than mere pleasure.

# «« « SLIP STIX » »»

## up and down

In the spring a young man's fancy turns to thoughts quite remote from text books. In a similar manner an older man's thought one day turned to reminiscences of his country school days. One warm, hazy afternoon, Professor Wilcox wistfully gazed out the window, forgot his equation of dynamic motion, and recalled a similar day in his childhood when the boys climbed on top of the school where the teacher couldn't get them down. The teacher, being equal to the occasion, started a spell down. And when a word was missed, the speller had to climb down voluntarily or be kicked down by his mates. All of which proves that instructors aren't so dumb—sometimes.

## it wasn't asthma

The Minnesota river was recently the scene of an informal initiation. One of the pledges, who had been sent ahead to act as a scout, came panting back to announce his discovery of a small fire on the opposite bank some hundred yards ahead. "Well," barked the smart pledgemaster, "blow it out!" And the sight of this fellow blowing and puffing would have moved the features on the statue of Poker Face Jim.

## have patience, sir

After a dance at a St. Paul hotel, a rather unsteady gentleman saw fit to ride down on the elevator rather than try to walk. Leaning heavily on the bell and getting no immediate response from the operator, he mumbled (as only a gentleman in that condition can), "Thash funny. She wash home lash night. Jush can't unnerstan't."

## scotch?

On one of the corners of Oak and Washington there is a very dilapidated weighing machine. On a Sunday afternoon three yokels strolled up to it while waiting for a street car. One hopped on and deposited his penny. After being weighed, he gave the machine a shake and out dropped his coin. The next fellow saw a bit of a business enterprise in the experience of his pal, so he stepped on and inserted his hundredth of a dollah. But alas, no end of shaking would bring back the cent. And when his car left, the puzzled lad was on his hands and knees peering under the rusty contraption.

## an m. e. proposes

(No. 3 in which a mechanical does a bit of wooing.)

Ahh, my little radiator, so full of heat that even in the cold of winter you need no alcohol, I would be your condenser unless you say me nay. Let us form a couple, and allow no pony to "brake" our love. I may be a crank, but I want you for my self starter. You are the illumination in my headlights, and you cause my heart to go in high. I adore all of you—even your stockings, cause they're synchro mesh. You will like me—my tongue is a silent second. Say you'll join me in a life of free wheeling. Diesel make me very happy.

## a quiet little town

Major Shippam was giving his class some inside "info" on their camp activities next summer at Fort Sheridan, which is located on the outskirts of Chicago. The major told how in past years a good deal of night firing was indulged in but that maybe this practice would be discontinued this year because Chicagoans were complaining about the shooting. Oh, yeah?

## banana oil

"Here's where I do a little back work," said the chiropractor as he punched the patient's spine.

Imitation of a grub worm winning his mate: Marry me, you worm!

They say the horns on the new Fords aren't so loud—but they sure can sneer.

Grandma, in a peppy car,
Shoved the throttle down too far;
Twinkle, twinkle, little star,

*Music by the D. A. R.*

## salmon for england

Lord Percival had been touring the United States. Lodged in a San Francisco hotel he asked the clerk to tell him a good American joke to take back to England.

The clerk seemed willing to oblige the Lord and answered with a question: "All right, have you been through any salmon canneries?"

"No," answered his lordship.

"Well," replied the clerk, "when you go through one and see the thousands of cans being filled the guide always tells you that they eat what they can and what they can't eat they can."

Lord Percival laughed long and hearty. On his return to England he prepared the first family gathering to hear his American joke.

"When we went through one of those salmon canneries, our guide had a jolly sense of humor. We were watching the little cans being filled when he said, 'We have an awful lot of salmon here. But we do our best. We eat what we can and what we can't eat we tin.' "

And Lord Percival led the long and hearty laughter.

Campus Big Shot, Techno-Log head, saw a chance for publicity and stole the good 'ol Blarney stone. City reporters, hot after latest campus scandal, arrived soon after kidnapping. But Dean's office force removed all mystery with one hearty laugh.

It has now been proved that lightning cannot strike the front of a street car because the motorman is a non-conductor.

▼ ▼ ▼

She was only a shoemaker's daughter, but she knew all the heels.

▼ ▼

He was just a boatswain's son, but he knew the riverbanks.

▼

This being next to the last issue of our good old' Techno-Log, your worn and haggard Sliderule wishes to sing his theme song: Just One More Chance. Tsk, tsk.

# AROUND THE WORLD WITH OUR ALUMNI

## *Architectural Engineering*

'92—Goodkind, Leo—Leo Goodkind has been with Schunemans and Mannheimers store of St. Paul as treasurer for some time now. His home address is at present 40 Crocus Place, St. Paul, Minnesota.

'22—Plank, Howard G.—Howard G. Plank, formerly with the Fairbanks-Morse company of Beloit, Wisconsin, is now at Two Rivers, Wisconsin, with the drafting design and testing department of the Metal Ware corporation of that town. He writes, "We have been here about eight months now. We enjoy this place and have met several Minnesota graduates while living here." Howard's home address is now Two Rivers, Wisconsin.

'24—Olson, Milford C.—Milford C. Olson has branched out from civil engineering and is now doing architectural work also. His official title is "Architect and Engineering" for the International Steel and Iron company of Evansville, Indiana. His address—708 South Harlan avenue of the same city.

'25—Grisson, A. H.—Aubrey H. Grisson, who used to be found at 127 W. Mount Palm street, Detroit, Michigan, has changed his address to 909 Wildwood avenue in the same city. His business is now estimating, and his office is 300 C.P.A. building in Detroit.

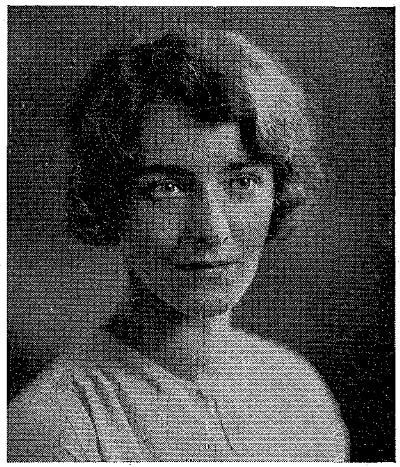
'27—Kastner, Arthur Henry—A. H. Kastner is still acting as instructor in architecture at the Boys' Technical high school in Milwaukee. There is now a little girl in the family. Art writes that she was born on January 28, 1932. His present address is 3334 N. 14th street, Milwaukee, Wisconsin.

'29 — Hakenjos, Fred M. — Fred M. Hakenjos, who recently finished his course at Columbia university, is now assistant manager for the R. Y. Ferner company, 1131 Investment building, Washington, D. C. His home address is 2440 16th street N. W.

'29—Shifflet, Glynne W.—Glynne W. Shifflet is still in Minneapolis as a member of the firm C. P. Pesek and G. W. Shifflet, architects. His business address is 914 Marquette avenue and his home is at 3327 Holmes avenue S.

'30—Melkus, L. A.—Leonard A. Melkus is no longer in Minneapolis, but is now in Grand Island, Nebraska, as architect for the Geer company. His work is mainly designing small homes, but occasionally he must also work on larger buildings. He writes the news that business is slower right now than at any time during the depression. He is optimistic, however, for better business later in the summer. His home address is 913 West 2nd street, Grand Island, Nebraska.

'31—Hoglund, M. L.—M. L. Hoglund is assistant industrial engineer for The Trane company of LaCrosse, Wisconsin. He says that he is sorry to hear of the discontinuance of the architectural engineering course. M. L. complains that he feels like an orphan now. His address is 625 Cass street, Lax, Wisconsin.



'29—Bradbury—Margaret Bradbury is sketching for Harrison & Smith Company, printers in Minneapolis. As a sideline she is doing advertising sketches for French and Company, Interior Decorators, and in December of last year published a group of sketches of familiar places in Minneapolis, including the Washington street bridge, the flour mill district, the Northrop auditorium, and a view of Sixth street. Margaret was Queen on Engineers Day of 1929. She is now staying at the Harvard apartments, near the University.

## *Chemical Engineering*

'10—Taylor—Carl Taylor is being kept busy at Alton, Illinois, where he is making shot and shell for the Western Cartridge company. Carl made a trip to St. Louis recently to attend a meeting of Alpha Chi Sigma, professional chemical fraternity. His home address is 3011 Brown Street, Alton, Illinois.

'10—Woolett—Guy H. Woolett met a number of his old friends at the American Chemical Society meeting in New Orleans. Doctor Woolett received his Ph.D. degree in 1918 and then served on the faculty here for some time. At present he is the head of the chemistry department at the University of Mississippi.

'15—Olsen—Leslie R. Olsen was recently re-elected chairman of the Northwest section of the American Association of Cereal Chemists. Leslie has been director of products control at the International Milling company for eleven years. He is living at 50 Luverne Avenue, Minneapolis.

'20—Fieger—Ernest Fieger is an assistant professor on the staff of the chemistry department at Louisiana State university. He is at present working on the chemistry of soils. Ernest resides at 400 Coorine Street, Baton Rouge, Louisiana.

'22—Kester—Ernest B. Kester read a paper on the compositions of fractions of low and high temperature tars at the meeting of the American Chemical society. Ernest is earning his salt at the United States Bureau of Mines Station at Pittsburgh. He is living at 36 Forest Hills Road, Wilkinsburg, Pennsylvania.

'27 — Crawford — Marjorie Crawford, who obtained her doctor's degree, is teaching chemistry at Vassar. Miss Crawford also made her way to New Orleans to meet old friends and to read a paper before the meeting of the American Chemical Society.

## *Civil Engineering*

'06—Loye, Benjamin W.—Benjamin W. Loye, who was formerly with the Detroit Insulated Wire company as superintendent, has changed to the General Cable corporation, a Detroit plant. He writes, "After June 1, I will be plant engineer at the Fort Wayne plant of the General Cable corporation. My address is now 15763 Strathmore avenue, Detroit, Michigan, but when in Fort Wayne, I can be found in care of the General Cable corporation."

'08—Olson, Melvin T.—Melvin T. Olson is at present working with the Bohn Refrigerator company of St. Paul. He dropped in to see Mr. Robertson in the experimental building recently and says that his present address is 2919 46th avenue S., Minneapolis, Minn.

'23—Olmstead, Charles F.—Charles F. Olmstead also dropped in at the campus recently and says that he is still working with the Marr Manufacturing company. His job is the manufacturing of oil equipment and his title is now assistant sales manager, Marr Manufacturing company. His home address is 4949 Russell avenue S., Minneapolis.

'23 — Sclarow, Abraham M. — A. M. Sclarow, who was formerly with the Manhattan Woolen Mills of Duluth, Minnesota, is now general manager of the Manhattan Sportswear company at 83 S. 9th street here in Minneapolis.

'23—Bachmann, Graydon A.—Graydon A. Bachmann is at present the branch manager of the Dry Ice Corporation of America, in Minneapolis. His business address is 426 Washington avenue North, and his home address is 4212 Tenth avenue South, both in Minneapolis.

'25 — Lushene, Joseph P. — Joseph P. Lushene is now working with the government geodetic survey. Just recently he finished making gravity observations in the Bahamas in connection with the International Scientific expedition to the West Indies, under the direction of Professor Richard M. Field of Princeton university. He observed 12 gravity stations in 32 days and on March 17 joined the party on the United States navy submarine S-48 engaged on gravity at sea work. He may be reached at box 2625, Fort Myers, Florida.

'26—Comfort—Thomas Comfort announces the addition of a pair of twin boys to the family on March 5. Congratulations, Tom, and here's hoping that they turn out to be real engineers. Tom's address is 1704 Pinehurst avenue, St. Paul.

'26 — Halbkat — Franklin Halbkat dropped in on the office gang the other day with the discouraging news that he, too, has joined the army of unemployed. Franklin isn't married yet, so things aren't quite as bad as they could be. He mentions that he met Paul Nelson, editor of the TECHNO-LOG in 1926, and had a nice little chat. Spring Valley, Minnesota, is the address to which news of good jobs can be sent.

'27—Luethi—Carl Luethi, a pilot with the Northwest Airways of St. Paul, is now on the airmail run from Fargo to Mandan, North Dakota. Carl is married, and the future engineer of the family is a red-headed boy 2.718 years old. His present address is 1518 9th street South, Fargo, North Dakota.

'27—Borne—Floyd Borne had been doing nicely in the engineering department of the Northern Pacific railroad—until the depression came along. Floyd is now trying to bring good times back by selling Chevrolets for a large Minneapolis automobile dealer.

'27—Morris—George E. Morris, who is with the United States Coast and Geodetic Survey, writes: "I am completing a year of shore duty here in our Washington office and will return to sea duty this spring. I'll be assigned on the Atlantic coast."

'31—Cowan, C. L.—C. L. Cowan recently visited the campus while on a short vacation he was taking to visit old friends at the university and in Minneapolis. He is at present working for the Savannah-

Sabala Bridge company on a Mississippi river bridge. His home address at present is Savannah, Illinois.

'29—Helseth—P. A. Helseth is working on the same bridge as C. L. Cowan, but is being employed by the Minneapolis Bridge company. His home address is the same also and is at Savannah, Illinois.

'31—Ramsdell—Robert Ramsdell has presented his Theta Tau pin to Miss Annie Shipley, a senior in the Arts College. Bob is now doing civil engineering work near Milaca, Minnesota, but congratulations can be sent to him at 46 Barton Ave. S. E., Minneapolis. It will be remembered that Miss Shipley's father was a professor in the Department of Mechanical Engineering before he entered the Minneapolis Heat Regulator company.

'27 — Turrittin, Hugh L. — Hugh L. Turrittin is at present an instructor in the mathematics department of the University of Wisconsin. His home address is 825 Mound street, Madison, Wisconsin.

'31—McNeil, L. L.—L. L. McNeil, at present living at 519 Parkview avenue, Barberton, Ohio, has become an apprentice engineer. He is with the Babcock and Wilcox company at Barberton.

'31—Krohn—Henry Krohn is now with the A. O. Smith company of Milwaukee, Wisconsin. He is married and the girl is Lillian Ellingson of Minneapolis.

## *Electrical Engineering*

'94—Chalmers, Charles H.—Charles H. Chalmers is the general manager of the Chalmers Oil Burner company at 1234 Central avenue, Minneapolis. He has recently secured some quite valuable patents in the oil burner industry. His home address is 523 7th street S. E., Minneapolis.

'12 — Daum, Henry A. — Henry A. Daum has wandered somewhat from electrical engineering and is now in the publishing field with the FARMER, a journal being published in St. Paul, Minnesota. He is circulation manager, and his present address is 1792 Juliet Street, St. Paul.

'23—Newman, John M.—John M. Newman, who is with the engineering department of the Cutler Hammer company in Milwaukee, was in town recently on business. He says business is rather quiet.

'24—Monsen, Manley B.—Manley B. Monsen is still with the Wisconsin division of the Northern States Power company as assistant general superintendent. He says, "Married Luella Tenold in Chicago, December 10, 1931. Also drafted as drum major of the American Legion drum corps here." Manley and the Missus will be glad to see you at 527 N. Barstow avenue, Eau Claire, Wisconsin.

'24—Lewis, John G.—John G. Lewis has strayed far from engineering by becoming the minister at the First Methodist church, here in Minneapolis. His church address is 1209 4th street S.E. and his home address is 813 University avenue S.E., both in Minneapolis.

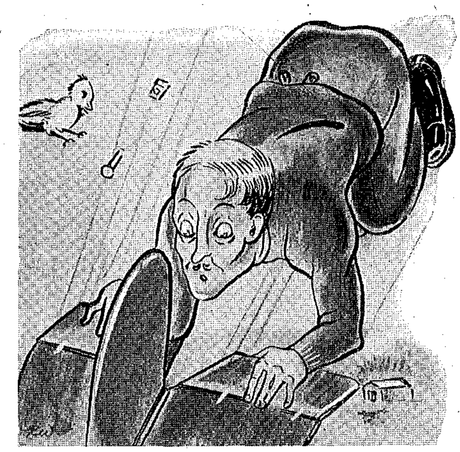
'24—McGregor, Frazer A.—Frazer A. McGregor has also taken to a different field and is now a grain dealer in Stanley, North Dakota. He may be addressed at Stanley, North Dakota.

'26 Ex—Jelley—Dewey B. Jelley is district manager of the Dallas division of Revere Copper and Brass incorporated. Dewey has two fine boys, but he states that they don't seem to care much about engineering. He declares that business is getting better in his territory but leaves a few caustic comments on the present conditions: administration gets its own salaries; sales gets just the salary necessary to dig up the business; production gets what's left and has to slave for that. Dewey can be found either at 1924 Laurel Avenue, Minneapolis, or one of Minneapolis's fine golf courses.

'26—Kelley—William Kelley is with the Daniels Nursery at Long Lake, Minnesota, and, we are told, is doing very well in the nursery and landscaping business.

'29—Kuefler—Edward Kuefler is still with the Westinghouse Electric company in Chicago. He is recuperating from a serious skull injury and is now taking things easy in the sales department of the plant. Ed and Mrs. Kuefler are living in Westmont, Illinois.

'26 — Mahachek, Ross M. — Ross M. Mahachek has recently written a book, Airplane Pilot's Manual, which is being published by Putnam & Sons. Though



Ross was graduated as an electrical engineer, he is now working in the air field and has become quite an authority on airplanes.

## *Mechanical Engineering*

'24—Koehler, E. F.—Edwin F. Koehler is also in Detroit, Michigan, and his new address is 13620 Forrer avenue. He writes, "Stan Tuttle, '24 ME, and I are leaving tomorrow to initiate a new trout stream 'up North' bright and early opening day, Sunday." Hope you and Stan won't have to tell a fish story when you get back home, Ed. Mr. Koehler is at present employed as safety engineer for the Standard Accident Insurance company of Detroit.

'26 — Letson, Donald E. — Donald E. Letson, who previously worked for the Fuller Brush company at Peoria Heights, Illinois, as field manager, is at present without employment and dropped in at the campus recently to see what there might be open for him. At present he is staying in Minneapolis at 3725 13th avenue S.

'29—Johnson, Roy M.—R. M. Johnson is still with the Bucyrus-Erie company of Evansville. He is working as "Rate-Setter" and we're sure he keeps everybody hopping. Roy's present address is 249 S. Barker avenue, Evansville, Indiana.

'30—Kojola—Hugh Kojola is working for the National Carbon company in Indianapolis, Indiana. Hugh has been married recently to an Indianapolis girl, evidently the girls around that part of the country know their business.

# NEWS FROM THE TECHNICAL CAMPUS

## *Ericson is Guest Speaker at Tri-Honorary Banquet*

Three honorary engineering fraternities announced the initiation of new members at the Tri-Honorary banquet held in a downtown hotel on May 5. Eta Kappa Nu, electrical; Pi Tau Sigma, mechanical, and Chi Epsilon, civil, were the initiating groups. Professor O. S. Zelner as toastmaster introduced the principal speaker, Lieutenant Richard A. Ericson, who told the group of his experiences during the World War.

Dean O. M. Leland, who was recently elected a national honorary member of Chi Epsilon, was presented with a gold key by the president of Chi Epsilon. Dr. Henry Hartig and Mr. Elmer Johnson of the electrical engineering department were initiated into Eta Kappa Nu as honorary members.

The new student members of Eta Kappa Nu are Paul Erickson, Adolph Kupka, Samuel Levy, J. Jay Mangan, Gerald Shepard, and James Stoddart.

Chi Epsilon initiated Jack Lenhart, Arthur Solum, Harold Sundstrom, and Jason Yaggy.

The Pi Tau Sigma initiates are Roman Arnoldy, Norman Carlson, Clayton Ebert, George Graetz, Roy King, Donald Rollins, and Robert Wherland.

Announcements of the three sophomore awards were also made at the formal initiation and banquet. Ralph Hammond was awarded the Eta Kappa Nu prize, Miles Kersten received the Chi Epsilon award, and Edwin Hartzman received the annual award of Pi Tau Sigma.

## *Two Chemists Receive Research Fellowships*

Angus Cameron, candidate for the Ph.D. degree in physical chemistry, and Donovan Kvalnes, instructor in organic chemistry, were awarded fellowships for one year by the National Research council. These fellowships, which are awarded each year to 24 men, begin in October and provide salary, materials and laboratory space for one year.

Kvalnes will work under Dr. L. F. Fieser, professor of organic chemistry at Harvard university. Cameron has not yet been notified of his research subject, but expects to receive an assignment very soon.

## *Gordon Wall Receives Albert Moorman Prize*

The Albert Moorman prize, awarded annually by Albert and Frank Moorman in memory of their father, was received this year by Gordon A. Wall, senior architect, on May 4.

The Albert Moorman prize was awarded first in 1920, when it was known as the Moorman scholarship. Several years ago the name was changed by the Board of Regents to the Albert Moorman Memorial prize.

The prize, consisting of approximately 250 dollars, enables the winning student to take an extended trip through the eastern states for a study of the more outstanding architectural achievements of the various cities. Many pictures are taken and, on returning, the winner must present two written reports, one to the department of architecture and one to the Moorman architectural firm.

The prize is usually given to the student receiving the highest grade on the long problem of the senior architectural class. The problem this year was that of designing a school of architecture for a large state university.


**In memory of Old Main this plaque will be unveiled June 6.**

## *Plaque of "Old Main" Has Revolutionary Design*

S. Chatwood Burton, Professor of Architecture and internationally famous for his etchings, has completed a bronze memorial plaque of the first campus administration building, Old Main, which will be unveiled June 6 by representatives of the class of 1892 at the place where Old Main once stood.

This is the first time that a building has been modeled on a panel in relief where its highest projection is no higher than the main plane of the panel. In order to accomplish this Professor Burton made the upper part of the panel concave and the lower part convex.

All who have seen the plaque regard it as a distinct artistic achievement; in fact, many have said this is the first time in history that the problem of a design of this kind has been correctly solved.

Mr. Burton has also a wide experience in stage designing. In this capacity he helped Yale University last year in some of its dramatic productions. Advocating many changes in the staging of opera, Mr. Burton believes that our opera is too much like that of the Italian in the Sixteenth Century.

Instructing embalmers in the art of rebuilding with wax, Professor Burton has revolutionized the undertaking business. The use of paint and powder in creating life-like effects and the use of colors in casket lining are among his contributions to this industry.

On the jury of the Chicago Etchers society, Mr. Burton participates in the selection of 300 etchings from candidates for etching honors from all over the world at the annual exhibit of the society at the Chicago art institute. One of Mr. Burton's etchings was reproduced in the Chicago Etchers society annual catalogue containing the ten best etchings of the year.


# "Hello, Hawaii"

Bringing Hawaii within speaking distance of the United States is one of the latest achievements of the Bell System in its program of telephone service extension.

Five years ago the United States had telephone connection only with Canada, Cuba, and the Mexican border. Since then, Bell engineers have so developed radio telephony that handling calls to Europe, South America, Australia, Bermuda, Samoa, and Hawaii is daily routine. Today more than 31,000,000 telephones can be reached — approximately 92% of all the telephones in the world!

Making the telephone practically world-wide in reach promotes understanding between nations. It has far reaching effects commercially and politically. That's what puts the thrill into such Bell System pioneering.

## BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

## *Chemistry Department Organizes Staff—Courses*

An announcement has been issued from the School of Chemistry concerning the organization of the department of organic chemistry for the coming year. During the past year the department has been short handed due to the death of Dr. William Hunter last fall and the leave of absence granted to Dr. Walter Lauer.

Dr. Lee I. Smith will be the acting head of the department next year. He will be assisted by Dr. Lauer, who will return from Germany in the summer. Two new men have been appointed as instructors of organic chemistry. They are Dr. Paul D. Bartlett and Dr. C. Frederick Koelsch. Both of these men have held National Research Fellowships at Harvard during the past year.

Dr. Smith has also announced a number of changes in the courses to be offered next year. All of the elementary courses in organic chemistry will remain unchanged. A new three-quarter descriptive course will be offered which will replace four of the old one-quarter courses. Two laboratory courses which deal with qualitative and quantitative organic analysis are to be introduced. Plans are under way for the presentation of a laboratory course dealing with some phase of modern organic chemistry. Dr. Lauer has made extensive studies in Germany in preparation for this course.

Arrangements are being made to provide more laboratory space for graduate students majoring in organic chemistry. There is a possibility that a large room on the fourth floor of the Chemistry building may be fitted up for these students.

## *Movie Shows Construction of Largest Cable Bridge*

The construction of the George Washington bridge, New York's newest span across the Hudson river, was shown in a four-reel movie given in the engineering auditorium at a recent meeting of the American Society of Civil Engineers.

Professor Parcel, in his lecture preceding the movie, stated that this bridge is the greatest span of its kind in the world. The total length of the bridge is not as great as that of some other bridges but the suspended portion of the bridge exceeds its nearest rival by some 1,700 feet, the length of the new bridge between supports being 3,500 feet.

Enough wire is used in the two huge cables supporting the roadway to stretch four times around the world at the equator. The film showed clearly the manner in which suspension bridge cables are first spun and then pressed tightly together to form a compact cable.

The anchor cables for the suspension towers on one side are imbedded in the solid rock of the Palisades. On the opposite side of the river the cables are held by a huge block of cement and steel buried deep in the earth.

## *Honorary Fraternity Plans Canoe Trip*

A canoe trip up the Minnesota river will be given by Eta Kappa Nu, honorary electrical engineering fraternity on the evening of May 14 in honor of the graduating seniors of the organization. Active members and alumni will meet at the boathouse at the mouth of the Minnesota river where canoes will be waiting for each couple. The group will paddle slowly up the river until about midnight, stopping only to eat the lunch that the girls are expected to prepare. Then, when the moon is at its height, they will again push off and drift slowly down the river to arrive back at the starting point in the wee hours of the morning.

## *Zelner Announces Reunion of Michigan Glee Club*

The Michigan Glee Club Alumni association of which Professor Otto Zelner is president will hold its second reunion on June 16 and 17 of this year at the University of Michigan.

The first reunion of the glee club alumni was held last year and, according to Professor Zelner, was probably the first reunion of a glee club of any school.

At the coming reunion there will be rehearsals held by groups assembled according to years, and these groups will be directed by leaders of the club during each period. The massed chorus of all the alumni members will lead the singing on Alumni Day, June 17.

The association aims to help the active Michigan glee club by building up the Music library and by assisting in the furnishing of club rooms. Professor Zelner added that if the financial condition of the organization is favorable, scholarships will be awarded to outstanding vocal students.

The secretary of the organization, also a Minnesota man, is Professor Earl Killeen of the School of Music here.

## *Bryant is Toastmaster at Tau Beta Pi Initiation*

Tau Beta Pi, honorary engineering fraternity, held initiation ceremonies at a downtown hotel on April 28. The new members of the organization are Fred Baumann, Stephen Erickson, Kenneth Goldblum, Robert Haxby, John Hayes, Sigmund Jacobs, Anthony Juettner, Gordon Lindner, Don Leslie, Sam Levy, Ray Milner, Albert E. Olson, Gayle Priester, and Albert Wenner; Professor Lorenz Straub was also taken into the fraternity at the request of the University of Illinois chapter of the fraternity.

Professor John M. Bryant, head of the electrical engineering department, as toastmaster of the banquet introduced the principal speaker, Professor E. W. Davis of the School of Mines, who told of his experiences while working in Russia for the Soviet government.

## *Architects' Yearbook to Use Half-Tone Cuts*

Work on the Architects Yearbook has progressed rapidly during the past few weeks, and the first pages of the issue are now being set up by the printers.

This book representing the best work done in the department of architecture during the past year will be ready for distribution about the last week in May. The lithographic presentation of last year's volume has been abandoned and only copper half tones will be used in printing the many drawings and sketches.

## *Air Circulating System Patented by Springer*

After five years of experiment and study, Professor Franklin Springer of the electrical engineering department has developed an electrically controlled heating and ventilating system which cleans, washes, humidifies, and circulates the air of an ordinary home at practically no extra expense. In an installation in the home of Professor Springer, a saving of over 50 per cent in fuel costs was shown for the winter months and the air in the home was always at the correct humidity for a maximum of comfort.

In this system, for which patents have already been applied, cold air is drawn from the floor of the front hall by an electrically driven six-inch blower to an air washer in the basement. Here a fine water spray removes all dust and dirt particles from the air. The cleaned cold air then passes through the pipes of an economizer around which pass the flue gases of an ordinary oil burning furnace. The warmed and cleaned air next passes over a lake of hot water in a humidifier and is given the proper moisture content, after which it is led out through pipes into the rooms of the home. The entire air content of the home is washed at least once an hour during the winter days, taking practically all of the dust out of the home.

While the main heat source of the house is the hot water radiator system heated by an ordinary "Bullet" oil burner with its furnace, the heat which ordinarily goes up the chimney from the oil burner is absorbed by the economizer and circulating air system, making for a very high efficiency of operation and greatly reducing the fuel costs. Since only the flue gases are needed, the air conditioning system may be used for either hot air or hot water heating systems. All of the heat of the fuel stays in the house, so the chimney flues are cold at all times.

Professor Springer believes that his system will be of especial value during the hot summer days for keeping the room air circulating, since live air is always more comfortable. For very hot days, the circulating air may at some part of the system be passed over cakes of ice in an insulated box, to cool the air and maintain a comfortable room temperature.

# Studying Hydraulic Structures

(*Continued from page 180*)

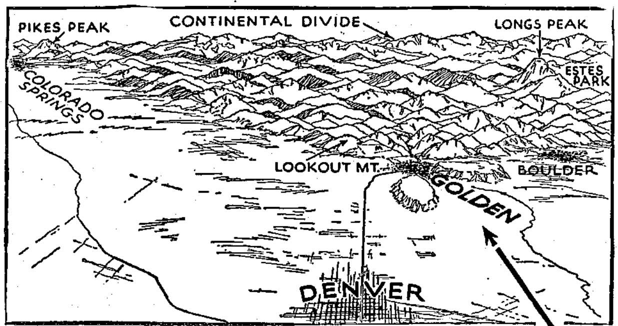
total quantity of water flowing in the model amounted to only 0.35 cubic feet per second. Many improvements were brought about by means of the model. The energy loss at the entrance to the power plant was reduced, much of the originally proposed diverting structure was dispensed with, and very marked improvements were made in the movable high water relief gates. This hydroelectric plant, which is one of the largest low head plants in Europe, was recently constructed across the Rhine at Ryburg-Schworstadt.

Some conception of the method of construction of a laboratory model used for making experiments may be obtained from figure 6 which is of the Maas river estuary forming the approach to the harbor district of Holland. In this instance the study concerned the entrance of "Vulcaan-Hafen," an off-channel harbor downstream of Rotterdam. It was difficult for large ships to enter the harbor without being thrown against the sides of the entrance during times of strong current in the river estuary. The study consisited in determining the proper design for the entrance; that is, one which would permit a better access for ships and still not cause an undue amount of sediment deposition in the harbor.

A unique method of recording phenomena of flow in this model is indicated in figure 6. This is a view after the latter had been completed and put into operation. With the exception of the zero contour line (which was painted on the model), all of the white broken lines in the river are the result of automatically controlled time exposures of lighted candles floating at the top of the stream. The experiment is one with the flow at ebb; the direction of flow is from right to left. Each dash in a broken line indicates the amount of movement of the light in one second, the camera being alternately opened and closed in the dark for one second intervals. The result is a record of the direction of flow and velocity near the water surface. There was evidently a very perceptible flow within the harbors (in the upper left and right portions of the picture), though the velocity was very low compared to that in the river.

Figure 7 presents the results of a study of the low water regulation works for navigation on the upper Rhine River. The picture was taken after water had been allowed to run through the model and transport sediment for a period of several hours. The broken white lines are the result of string which was placed on the model after the experiment had been completed for the purpose of showing the contours. Adjoining lines represent a difference in elevation of 1 meter in the actual river.

There are, of course, numerous other applications of the principle of similarity, not only in the field of hydraulics, but also in aeronautics, structures, and other fields of engineering. The success of the isolated experiments performed under the direction of capable investigators points definitely to the remarkable possibilities of this method of design.




# Engineering Summer School of the Rockies

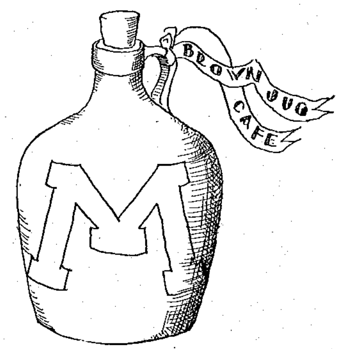
Students of Engineering who wish to make up work or secure additional credit during the summer are offered an unusual opportunity to combine work and recreation in Golden, the Gateway of the Rockies.

**July 11 to August 26, 1932**

*For detailed announcement of courses, write to the Registrar for Bulletin S-2.*

## Colorado School of Mines

*Golden, Colorado*

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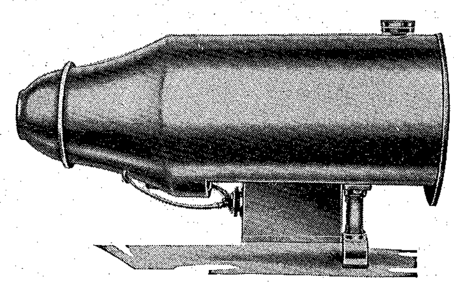

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# ELIMINATING SMOKE

(*Continued from page 183*)

thus be made for various stations in the same or different cities.

The ordinances specifying "dense" as a standard of density are not capable of rigid enforcement, and so are worthless of the "special" standards of density. The greater number of our cities call for the use of the Ringleman chart in the determination of smoke density.

The Ringleman chart consists of a series of ruled spaces so constructed as to give each space a distinctly different shade from any of the others. The various gradations together with their number are:

| Number | Per cent White | Width of Lines | Width of Spaces |
|---|---|---|---|
| 0 | 100 | No lines | |
| 1 | 80 | 1 mm | 9.0 mm |
| 2 | 60 | 2.3 | 7.7 |
| 3 | 40 | 3.7 | 6.3 |
| 4 | 20 | 5.5 | 4.5 |
| 5 | 0 | All black | |

In using, the chart is placed in a vertical position at such a distance from observer that the charts appear as even shades of coloring. The observer's position should be such that the direction of observation is at right angles to the direction of travel of the smoke, not less than 100 feet nor more than one-quarter mile from the stack. The background immediately beyond the stack top should be free of buildings or other large dark objects. Avoid looking toward bright sunlight.

The number of the shade on the chart which most nearly corresponds to the shade of smoke emitted for each 15 seconds period is recorded.



NOTICE

All Crew Members, Supervisors, Team Captains and Student subscription salespeople who wish to avail themselves of the opportunity for free scholarships made possible through the courtesy of the Leading Magazine Publishers again this year are requested to apply to the national organizer, M. Anthony Steele, Jr., Box 343, San Juan, Porto Rico, stating qualifications fully.

## That Apprentice Idea

(*Continued from page 177*)

he attain the great accuracy and high efficiency required in modern industry.

Here again a danger must be avoided. The apprentice must not be allowed to commit mental suicide just because his wits are not continually required by the task in hand. If monotony lulls his consciousness, he becomes a mere automaton. Only as he learns to subjugate his immediate efforts to the repetition of effective production, while keeping his wits set free by routine alert to the variant and the new in his surroundings, can he become an effective practicing engineer.

Lastly there is the problem of interest. No mere orientation of professional aims, or of methods of accomplishment, can fully adapt a man to an industrial career. Even the most hard boiled engineer is somehow a creature of sentiment. Loves or hates, friends or enemies, these are the real driving forces that move all men alike, and these the engineer must have in proper relation to his work if he is to succeed greatly.

Only by intimate contact with the human beings who compose a giant industrial machine can a technical man acquire the necessary lasting human interest in his work. Only through a broad first hand knowledge of the great interrelations of industry with industry, of occupation with occupation, and of the individual to the aggregate, can he come to realize his own place as a part of the whole.

The modern technical apprentice course attempts to have its men review and pass in review throughout the organization that sponsors it. It furthers a multitude of personal contacts and promotes a myriad of mutual confidences. Before an engineering graduate can enter the ranks of industry his apprentice course must certify his qualification to speak of "our company," and to perform in its name that superior work which can come only when heart and soul drive hand and head in a consummate loyalty.



## ALUMNI NEWS

'07—Bell, Maurice Dwight—Maurice Dwight Bell is still a consulting engineer here in Minneapolis. He writes, "I appeared on behalf of the flour mills of Minneapolis as opposed to the locks through St. Anthony falls, at the hearing by the U. S. Engineers office at Minneapolis on March 16." His present business office is 1220 Flour Exchange building while his home address is 1416 West 27th street.

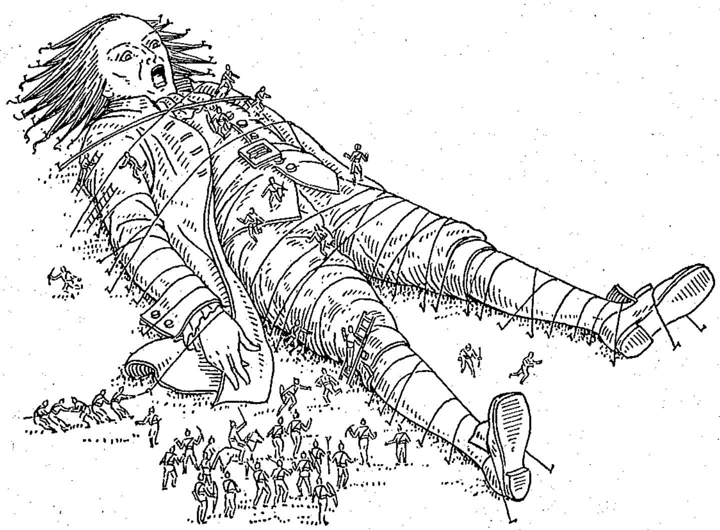
'08—Morris, T. C.—Thomas Carlyle Morris is no longer living in Hopewell, Virginia. He is still working for the Atmospheric Nitrogen company of which he is the chief engineer, having moved to 1758 Monticello avenue, Petersburg, Virginia.

'16—Wolff, W. S.—William Samuel Wolff, owner of the Wolff Motor Car company, 811 E. 7th street, St. Paul, wrote to let us know things are still as usual. His home address is 1108 Hyacinth avenue, St. Paul.

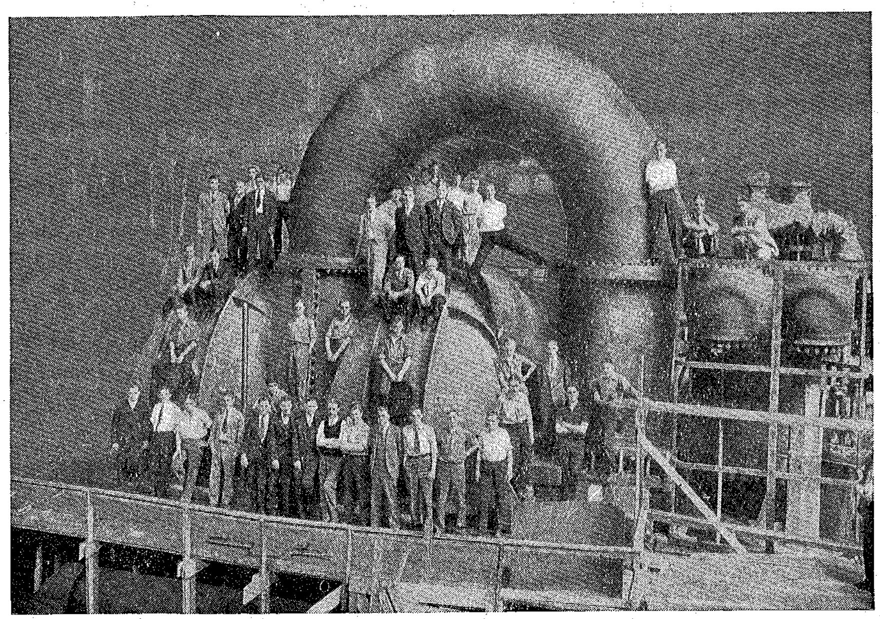








# *An Electrical* GULLIVER AMONG LILLIPUTIANS?



*160,000-kw. G-E tandem-compound turbine-generator set on test.*

**No**—but the immense size of this 160,000-kilowatt turbine-generator dwarfs the 44 test men who test such apparatus. This turbine-generator for the Brooklyn Edison Company—the largest single-shaft unit yet developed—is capable of furnishing muscle power equal to all the inhabitants of New York City. Its 214,400 horsepower operates both day and night, lifting heavy burdens from human shoulders, and supplying electric energy to countless devices in homes, in offices, and in factories.

The 44 test men shown above represent 31 colleges and universities from New Mexico to New Hampshire, including the University of Porto Rico. Each year many college-trained men join the General Electric Testing Department, which trains them for future responsible positions and electrical leadership on land, on sea, and in the air.

95-895DH

## GENERAL ELECTRIC

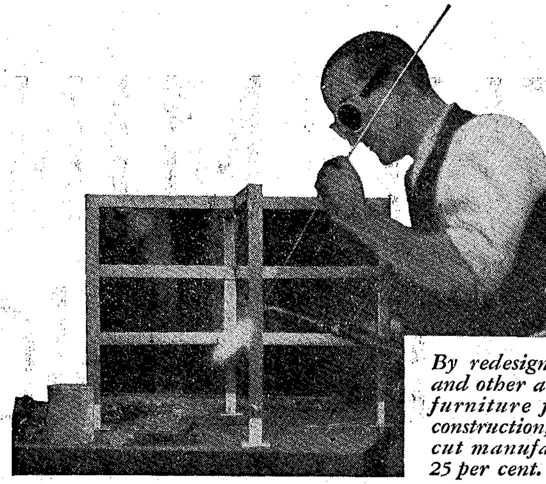
# THE MINNESOTA TECHNO-LOG

Vol. XII MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED No. 9

JUNE, 1932

## ALUMNI DIRECTORY ISSUE

# Design for OXWELDING



*By redesigning this table and other aluminum alloy furniture for oxwelded construction, the producer cut manufacturing costs 25 per cent.*

# *and lower production costs*

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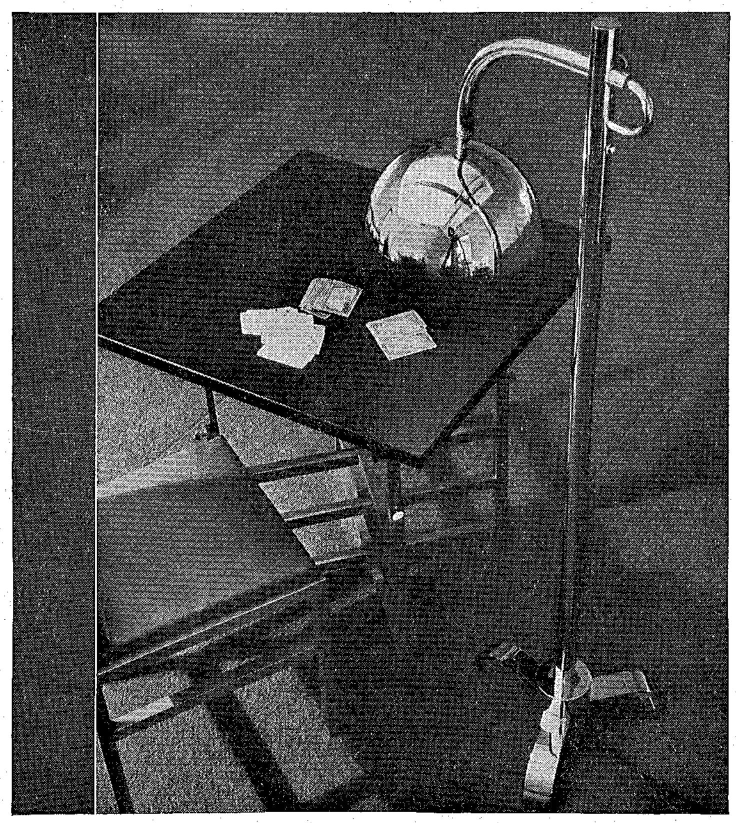
Tomorrow's engineers will be expected to know how to apply the oxy-acetylene process of welding and cutting metals. For their assistance, we have prepared several interesting technical booklets explaining how this modern metal-working process is used in the design, construction, and fabrication of metal parts and structures. These books contain newer and more practical material than most texts and will form a helpful addition to your personal library. Write to us and we will send them to you without charge.



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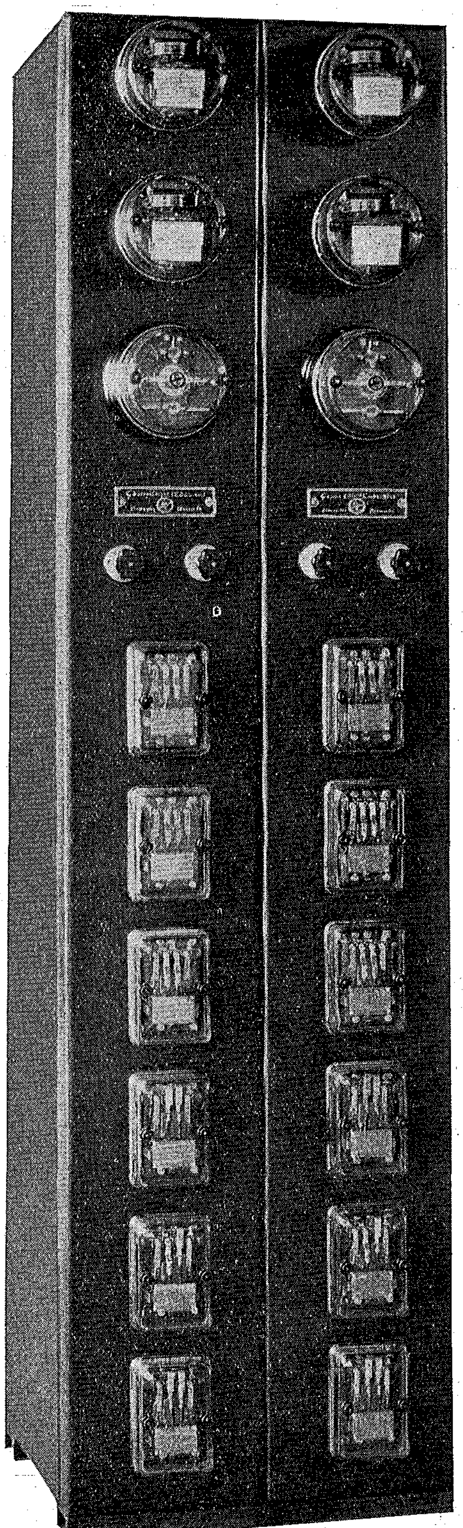

Automatic synchronizing panels installed in North Fond du Lac interconnecting substation of Wisconsin Power & Light Company for closing 132,000 volt circuit breakers.

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# General Control Corporation

## Minneapolis Minnesota

June, 1932

Volume XII, Number 9

# the MINNESOTA TECHNO-LOG

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TO REPRESENT *the universe in such a manner that the heavenly bodies were shown in their true relation to each other has been the aim of astronomers for centuries. Many intricate mechanical models have been constructed, but the Zeiss Planetarum is the first to portray accurately and in a clear manner the movements of the visible portions of our universe.*

BEFORE *any construction work can be begun on a power development in the United States, many surveys and comprehensive reports of the proposed development must be prepared.*



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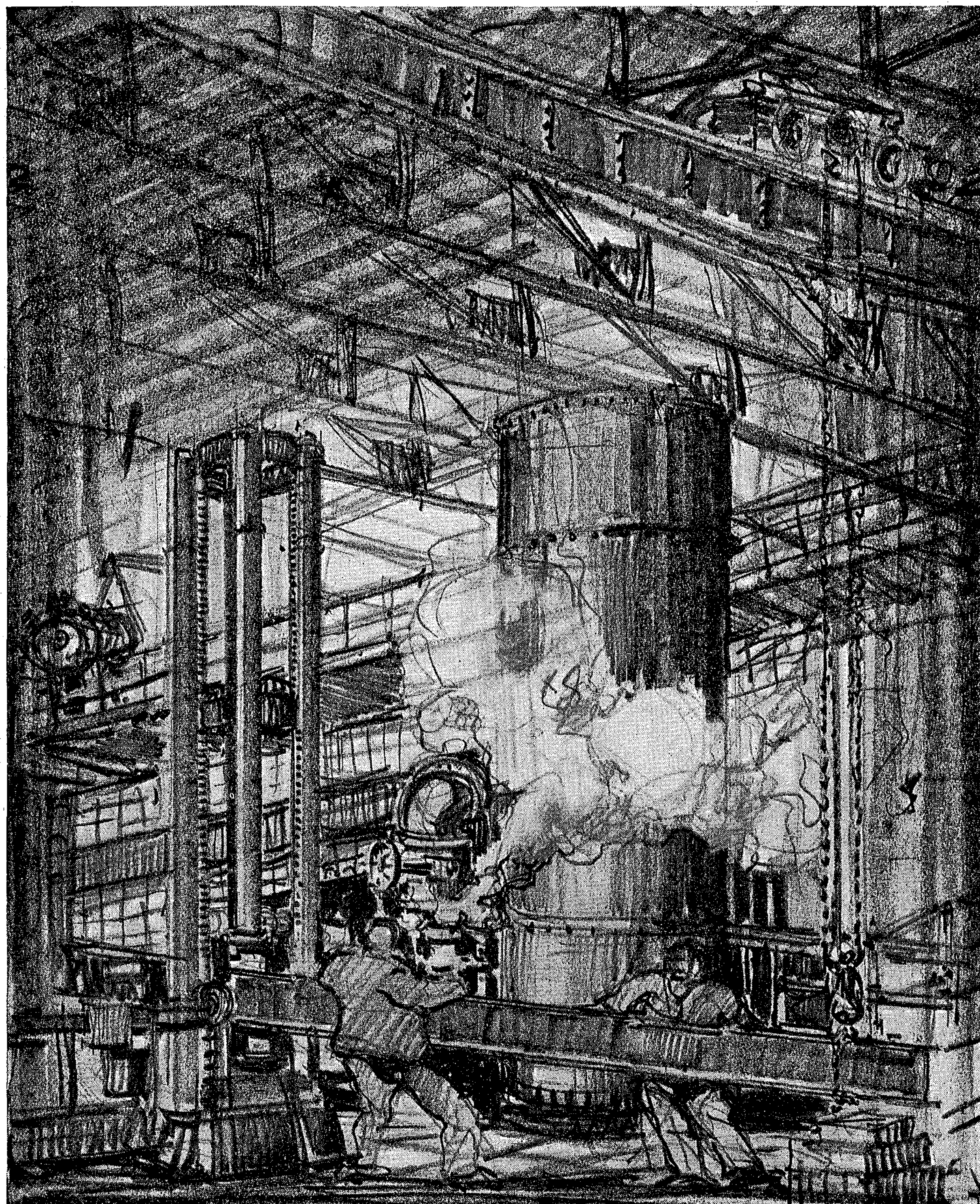


A Campus Laboratory
—By Robert Cerny

# The Signal Corps in action at Fort Snelling

*Cledo, a second lieutenant in the signal corps, relates his experiences last summer at Fort Snelling.*

As told to George Taft by
CLEDO BRUNETTI, E. E. '32

THAT last night provided for us what was probably the most interesting military activity at camp. Details representing the enemy were sent out with instructions to attempt to penetrate a defense which had been set up on all sides of the camp. Utter darkness prevailed; it was the duty of the signal corps to keep the headquarters posted at all times as to the position of the enemy and our own troops. Signal detachments were sent out with each defensive unit and signal lamps were used as a means of relaying information of the enemy back to headquarters.

Out of the darkness came intermittent flashes of light, as some operator stationed in a lonely tree told the headquarters of the enemy's whereabouts. The new guard was being posted. From the woods came men bearing litters upon which were stretched prostrate figures. News that the enemy had broken through in some section reached us. Reinforcements were being sent out. A shrill cry is heard from a nearby field, "Corporal of the guard. Post number two!" The corporal of the guard is seen running at top speed to the field where the guard on duty is valiantly battling with one of the enemy who had taken too great a chance and exposed himself to the keen eyes of the watchman. So intent had been the enemy on making his escape that he had failed to see a barbed wire fence in his path with the result that, when the corporal of the guard arrived, the fugitive was attempting to extricate himself from the clutches of both the wire and the guard.

The mock battle climaxed the last week's work for members of the signal corps from the University of Minnesota. The six weeks camp at Fort Snelling was part of the regular training of the advanced drill course.

Making camp with a group of college students is a unique experience. We had started early in the morning. The signal corps operated a radio station while enroute in a mule-powered army wagon. What an experience operating a radio set in the back of a wagon (with unflexible springs) as it plodded its way along a typical army road! And at camp the station was kept busy all afternoon sending urgent messages for forgotten pajamas or candy and pop for the canteen. The battle was the final test for all organizations and equipment.

The operation of the radio sets was a common source of joy for every signal corps man at camp. To most of us it was our first experience with a transmitting and receiving combination in one and we neglected no opportunity to take the sets out and operate them. Radio operation under adverse conditions closely simulating battle situations was both a very interesting and an exacting experience. The tenseness of the moment, the crackle of guns coupled with an almost untenable location was more than different from the familiar quiet of the electrical engineering balcony.

One Sunday we took a small set over to the Wold-Chamberlain airport and as we watched a noted lady flyer attempt to break a world's record for looping the loop our busy telegraph keys told the boys back at the barracks the story of her progress.

And what wasn't sent over those sets! Toward the end of camp a complete signal corps communication system was set up for an inspection by Colonel Moorman, officer in charge of R. O. T. C. activities in the middle western states. Everything was in readiness and the men were sending messages back and forth waiting for the Colonel. Just when the men were becoming the most impatient, the colonel appeared at my station and puts the receiver to his ear in time to hear the message, "Has the colonel come yet? What kind of an old dodger is he?" The colonel grinned, laid the headset down, and continued his inspection. Incidentally, the word "dodger" is used here in place of a typical army phrase.

But the radio work didn't demand all of our attention. We practiced diligently with pistol, with two of our men, Parker Lowell and Jack Starkerson, being qualified as expert pistolmen. Nearly half the unit placed as sharp-shooters or better. The expert grade requires an average of 85 per cent while the sharpshooter requires a 78 per cent average.

The social part of our camp life was something looked forward to every week. The camp hostess arranged dances for us twice a week. Attendance showed that even in a place where men are men the women can hold an invasion; they came out in buses, street cars, limousines, tin cans, and Austins.

Preliminary to each dance boxing matches were held. The camp boxing tournament which lasted the duration of the camp session, was one of the high lights of a very active athletic program. Every kind of sport was indulged in and the last week of camp found the members engaged in swimming meets, track meets, tennis, and golf tournaments, baseball series, and horseshoe tournaments to determine the camp champion in each respective sport.

Work? Sure we had work. We indulged in drill with the infantry and had regular field exercises. A large part of our time was spent in constructing and perfecting a complete corps, division, and brigade communication net in the woods adjacent to the camp. But the greatest thrill was sitting in the shade of large elm trees and watching the infantry labor and perspire under the hot sun while we nonchalantly pounded away on telegraph keys.

# preliminary surveys of Power Dam Sites Needed for federal permit

***Before any water power development can be started, preliminary surveys must be made and a report presented to the Federal Water Power Commission. The location survey report, the statement of water rights, the statement of the effect of operation on the normal flow of the stream, and the estimated power capacity of the proposed development must be included in the application.***

By W. C. HILL,
C. E. '32

WHEN a power project is first conceived, a corps of engineers is gathered and an application for preliminary permit is made to the Federal Water Power Commission. This embodies three statements. One consists of the data then available for the Commission such as surveys, maps, plans, stream measurements, foundation explorations, and of the work already performed on the site as preliminary construction. The second statement must show the extent and nature of the work to be performed under the preliminary permit and its estimated cost. A third statement must accompany the application pertaining to the water rights which the applicant intends using in the development of each project. This must include an estimate of the possible water power energy of the site computed by the formula cubic feet per second multiplied by the fall and the factor 0.08. Also a statement of the possible outlet for the power and the proof that at least 0.9 of the possible development of the stream could be utilized constantly. The ways the applicant plans to perfect its water rights must be included in this statement.

With these statements, the engineers submit a map showing both the nature of the project, its principal features, and the location of the project as a whole with reference to some well known town or stream. On this map is placed a line enclosing all 40 acre tracts or similar sub-divisions of the public land survey which are to be occupied in whole or in part by the project works. This term, "project works," includes dams, reservoirs, forebays, waterways, and power houses, but excludes transmission lines. Should the project be in areas not covered by the public land survey, then points on the project boundary should be located by bearings and distances from well defined and easily located natural objects or permanent monuments. On this map should be shown the status of the lands, "indicating separately lands patented, lands entered or embraced in any unperfected claims under the public-land laws, unreserved public lands," and lands of every reservation affected.

With the granting of the preliminary permit, the field engineers begin the surveys. Establishing a true meridian by polaris observation at the dam sites, if there are no government monuments nearby from which a meridian can be run, is the first step.

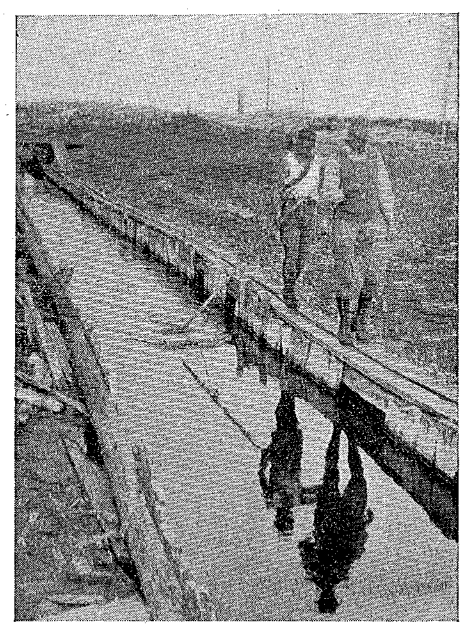
Along some streams there are government bench marks on each bank between which there has been established an azimuth from the south. When these are available, or if there is a system of triangulation points available, it is better to use these. Such a system of bench marks flanks the Mississippi River and is called "stone lines." These "lines" consist of three or more bench marks set on an approximate straight line normal to the stream, one on each bank just above high water and the others a thousand meters or so back from the banks where a good line of sight can be obtained between bench marks for azimuth.

There are three distinct parts to the survey of the reservoir; one for the location of the public-land survey lines, or section and township lines, and the establishment of a horizontal control; one for mapping the area and tying in the land lines to the boundary; and one for establishing the bench marks or vertical controls and the reservoir level.

Working independently in advance of the transit parties, the level party establishes bench marks which serve as the vertical control about every mile or so, depending on the terrain of the country passed over, the elevations of which are carried from government bench marks or an assumed bench mark at the dam site. The elevations must be referred to mean sea level, except when using bench marks accepted by the United States Engineer Corps of the war department.

Particular attention should be paid by the level party to towns, factories, or any valuable property that is liable to damage by flood. Note should be made of high water marks, obtaining the elevation and the probable date of the flood or any information that the local inhabitants can supply.

In the pool area, the elevation of the



**Meter rating at Cass Lake. The meter is towed by hand through still water.**

crest of the dam is marked with bright roofing washers nailed onto blazes in trees, every 500 to 1,000 feet, or onto every permanent structure at the nearest tenth of a foot. From these marks the backwater curve as computed can be measured and the severance lines which establish the boundary of the project area marked out on the ground.

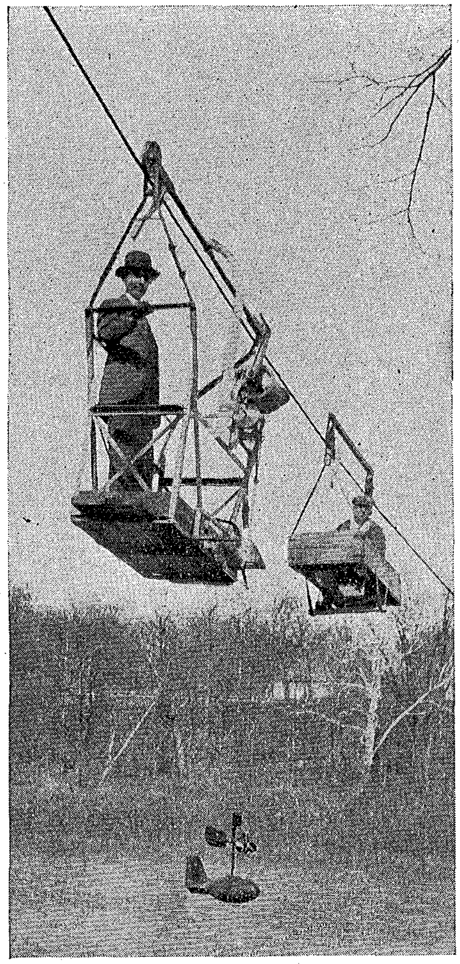
The elevations are established from the precise bench marks previously set a considerable distance back from the banks of the stream, probably along some railroad track. The kind of bench mark is that generally set by the United States Geological survey and consists of a tile block about 18 inches square and a foot deep sunk into the ground below the frost level with a copper bolt firmly set in the top surface. The elevation of the bolt is established and is the official elevation of the bench mark. On top of the tile is set a cast iron pipe about five

**One of the bench marks which are placed seven miles apart along the Mississippi.**

feet long with a copper cap bearing identifying marks and a definite elevation. While this cap is firmly set on the iron pipe it can be removed and access had to the bolt in the tile. Each bench is thoroughly referenced to definite objects.

The triangulation system established in the absence of these supplementary systems will vary with the terrain, but should have an accuracy of secondary triangulation which has an angle closure of three seconds of arc and a base line closure of less than one in 10,000. Generally the system is started from the site where a base line along the center of the dam can be established. Under some conditions it may be necessary to run in from the side from a base established in a preferable location. However, it is good practice to arrange the system so that the center line of the dam forms an integral side of the triangulation system.

Should triangulation be deemed not



**Modern stream gaging car, showing a self-reading depth recording drum.**

suitable for the control, a precise traverse can be run with equal accuracy if care is taken with the angles and the chained distances. With the establishment of both vertical and horizontal controls, the topographical parties can be set up and the mapping of the reservoir area begun.

Ofttimes the mapping and the establishment of the horizontal controls are started at the same time, as the mapping is a slow process. The accuracy of the land line survey must be such that the coordinates of the transit stations computed from an assumed base line will agree with the coordinates of the established triangulation or traverse stations. The land lines within two miles of the project area must be established to locate the initial point on the project boundary, as distances and bearings from this point must be measured to an established land-survey corner within this distance. Where the project boundary intersects with a line of the public-land survey, distances and bearings must be taken to the nearest identified corner in each direction on the line crossed, if that distance is not greater than one mile. At the intersections of the boundary with the land lines, monuments must be placed and referenced to the monuments of the public-land survey in accordance with good practice in land surveying. The mapping party or topography party may be either a plane table or a transit party equipped for stadia surveys.

In gathering the data for the maps, all roads, houses, fences, timbered lands whether heavily timbered or sparsely wooded, meadows, swamps, sewer outlets, bridges and all permanent and natural objects should be located and the elevation taken so as to determine the possible damage to them and the cost of reparation.

With the project area survey under way, the details of the dam site are mapped and the foundation explorations started. These consist of test borings taken along the center line, the upstream edge, the downstream edge of the dam, and at the abutments and any other place where there is doubt as to the quality of the rock or soil. These holes must be referenced and methods devised to determine the elevation of the samples taken out. Of all the surveys for a dam, the test borings are the most important. More dams have failed because of a faulty knowledge of the foundation characteristics than from any other cause. These borings must be taken in such quantities and such care must be taken in the analysis of the samples that there is no doubt as to the imperviousness of the foundation to water under pressure. In rocky country, the diamond core drill seems to be the best machine. In silty river beds, a wash core drill is satisfactory for all general conditions up to 100 feet depths, but care must be taken to recognize clays and silts. To obtain samples in which there is a predominance of either one or the other will mean a saving or increase in the cost of excavation depending on whether it is silt or clay. In one instance that the writer has seen, the borings called the foundation predominantly silt. With that in mind the contractor rigged up a sluiceway on the bank of the excavation, proceeded to "clam" out the flooded cofferdam, and dump the soil into the sluiceway to be carried away by water. The material was found to be clay that would not break up into small enough pieces to allow the water pumped into the sluice to carry it along. This scheme cost the contractor several thousands of dollars, and was a total loss.

One way in which the proportion of

*(Continued on page 270)*

# THE MINNESOTA TECHNO-LOG

## UNIVERSITY OF MINNESOTA




## Next Year—Electives

THE engineering college is often criticized by the sophomores because the list of electives open to them is very meager.

However, it may be fortunate that only a few of the electies open to the sophomore are prerequisites to more advanced courses in the same field. It is at the start of the junior year that specialization in each field begins. Therefore, the sophomore still has time to carefully consider in which field to specialize.

The choice of a specialized course must be determined by the student's ability, by his interests, and by the opportunities in the field. Generally the student does best in the subjects in which he is most interested. However, in some fields, the nature of the work may be such that employment is only for a certain part of the year or for irregular periods; opportunities may be best in foreign countries; and some field may even be on the road to extinction for technical reasons. These facts must be considered.

A consultation with the head of the department of engineering to which a sophomore belongs will aid the student greatly in making his decision. The head of the department knows more about the various types of employment and the demands of the many companies which engage engineers than do the rest of the professors. He must examine the curriculum of his department, that is, the courses required, the electives offered, and the sequence of courses, to find whether or not the student will be best able to do the work expected of him.

Likewise the head of the department knows from experience in which subjects a student must show considerable aptitude to succeed in a particular field. By the middle of the sophomore year the student has taken a sufficient variety of courses to indicate in which he has the greatest ability. A frank discussion with the head of the department about the young engineer's ability, likes and dislikes, will enable the professor to advise the student what field to enter.

The sophomores should determine their future fields of study as they can consider the question of what field to enter with much greater care during the next few months than they can amidst the clamor and bustle on registration day.

## Jobs

IN the year of the depression, 1932, a group of seniors will soon be searching for ways and means of doing profitable work. How many men will gain such labor and just what type will be most successful in their search? Time only will tell, but a few pointers might help this large group of men and also offer a series of suggestions to underclassmen earning their college education.

Perhaps the best way to approach the solution of this problem is from the angle of work. A little research will reveal thousands of small jobs which should be done. A small company may need a survey of a potential market, a neighborhood store may have a show window needing a new lighting system, and your home town may need several new curbs or culverts. A word to the authorities will reveal the need for the repair or improvement and you will undoubtedly get the job. These small tasks may keep a man busy during the entire summer and one of them may lead to future employment.

## Printed Chords

AN editor composing a college publication plays with a series of notes—types of articles, departments of the college, arrangement of the type and illustrations. He attempts to arrange these notes into a series of chords, or issues, all pleasing and interesting to the engineering students and alumni reading the final product.

In order to best serve the magazine's readers the editor follows an editorial policy based on one fundamental, that all are interested in engineering. This theme is built into the magazine with the help of many men, each of whom contributes a small amount of work.

For these small amounts of labor the present staff would like to thank the helpers. News gatherers, editorial writers, art contributors, feature article writers, and alumni contributors deserve the highest of praise for a year which, we hope, has been interesting to TECHNO-LOG readers. And we must not forget those who, without actually contributing to our columns of type, have aided the publication of Vol. XII of the MINNESOTA TECHNO-LOG.

# « « « SLIP STIX » » »

## a narrow escape

The favorite story of a certain mathematics professor has not been told this year, so your blind and toothless sliderule tells it for the forgetful teacher.

A man wanted to hang himself. Taking a rope to a high cliff, he tied one end of it around a tree and dropped the other end over to see how far it came from the rocks below. On pulling up the rope he discovered a very thin spot which would undoubtedly break with his own weight. He immediately untied the rope and went home muttering, "Good thing I discovered that weak spot. Why, I might have been killed!"

## it must be the heat

Incident at campus gateway entrance:

"Hello, Pete."

"Hello, Joe."

"How's everything?"

"O-kay by me."

"Say, Pete, was I going this way or that when I met you?"

"That way, I guess."

"Thanks, Pete. Then I must have been going home."

"So long, Joe."

"So long, Pete."

▼ ▼ ▼

What poker player, radio fan, bridge expert was it who, when accosted by a small girl with the question, "Poppy?" absentmindedly replied, "No, little girl, I'm not your father," and then hastily bought a flower?

## there should be a law

A waggy gentleman stepped into a campus clothing store and said, "I say—aw—could you take that yellow tie with the pink spots out of the show window for me?"

The clerk replied, "Certainly, sir. Pleased to take anything out of the window any time, sir."

Whereupon the man strolled out saying, "Thanks awfully. The beastly thing bothaws me every time I pass. Good mawning."

▼ ▼

Famous last words: Ask papa.

What business manager of the Techno-Log for next year fell asleep in the office one morning and woke to find his tie stolen? And right off his neck too. (It's a good thing he wears suspenders.)

## the college grad

Two preposterous fellows were giving their impression of an office scene. One came in to apply for a job and the other asked, "How many years of college training have you had?"

"Four years."

"Hmm, the janitor we have now has had eight years."

## not so damp

One of our brethren (named Allan) tells a tale of his latest dream. Curiously, it has some sense to it.

Al dreamed he applied for a job on a boat. The captain said, "Sure. And bring three more fellers with you. But get small ones—they won't eat so much."

▼ ▼

Another "meanest guy" would be the warden who gave the bread and water convict a cook book to read.

▼ ▼ ▼

At what banquet at Kings-X were three young men awarded a bottle of beer, a heart shaped box, and a record of Betty Coed for certain meritorious services?

## room—and board

It seems a student didn't agree with the diet his landlady set before him. The following dialogue ensued.

Landlady: "I think you had better board elsewhere."

Student: "Yes, I'll admit I frequently have."

Landlady: "Have what?"

Student: "Had better board elsewhere."

▼ ▼

It's just another sad story when an architect can't even draw his own breath.

▼ ▼

A certain young man, first name Robert, sallied forth to Wold Chamberlain field one day to apply for a flying test. The officer asked, "How much math have you had?" To which Robert replied, "Up to and including differential calculus." "Well," said the officer, "have you had trigonometry?"

And that, men, is the height of something or other.

▼

The bell had rung, but Oscar Cook
Decided to his sorrow
To look once more inside his book.
He's leaving school tomorrow.

## a c. e. proposes

My darling Inertia, you are my big moment. My heart whirls in eccentric orbits, and when I think of you my brain spins as though it had lost its radius of gyration. Though you are far away, I steel love you. Each time I leave you, I hurry back saying to myself, "I cantilever alone." When I beam on you, the stress in my heart strings approaches the elastic limit. As two bars are firmly riveted together, so let us be forever united by the bonds of matrimony.

▼ ▼

A man bought a dog for five dollars and then sold it. He bought the dog back for three dollars. How much did he make?

## with apologies

Now that the year is ended, we are leaving school for a while,—some of us. For those who will be back in the fall there is some sad information: so will the editors of Slipstix. If you have followed us down through the months, we suggest that you go and have your head examined. Remember, four out of five have dandruff and the fifth is bald.

▼ ▼

Before they get married, men call their girls sweetheart. After they are married, they don't call them anything. That shows their self control.

▼ ▼ ▼

An optimist is a junior who sells his trig book before he writes the final.

▼ ▼ ▼

The end is drawing near.

▼ ▼

Farewell until October.

▼

Be seeing yah.

# THOSE HONORED

*Many technical students are included in the annual announcement of prizes, awards and elections to scholastic fraternities*

## Iron Wedge

Iron Wedge, senior honor society, has this year elected John Bailey, Forton Christoffer, Steve Gadler, and Henry Yutzy.

## Grey Friar

Grey Friar, senior honor society, has this year honored by initiation Nelson Anderson, Gordon Bodien, Cecil March, and Paul Salo.

## Phoenix

Phoenix, a junior men's honorary society, has elected for membership from the School of Engineering this year Robert Lillyblad, Bernard McDermott, and Thomas A. Rogers.

## Silver Spur

Silver Spur, a junior men's honorary group, has this year elected John Tews.

## A. S. M. E. Prizes

The A. S. M. E. prizes were won this year by Himan Radow, John M. Appert, and Russell F. Erickson.

## Chemistry Faculty Prize

The Chemistry Faculty has this year honored Kenneth C. Johnson for his good work during the year.

## Iota Sigma Pi

Iota Sigma Pi, a national honorary chemical society for women, has this year initiated Roslyn Giraud, Ruth Harrer, Marie Lindberg, Louisa Plummer, Agnes Robinson, Anita G. Sallans, Lois Sellers, Sister Glenore Reidner, Marion Warner, Marion Chinn, Villa May Emblom, Sister Loyola, Mary Allen Steers.

## The du Pont Fellowship

The du Pont Fellowship in Chemistry for this year has been awarded to Marvin A. Spielman.

## The Shevlin Fellowship

Erling Josef Ordahl has won the Shevlin Fellowship in Chemistry for this year.

## Phi Lambda Upsilon

Phi Lambda Upsilon, a national honorary society in the field of Chemistry, has this year initiated Isaac M. Kolthoff, J. Lewis Maynard, Charles E. Bartsch, Frank T. Donaldson, Charles L. Faust, Carl M. Langkammerer, Edward E. Litkenhous, Sidney E. Miller, William J. Mitchell, Romund Moltzau, Grant W. Smith, John S. Andrews, Webster W. Benton, Robert E. Jeffrey, Clinton W. MacMullen, Jose B. Calva, Arthur E. Hebbard, John W. Hoekstra, Clarence E. Larson, Einar R. Michalson, Eugene Nelson, Marvin F. Goldberg, Kenneth B. Goldblum, Julius R. Katz, Ralph E. Peck, Henry C. Yutzy, Benjamin Moskovitz, Edgar L. Piret, Marshall F. Ruley, Francis W. Martin and Frederick T. Wall.

## Tau Sigma Delta

Tau Sigma Delta, a national honorary fraternity in architecture, has initiated this year Robert Cerny, Eino A. Jyring, Austin Lange, Ruth Richardson, Jarl Seppanen, David A. Anderson, Helmer Brockhoff, Kenneth Lundberg and Gordon A. Wall.

## Pi Tau Sigma

Pi Tau Sigma, an honorary society in the department of mechanical engineering, has this year initiated Henry A. Kannainen, Roman F. Arnoldy, Norman E. Carlson, Clayton E. Ebert, Robert B. Wherland, George M. Graetz, Roy L. King, Morris C. Knight, Donald E. Leslie, Norbert E. Mengelkock, Gayle B. Priester and Donald C. Rollins.

## Pi Tau Sigma Prize

This year the Pi Tau Sigma Prize has been awarded to Edwin Hartzman.

## Eta Kappa Nu

Eta Kappa Nu, an honorary electrical engineering fraternity whose object is to obtain closer cooperation among students and others in the profession, has this year initiated Henry E. Hartig and Elmer W. Johnson as honorary members, and the following undergraduates: Fred W. Baumann, Carl W. Christenson, Robert J. Kutzler, Albert E. Olson, Paul L. Erickson, John E. Hancock, Robert O. Haxby, Adolph J. Kupka, Raymond E. Milner, William G. Shepherd, James E. Stoddart, Samuel Levy, John Jay Mangan and Laddy J. Markus.

## Chi Epsilon Prize

The Chi Epsilon prize for 1932 has been awarded to Miles S. Kersten.

## Chi Epsilon

Chi Epsilon, an honorary society in the department of Civil Engineering, has this year initiated J. Donovan Jacobs, George F. Weigel, John C. Hubbard, Arthur Solum, Harold J. Sundstrom, Howard Wakefield, Gordon H. Carlson, Harry Carlson, Jack Lanhart, George E. Lindhjem, Ernest Margulas, Roy Oltman and Jason Yaggy.

## Tau Beta Pi

Tau Beta Pi, the honorary engineering fraternity for all engineering groups, has this year elected to membership John Appert, Fred Baumann, Carl W. Christenson, Winfield W. Foster, Gordon F. Lindner, Cecil March, Hugh Meindl, Einar Michalsen, Albert E. Olson, Milton Olson, Paul W. Salo, Milton Schmidt, Albert M. Wenner, Robert Calton, Stephen Erickson, Robert Geehan, Kenneth Goldblum, Robert O. Haxby, John H. Hayes, Sigmund J. Jacobs, Archie B. Japs, Marvin Johnson, Richard C. Jordan, Anthony A. Juettner, Julius Katz, Robert F. Kreiss, Donald Leslie, Albert Lilja, Raymond Milner, Ralph Peck, Gayle Priester, George Townsend, George F. Weigel, Benjamin M. Axilrod, Edgar L. Piret and Sam Levy.

## Plumb Bob

Those initiated to Plumb Bob, honorary engineering society, this year are: John H. Kuhlman, professor of electrical design, and Clifford O. Anderson, Nelson E. Anderson, Gordon E. Bodien, Robert G. Cerny, Kenneth E. Haugen, William C. Hill, Cecil C. March, Paul W. Salo, Martin G. Swanson, George H. Taft, and George B. Townsend, students.

## Alpha Tau Sigma

Alpha Tau Sigma, an honorary engineering fraternity, has this year initiated six new members. Dean O. M. Leland of the engineerng school has been made an honorary member. Laddy Markus, Tom Rogers, George Flanagan, Russell Williams, and Earl Ruble have been elected as undergraduates.

## Albert Moorman Memorial Fellowship

The Albert Moorman Memorial fellowship in Architecture has this year been awarded to Lyell G. Halverson and Gordon A. Wall.

## American Institute of Architects Medal

Gordon A. Wall has won the American Institute of Architects Medal for 1932, and Geo. B. Townsend was awarded second prize.

## Scarab Medal in Architecture

Kenneth R. Lundberg is honored by the Scarab Medal in architecture for this year.

## School of Architecture Faculty Prizes

The first prize in the School of Architecture Faculty Prizes was awarded this year to George C. Lindquist, and the second prize was taken by Jarl Seppanen.

## Magney and Tusler Prizes

Bernard Knobla and Bernard G. Lampe, respectively, won the first and second prizes in the Magney and Tusler architectural contest.

## Gargoyle Club Prizes

The Gargoyle Club awarded its first prize to Kenneth R. Lundberg, and its second prize to Austin H. Lang.

## William A. French Prizes

The William A. French prizes in interior decoration have been awarded this year to Evelyn Russel and Elizabeth Cargill.

## Sigma Xi

Among the members chosen by Sigma Xi, honorary scientific society, were Henry C. Yutzy, Benjamin Moskovitz, Henry M. Davis, Charles Rosenblum, Grant Smith, Vernon Stenger, Burrell F. Ruth, Eldred M. Murer, E. L. McMillen, Loren W. Neubauer, John H. Roe, Clarence L. Moyle, Nordahl T. Rykken, Theodore R. Corbet, D. E. Kvalnes, R. W. Sandelin, Gladstone B. Heisig, James J. Ryan, C. A. Hughes, Henry E. Hartig, Gordon D. Byrkit. Henry C. Yutzy also received the Thomas F. Andrews prize for undergraduate research.

## Alpha Rho Chi Medal

The Alpha Rho Chi Medal for 1932 has been awarded to Robert G. Cerny.

## Northern States Power Co. Prizes

No first prize was awarded by the Northern States Power Co. this year but the second prize was won by Harlan D. Boss.

## Phi Lambda Upsilon Prize

The Phi Lambda Upsilon prize for 1932 is awarded to William E. Lundquist, a sophomore chemical engineer.

## Alpha Chi Sigma Prize

The Alpha Chi Sigma Prize was also won by William E. Lundquist.

## A. S. C. E. Prizes

The A. S. C. E. prizes for the year are won by Gordon Bodien and Milton Schmidt.

## Bookstore Board

The 1932-33 bookstore board will be in the hands of Clarence E. Lund, Malcolm Hope, Paul L. Erickson, Edward A. Hammerski, and C. Herbert Starkey.

## The Tau Beta Pi Prize

The Tau Beta Pi Prize was awarded to Richard S. Olson.

## The Eta Kappa Nu Prize

The Eta Kappa Nu Prize for 1932 was awarded to Ralph Hammond, a sophomore in the Electrical Engineering school.

# THE 1932 ALUMNI DIRECTORY

of the

# Technical Colleges *of the* University *of* Minnesota

# 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. In 1929 the course in Interior Decoration was changed to that of Interior Architecture.

### 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. — Walker, Frank B.
Lee, Engbret A. — Woodman, Howard H.

*Electrical Engineer*

Abbott, Arthur L.
Chestnut, George L.
Hibbard, Truman
Lang, James S. (B. M. E. 1896, M. E. 1899)
Markhus, Olaf G. F.
Miller, William L.
Myers, Mortimer

*Mechanical Engineer*

Blake, Robert P. — Lonie, James H.
Craig, Robert E. — Savage, Edward S.
Cross, Charles H. — 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. — McKellip, Frank W.
Gilchrist, Charles C. — Wagner, Adolph W.

*Mechanical Engineer*

O'Brien, John E. — Wright, Roydon V.
Willson, Manton F. — Zeleny, Frank

ADVANCED DEGREES

*Civil Engineer*

Crane, Fremont (B. S. 1886, B. C. E. 1887)
*Gillette, Lewis S. (B. C. E. 1876, B. S. 1877)
Hoyt, William H. (B. C. E. 1890)
Long, Fred W. (B. C. E. 1896)
Mann, Fred M. (B. C. E. 1893)

*Electrical Engineer*

Burch, Edward P. (B. E. E. 1892)
Gray, William I. (B. E. E. 1892)
Reidhead, Frank E. (B. E. E. 1893)
Springer, Franklin W. (B. E. E. 1893)

*Mechanical Engineer*

Avery, Henry B. (B. M. E. 1893)

**1899**

*Civil Engineer*

Anderson, John G.

*Electrical Engineer*

Artz, Emmanuel A. (B. S. 1897) — Huntoon, Milton B.
Graling, Verney — MacKusick, Elwood M.
Hildebrandt, Henry A. — Pratt, Arthur K.

*Mechanical Engineer*

Bayless, Harry C. — Wennerlund, Elias C.
Richardson, Wilbur P.

ADVANCED DEGREES

*Civil Engineer*

Douglas, Fred L. (B. C. E. 1891)

*Electrical Engineer*

Huntoon, Milton B.

*Mechanical Engineer*

Lang, James S. (B. M. E. 1896, E. E. 1897)

**1900**

*Civil Engineer*

Grime, Edwin N. — Whitman, Edward A.
*Prendergast, Paul S.

*Electrical Engineer*

Dow, James C. — Stussy, William T.
*Johnson, Frank E. — Thaler, James A.
Kinsell, William L. — Thompson, Roy E.
Parkhurst, Harleigh — *Tracy, Fred G.
Shumway, Ernest J. — Wiltgen, Edward

*Mechanical Engineer*

Ashbaugh, Lewis E. (C. E. 1907) — *Higgins, Charles C.
Daniel, T. Lester — Johnston, William W.
Newhall, William B.

ADVANCED DEGREE

*Civil Engineer*

Shenehon, Francis C. (B. C. E. 1895)

**1901**

*Civil Engineer*

Everington, James W. — Quense, John H. (M. E. 1902)
Gunstad, Paul I. — Strate, Thomas H.
Klemer, Frank H.
McKittrick, James

*Electrical Engineer*

Anderson, Martin E. — Houts, Guy J.
Blake, Henry B. — Reque, Styrk G.
Danner, Jake — Tullar, Chas. E.
Houlton, Amos D.

*Mechanical Engineer*

Robertson, Philip W.
Wilson, Eliel F. (E. E. 1902)

*Bachelor of Science (in Engineering)*

Groat, Ben. F. (L. L. B. 1908, L. L. M. 1911)

**1902**

*Civil Engineer*

Allee, David A. — Lambert, Fred T.
Beaulieu, Richard L. — McClelland, Claude L.
Hallan, Christian — Shepley, Charles R.
Houston, George S. — Weston, William S.
*Knowlton, Warren C.

*Electrical Engineer*

Burns, Harvey L. — Nilson, Wilhelm
French, Edwin L. — Spence, William J.
McPherson, William B. — Wilson, Eliel F. (M. E. 1901)

*Mechanical Engineer*

Acomb, William E. — Quense, John H. (E. E. 1901)
Bean, William L. — Ramstad, Edward C.
Cook, Robertson — Stone, Melvin O.
Grimshaw, William E. — *Sudheimer, Edwin L.
Herrick, Carl A. — Taylor, Ralph G.

*Bachelor of Science (in Engineering)*

Graham, Eugene C.

ADVANCED DEGREES

*Mechanical Engineer*

Couper, George B. (B. M. E. 1893)
Quense, John (C. E. 1901)

**1903**

*Civil Engineer*

Barlow, Harry E. — Oltman, Charles A.
Bennett, Walter J. — Prendergast, Arthur A.
Beyer, Theodore A. — Robbins, Orison B.
Carr, Harvey C. — Smith, Leighton H.
Davison, Joseph H. — Smith, Paul S. (B. S. 1901)
Grow, Harry A. — Stewart, Clarence H.
Madden, Francis
*Novig, Ole S.

*Electrical Engineer*

Benedict, George F. — *Miller, Lucius W.
Dibble, Barry — Page, Mark L.
Eberhardt, Otto I. — Rask, Louis G.
Erickson, Carl G. — Rosok, Ingwald A.
Ireland, Roy R. (B. S. 1901) — Schumacher, John H.
Laird, Lee R. — Vincent, Jay C.

*Mechanical Engineer*

Hughes, Frank C. — Williams, Edward H.
Kjcsness, Ingram G.

*Bachelor of Science (in Engineering)*

Crounse, Avery F. — Whitney, Alfred C.

ADVANCED DEGREES

*Electrical Engineer*

Chalmers, Charles H. (B. E. E. 1894)
Ford, Robert E. (B. E. E. 1895)

*Mechanical Engineer*

Morris, John O. (B. M. E. 1888)

**1904**

*Civil Engineer*

Bouge, Nathan H. — *Holland, Jay C.
Downing, Frank E. — Nelson, Nels B.
Fernald, Frank O. — Rothi, Paul

*Electrical Engineer*

Bouman, Bernhard M. — Morton, Harry G.
Cheney, Edward J. — Otto, Frederick A.
Crabbe, George — *Rosok, Peter A. M.
Goodwin, Victor E. — Taplin, Robert B.
*Helms, Frank C. — Tomlinson, L. C.
Howatt, John — Wicks, John

*Mechanical Engineer*

Fager, Simon R. — Stanton, Raymond E.
Otto, Robert W. — Davis, Gilbert N.

*Bachelor of Science (in Engineering)*

Collins, Stewart G.

ADVANCED DEGREES

*Mechanical Engineer*

*Bray, George E. (B. M. E. 1894)

*Master of Science*

Hickok, Jessie E. S. (B. S. 1896)

**1905**

*Civil Engineer*

Bisbee, Elmer — Jensen, John A.
Brockway, Royden R. — Johnson, Nels
Burke, Roy L. — King, Wesley E.
Cutler, Alvin S. — McMillan, Franklin R.
Feyder, William H. — Mattison, Oliver
Finley, Joseph E. — *Mueller, Henry J.
Gillette, George L. — Nelson, Oscar B.
Hopeman, Albert M. — Smith, Donald T.

*Electrical Engineer*

Adams, William C. — Jones, Raymond L.
Anderson, Emil — Kochendorfer, Milton J.
Billau, Louis S. — LeBlond, Edmond J.
Boman, Carl E. — LeTourneau, Edward H.
Coleman, Frank D. — Lundquist, Reuben A.
Davis, Charles A. — Morris, Robert
Ely, Irving R. — Ryan, William T.
Frankoviz, John J. — Simmon, Karl A., Jr.
Gibson, Charles B. — *Smith, Clinton B.
Jackson, Earl D. — Wood, John W.

*Mechanical Engineer*

Andrews, George L. — *Johnson, Ernest P.
Bates, Albert H. — Lewis, Edward B.
Clipfell, Carroll D. — *Pancratz, Alexander J.
Cutter, Francis C. — Rydeen, Francis G. A.
Gerrish, Harry E. — Sperry, Leonard B. (E. E. 1908)
Harris, Sigmund — Tuck, George A.
Johnson, Austin G.

*Bachelor of Science (in Engineering)*

Gregg, Treshame D. (C. E. 1906)

ADVANCED DEGREE

*Electrical Engineer*

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

**1906**

*Civil Engineer*

Adams, Elmer E. — Hayward, George I.
Alrick, Bannona G. — Malloy, Charles J.
Alsop, Ernest B. — *Murphy, John G.
Bowen, Fred P. — Norelius, Lewis M.
Childs, Hervey B. — Reed, Arthur L.
Childs, John C. — Wiesner, Frederick E.
Hanauer, Monroe H.

*Electrical Engineer*

Albrecht, George M. — Lang, Charles A.
Bunce, Paul F. — Mowry, Harry W.
Calmeyer, John P. — Payne, Harold G.
Cohen, Nathan — Roepke, Otto B.
Cooper, Leo H. — *Schow, Harry A.
Cornelius, Martin — Schwedes, Walter F.
Dunn, Andrew P. — Shuck, Gordon R.
Englin, Charles F. — Stenger, Laurence A. (M. S. 1916)
Finchy, Jacob O. — Stone, Harris G.
Glascock, Henry H. — Ungerman, Carl M.
*Gunther, Albert N. — Weber, Erwin L. F. (M. E. 1908)
Haeberle, Elmer H. — Wiggins, Gerald G.
Hoff, Christopher — Zimmer, William A.
Hokanson, Clarence E.
Hubbard, Robert T.

*Mechanical Engineer*

Armstrong, Thomas S. — *Matteson, Frank E.
Crawford, Wallace T. — Ringsred, Arthur C.
Garber, Gabriel E. — Rose, Norman W.
Loye, Benjamin W.

*Bachelor of Science (in Engineering)*

Swensen, Karl P. (M. S. 1907)

ADVANCED DEGREE

*Civil Engineer*

Gregg, Tresham D. (B. S. Eng. 1905)

**1907**

*Civil Engineer*

Batson, Charles D. — Green, Fred H.
Blomquist, Hjalmer F. — Haverson, Henry D.
Cram, Clyde M. — Hawley, Harry G.
*Dougherty, Joe — Hobart, Walter B.
Dunham, John A. — Huston, David B.
Grant, James A. — Jones, Lewis A.

*Civil Engineer*

| | |
|---|---|
| Kelly, Earl W. | Tondell, Mandel G. |
| Swenson, Charles A. (L. L. B. 1910) | VanCleve, Horatio P. |
| | Yager, Louis |

*Electrical Engineer*

| | |
|---|---|
| Alton, Herbert D. | Pearce, John H. |
| Andrus, Raymond J. | Rezab, John J. |
| Baer, Louis E. | Schow, William P. |
| Countryman, Peter F. | Smith, Byron E. |
| Eddy, Lynne W. | Smithson, John E. |
| Fairchild, Albert R. | Sternberg, Carl |
| Kerns, Ralph W. | Uzzell, George W. |
| Norcross, Arthur F. | Woehler, William L. |

*Mechanical Engineer*

| | |
|---|---|
| Bell, Maurice D. | Meany, James M. |
| Bjorge, Oscar B. | Nekola, John W. |
| *Brown, Oliver L. | Rawson, Ralph H. |
| Buhl, Paul S. | Spring, Willis W. |
| Burwell, Loring D. | *Stacy, Elmer N. |
| Fee, E. Franklin | Stephenson, Oliver H. |
| Gessert, George R. | Tubby, Oliver G. |
| Gilman, Nicholas A. | Wagner, Otto H. |
| Krag, Walter C. | |

ADVANCED DEGREES

*Civil Engineer*

Ashbaugh, Lewis E. (B. S. in Eng. 1900)

*Master of Science*

Swensen, Karl P. (B. S. in Eng. 1906)

## 1908

*Civil Engineer*

| | |
|---|---|
| Ash, James W. | Longfellow, Dwight W. |
| Bergoust, Oscar J. | McCall, Harry J. |
| Borrowman, LeRoy F. | McCree, Andrew A. |
| Brenchley, Harry E. | Mowery, Clarence W. |
| Comstock, John W. | Norelius, Lewis M. |
| Dallimore, Arthur N. | Okes, Day I. |
| Doeltz, William F., Jr. | Olson, Melvin S. |
| Dougan, Henry K. | Quinn, John I. |
| Fleming, Douglas R. | Robertson, Charles N. |
| Furber, Pierce P., Jr. | Schlattman, Edward C. |
| Gage, Hugh N. | Walker, George W. |
| Hustad, Andrew P. | Widell, Gustaf F. |
| Knowlton, Herbert H. | Willis, Roy |
| Krauch, William L. | Woodrich, Oscar F. |
| Lang, Fred C. | |

*Electrical Engineer*

| | |
|---|---|
| Anderson, Frank A. | Peterson, Clarence A. |
| Bachrach, Alfred | Prentice, Robert S. |
| Brown, George J. | Schildt, William F. H. |
| Carter, Robert J. S. | Schoepf, Alfred W. |
| Casberg, James W. | Scobie, Francis G. |
| Currie, Neill, Jr. | Sperry, Leonard B. (M. E. 1905) |
| Frahm, Alfred R. | |
| Hoppin, Glenn H. | Sturtevant, Percy G. |
| *Hovelson, Henry | Svendsen, George P. |
| Kauffman, Roy | Swanstrom, Frank N. |
| King, Alfred B. | Sweningsen, Oliver |
| McAfee, Allan L. | Weibeler, William M. |
| Pancratz, Frank J. | Zimmerman, Louis P. |

*Mechanical Engineer*

| | |
|---|---|
| Anderson, Ole A. | Hetherton, Percival |
| Bingham, Stanley E. | Morris, Thomas C. |
| Councilman, Halstad P. (B. S. Eng. 1909) | Norelius, Emil F. |
| | Norton, Clyde W. (M. E. 1909) |
| Cox, Richard F. | |
| Estep, Harvey C. | Peterson, George T. |
| Fleming, Frank R. (E. E. 1909) | Priedeman, George W. |
| | Walsh, James (E. E. 1909) |
| *Frary, Hobart D. (M. S. 1909) | Weber, Erwin L. F. |
| Harwood, Stanley G. | (E. E. 1906) |

*Bachelor of Science (in Engineering)*

Clarke, Charles P. (C. E. 1909)
Fruen, Arthur B. (C. E. 1909)
King, Robert N.
McKeehan, Louis W. (M. S. '09, Ph. D. '11)
Rowe, Harry B.
Schmid, Robert J.

## 1909

*Civil Engineer*

| | |
|---|---|
| Childs, James A. | King, Lawrence W. |
| Ellison, Jay T. | Mitchell, John B. |
| Ellsberg, N. W. | Nelson, Edward S. |
| Esser, Frank F. | Okes, Sidney R. |
| Fiske, F. William, Jr. | Paul, Frederick T. |
| Houston, Cecil C. | Sheffield, Fred W. |
| Hubbard, Fred A. | Shepard, George M. |
| Hubbard, Henry A. | Siverts, Samuel A., Jr. |
| Ingberg, Simon | Torrance, Ell |
| Jaques, Robert | |

*Electrical Engineer*

| | |
|---|---|
| Beckjord, Walter C. | Johnson, Herman R. |
| Brockway, Alvah E. | Kristy, George A. |
| Cobban, Rollo J. | Lindelef, Charles G. |
| Converse, Clovis M. | McKenzie, Lauren F. |
| Davies, Ralph M. | Murrish, Frederic E. |
| Fitts, Joel A. | Poore, Orson B. |
| Fleming, Frank R. (M. E. 1908) | Robison, Archer R. |
| | Stillman, Marcus H. |
| Gadsby, Lester H. | Todd, Milo E. |
| Grant, Fred R. | Turner, Leslie E. |
| Harris, Clayton | Vita, Theodore |
| *Hitzker, Albert J. | Walling, Benjamin B. |
| Hopkins, Mark L. | Walsh, James (M. E. 1908) |
| Hornibrook, James W. | |
| Japs, Bernard G. | Williams, Fred M. (B. A. 1905) |

*Mechanical Engineer*

| | |
|---|---|
| Beery, Charles B. | Mark, Walter J. |
| *Bieri, John B. | Morris, John E. |
| Birnberg, Zingel C. J. | Moyer, Malcolm B. |
| Buck, Frederick W. | Nemec, Frank L. |
| Buhl, John E. | Shippam, Willis |
| Forfar, Donald M. | Souba, William H. |
| Holmgren, Charles E. | Starrett, Howard M. |
| Kircher, Frank J. | Udell, Carl D. |
| Kircher, George A. | Williams, Wilbur S. |
| Knopp, William R. | Wright, Harris H. |
| Lambert, Edwin M. | |

*Bachelor of Science (in Engineering)*

Curtiss, Lindsley B.
Councilman, Halstad P. (M. E. 1908)
Norton, Clyde W. (M. E. 1908)

ADVANCED DEGREES

*Civil Engineer*

Anderson, Ole A. (B. S. M. E. 1893)
Clarke, Chas. P. (B. S. Eng. 1908)
Fruen, Arthur B. (B. S. Eng. 1908)

*Master of Science*

*Frary, Hobart D. (M. E. 1908)
McKeehan, L. W. (B. S. Eng. '08, Ph. D. '11)

## 1910

*Civil Engineer*

| | |
|---|---|
| Adams, Benjamin W. | Jevne, George W. |
| Asleson, Hans | Leach, Edward W. |
| Bolme, Ole M. | Meyer, Carl F. |
| Boyum, Benjamin C. | Motl, Charles L. |
| Brownell, Otto E. | Nason, George L. |
| Chapman, Burton L. | Olson, Arthur O. |
| Dahlquist, Philip L. | Overholt, Harley G. |
| Ekman, Claes T. | Sawyer, Emerson D. |
| Garen, George M. | Sommerfeld, Adolph A. |
| Godward, Alfred C. | Timperley, William D. |

*Electrical Engineer*

| | |
|---|---|
| Anderson, Oscar P. | Jesperson, Clarence M. |
| Anderson, Oscar V. | Johnson, Leonard T. |
| Beck, Vernon S. | Josephson, Eliot B. |
| Conley, Wilfred E. | Landeen, Arvid G. |
| Dahlstrom, Raymond E. | Nelson, Carl H. |
| Finke, Walter J. | Phelps, Ray R. |
| *Hagstrom, Herbert E. | Powles, James W. |
| Hansen, Christian | Reid, Harry A. |
| Hustad, Byron P. | Skytte, Ernest E. |

*Mechanical Engineer*

| | |
|---|---|
| *Atkinson, William B. | Martin, Wallace H. |
| Comb, Fred R. | Meixner, Bernard A. |
| Cook, Harry C. | Moyer, Amos F. |
| DuToit, George A., Jr. | Nichols, Browning, Jr. |
| Fleming, Laurence T. | Pease, Maynard W. |
| Frear, Jenness B. | Wesbrook, Donald M. |
| Kaplan, Eugene V. | |

*Bachelor of Science (in Engineering)*

Salisbury, Willis R.

## 1911

*Civil Engineer*

| | |
|---|---|
| Ainslie, Arthur F. | Maney, George A. |
| Arnesen, Herbert P. | Mark, Reuben A. |
| Boerner, Francis C. | Mattison, George C. |
| Cottingham, William P. | Methven, Clyde L. |
| Croft, Ernest B. | Miller, Erwin J. |
| Elfstrum, Axel E. | Orbeck, Martin J. |
| Enger, Edward H. | Roth, Lewis M. |
| Fieldman, David P. | Siverson, Sigvel J. |
| Hodnett, Ralph M. | Smith, Sydney H. |
| Hoffman, Michael J. | Swedberg, M. Roy |
| Johnson, Carl A. | Walby, Arthur C. |
| Kvitrud, Ingvald | |

*Electrical Engineer*

| | |
|---|---|
| Ashworth, Roy H. | Butterworth, Allan C. |
| Blossom, George W. | Chapman, Arthur G. |
| Burrows, Robert P. | Demarest, Charles S. |
| Drinkall, Leon R. | Markuson, Oscar S. |
| Emerson, Lynn A. | Mittag, Albert H. |
| Forsberg, William P. | Nebel, Walter H. |
| Fredrickson, Harry B. | O'Brien, Raymond J. |
| Hansen, Maurice J. | Pengilly, Joseph H. |
| James, Henry C., Jr. | Riegel, Louis F. |
| Johnson, Edward J. | Shepard, Donald D. |
| Jones, Watkin W. | Soulek, Joseph H. |
| Lyford, Dartt H. | *Stinson, Will V. |
| McCoy, Ira C. | Walker, William A. |
| McQuillin, Raymond E. | Wilson, Glenn W. |

*Mechanical Engineer*

| | |
|---|---|
| Barnum, Marvin C. | Olstad, Oscar A. |
| Bishop, Ira L. | Oram, Robert C. |
| Farnam, Julian P. | Owens, Leo E. |
| Kasper, Walter F. | Sneve, Jack S. |
| Larson, Martin S. | Woodman, Joseph C. |

*Bachelor of Science in Science and Technology*

Hoffman, Ralph M.
Klopsteg, Paul E. (M. A. 1913, Ph. D. 1916)

ADVANCED DEGREE

*Electrical Engineer*

Morse, George H. (B. E. E. 1893)

## 1912

*Civil Engineer*

| | |
|---|---|
| Adams, John W., Jr. | Hosfield, Raleigh W. |
| Curtis, Thomas H. | West, Robert W. |
| Flygare, August L. | |

*Bachelor of Science in Engineering (Civil)*

Anderson, Harvey B. (C. E. 1913)
*Bailey, William H. (C. E. 1913)
Bingen, William J. (C. E. 1913)
Cummings, Elmer F. (C. E. 1913)
Diamond, Grover W.
Giertsen, Marcus O. (C. E. 1913)
Haberle, Edward L. (C. E. 1913)
Jorgens, Charles R. Danevin (C. E. 1913)
Kapphahn, Raymond J. (C. E. 1913)

*Bachelor of Science in Engineering (Civil)*

King, Forest V. (C. E. 1913)
Kriz, Joseph J. (C. E. 1913)
Pagenhart, Clarence C.
Pease, Raymond A. (C. E. 1913)
Peterson, Barney J. (C. E. 1913)
Ryan, Loiel S. (C. E. 1913)
South, Willard A. (C. E. 1913)
Souther, Morton E. (C. E. 1913)
Swenson, Hjalmer S. (C. E. 1913)
Torgerson, Irving E. (C. E. 1913)
Wangaard, Oscar H. (C. E. 1913)
Welin, Arthur G. (C. E. 1913)
Wolff, Henry E. (C. E. 1913)

*Electrical Engineer*

| | |
|---|---|
| Anderson, Arthur R. | *Purves, Leland E. |
| Bill, Earl McM. | Streich, Harry C. |
| Dorrance, Albert P. | 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. | Markoe, James C. P. |
| Brown, William P. | Thompson, Herbert L. |
| *Johnson, Frank | |

*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)

*Mechanical Engineer*

| | |
|---|---|
| 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. | Mixer, Walter R. |
| Buckhout, Donald H. | Poulsen, George F. |
| Gilman, Howard B. | Prudden, George H., Jr. |
| Kreinkamp, Linton H. | Riedesel, George M. |

*Bachelor of Science in Engineering (Civil)*

| | |
|---|---|
| Boyce, Ellsworth R. | Luxford, Ronald F. |
| Brataas, Mark G. | Rader, Clarence McK. (C. E. 1917) |
| Douglass, Addison H. (C. E. 1920) | Riekman, Herman W. |
| Fossen, George | Tryon, Philip D. |
| Linden, Henning | Wolfangle, Raymond J. |
| Luplow, Walter D. | |

*Bachelor of Science in Engineering (Electrical)*

| | |
|---|---|
| Becker, Ward E. | *McKibbin, Ray (E. E. 1918) |
| Boyum, Irvin L. | *Melby, Einar C. |
| Carlson, Chauncy M. | Scott, Willard W. |
| Dunlap, Lemuel J. | Swenson, George W. (E. E. 1921) |
| *Ebert, Solomon B. | Thomas, William A. |
| Eckenbeck, Evertt E. | Wheeler, Herbert H. |
| Jacobs, Arthur R. | Williams, Frederick J. |
| Juvrud, Edwin C. | Willis, Benjamin S. |
| Lilly, Clarence W. | |
| Malmstrom, Axel L. | |

*Bachelor of Science in Engineering (Mechanical)*

| | |
|---|---|
| Andersen, Edward I. (M. E. 1919) | Hvoslef, Frederik W. (M. S. 1919) |
| Boehnlein, Charles (M. E. 1919) | Jones, Edwin F. |
| Bros, Ernest T. | Knutson, Harry |
| Brown, Homer L. | Larson, Victor F. |
| Carlson, Arvid P. | Murray, John H. |
| Ek, Gustav A. | Nelson, Otis S. |
| Eustis, Irving N. (M. E. 1918) | Romero, Cirilo L. P. Y. (M. E. 1918) |
| Gerlach, Arthur C. | Rosenbloom, Abraham E. |
| Guggisberg, Charles F. | Swenson, Clarence Q. (M. E. 1920) |
| Hektner, Joel | Taylor, Duane L. |
| Holmstine, Arthur G. | |

### 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. | King, Harvey M. |
| Kaplan, Seeman | Moorman, Albert J. |

*Bachelor of Science in Engineering (Civil)*

| | |
|---|---|
| Battles, Leon E. | Konstantinopoulos, Nicholas (Konstants) |
| *Chamberlain, Herbert D. | Nickerson, Neal C. |
| Deutsch, Richard E. | Smith, Cedric B. (B. A. 1914) |
| Eliassen, Sigurd | Smolensky, Martinian G. |
| *Gould, Reed D. | |

*Bachelor of Science in Engineering (Electrical)*

| | |
|---|---|
| Brooke, Harold L. | Ross, Russell H. |
| Gibbs, Clayton T. | Schlenk, Hugo, Jr. |
| Hartig, Henry E. | Smith, Donald C. |
| Hotchkiss, Fred W. | Smith, Hugh A. |
| Levin, Jake M. | Talbot, Thomas F. |

*Bachelor of Science in Engineering (Mechanical)*

| | |
|---|---|
| Abrahamson, Howard B. | Greenberg, Morris |
| Anderson, Hilder A. | Hagerman, Oliver S. |
| Bierman, George H. (M. E. 1919) | Kivley, Ray C. |
| Francis, Paul E. | 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 | Hamilton, Jefferson M. |
| Deane, George B. | Hammett, Ralph W. |
| Deneen, David J. | Schwartz, John S. |
| Emery, George C. | Wright, Stewart V. |
| Fraser, George | |

*Bachelor of Science in Engineering (Civil)*

| | |
|---|---|
| Coe, Edward H. | Rosenthal, Oscar L. |
| Elstad, Rudolph T. | Sushan, Harry M. |
| Hawlick, Henry I. | |

*Bachelor of Science in Engineering (Electrical)*

| | |
|---|---|
| Christensen, Edgar W. | Marshall, Donald E. |
| Cotton, Ernest H. | Nelson, Gustav A. |
| Drinkall, John F. | Olson, Richard H. |
| Duncan, George R. | Peterson, Albert E. |
| Grimes, David | Peterson, Arthur P. |
| Hartman, Walter K. | Petrich, Alfred C. |
| Heinemann, John R. | Pierson, Joe W. |
| Jordan, Frank W. | Reeve, Charles H. |
| Klass, Frederick | Sander, Theodore, Jr. |
| Langland, Harold S. | Swanson, Edwin W. |
| Lee, Oscar C. | |

*Bachelor of Science in Engineering (Mechanical)*

| | |
|---|---|
| Baker, Arthur W. | Moffat, George N. (M. E. 1920) |
| Bros, Raymond J. (M. E. 1920) | Pavek, William J. (M. E. 1920) |
| Cosh, Richard A. | Williams, Arthur H. |
| Dowd, Archie J. | Wunderlich, Milton S. (M. E. 1920) |
| Elliot, Harry C. | |
| Foltz, Ross M. | |
| Hartzberg, Edward M. | |

*Bachelor of Science in Engineering*

| | |
|---|---|
| Briggs, Hiram K. | Kroeze, Herbert A. |
| Gee, Harry J. | Lewis, Carroll E. |
| Kapphahn, Ernest H. | 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. | Loye, Edwin M. |
| Kleinschmidt, Florian A. | Lyon, Glenn H. |
| Korslund, Harry J. | Raugland, Arnold I. |
| Lin, Shu M. | |

*Bachelor of Science in Engineering (Civil)*

| | |
|---|---|
| Alexander, George D. | Friar, Floyd M. |
| Beneke, Walter E. | Gilbert, Roy |
| Berg, Karl A. E. | Gould, Edward S. |
| Bernt, Hans E. | Hanke, Carl C. |
| Bleifuss, Donald J. | Hansen, Carlos C. |
| Dever, Francis A. | Holm, Edwin R. |
| Fitzgerald, William J. | Johnson, Byron F. |

| | |
|---|---|
| Larson, Amandus C. | Pless, Arnold G. M. |
| Lebeck, Carl E. | Purdy, Irving B. |
| Lende, Henry M. | Seemann, Ernest W. |
| Malmberg, Victor A. | Sherwood, Edward B. |
| Nelson, Donald O. | Staehle, Gilbert C. |
| Neville, Earle L. | (M. S. Eng. 1922) |

*Bachelor of Science in Engineering (Electrical)*

| | |
|---|---|
| Aske, Irving E. | McKenzie, Leonard F. |
| Bauer, Ruben B. | Mayer, Albert F. |
| Carlson, Victor H. | Miller, George W. |
| Ellsworth, Charles D. | Mitchell, Alexander C. |
| Engquist, Victor E. | Molskness, Nels S. |
| Goss, Harold R. | Nelson, Clarence L. |
| Groth, Arthur W. | Noel, Clay W. |
| Hunt, Gates E. | Peterson, Peter I. |
| Janzen, William H. | Peterson, Richard M. |
| Jules, Harold A. | Peterson, Vance C. |
| Kingsley, Norman W. | Price, Clarence R. |
| Knowles, Everett H. | Siegmann, Chester W. |
| Kruse, Orlin O. | Strothman, Russell A. |
| Larson, Walter J. | Triem, Ralph H. |
| Lee, Walter J. | Waldron, Ralph E. |
| Lockwood, Raymond A. | Westberg, Russell E. |

*Bachelor of Science in Engineering (Mechanical)*

| | |
|---|---|
| Anderson, Helmer N. | Merrill, Lewis E. |
| Ball, Hampton B. | (M. E. 1921) |
| Cerney, Glen C. | Odegaard, Harold T. |
| Curry, Esra B. | Powell, Knox A. |
| (M. E. 1921) | *Reasoner, Clayton M. |
| Czock, Jacob H. | (M. E. 1921) |
| Egilsrud, Fridtjof S. | Rhame, Paul W. |
| Fortune, Harry G. | (M. E. 1921) |
| Gerow, Theron G. | Shellenberger, Hiram R. |
| Hayes, Edward J. | Tuve, George L. |
| (M. E. 1921) | (M. E. 1921) |
| Joachim, William F. | Wallfred, John E. |
| (M. E. 1921) | Waterous, Fred A. |
| | William, Myrl J. |

*Bachelor of Science in Engineering*

| | |
|---|---|
| Didriksen, Philip H. | Moore, Clarence F. |
| Hanrahan, Edmund C. | Swenson, Gustav A. |
| Harris, Nathan | Vallacher, Theodore L. |
| Madsen, Olav | 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. | Larson, Edwin |
| Dahl, George L. | Melander, Albin R. |
| Damberg, Rheuben P. | *Thorshov, Olaf |
| Gewalt, Carl H. | Wills, Arthur D. |

*Bachelor of Science in Civil Engineering*

| | |
|---|---|
| Barber, Harold A. | Henry, Burt C. |
| Carpenter, Hugh W. | Jensen, Cyril D. |
| Christilaw, George M. | Johnson, Alphonse N. |
| Daly, Richard T., Jr. | Johnson, Carl S. |
| Dehn, Eltor A. | McCubrey, Everett J. |
| Del Plaine, Carlos W. | Mackintosh, William S. |
| (C. E. 1922) | Muessel, Robert W. |
| Enke, Fred A. | Simmonds, Richard R. |
| Grochau, Earl H. | Sverdrup, Leif J. |
| Hallady, Leslie L. | Weis, Wallace D. |
| Hanson, Edwin L. | Werdenhoff, James H. |

*Bachelor of Science in Electrical Engineering*

| | |
|---|---|
| Anderson, Edward S. | Loye, Percival E. |
| Austin, Paul D. | McKibben, Lloyd S. |
| Barger, Harold L. | McVean, Norman S. |
| Barnes, Dean M. | Maine, Basil C. |
| Beardmore, Albert E. | Manderfeld, Emanuel C. |
| Berg, Samuel A. | Mangney, Elmer J. |
| (B. A. 1921) | Miller, Andrew L. |
| (E. E. 1922) | Nelson, Richard L. |
| Briggs, William G. | Palmer, Roy A. |
| Carlson, Carl P. | Pearson, Charles W. |
| Colson, Lauren G. | Peterson, Harold W. |
| Donahoe, Robert E. | Podosin, John |
| Hammerstrom, Aleck A. | Satori, Roy H. |
| Hayward, Laurence W. | Shuirman, Gabe |
| Hougan, Sander | Stanius, Godfrey |
| Johnson, Edgar F. | Sweet, Ray R. |
| Johnston, Charles K. | Wahlquist, Hugo W. |
| Larson, Ludvig C. | Wessale, George |
| (E. E. 1923) | Wilson, Paul R. |

*Bachelor of Science in Mechanical Engineering*

| | |
|---|---|
| Arneson, Lloyd O. | Lewis, George R. |
| Elmer, Lloyd A. | Luce, Alexander W. |
| Farmer, John W. | (M. E. 1923) |
| Forsberg, Elmer J. | Reuter, Peter T. |
| (M. E. 1922) | Roy, Milo C. |
| Gjesdahl, Maurice S. | Umbehocker, Frank |
| Hamlin, Lehan H. | Vaule, Sven A. |
| Johnson, Carl A. | von Rohr, Herbert H. |
| (M. E. 1922) | |

*Bachelor of Science in Engineering*

| | |
|---|---|
| Beeman, Harry J. | McLean, Milton D. |
| Carlton, Richard P. | McMeekin, Glenn D. |
| Cowin, Clifford C. | Martin, Curtis R. |
| Dills, Lyle A. | Noble, John F. |
| Godwin, Kenneth A. | Papenthien, Roy O. |
| Jacobson, Howard C. | Young, Joseph E. |
| Liddle, Ralph W. | |

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. | Haines, Howard N. |
| Croft, Edna K. | Kreinkamp, Herbert A. |
| Damberg, Paul S. | Little, Alice V. |
| Dawson, John W. | Moorman, Frank S. |
| Gerlach, Henry C. | Smit, Catherine |
| Graf, Donald T. | Stewart, George A. |
| Hahn, Stanley W. | Willner, William E. |

*Bachelor of Science in Civil Engineering*

| | |
|---|---|
| Anderson, Nels S. | Mattson, Dewey F. |
| Andrus, Harry J. | Morrison, John E. |
| Bailey, George R. | Newberry, Lester W. |
| Berdan, Hubert J. | Ost, Roland E. |
| Chernus, Maurice | Palda, Chas. H. |
| Cook, Walter K. | Palmer, Howard B. |
| Cray, Seymour R. | Paulson, Thorwald S. |
| (C. E. 1923) | Peterson, Neander E. |
| Erickson, Edwin C. O. | Pinska, Lawrence F. |
| Espenett, Edward L. | Reardon, John M. |
| Feder, Max | Rosenthal, Paul |
| Fraser, Carlisle G. | Silverman, Emil M. |
| Frost, Herbert J. | Slade, Loring |
| Greenberg, Jack | Soshnik, Edward J. |
| Hortskotte, Arthur E. | Stoutland, Oliver A. |
| Johnson, Ellsworth | Swanson, Clifford L. |
| Keeler, Jasper F. | Tarbell, William P. |
| Kelley, William | Teberg, Lawrence E. |
| Levens, Alexander S. | Thompson, Claudius A. |
| (M. S. in C. E. 1924) | Tierney, Festus P. |
| (C. E. 1927) | White, Arden D. |
| Lund, Earl H. | Wilson, Charles A. |
| (C. E. 1923) | Wood, Victor R. |
| Markson, Christian O. | |

*Bachelor of Science in Electrical Engineering*

| | |
|---|---|
| Aultfather, David H. | Magnuson, John E. |
| Bergstrom, Marlow B. | Mentzer, Clarence A. |
| Bisbee, Bertin A. | Merritt, Alva W. |
| Bjonerud, Earl S. | Mintz, Nathaniel |
| Bochus, Gerald H. | Nielsen, Walter M. |
| Bosshardt, Wilmert C. | Nordlien, Berger W. |
| Carlson, Richard E. | Olson, Arnim G. |
| Cooley, Gilbert | Oscarson, Gerhard L. |
| Dahl, Hjalmer A. | Pangburn, Carroll G. |
| Downie, John M. | Plank, Howard G. |
| Drost, Henry F. | Ransom, Glen B. |
| Dunnum, Orney E. | Rome, Robert C. |
| Ellestad, Irwin M. | Rood, Arnold E. |
| Enger, Arne | Sannicolo, Joseph F. |
| Fiske, Harold C. | Selander, Karl W. |
| Forbes, Henry C. | Sorensen, John E. |
| Hagelin, Lawrence W. | Steffens, Robert A. |
| Heidelberger, Roy J. | Tuve, Merle A. |
| Hendrickson, Arnold B. | Wickman, Martin F. |
| King, John E. | Willard, Arthur C. |
| Linhoff, Carl H. | Williams, Percival H. |
| McEachin, John | Wilson, Abner W. |
| McMillen, James S. | |

*Bachelor of Science in Mechanical Engineering*

| | |
|---|---|
| Aure, Roy | Clark, John S. |
| Bros, Chester W. | Curtis, Verne F. |
| (M. S. in M. E. 1924) | Eddy, Clarence |
| Carlson, Ernest F. | Fahland, Frank, Jr. |
| Hemsey, Clayton E. | Mikesh, Edward S. |
| Hilgedick, Ralph V. | Nordenson, Arnold |
| Hoffman, Richard H. | Nordstrom, Ernest A. |
| Holmsten, Victor T. | Olmstead, Charles F. |
| Katter, Calvin K. | (M. E. 1923) |
| Katter, Reuben L. | Peters, Walter C. |
| Kelsey, Howard C. | *Rood, Olaf T. |
| Kleinschmidt, Armin R. | (M. E. 1923) |
| Kumm, Arthur W. | Rosendahl, Harold R. |

*Bachelor of Science in Engineering*

| | |
|---|---|
| Adams, Edward H. | Forssell, William |
| Brown, Harry | Hayes, Harold |
| Capstick, Donald | Meili, Rudolph E., Jr. |
| Dock, Chester | 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. | Nielsen, Eunice V. |
| Holien, Edward O. | Sime, Theodore L. |
| Johnson, Elving L. | Strom, Arthur |
| Markuson, Miner J. | Walquist, John A. |

*Bachelor of Science in Architectural Engineering*

| | |
|---|---|
| Luedeman, Clarence H. | Sutherland, Samuel J. |

*Bachelor of Science in Civil Engineering*

| | |
|---|---|
| Aasland, Arne | Lazarus, Morris W. |
| Abramson, Harry W. | Leonard, Aubrey C. |
| Aldrich, Louis W. | Maiser, Walter L. |
| Aslakson, Carl I. | Manger, Henry J. |
| Berg, Swan P. | Meskal, George A. |
| Bergford, Lester M. | Mitchell, Lloyd S. |
| Bergford, Rolf E. | Nelson, Elmer A. |
| Buhr, Leo | Nelson, Glenn |
| Christlieb, Frank B. | Odquist, Carl |
| Cribbs, Harry E. | Olson, Elmer J. E. |
| Curry, Byron K. | Peck, Lloyd A. |
| Darrell, James E. | Sauer, Arthur A. |
| DeFreece, Paul R. | Schaller, George C. |
| Dindorf, Edward C. | Schlenk, John J. |
| Flindt, Richard H. | Sclarow, Abraham M. |
| Hill, Hibbert M. | Spencer, Raymond D. |
| Hiner, Walter G. | Stephens, Clifford S. |
| Hosmer, Orville H. | Swanson, Paul H. |
| Johnson, Albert W. | Tennstrom, Carl H. |
| Johnson, Nels | Thompson, Everett |
| Judd, Maurice D. | Villaume, Walter F. |
| Kotz, Walter E. | 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. | Bachmann, Graydon A. |
| Amidon, Lee L. | Bergsland, Grant C. |
| Ascher, Raymond C. | Bros, Bernard M. |

*Bachelor of Science in Mechanical Engineering*

| | |
|---|---|
| Brossard, Edward V. | Larson, Glen M. |
| Copeland, Floyd E. | Lindelien, Engen |
| Cross, Roland E. | Marshall, Chester R. |
| Eige, Elmer H. | Messer, Harold D. |
| Gilstad, Arthur | Parkin, Orrin G. |
| Halden, Herbert O. | Peckham, Harold E. |
| Hibbard, Shelden S. | Ransom, Ralph W. |
| *Keiser, Karl W. | Sear, Arthur W. |
| (M. S. in M. E. 1924) | Swanson, Philip G. |
| Kuhlman, Rudolph H. | 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. | Johnson, Raymond V. |
| Bauer, Roscoe W. | Kaufman, Morris B. |
| Bergquist, Edwin T. | Larson, Peter L. |
| Bergquist, Philip L. | Liese, Herbert W. |
| Bestor, George C. | Lund, Roy V. |
| Bevan, R. Louis | McCrady, Archie R. |
| Braddock, Edward | Nelson, Martin E. |
| Brody, Mace F. | Normann, Rolf A. |
| Bullis, Everard J. | Olson, C. Milford |
| Chapin, S. Caryl | Parker, Robert M. |
| Dedic, Richard J. | Peterson, Lloyd L. H. |
| Erickson, Carl E. | Powell, Louis H. |
| Garzon, Julian R. | Ranger, Donald R. |
| Gillard, Herbert W. | Roos, Frank T. W. |
| Grant, Elberth R. | Somero, Waino M. |
| Guerin, George V., Jr. | Sprehn, George H. |
| Guesmer, George O. | Stoddart, Hugh A. |
| Gustafson, Reuben W. | Stoner, Clifford M. |
| Hankins, Nathaniel R. | Tews, Arthur W. |
| Harrington, Marzy V. | Thompson, Theodore S. |
| Hayden, Claude E. | Velz, Clarence J. |
| Herberg, Sanford | Wilson, Walter E. |
| Holder, Laurance E. | |

*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. | Rankin, Dean W. |
| Grisson, Aubrey H. | Vaudreuil, Lionel H. |
| 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. | Christensen, Arthur L. |
| Albrecht, Karl J. | Cosandey, Charles J. |
| Anderson, Arthur P. | Countryman, M. Alden |
| Benson, Ikel C. | Cousins, Van M. |
| (M. S. E. E. 1927) | Edwards, Richard G. |
| Boe, Lester L. | Ellis, Carl E. |
| Borchert, Oscar H. | Franzen, Roy O. |
| Bordeau, Sanford P. | Gilman, Gaylord |
| Brossard, Henry F. | Hammer, Harold E. |
| Burlingame, Robert E. | Hanft, Hugo H. |
| Cameron, Harry D. | Heins, Harold H. |
| Childs, Morris P. | Hill, Edward L. |
| Holmes, Raymond H. | Peterson, Lewis E. |
| Hussey, Norman W. | Postma, John |
| Jacobsen, Arthur C. | Reed, Henry R. |
| Johnson, Enan C. | (M. S. E. E. 1927) |
| Johnson, Robertson B. | Richardson, Philip E. |
| Kauppinen, Heino | Robertson, Kenefick |
| Keller, Raymond W. | Schenckloth, Harry H. |
| Knoll, Franklin O. | Schuck, Roy D. |
| (B. S. C. E. 1922) | Shavor, George J. |
| (St. Thomas) | Smith, Harold D. |
| Koch, Winfield R. | Solomonson, Lawrence D. |
| Lewis, Berkeley R., Jr. | Steinert, Emil |
| Ludlum, Robert V. | Taylor, Richard G. |
| Lund, Jeffery L. | Thomas, Richard L. |
| McClung, Karl R. | Thomson, Andrew |
| McCully, James P. | Thyberg, Clarence W. |
| McEwen, Alexander D. | Tunell, Clement R. |
| Malmgren, Richard V. | Untinen, August L. |
| Meagher, Joseph E. | Upton, Albert P. |
| Nelson, Carl C. | Westigard, Glenn A. |
| Nelson, Clarence H. | Wieland, Willard W. |
| Nickerson, Edward | Winslow, Harry J. |
| Nierling, Grant C. | Wurzbach, Henry A. |
| Parsons, Sidney A. | |

*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 | Naslund, Gustave A. |
| Kronick, T. Gerald | Potter, Robert P. |
| Lighter, Clyde W. | Stageberg, Oswald C. R. |

*Bachelor of Science in Architectural Engineering*

| | |
|---|---|
| Kranzfelder, Robert H. | Redin, R. Kenneth |
| Rasey, Raymond F. | |

*Bachelor of Science in Interior Decoration*

| | |
|---|---|
| Ehrenberg, Muriel L. | Snyder, Dorothy E. |
| Guesmer, Marie W. | |

*Bachelor of Science in Civil Engineering*

| | |
|---|---|
| Balkin, Samuel W. | Juell, Barton |
| Bolstad, Roswell C. | Kelly, Raymond R. |
| Breeden, James R. | Krefting, Arthur S. |
| Bunnell, Charles W. | Lewin, Sherman W. |
| Comfort, Thomas H. | Liese, Carl R. |
| Cooper, R. Conrad | Lindstedt, Philip C. A. |
| Croswell, Leslie D. | Lipchick, Alex A. |
| Deegan, Raymond C. | Lorens, Edward R. |
| Drdla, Robert L. | Lund, Clarence V. |
| Fenton, Paul C. | Manson, Philip G. |
| Flaaten, Percy H. | Meyerdick, Clarence E. |
| Foster, Kenneth W. | Nasvik, Adolph C. |
| Gould, Edward C. | Neubauer, Loren W. |
| Haakensen, N. Theodore | Nyvall, Clifton S. |
| Halbkat, Franklin J. | Ohman, Uno G. |
| Hoffman, John R. | Peterson, Garvin E. |
| Jakkula, Arne A. | Sandberg, Clifford H. |
| (M. S. C. E. 1927) | Schulz, Alex A. |
| Johnson, Clifford S. | Young, Edward F. |
| Johnson, James R. | Young, Truman P. |
| Johnson, Raymond A. | |

*Bachelor of Science in Electrical Engineering*

| | |
|---|---|
| Ageton, Edwin O., Jr. | Berghs, Charles J. |
| Anderson, Lowell W. | Bergman, Hilder W. |
| Ayshford, Loren C. | Beveridge, Robert A. |
| Barron, John H. | Bullard, Henry M. |

| | |
|---|---|
| Carman, Willard J. | Larsen, Einar H. |
| Christen, Ray L. | Lee, Albert A. |
| Coon, Lawrence C. | LeVesconte, Lester B. |
| Dahl, Merle G. | Levy, Max L. |
| Deinema, George R. | Lindquist, Oliver J. |
| Deterling, Edward A. | Lostrom, Herbert W. |
| Dimmick, Merton A. | Lyberg, Verele C. |
| Etem, Victor | Lynskey, Joseph P. |
| Faulkner, Louis L. | Mackay, Donald H. |
| Feldman, Carl B. H. | Mahachek, Ross |
| Ferguson, Kenneth R. | Mann, Alvin K. |
| Fiene, Marcus | Meader, Glenn S. |
| Forsmark, Ulrik E. | Mindrum, Arthur I. |
| Gaalaas, George L. | Murdoch, George B. |
| Gemmell, Robert W. | Nelson, Paul B. |
| Getchell, Earl | Nelson, Robert B. D. |
| Graf, Alois W. | Nimmer, Walter B. |
| Gross, Leon A. | Orning, Harold |
| Haedecke, August D. | Parry, John E. |
| Hafstad, Lawrence R. | Quine, William M. |
| Hammond, Joseph A. | Rhoades, Herbert E. |
| Hargrave, William A. | Robinson, Lawrence T. |
| Hart, Maurice W. | Salstrom, Paul S. |
| Hartley, Lowell J. | Schroeder, Clarence A. |
| Hilgedick, Winfred C. | Schweppe, Walter A. |
| Holcomb, Harry S. | Scott, Franklin B. |
| Hummel, Carl | Sjoberg, Roy H. |
| Irons, George R. | Slaggie, Eucharius L. |
| Jensen, Otto L. (B. A.) | Tholstrup, Henry L. |
| Joesting, Frederick D. | Tighe, James S. |
| Johnson, Clarence A. | Walters, Robert P. |
| Johnson, Welton V. | Wenrich, James R. |
| Jones, Richard W. | Wentz, Edward C. |
| Kelly, William J. | Williams, William R. |

*Bachelor of Science in Mechanical Engineering*

| | |
|---|---|
| Anderson, Wesley J. | Kleinfeld, Leonard S. |
| Bancroft, Henry K. | Letson, Donald E. |
| Beek, Hiram D. | Lundgren, Carl W. |
| Bennett, John C. | Maney, James E. |
| (M. S. M. E.) | Mork, George W. |
| Bohannon, George W. | Norrbom, Oscar E. |
| Burt, Paul R. | Nordenson, Willard H. |
| Cole, Ernest C. | O'Donnell, Lawrence |
| Comfort, Clifford E. | Pierce, Walter H. |
| Corbett, Theodore R. | Pike, Jay B. |
| Dewaji, Gunaker | (M. S. M. E. 1927) |
| DuBois, N. Warren | Roberts, Norman A. |
| Fornfeist, Carl H. | Rollin, Harold E. |
| Grant, Russell S. | Slaby, Louis J. |
| Hanna, Cyril C. | Tucker, Carl W. |
| Hass, Paul O. | |

## 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. | Flegal, Ai Claude |
| Backstrom, K. A. W. | Gustafson, Robert F. |
| Broderick, Vere H. | Havens, Paul Maynard |
| Cameron, Lester W. | Kastner, Arthur Henry |
| Close, Winston A. | Kilpatrick, Porter Warren |
| Eaton, Paul Frederick | McCan, Realino Vincent |
| Edwards, William H. | Melius, Arnold A. |

*Bachelor of Science in Architectural Engineering*

| | |
|---|---|
| Bull, Alvah Stanley | Nyquist, Roy L. |
| Davidson, Henry A. | Park, James Injun |
| Gilfillan, Donald Wm. | Sorenson, Russell L. |
| Nelson, Neal N. | Stolte, Sidney L. |

*Bachelor of Science in Interior Decoration*

| | |
|---|---|
| Cameron, Grace | Grafslund, Geneva Louise |
| Wilkinson, Gladness B. | |

*Bachelor of Science in Civil Engineering*

| | |
|---|---|
| Bolnick, Harry Wm. | Hoving, John E. |
| Borne, Floyd O. | How, Francis Waldo |
| Borrowman, John Keeley | Johnsen, Kenneth A. |
| Brattlof, Clifford | Johnson, Laurence Victor |
| Briggs, Luerd E. | Lande, Clarence C. |
| Brohaugh, Gustave C. | Luethi, Carl Francis |
| Campbell, Douglas M. | Loucks, Roger Brown |
| Carlson, Elmer W. | Lundsten, Frank Rueben |
| Castner, Roy W. | Lund, Stanley D. |
| Christianson, Elmer John | Marcroft, John Clifford |
| Clark, Kenneth Miles | Morris, George Edward |
| Crowell, Sidney Howe | Murray, Harold E. |
| Engler, Myer | Norman, Henry Robert |
| Edlund, Ray Clinton | Pajari, Tauno |
| Gehring, Lester George | Paulson, Joseph Bernard |
| Hagman, Walter Fred | Pearson, Einar Otto |
| Pearson, Harold Theodore | Santelman, Ralph Henry |
| Peterson, Frederick G. | Sperling, Abe J. |
| Platzer, George John | Teske, Frederick Carl |
| Pohl, Loren Frank | Turrittin, Hugh Lonsdale |
| Preus, Christian K. | Wentz, Clarence Arthur |
| Riedesel, Russell Irving | Witt, Edward John |
| Rosing, Donald Clay | Youngquist, C. Vernon |
| Ruth, Fred Louis | Zuckman, George J. |

*Bachelor of Science in Electrical Engineering*

| | |
|---|---|
| Anders, Milton F. | Moosbrugger, Frank John |
| Anderson, Henry Alvin | Moses, Marlowe Grant |
| Asphalt, Filip Johanson | Nelson, Clarence Enoch |
| Bailey, Stuart Lawrence | Nergaard, Leon Severin |
| Barton, James Parker | Nielsen, Andres H. |
| Beach, George | Nolan, George Charles |
| Berglund, Erick Bernard | Norberg, Hans A. |
| Berkner, Lloyd Biel | Ofelt, George R. |
| Byer, Randall R. | Osburn, Roy Wesley |
| Bezek, Albert | Peters, Charles Max |
| Bonner, Arthur Lee | Pilger, Clarence L. |
| Bottemiller, Edward L. | Prehn, Victor Nicholas |
| Boyce, Harold J. | Rauscher, Paul Frank |
| Brandt, Clifford Alois | Redding, James A. |
| Brayden, Giles William | Ringstrom, George H. |
| Brightfelt, John Charles | Robinson, Richard Burton |
| Buccowich, Paul | Rogers, H. Barrett |
| Burmeister, Charles H. | Scholz, Edmund Henry |
| Clark, Charles Stevens | Schultz, Albert W. |
| DuBois, John Harry | Schulze, LeRoy Edward |
| Edgar, Robert Ferguson | Smith, Jerome Conrad |
| Farmer, Herbert Fred | Speer, Paul B. |
| Gibson, Robert | Sunblad, Everts William |
| Heimer, Amos Kingsley | Swanson, Carl Everett |
| Hortberg, Reynold Olof | Thompson, Niles J. |
| Hovey, Bertram Kelsey | Volkenant, Gordon W. |
| Johnson, Gustave F. | Wald, Joseph Harold |
| Lange, George M. | Ward, Stanley A. |
| Lee, Albert Christian | Weber, Clyde |
| Lee, Paul Raymond | Weeks, Leonard H. |
| Leider, Albert E. | Wehlitz, Hubert Frank |
| Lewis, Lloyd W. | Weom, Laurel Allan |
| McDonnell, Lawrence P. | Whiteley, Howard Orville |
| McKesson, Lewis James | Witts, Seth Newton |
| Miller, William S. E. | Woloshin, Boris |
| Moore, Gordon B. | |

*Bachelor of Science in Mechanical Engineering*

| | |
|---|---|
| Akins, Clifford Miller | Little, Fred Wellington |
| Bliven, Paul | Loo, Yuson |
| Boyce, Norman Elliott | Lowther, Wilfred Wesley |
| Bros, Kenneth Donald | McNeill, Lyle D. |
| Carlson, Clifton Conrade | MacDonald, George A. |
| Chapman, Wilbur J. | Mongren, Richard Vern |
| Coates, Joseph Edwin | Munger, Maurice |
| Cook, Lyle M. | Parten, Carl Darius |
| Dacanay, Lino P. | Richardson, Ralph Arthur |
| Dixon, Donald Kenneth | Roberts, Dimon Albert |
| Evans, Ralph B. | Schneider, Frank Mahlon |
| Giessel, Paul Albin | Spehr, Peter Eldon |
| Hall, John Whitmore | Spencer, John Boyd |
| Hutchinson, Edwin T. | Trexler, Richard Rollo |
| Irons, Roy Cecil | Tubbesing, Norman F. |
| Isaacson, Arthur M. | Vye, George Parks |
| Lamon, Harold Joseph | |

## 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

*Bachelor of Architecture*

| | |
|---|---|
| Carjola, Chester L. | Huchthausen, Walter J. |
| Church, Bruce R. | Jones, Paul W. |
| Ekman, Harold | Rakov, Avner |
| Grossman, Frederic R. | Thorshov, Roy N. |
| Holien, Gilman C. | Witt, Edward H. |

*Bachelor of Architectural Engineering*

| | |
|---|---|
| Affleck, Dean H. | McGinnity, William J. |
| Davidson, John E. | Meyers, Clare F. |
| Jerabek, Daniel A. | Pearson, George O. |
| Jones, Gurdon W. | Ramey, John M. |
| Loo, Pang Chieh | Roston, Rees E. |

*Bachelor of Interior Decoration*

| | |
|---|---|
| Berman, Florence C. | von Sien, Ruth E. |

*Bachelor of Civil Engineering*

| | |
|---|---|
| Amidon, Roger E. | Bergford, John F. |
| Beaudin, Lawrence A. | Bolton, John M. |
| Benson, Mons H. | Daly, Frank A. |
| Dreveskracht, Wallace W. | McNally, Lee D. |
| | Maturi, Rudolph |
| Engstrom, LeRoy | Meyeron, Ben |
| Erickson, Hugo G. | Normann, Olav. K. |
| Erickson, Lloyd R. | Olson, Clarence C. |
| Ferguson, George E. | Parker, Clyde H. |
| Frank, Carl W. | Prior, Charles H. |
| Gard, Donald L. | Rinell, Eric A. |
| Goldberg, Hymen | Ringwood, James B. |
| Gustafson, J. Melvin | Rydeen, James P. |
| Johnson, Ralph P. | Schroepfer, George J. |
| Knox, Charles E. | Silliman, Paul D. |
| Kopp, David C. | Tauber, Joseph H. |
| Kopplin, Charles D. | Tebo, Frank A. |
| Kreger, Lynn S. | Thwing, George Jr. |
| Lexau, Ole H. | Vorisek, Jerry J. |
| McDanield, Laren A. | Wielde, John A. |

*Bachelor of Electrical Engineering*

| | |
|---|---|
| Ackermann, Robert W. | Johnson, Sheldon F. |
| Anderson, Elwood C. | Klammer, Kalmer K. |
| Barnes, James C. | Koerner, Allen M. |
| Benesovitz, Abe | Kotchevar, Joseph F. |
| Braaten, Arthur M. | Kriechbaum, John P. |
| Brown, Glendon C. | Krieger, Keith M. |
| Burris, Arthur P. | Kritzer, Louis W. |
| Christopherson, Arnold J. | Larson, Seymour R. |
| Clousing, Lawrence A. | Lende, Willard H. |
| Compton, Milton E. | Lee, Alfred H. |
| Cook, J. Marvin | McCrea, John A. |
| Cooper, Jack I. | *McIntire, Elmer E. |
| Corliss, Charles V. | Neill, Clarence L. |
| Dahl, Paul E. | Nogueria, Frederico P. |
| Elmburg, John C. W. | Ohman, Leo S. |
| Engquist, Emil B. | Peterson, Randall J. |
| Fisher, George L. | Peterson, Valgar N. |
| Fogelholm, Edward G. | Riddell, Donald J. |
| Frankovich, John J. | Schvone, Anthony P. |
| Fredrickson, Edwin W. | Schliep, Carl J. |
| Froberg, Harold E. | Seeger, Franklin H. |
| Furber, Richard D. | Sharpless, William M. |
| Grimm, Raymond E. | Sheire, James B. |
| Gustafson, Thor A. | Smeby, Lynne C. |
| Hamilton, Sam R. | Soderholm, Lauren V. |
| Harwick, Henry C. | Stevens, Donald T. |
| Hawkins, George C. | Stevens, Bruce E. |
| Heywood, George L. | Stuart, Donald M. |
| Holt, Gunnard T. | Swanson, Carl E. |
| Holt, Leo G. | Sweeney, Frank C. |
| Hoover, Lloyd H. | Thelin, Ruben E. |
| Jarchow, Theodore L. | Towey, James M. |
| Johnson, Douglas O. | Young, Clifford L. |

*Bachelor of Mechanical Engineering*

| | |
|---|---|
| Angell, Glenn H. | Knutson, Melvin I. |
| Arko, Frank W. | Kusnerek, Clement J. |
| Barthelemy, Carl R. | Larson, Werner L. |
| Blackmore, Frank E. | Libby, Calvin R. |
| Blackshaw, Joe L. | Lundquist, Wilton G. C. |
| Bowers, Raymond | McGladrey, Lyle L. |
| Boyce, John | Mayhugh, Benjamin F. |
| Burke, James J. | Miller, Marvel P. |
| Dunning, Robert M. | Nelson, Arthur |
| Elliott, Merle B. | Osrowske, Arthur B. |
| Fritzberg, L. Hilding | Pettersen, Wilber E. |
| Gustafson, Hugo F. | Roberts, Henry M. |
| Hathaway, Herbert F. | Robertson, Haney M. |
| Hemenway, Edward L., Jr. | Spotts, Herbert J. |
| | Von Stocker, Selmer G. |
| Japs, Wilbur H. | 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)

## 1929

*Bachelor of Architecture*

| | |
|---|---|
| Bayliss, Dudley C. | Melzian, Milton W. |
| Ben-Ora, Samuel | Nelson, Erling W. |
| Hakenjos, Frederick M. | Nelson, Lyle |
| Hovik, Lawrence E. | Redmond, Fabian |
| Juran, Nathan | Santo, Louis |
| Leach, Stowell D. | Shiffett, Glynne W. |

*Bachelor of Architectural Engineering*

| | |
|---|---|
| Amundson, Leland R. | Hansen, Oliver S. |
| Anway, Fred L. | Johnson, Laurence E. |
| Berzelius, Carl E. | Kline, Marvin L. |
| Cramsie, Kenneth J. | Poss, John A. |
| Dutcher, Lloyd L. | Schilken, Donald R. |
| Fergestad, Marvin L. | Youatt, Glen B. |

*Bachelor of Interior Architecture*

Bradbury, Margaret B.
Breding, Lucene A.
Carter, Ruth
Grahek, Rosabelle
Lieb, Janet
Undine, Eugene A.
West, Jane

*Bachelor of Civil Engineering*

Alderson, Donald A.
Anderson, Frederick S.
Anderson, Irving E.
Anderson, Walter W.
Bernick, Leslie L.
Borne, Floyd Orville
Burch, Cecil J.
Eck, Melvin C.
Eggen, Karl M.
Erickson, David W.
Eyberg, Carl J.
Fredrickson, Fred C.
Grant, John W.
Gunnarson, Jon
Hanson, James B.
Hartigan, James J.
Heath, Delbert W.
Helseth, Paul A.
Hinderman, Winfred
Jenson, Theodore B.
Kingston, Paul S.
Lohn, Robert N.
McCauley, John S.
Melin, Kenneth R.
Oustad, Carl B.
Post, Edward
Rykken, Nordahl T.
Schaller, Louis M.
Shoemaker, Douglas H.
Waits, J. Grant
Wallin, Stanton E.
Zeuthen, Victor E.

*Bachelor of Electrical Engineering*

Abrahamson, Arthur L.
Abrahamson, LeRoy M.
Anderson, Arnold O.
Anderson, Merle W.
Bailey, John T.
Bierwagen, Rudolph W.
Bohrer, Donald M.
Borchardt, Lester F.
Borden, John C.
Brauch, Harold N.
Braum, Cyril M.
Briggs, Maynard R.
Cahn, Harold
Clark, Charles J.
Cutliffe, Wendell W.
DeVoy, William T.
Dybvig, Edwin S.
Edey, Francis E.
Fisher, Addison M.
Fox, C. Clair
Franks, George E.
Freeman, Raymond C.
Gill, Roscoe L.
Gille, Willis H.
Ginnaty, J. Robert
Goodner, Theodore C.
Gran, Conrad L.
Granbois, Kenneth J.
Gray, Wesley
Halverson, Vernon E.
Harris, Gordon C.
Healey, Joseph M.
Heidmann, Karl R.
Holmstrom, George
Jacobson, Carl Arnold
Johnston, Clinton J.
Korba, Anton A.
Krueger, Walter R.
Kuefler, Edward L.
Larson, Harold Oscar
Larson, Maurice C.
Liu, Maoling
Locklin, Robert B.
London, William
McIlvaine, Wm. D., Jr.
Mayer, Francis L.
Meeks, Edwin D.
Millunchick, John W.
Mueller, Robert
Newhouse, John C.
Nissenson, Phineas
Finnell, Thomas C.
Oman, Lloyd L.
Owens, Remus R.
Perotti, John J.
Raney, Donald G.
Russ. Lloyd A.
Saxhaug, Erling B.
Saxon, Paul M.
Specht, James E.
Stark, John X.
Steiner, Edmund F.
Suhr, Frederick W.
Vartdal, Victor K.
Vigness, Carl I.
Warneke, Roman C.
Williams, W. Glenn

*Bachelor of Mechanical Engineering*

Baldock, Frederick C.
Brewer, Carlos W.
Bruess, Edward C.
Cederstrom, Curtiss
Cherne, Realto
Deschner, Richard E.
Dey, Philip S.
Doepke, Christoph
Fedders, Melvin P.
Felthouse, Donald G.
Foss, Arbie
Freeman, Frank S.
Hanson, Manford P.
Heath, Owen M.
Heyer, Robert H.
Hoffman, Walwin H.
Ives, Kenneth S.
Johnson, Roy M.
Kuempel, Leon L.
Leegard, Clifford
Lockhart, Harold A.
Matzke, Walter W.
Moisesku, William
Nelson, Chester L.
Nickey, William E.
Norley, William H.
Peterson, Roy C.
Pfeifer, Otto J., Jr.
Read, Leland B.
Reed, Gordon
Reutiman, F. Rudolph
Rollin, Vern G.
Rowell, Lester J.
Sanders, Paul
Shannon, Harold R.
Sinnott, Irvine G.
Skanse, C. Theodore
Smilow, Leo
Smith, Rolf M.
Swanstrom, Carl Wm.
Tanner, Elo C.
TenBrook, Charles S.
Tiller, Louin
Watland, Maynard B.
Young, Donald

ADVANCED DEGREES

*Master of Science in Civil Engineering*

Sandberg, Clifford Helmer (B. S. in C. E. 1927)
Swanberg, John Howard (B. S. in C. E. 1925)

*Master of Science in Electrical Engineering*

Edgar, Robert Ferguson (B. S. in E. E. 1927)
Pregel, Alexander Julius (B. S. in E. E. 1928, Robert College, Constantinople)

*Master of Science in Mechanical Engineering*

Carlson, Clifton Conrad (B. S. in M. E. 1927)
Schermerhorn, James Roy (B. S. in M. E. 1926)
Decanay, Leno P. (B. S. in M. E. 1927)

*Mechanical Engineer*

Acker, Sidney (B. S. in M. E. 1923)

**1930**

*Bachelor of Aeronautical Engineering*

Dawson, Ivan Richard
Kernkamp, Lloyd F.
Larson, Karl O.
Rodert, Lewis August
Wang, Clarence

*Bachelor of Agricultural Engineering*

Colby, Bruce Roland
Colby, Byrnon Charles

*Bachelor of Architecture*

Brunet, James Abelardo
Crimmins, John E.
Doneghy, William Van Cleve
Fridlund, Harold Wilfred
Hanson, Edward William
Melkus, Leonard A.
Peterson, Gerhard C.
Wallace, Bruce Vernelle
Wessel, Hans John
Woollett, William

*Bachelor of Architectural Engineering*

Christensen, Russell P.
Erickson, Vernon George
Hansen, Tom W.
Johnson, Elmer Vincent
Jones, Noel Wynn
Knuth, Lloyd J.
Lindberg, Arthur F.
McNerney, George W.
Mullen, Francis E.
Noble, Theodore G.
Peterson, Floyd Delner
Petrick, Edward Donovan
Schradle, Juston E.
Steinberg, Israel H.
Thouren, Earl H.

*Bachelor of Interior Architecture*

Carlson, Loraine Alice
Eckman, Adelaide Margaret
Edwards, Norma E.
Hupp, Eleanor Katherine
Mailand, Marjorie Jane
Thian, Helen Marguerite
Wood, Inez Caroline

*Bachelor of Civil Engineering*

Antilla, George W.
Anderson, Rex Smith
Campbell, Vernon R.
Cheney, Russell S.
Chloupek, William V.
Clausen, Harold Luther
Crippen, Curtiss E.
Dimmitt, Bruce Stevens
Dominick, Earl H.
Hertel, Raymond Ernest
Hill, Erwin George
Johnson, Arthur B.
Kab, Benjamin J.
Kocian, Charles J.
Lieske, Harold William
Louk, Frank
Markus, Harry
Meffert, George Henry
Ralphe, Wendell William
Sandler, Theodore T.
Shellenbarger, Lyell R.
Skidmore, John Gardner
Sandness, Erling
Snodgrass, George F.
Weber, Eugene William
Wieseke, Reuben Carl
Zeese, Robert Kenneth

*Bachelor of Electrical Engineering*

Allison, Ralph Edward
Bailey, James Gilbert
Bayers, Donald Ries
Berner, John August
Braga, Felix John
Brown, Homer
Bruncke, Harry Paul
Bugenstein, Arthur A.
Campbell, Robert Leroy
Carsberg, Edgar C.
Chalek, Isadore
Comstock, Roy Herman
Coryell, Harry Bahn
Cotton, Richard John
Diedrich, Erwin H.
Edgell, Earnest Ensign
Effertz, Orman George
Elmquist, Melvin Leslie
Elmstrom, Raymond E.
Emlein, Harold
Englund, Raymond V.
Everett, Erwin Burgess
Ewald, Earl
Ewy, Albert
Farel, Gordon Marcellus
Fenton, Ransford W.
Field, William John
Finch, James Boss, Jr.
Fire, Vladimir
Fitzgerald, William G.
French, Edwin Charles
Friis, Robert W.
Garrison, Millard M.
Gogins, John Fredrick
Grabert, Harmond T.
Green, Arthur Thomas
Hastad, C. Jerome
Hauge, Morris Jacobson
Heller, A. Robert
Hendrickson, Charles Theodore
Jacobs, William Albert
Johnson, Edward LeRoy
Johnson, Floyd Melvin
Johnson, Marvin O. C.
Kallio, Wilho
Kaplan, Donald J.
Karageorges, George P.
Kendall, Donald Buswell
Kloski, Leonard A.
Knauss, Edison Alton V.
Knudson, Manches Edward
Langenberg, George Willis
Lehnert, Walter E.
Lethert, Carl William
Lindfors, Onni
Madden, John Sidney
Mears, Leon A.
Merriman, John Herring
Mielke, Warren C.
Norman, Vernon R.
Nygaard, Herman
Painter, William Henry
Pawlak, Frank John
Pehrson, Elmore Leroy
Punkari, Helgi V.
Roe, John Huntington
Roiko, Wilho
Rollins, Milo F.
Rudman, Mirko Joseph
Rudser, Melnor Clarence
Shortley, George H., Jr.
Siebens, Joseph Vincent
Sommermeyer, Karl H.
Soufal, Roman N.
Sparrow, Hubert T.
Spicola, James A.
Stewart, John P.
Stowe, George Edward
Swanson, Clarence
Thompson, William F.
Viebahn, William W.
Wald, Reuben E.
Wall, Cyril T.
Wang, Harold Sigurd
Warren, Robert Elliott
Warrington, J. Lamont
Warrington, William Gerald
Westin, Lloyd Judson
Wherland, Fred C.
Willson, Edwin A.

*Bachelor of Mechanical Engineering*

Barstow, William Frank
Baskerville, Ralph James
Bauer, Albert Edward
Conner, Henry F.
Conrad, Gordon

Danielson, Ellsworth Henry
Eckley, William Arthur
Ervin, Wilbur Berry, Jr.
Ewald, William
Ford, James Morrison, Jr.
Guppy, Richard Hendon S.
Hall, John Robert
Hanson, Leslie Paul
Hawkinson, Conroe F.
Johnson, Ellwood Leslie
Kojola, Hugo Viljo
Lee, William Brooke
Lilja, Oscar Luther
Marek, Glenn
Martenis, William W.
Northfield, Glenn H.
O'Brian, Maurice
Pappenfus, Clarence M.
Petrok, Bernard R.
Reichow, William A.
Ringer, Adolph George
Schwager, Oliver I.
Sheppard, Raymond
Tanglin, Ernest S.

ADVANCED DEGREES

*Master of Science in Civil Engineering*

Schroefer, George John (B. S. CE 1928)

*Master of Science in Architecture*

Undine, Eugene Arvid (B. of Int. Arch. 1929)

*Civil Engineer*

Velz, Clarence J. (B. S. CE 1924)

*Electrical Engineer*

Nelson, Carl C. (B. S. EE 1925, M. S. EE 1926)
Helwig, William F. (B. S. EE 1923, M. S. EE 1927 (Texas)
Peterson, Lewis S. (B. S. EE '25, M. S. E.E. '30)

**1931**

*Bachelor of Aeronautical Engineering*

Bowker, Walter G.
Brouilette, Theodore R.
Cunningham, Owen E.
Hearn, Charles A.
Hill, Ralph W.
Jewett, Robert H.
Jordan, Richard C.
Mayhugh, Benjamin F.
Pauli, Julius A.
Patterson, Donald M.
Pittelkow, Henry B.
Wettels, Albert J.
Werner, Alfred J.

*Bachelor of Agricultural Engineering*

Whiting, Laurence M.

*Bachelor of Architecture*

Anderson, LeRoy O.
Barber, Edward W.
Bergstedt, Milton V.
Bestic, Gordon F.
Bingham, Erwin W.
Cone, Earle R.
Gorman, Francis V.
Gray, Eugene M.
Halverson, Lyell C.
Hunner, John C.
McMahon, John S.
Malakowsky, Irwin R.
Newton, Kenneth H.
Nichols, Loren D.
Olsen, Clarence J.
Waechter, Raymond C.
Woo, Howard F.

*Bachelor of Architectural Engineering*

Bolline, Flavio C.
Brightbill, Linwood J.
Dovolis, James J.
Dunn, James W.
Erickson, Vernon G.
Harvey, Howard G.
Hoglund, Milton L.
Hubbard, Frank R., Jr.
Laub, George R.
Levine, H. Lynn
Monthey, Arthur E.
McHugh, James L.
Morrison, John A.
Pass, Melvin K.
Pedersen, William E.
Swanstrom, Alfred E.
Vercoe, Walter B.
Webster, Marvin J.
Witcher, Dean L.

*Bachelor of Civil Engineering*

Anderson, Donald N.
Anderson, Gordon S.
Anderson, Lester R.
Beadie, William M.
Beschenbossel, Harlo P.
Campbell, Ralph L.
Cowan, Cedric L.
Dartt, Harvey S.
Dunshee, Donald T.
Ekern, W. Stanley
Fahy, Francis M.
Farin, Sheridan E.
Felt, Earl J.
Fryhofer, Willard W.
Griggs, Mylre E.
Hanlon, Edward B.
Hella, Udert W.
Holtan, Raymond N.
Jennings, Gordon J.
Johnson, Wendell E.
Johnson, William Stuart
Knutson, Otto N.
Krohn, Henry J.
Krema, John H.
Kuhfeld, Frank W.
Laska, Frank V.
Larkin, Giles W.
Larson, Carl M.
Latvala, Aksel A.
McGhie, Kenneth M.
McMillan, Godfrey H.
Merzweiler, John M.
Mohr, Daniel F.
Molstad, Arnold R.
Olson, Roy W.
Porter, Earl L. F.
Ramsdell, Robert C.
Roscoe, Orvel L.
Schoettler, James L.
Schumacher, Maurice J.
Shepard, Lewis S.
Snell, Leonard J.
Sonnen, Charles G.
Sprungman, Ralph H.
Staffeld, Paul R.
Stoebe, Rolland W.
Swanson, John A.
Udd, Kermit W.
Watkins, Stanley S.

*Bachelor of Electrical Engineering*

Ackerman, C. Julian
Agather, Martin A.
Anderla, Joseph T.
Anderson, Leslie A.
Aune, Albert W.
Bauck, Leland H.
Bemis, Roy I.
Biltz, Franic J.
Bowers, Gordon G.
Buchak, Kirk
Cady, Richard C.
Christoferson, Everett W.

Cope, Dana S.
Cunningham, Robert F.
Darin, Roy L.
Dittman, Arthur D.
Doleman, George H.
Eggers, Evrett B., B.A.
Evans, Earl J.
Finch, Edward H.
Furber, Stanley L.
Goffstein, Albert A.
Grover, Roy L.
Hanson, Rudolph
Harmer, Harland D.
Hedke, Hellmuth A. W.
Hopkins, Albert F., Jr.
Hoskin, Graydon J.
Hustrulid, Andrew
Johnson, George V.
Johnston, Dorrance H.
Jones, Richard E.
Kanne, Donald W.
Kinsell, William L.
Kochevar, John S.
Lackrie, William J.
Lee, Irvin H.
Lorentzen, Carl C.
McNally, Irvin L.
Mangskau, Hugh E.
Markson, Paul A.
Marofsky, Henry J.
Maynard, Midas J.
Moe, Harold O.
Norgorden, Oscar
Olin, Stanley C.
Palmer, Harry A.
Pokorney, Harold F.
Quanrud, O. Gerhard
Reinbold, Robert E.
Rice, Robert E.
Rivkin, Solomon M.
Rovelsky, Leon A.
Sedgwick, Harvey J.
Skovholt, Joseph W.
Small, Gordon J.
Smykal, Frank J.
Soules, Webster F.
Staff, Clarence E.
Swendson, Lyman G.
Swennes, Telford G.
Taylor, Wesley D.
Thorson, Harry L.
Trimble, Myrl A.
Vouk, Frank K.
Walker, Basil G.
Weichselbaum, John F.
Weiner, Phillip J.
Wiprud, Roy B.

*Bachelor of Mechanical Engineering*

Anderson, Olaf J.
Bailey, Charles N.
Bjorklund, Edward E.
Boucher, Charles J.
Brakke, Hubert E.
Clysdale, Edward G.
*Cooley, Kenneth J.
*Edman, John H.
Giese, Howard D.
Grant, Irving G.
Hayden, Richard E.
Honey, Paul K.
Jordre, William S.
Kindseth, Harold V.
Kullberg, Ray E.
LaChapelle, Robert L.
Larsen, Stanley J.
McNeil, Lawrence L.
Myers, Robert M.
Nichols, Freeman A.
Nordeen, Harold E.
Olson, Melvin L.
Olson, Morris T.
Orth, Robert W.
Sawyer, Thomas P.
Thayer, Russell M.
Toogood, Loren S.
Watson, Henry Duncan
Whaley, Frank J.
Wiggins, Oswald J.

*Bachelor of Interior Architecture*

Betlach, Elvira J.
Espeland, Bertha O.
Hulett, Susan B.
Johnson, Beatrice A.
McVoy, Margaret
Russell, Evelyn V.
Sutton, Theodora M.

ADVANCED DEGREES

*Master of Science in Architecture*

Heath, Donald C. (B. S. Arch. 1916)

*Master of Science in Civil Engineering*

Lohn, Robert N. (B. C. E. 1929)
Rykken, Nordahl T. (B. C. E. 1929)

*Master of Science in Electrical Engineering*

McIlvaine, Wm. D., Jr. (B. E. E. 1929)
Vigness, Carl I. (B. E. E. 1929)

*Master of Science in Mechanical Engineering*

Corbett, Theodore R. (B. S. M. E. 1926)
Eckley, William A. (B. M. E. 1930)
Todd, Paul E. (B. S. M. E. 1917)
(B. S. E. E. 1922 Wash. State College)

# 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.
Juvrud, Ingvald O.
Merton, Howard V.
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.
Durham, Samuel W.
*Eckman, Lawrence R.
*Egge, Walter
Markus, Benjamin
Marr, Horace S.
Marshall, Olive W.
Owens, Jay C.
Rask, Olaf S.

*Bachelor of Science in Chemical Engineering*

Burningham, Foster A. (Ch. E. 1918)
Domovsky, Aaron
Higburg, William
Kuentzel, Ward E.
Luft, Oscar W.
Strong, Frank D.
Washburn, Frederick M.
Widell, Gideon

*Chemical Engineer*

Bell, Alexander D. (B. S. 1916)

*Master of Science in Chemistry*

Barrows, Vera (B. A. 1906)
Cade, Arthur R.
(B. S. 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
Kesselman, Leo
Nelson, Harry G.
Pan, Wen Ping

*Bachelor of Science in Chemical Engineering*

Donauer, Max (Ch. E. 1925)
Hogness, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 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.
Brooks, Leslie C.
Engstrom, Leslie G.
Heck, Frank J.
Thorson, Stuart J.

*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.
Epstein, Hymen
Kryger, Edward R.
Nygard, Edwin M.
Riley, Philip J.
(M. S. 1924)
Seymour, Merrill W.
Westerberg, Carl G.

*Bachelor of Science in Chemical Engineering*

Aronovsky. Samuel I. (Ch. E. 1922)
Boxell, Morris L.
Cornell, Reuben W. (Ch. E. 1922)
Lee, Melville R. (Ch. E. 1922)
Leerskov, Gerhard W.
Nicholson, Harry G.
Peterson, Marshall A. (Ch. E. 1922)
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)
Halverson, Halvor O. (B. S. 1922)
Langseth, Axel O. (B. S. 1922)
Morin, William T. (B. S. 1922)
Stone, Leslie F. (B. S. 1922, Ph.D. 1927)
Wyman, LeRoy L. (B. S. 1922)

*Master of Science in Chemistry*

Anderson, Winslow S. (B. S. 1921, Bates College)
Bakken, Adolph C. (B. A. 1919, St. Olaf)
Pagel, Herbert A. (B. A. 1922)

*Bachelor of Science in Chemical Engineering*

Ernst, Robert C. (B. S. 1921, N. C. State College)
Kester, Ernest B. (B. A. 1922)

*Doctor of Philosophy*

Levine, Arthur (B. A. 1916, Augustana College)

**1924**

*Bachelor of Science in Chemistry*

Fredrickson, Edna M.
Ludwig, Llewellyn G.
Humphrey, Gertrude J.

*Bachelor of Science in Chemical Engineering*

Bache, Edmund
Dahlen, Miles A.
Fuhrman, Alvin O.
Glenn, Harry W.
Krantz, Rudolph W. (B. A. 1923, M. S. 1925)
Lavine, Irvin
Luft, Hans L. (M. S. 1924)
Paul, Karl F.
Roque, Feliciano T.
Zima, Albert G.

*Master of Science in Chemistry*

Bauer, Esther E. (B. A. 1921)
Darling, Stephen F. (B. S. 1922)
Dobrovolny, Frank J. (B. A. 1920, Dakota Wesleyan)
Ellestad, Reuben B. (B. S. 1922)
Elmquist, Ruth E. (B. A. 1921)
Riley, Philip J. (B. S. 1921)

*Master of Science in Chemical Engineering*

Eck, Lester J. (B. S. 1923)
Hartkemeier, Leonard (B. S. 1921, Louisville)
Luft, Hans L. (B. S. 1924)
Nelson, Ernest W. (B. A. 1920)
Paulson, Paul M. (B. S. 1923)
Rademacher, Richard L. (B. S. 1923)
Sorenson, Ben E. (B. S. 1923, Ph. D. 1927)
Thordarson, William (B. S. 1923)
White, Robert H. (B. S. 1923)

*Doctor of Philosophy*

Fuson, Reynold C. (B. A. 1920, Montana, M. A. 1921, Calif.)
Kohlhase, Arthur H. (B. S. 1919, Hamline, M. S. 1921)
Kracek, Frank C. (B. S. 1920)
Lauer, Walter M. (B. A. 1913, Ursinus College, M. S. 1917)
Sarver, Landon E. (B. A. 1915, Randolph Macon, M. A. 1919, Lafayette)
Stoppel, Arthur E. (B. S. 1920, Ch. E. 1921)
Weber, Ludwig J. (B. S. 1920, Ch. E. 1921)

**1925**

*Bachelor of Science in Chemistry*

Anderson, Alvin P.
Ayers, Ellsworth B.
Brinker, Howard C.
Galvez, Nicolas L.
Gillman, Hyam
Hamm, Homer A.
Vievering, William A.

*Bachelor of Science in Chemical Engineering*

Bekkedahl, Norman P.
Coult, Lyman H.
Covell, Paul L.
Edmunds, Alvin M.
Jewett, Ernest E. (M. S. 1926)
Johnson, Lester L. (M. S. 1927)
Johnston, Charles L.
McKee, John B. (M. S. 1926)
Reiter, Alfred A.
Scandling, Joseph E.
Sprung, Murray M.
Stier, Ruth I. (Mrs. Cecil Mayo)
Zeidlik, William J. (M. S. 1926)

*Chemical Engineer*

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.
Dysterheft, George A.
Johnson, Waldo C.
Thompson, Warren L.
Weetman, Bruce

*Bachelor of Science in Chemical Engineering*

Bunger, Harold A.
Haugsrud, Parmalee S.
Jerabek, Henry S.
Kobe, Kenneth A.
Kugler, Joseph H.
Lewenstein, Abraham
Murray, Robert
Reiter, Alfred A. (M. S. 1926)
Rogers, Marvin
Schlafge, William H. (M. S. 1927)
Shirk, Loren H. (M. S. 1926)
Smith, Allen S.
Sverdrup, Edward F. (M. S. 1927)
Tronson, John L.
Rauen, Theodore
Jordan, Wallace E.

*Master of Science in Chemical Engineering*

Jewett, Ernest E. (B. S. 1925)
Kameda, Tohru (1925, Tokio Technical School)
McKee, John B. (B. S. 1925)
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.
Dumke, Walter H.
Lux, Lester

*Bachelor of Science in Chemical Engineering*

Arnold, Jerome H.
Beal, John L.
Bercovitz, Henry
Cornell, L. Wallace
Elston, Arthur A.
Gerlicher, Harold W.
Holst, James E.
Languth, Karl H.
Maehl, Kenneth A.
Moffat, Harold A.
Murray, Robert C.
Ohlweiler, William
Wheeler, Roger B.

*Master of Science in Chemistry*

Kilburn, Elsie I. (B. A. 1924)
Lampert, Kenneth C. (B. S. '25)
Lohman, Anne L. (B. A. 1922)
Wernlund, Christian J. (Ph. B. 1913, Hamline; M. S. 1916, Northwestern)
Willman, August (B. A. Rude College)

*Master of Science in Chemical Engineering*

Johnson, Lester L. (B. S. '25)
McMillen, Elliot L. (B S. 1923)
Schlafge, William H. (B. S. '26, M. S. '27)
Sverdrup, Edward F. (B. S. '26)

*Doctor of Philosophy*

Crawford, H. Marjorie (B. A. '20, Miami; M. S. '22, Iowa)
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 Chemistry*

Blosjo, Herbert Helmer
Goldberg, Will Mordecai
Hansen, Theodore Bruce
Hargrove, Lorin Donald
Knutson, Reuben W.
Robinson, Helen M.
Silverman, Reuben
Sandell, Ernest B.
Wells, Percy Albert

*Bachelor of Chemical Engineering*

Kurtz, Kerwin K.
Fawcett, Robert B.
Foker, Leslie Warren
Gehrenbeck, Gilbert B.
Gerlicher, Robert A.
Hella, Roy Paul
Jallings, Kenneth R.
Merrill, Grant S.
Seestrom, Hjalmer E.
Stodola, Frank Harold
Swenson, George W.
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)

**1929**

*Bachelor of Chemical Engineering*

Baker, Lawrence G.
Butler, Clifford Thomas
Clark, Carroll
Draper, Howard Clinton
Eaton, Wentworth Ch.
Erickson, Gust Erick
Fuller, Donald Leask
Glaser, David Walter
Gordon, Moses
Heinemann, Gustave
Hill, Donald Paul
Hovde, Frederick L.
Kantor, Max
Langkammerer, Carl M.
Linden, Carlyle Maurice
Lyden, Arvid E.
McConnell, John R.
Micks, Kerwin
Mitchell, William James
Mohrenweiser, Elmer H.
Moore, Leonard P.
Nelson, Lawrence Wm.
Netherly, George P.
Otis, Lawrence Bradley
Parkin, Fremont Peter
Petry, Theodor Arthur
Rehfeld, Harold
Rolwes, Edward A.
Shabaker, Hubert A.
Shoup, Geo. L., Jr.
Straub, Wm. Sanford
Stromberg, Hans Bernhard Severin
Thompson, Boyd Alpha

*Bachelor of Chemistry*

Brick, Bayard R.
Ramsden, Allyn M.
Sperry, Wilbur
Roe, Charles P.
Shields, Charles Dohm
Wolk, Isadore

ADVANCED DEGREES

*Master of Science in Chemical Engineering*

Beal, John Linden (B. S. 1927)
Kurtz, Kurwin Kenton (B. S. in Ch. E. 1928)
Lauer, Byron E. (B. S. '27, Oregon State Ag. Col.)
Holst, James E. (B. S. '27, Univ. of Minn.)

*Doctor of Philosophy*

Aronovsky, Samuel I. (B. S. in Ch. E., '21, Ch. E. '22, Univ. of Minn.)
Marks, Barnard M. (B. S. '26, Ch. E. '27, Univ. of Mo.)

*Master of Science in Chemistry*

Lux, Albert R. (B. A. '26, Univ. of Minn.)
Sandell, Ernest B. (B. S. '28, Univ. of Minn.)

**1930**

*Bachelor of Chemical Engineering*

Adams, R. S.
Benson, D. G.
Beyer, F. C.
Buehl, W. M.
Hammerquist, W. L.
Higgins, G. R.
Joyce, T. R.
Kay, W. C.
Levy, M. W.
Lundquist, J. T.
Miller, R.
Miller, Standish
Pass, Sigmund
Peterson, E. V.
Sandelin, R. W.
Schwenke, H. H.
Scott, L. D.
Selund, R. B.
Strain, B.
Taylor, D. M.
Tierney, H. J.
Windus, R. F.
Ziegler, R. D.

*Bachelor of Chemistry*

Meyette, C. L.
Pemble, A. S.
Schriver, F. J.
Lindstrom, O. R.
Stansby, M. E.

*Master of Science*

Clark, C. A.

*Master of Science in Chemical Engineering*

Eaton, W. C.
Heinemann, G.
McConnell, J. R.
Mick, K. L.
Petry, T. A.
Shabaker, H. A.
Van Duzee, E. M.

*Doctor of Philosophy*

Byrkit, G. D.
Ogg, E. F.
Ernst, R. C.
Bull, H. B.
Elmquist, R. E.
Kameda, T.
Lavine, Irvin

**1931**

*Bachelor of Chemical Engineering*

Allen, William W.
Bachmann, John H.
Beatty, Leonard E.
Becker, Leonard
Burrock, Richard J.
Elmquist, Ralph C.
Fritzberg, Edward L.
Garvey, Arthur H.
Gernes, Donald C.
Gislason, Carl F.
Heckman, Russell F.
Heidemann, Herbert E.
Hoffman, Everett J.
Hultin, Clifford T.
Jewett, Clifford L.
Jurgensen, Delbert F., Jr.
Kaplan, Ray
Kinzie, Roy W.
Laugen, Gordon E.
Lindert, Albert W.
Lindstrom, Clarence G.
Midtlien, Norten O.
Nelson, Floyd M.
Peck, Leander C.
Pemble, Carl A.
Peterson, William R.
Robins, Maurice L.
Rosenstein, Arnold
Schroeder, Victor H.
Stoep, Henry C.
Swenson, Oscar J.
Taras, Mike
Wakefield, Ray B.
Winding, Charles C.

*Bachelor of Chemistry*

Calverley, Charles E.
Duoos, Stener B.
Strout, James E.

*Master of Science*

Bayliss, Milward L.
Benson, Donald G.
Black, Richard G.
Chelberg, Raymond R.
Eckles, Nylene E.
Lasby, Helen A.
Maynard, Julian L.
Roduta, Feliciano

*Master of Science in Chemical Engineering*

Adams, Robert S.
Mitchell, William J.
Scott, Leonard D.

*Doctor of Philosophy*

Blumer, Donald R.
Freche, Hertha R.
Kvalnes, Donovan E.
Lauer, Byron E.
McMillen, Elliot
Pearson, Elmer A.
Rosenblum, Charles
Ruth, Burrell F.
Truesdale, Edward C.
Yohe, Robert V.

# ALPHABETICAL DIRECTORY

## *College of Engineering and Architecture*

Alumni, help us keep these lists correct. In spite of our efforts we realize that there are errors and old and incorrect addresses. Those graduates whom we have not heard from have been listed with their addresses the same as last year. We would appreciate having corrections sent to the Dean's Office.

### ABBREVIATIONS

*Courses*

**Ae, Aeronautical Engineering; Ag, Agricultural Engineering; A, Architecture; AE, Architectural Engineering; ID, Interior Decoration; IA, Interior Architecture; C, Civil Engineering; E, Electrical Engineering; M, Mechanical Engineering; G, General Engineering; Ch, Chemistry; Ch E, Chemical Engineering.**

*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; ChE, Chemical Engineering; PhD, Doctor of Philosophy.**

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ADAMS, ELMER E. '06 C
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Realtor.

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Oakland, Calif.

AGATHER, MARTIN A. '31 E
Sauk Rapids, Minn.

AGETON, EDWIN O. '26 E
Stillwater, Minn.
Asst. Supt. Northern States Power.

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Supervisor, Bridges and Bldgs., N. P. Ry.

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409 Johnson St. N. E.

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St. Paul, Minn.
Tri-State Tel. and Telg. Co.
Trans. Inspr.

ALBRECHT, GEORGE M. '06 E
Albrecht & Freeman, Patent Attorneys
807 Mariner Tower, Milwaukee, Wis.

ALBRECHT, KARL J. '25 E
Washington, D. C.
Patent Attorney. U. S. Patent Office.

ALDERSON, ANTHONY D. '29 C
South Shore Dock Co., Marquette, Mich.

ALDRICH, LOUIS W. '23 C
Los Angeles, Calif., Bureau of Eng., Jr. Civil Engineer.

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417 New York Life Bldg., Minneapolis.

ALGREN, AXEL B. '25 M
3049 10th Ave. S., Minneapolis.
Instructor in Engineering at U. of M.

*ALLBEE, PIERCE '16 A

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Room 643, Schenectady, N. Y.
General Elec. Co.

ALLISON, RALPH E. '30 E.
Bell Telephone Laboratories,
New York City, N. Y.

ALRICK, BANNONA G. '06 C
4456 18th Ave. S., Minneapolis, Minn.
Asst. Engineer, C. A. P. Turner Co.

ALSOP, ERNEST B. '06 C
Boise, Idaho.
Morrison-Knudsen Co., Engr. and Supt.

ALTON, HERBERT D. '07 E
Spokane, Wash.
The Laidley Co., 918 Riverside Ave.

AMIDON, LEE L. '23 M
Morgantown, W. Va.
Instructor, Dept. Steam and Exp. Eng'g, W. Va. University.

AMIDON, ROGER '28 C
Marshall, Illinois.
Jr. Topographic Engineer, U. S. Geol. Survey, Washington, D. C.

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420 N. 8th St., Brainerd, Minn.
Eng. Dept., Northern Pacific R. R.

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New Post Office Bldg., Portland, Ore.
Engineer, Bureau of Public Roads.

ANDERSEN, EDWARD I. '17 M '19 ME
35 North View Park, Attica, N. Y.
Asst. Works Mgr., Westinghouse Elect. Co.

ANDERSON, ARNOLD O. '29 E
Pittsburgh, Pa.
Westinghouse Elect. Co.

ANDERSON, ARTHUR P. '25 E
Public Service Co. of Northern Ill.
101 Williams St.

ANDERSON, ARTHUR R. '12 E
1114 Mission St., San Francisco, Cal.
Lundstrom Hat Works, Salesman.

ANDERSON, CLIFFORD H. '26 C
Gen'l. Supt. Crown Iron Works Co.
1229 Tyler St. N. E., Minneapolis

ANDERSON, DONALD N. '31 C
Construction Work
W. P. Roscoe Co., Billings, Montana.

ANDERSON, EDWARD S. '21 E
Ft. William, Ont., Canada.
Great Lakes Paper Co., Ltd.

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Langford Electric Co.,
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Bureau of Standards, Washington, D. C.

ANDERSON, FAYETTE C. '24 E
Westfield, New Jersey.

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935 Sandy Blvd., Portland, Ore.
National Appliance Co. Manager.

ANDERSON, FRANK L. '16 E
Minneapolis, Minn.
Testing Department, Elec. Machinery and Manufacturing Co.

ANDERSON, FRED S. '29 C
Washington, D. C.
Asst. Eng., Interstate Commerce Commission, Bureau of Valuation.

ANDERSON, GEORGE T. '15 C
City Engineer, Chisholm, Minn.

ANDERSON, GORDON S. '31 C
Pipestone, Minn.
Minnesota State Highway Dept. Draftsman.

ANDERSON, HARVEY B. '12 C '13 CE
Hopkins, Minn.

ANDERSON, HELMER N. '20 M
220 E. 5th St., St. Paul, Minn.
Fairbanks-Morse & Co.,
Mgr. Diesel Engine Dept.

ANDERSON, HENRY A. '27 E
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2825 E. Hennepin Ave., Minneapolis, Minn.
Johnston Mfg. Co.

ANDERSON, IRVING E.
U. S. Geological Survey, Tucson, Ariz.

ANDERSON, JOHN G. '99 C
Minneapolis, Minn., M. St. P. & S. Ste. M. R. R., Asst. Engr., Structural Design.

ANDERSON, JOSEPH A. '24 M
Flint, Mich.
A. C. Spark Plug Co., Chief Inspector, Speedometers.

ANDERSON, JOSEPH W. '15 E

ANDERSON, LAWRENCE B. '27 A

ANDERSON, LEROY O. '31 A
Draftsman, Minn. State Highway Dept.

ANDERSON, LESLIE A. '31 E
Westbrook, Minn.

ANDERSON, LESTER R. '31 C
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ANDERSON, LOWELL W. '26 E
Schenectady, New York. General Electric Co.

ANDERSON, MARTIN E. '01 E
601-610 Interstate Trust Bldg.,
Denver, Colo.
c-o A. J. O'Brien, Patent Attorney.

ANDERSON, MATTHEW '24 E
N. S. Power Co., Special Const. Dept.,
308 Lincoln Bank Bldg., Minneapolis, Minn.
Cost Engineer.

ANDERSON, MERLE W. '29 E
15 S. 5th St., Minneapolis.
Electrical Engineer.
Northern States Power Co.

ANDERSON, MILTON J. '20 A
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c-o W. C. Agnew, Architect.
Draftsman.

ANDERSON, MILTON L. '21 A
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Architect, Nordstrom & Anderson.

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404 North Third Street, Montevideo, Minn.
Field Office Engineer, Construction Dept.
Minnesota Highway Dept.

ANDERSON, OLAF J. '31 M
Nashwauk, Minn., Box 555.

ANDERSON, OLE A. '93 M '08 ME
Edison High School, Minneapolis, Minn.
Instructor.

*ANDERSON, OLE J. '93 C

ANDERSON, OSCAR P. '10 E
Nela Park, Cleveland, Ohio
Incandescent Lamp Dept. of Gen. Elec. Co.

ANDERSON, OSCAR V. '10 E
Toronto, Ontario, Canada.
Duncan and Nelson,
Toronto Hydro Electric System.

ANDERSON, REX S. '30 C.
U. S. Bureau of Public Roads,
Washington, D. C.

ANDERSON, WALTER W. '29 C
701 Washington Bldg., Washington, D. C.
Supervising Architect's Office,
Asst. Structural Eng.

ANDERSON, WESLEY J. '26 M
1841 S. Euclid, Berwyn, Ill.

*ANDREWS, GEORGE C. '87 M

ANDREWS, GEORGE L. '05 M
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Draftsman, American Hoist and D. Co.

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Pres. Public Utilities Consolidated Corp.

ANGELL, GLENN H. '28 M
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ANTILLA, GEORGE W. '30 C.
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APPLEMAN, FRANK C. '24 E
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Engineer, Ill. Bell Telephone Co.

ARENSON, TIMOTHY G. '16 E

ARKO, FRANK W. '28 M
Chisholm, Minn.

ARMSTRONG, THOMAS S. '06 M

ARNESEN, HERBERT P. '11 C
Newport, Minn.
Toltz, King & Day, Builders Exch.
St. Paul, Minn. Office Engineer.

ARNESON, LLOYD O. '21 M
Bailey Meter Co., Cleveland, Ohio.
Engineer.

ARSTAD, LEONARD O. '24 E
420 3rd Ave. S., Minneapolis.
Northwestern Bell Tel. Co., Engineer.

ARZT, EMMANUEL A. '97 BS '99 E
211 5th St., Sioux City, Ia.
Electrical Contractor.

ASCHER, RAYMOND C. '23 M
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Republic Flow Meters Co., Sales Agent.

ASFALT, FILIP J. '27 E
Distribution Dept., Northern States Power Co.,
Minneapolis, Minn.

ASH, JAMES W. '08 C
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American Horticulture Co.
Landscape Arch.

ASHBAUGH, LEWIS E. '00 M '07 CE
1635 Court Place, Denver, Colo.
Consulting Engineer.

ASHWORTH, ROY H. '11 E
618 Kearns Bldg., Salt Lake City, Utah.
Utah Power and Light Co.

ASKE, IRVING E. '20 E
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Pres.-Gen'l. Mgr., Aske-Fuemer Co.

ASKEW, THOMAS A., JR. '16 C
Plainview, Minn.
Thomas Askew Co., General Merchandise Manager.

ASLAKSON, BAXTER M. '91 M
Drexel Arms Hotel, Chicago, Ill.

ASLAKSON, CARL I. '23 C
U. S. Coast & Geodetic Survey,
Perrytown, Texas.

ASLESON, HANS J. '10 C
Engineer and Contractor,
606 Wesley Temple Bldg., Minneapolis

*ATKINSON, WILLIAM B. '10 M

AULTFATHER, DAVID H. '22 E
Western Electric Co., Kearney, N. J.

AUNE, ALBERT WM. '31 E
Underwood, Minn.

AURE, ROY '22 M
St. Paul, Minn. N. P. Ry., General Office Bldg., Draftsman.

AUSTIN, PAUL D. '21 E
15 S. Fifth St., Minneapolis, Minn.
N. S. P. Co., Sales Dept.

AUXER, WILLIAM L. '25 C

*AVERY, HENRY B. '93 M '98 ME

*AVIS, S. L. '12 E '13 EE

AYSHFORD, LOREN C. '26 E
Chicago, Ill.
Western Electric Company.

BABCOCK, VERNON M. '23 E
14-230 General Motors Bldg.,
Detroit, Mich., General Motors Corp.

BACHELDER, WILLIAM H. '24 C
Exp. Eng. Building, Univ. of Minn.
Minn. Dept. of Highways.

BACHMANN, GRAYDON A. '23 M
4212 Tenth Avenue South,
Minneapolis, Minn.
Dist. Sales Mgr., Dry-Ice Corp.,
426 Washington Ave. N., Minneapolis.

BACHRACH, ALFRED '08 E
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General Elec. Co.

BACKSTROM, EMIL F. '24 A
10 N. Fulton St., Mt. Vernon, N. Y.

BACKSTROM, KENNETH A. '27 A
25 Pandfield Road W., Bronxville, N. Y.

BACKSTROM, RUSSELL E. '25 M
Engineering Specialist, Nat'l. Com. on Wood Utilization, Department of Commerce, Washington, D. C.

BACKSTROM, WILBURG A. '23 A

BAER, LOUIS E. '07 E
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BAILEY, CHARLES N. '31 M
Northern Pump Co., Minneapolis, Minn.

BAILEY, GEORGE R. '22 C
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BAILEY, JAMES G. '30 E.
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Senior, Arch. Eng., U. of M.

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Levy, M. W. '30 ChE
Lexau, Ole '28 C
Little, LeRoy C. '24 E
Lund, Earl H. '22 C, '23 CE
McBride, Russel S. '08 Ch
McQuillan, Raymond '11 E
Morey, Geo. W. '09 ChE
Morris, Geo. E., Jr. '27 C
Ofelt, George R. '27 E
O'Hanrahan, Edmond C. '20 G
Parker, Helen R. '25 ID
Peterson, Barney J. '12 G, '13 CE
Peterson, Clarence A. '08 E
Reed, Gordon '29 M
Robbins, Orison '03 C
Rydeen, James '28 C
Saxhaug, Ehrling B. '29 E
Smilow, Leo '29 M
Stevens, Don T. '28 E
Trask, Alfred S. '23 E
Trexler, Richard '27 M
Tuve, Merle A. '22 E
Zeese, Robert K. '30 C

### FLORIDA

FORT MYERS
Lushene, Joseph '25 C
JACKSONVILLE
Long, Fred W. '96 C, '98 CE
Mattison, Geo. C. 11 C
LAKELAND
Purdy, Irving '20 C
LAKE WALES
Morse, G. '93 A
Morse, George A. '13 C, '14 CE
LAKWORTH
Hoag, William R. '84 C, '88 CE
MIAMI BEACH
Laurence, Philip J. '15 C
Zimmerman, Arthur C. '23 C
ST. AUGUSTINE
Coe, Clarence S. '89 C
TAMPA
Hamilton, Jefferson M. '19 A
WINTER PARK
Anderson, Winslow S. '23 MS

### GEORGIA

ATLANTA
Buenger, H. A. '26 ChE
Chase, Arthur W. '93 E
BRUNSWICK
Reu, Albrecht H. '19 ChE
COLUMBUS
Andrus, Harry J. '22 C
FELDESTA
Rousseau, C. C. '24 M
SOCIAL CIRCLE
Amidon, Roger E. '28 C

## IDAHO

**Boise**
Alsop, Ernest B. '06 C
Morse, Guilford A. '15 ChE
**Lewiston**
Kjosness, Ingraham G. '03 M
**Moscow**
Melzian, Milton '29A
Stageberg, Oswald '26 A
**Wallace**
Baer, Louise '07 E

## ILLINOIS

**Alton**
Cosh, Richard A. '19 M
Klammer, K. '28 E
Taylor, Carl A. '10 Ch
**Aurora**
Brown, Homer L. '17 M
Cook, Lyle M. '27 M
Holmstein, R. D. '24 M
Montgomery, Ralph M. '24 M
Thompson, Clarence W. '25 C
Zeleny, Frank '98 M
**Berwyn**
Anderson, Wesley J. '26 M
Bergman, Hilder '26 E
Eige, Elmer H. '23 M
Wiggins, John B. '23 E
**Champaign**
Mark, Max '25 C
Porter, Allen H. '08 Ch
**Chicago**
Appleman, Frank C. '24 E
Aslakson, Baxter M. '91 M
Ayshford, Loren C. '26 E
Bayless, Harry C. '99 M
Beeman, Harry J. '21 G
Bergquist, Edwin T. '24 C
Bernt, Hans E. '20 C
Bezek, Albert J. '27 E
Bohrer, D. M. '29 E
Bouquet, Otto T. '23 E
Braden, Rene A. '23 E, '25 MS
Brinker, Howard C. '25 Ch
Brody, Mace J. '24 C
Carlson, Richard E. '22 E
Carlson, Warren E. '24 E
Carman, W. J. '26 E
Cassidy, Walter J. '24 E
Childs, Morris P. '25 E
Colson, Lauren G. '21 E
Conner, Henry F. '30 M
Converse, Clovis M. '09 E
Cook, Lyle M. '27 M
Cook, Walter K. '22 C
Copeland, Floyd E. '23 M
Corliss, C. V. '28 E
Cornelius, Martin '06 E
Craig, Hamilton S. '25 C
Crosby, Milton E. '15 M, '16 ME
Curtis, Benjamin J. '13 C, '14 CE
Cutliffe, Wendell W. '29 E
Dahl, Merle G. '26 E
Dahlquist, Philip L. '10 C
Daniels, Elmer Anson '12 Ch
Danner, Jake '01 E
Deinema, George R. '26 E
Dixon, Donald K. '27 M
Donahue, S. '25 C
Drdla, Robert '26 C
Drost, Henry F. '22 E
DuBois, John H. '27 E
Dunlap, Lemuel J. '17 E
Eckenbeck, E. E. '17 E
Eddy, Lynne W. '07 E
Edelman, Philip '16 E, '17 EE
Edwards, Norma E. '30 IA
Elliott, Merle B. '28 M
Engler, Myer '27 C
Engquist, Emil '28 E
Ewald, W. '30 M
Farel, Gordon M. '30 E
Fisher, A. M. '29 E
Fitts, Joel A. '09 E
Fleming, Laurence T. '10 M
Fox, C. C. '29 E
Frank, Carl '28 C
Frankovich, John J. '28 E
Frear, J. B. '10 M
Froberg, Harold '28 E
Galanter, Samuel S. '25 C
Getchell, Earl '26 E
Gilchrist, Charles C. '98 E
Gillard, Herbert W. '24 C
Gould, Edward C. '26 C
Grow, Harry A. '03 C
Gutsche, Frank C. '10 ChE
Hagerman, O. S. '18 M
Hammond, Joseph A. '26 E
Hanke, Carl C. '20 C
Hart, Maurice W. '26 E
Harwick, Henry C. '28 E
Hawkins, Edward W. '24 A
Hayes, Harold '22 G
Healy, Joe M. '29 E
Hodnett, Ralph M. '11 C
Hogness, T. R. '18 ChE
Holmsten, Victor '22 M
Holt, Leo '28 E
Houston, Cecil C. '09 C
Howatt, John '04 E
Hubbell, Arthur C. '14 M, '15 ME
Huseby, Gisle E. '24 E
Johnson, Raymond A. '26 C
Jones, Richard W. '26 E
Juell, A. Barton '26 C
Juran, Joseph M. '24 E
Kater, Jozef J. '24 E
Kelsey, H. C. '22 M
Kern, Herbert A. '13 ChE
King, John E. '22 E
Kingston, Samuel P. '29 C
Kivley, Ray C. '18 M
Kleinfeld, Leonard S. '26 M
Klopsteg, Paul E. '11 G, '13 MA, '16 Ph.D.
Konstant, Nicholas '18 C
Krause, Fred E. '24 E
Kristy, George A. '09 E
Kriz, Joseph J. '12 C, '13 CE
Kruse, Orlin C. '20 E
Lambie, Horace '23 E
Lantz, R. S. '25 A
Larson, Emil L. '25 AE
Lazarus, Morris W. '23 C
Lee, M. R. '21 Ch, '22 ChE
Lende, Willard '28 E
Liddle, Ralph W. '21 G
Lieberman, Henry '23E
Linhoff, Carl H. '22 E
Little, Fred W. '27 M
Lonie, James '97 M
Lund, Clarence V. '26 C
Lynskey, Joseph P. '26 E
McConnell, Edmond S. '24 E
McCrea, John A. '28 E
McMillan, Franklin R. '05 C
Manuel, Earle V. '07 Ch
Martin, Edmund W. '12 Ch.E.
Mayeron, Ben '28 C
Messer, Harold D. '23 M
Miller, William S. E. '27 E
Moosbrugger, Frank J. '27 E
Morse, M. '25 Ch
Morris, John O. '88 M, '03 ME
Neill, C. L. '28 E
Nelson, Paul B. '26 E
Nelson, W. K. '13 Ch
Newbery, Lester W. '22 C
Northfield, G. H. '30 M
O'Brien, John E. '97 M
O'Brien, Thomas E. '25 C
Olson, Armin G. '22 E
Olson, Kenneth M. '25 C
Olson, Roy H. '23 E
Owens, Jay C. '17 Ch
Park, James I. '27 AE
Peterson, Albert E. '19 E
Peterson, Clarence R. '25 C
Pierson, Joe W. '19 E
Pohl, L. F. '27
Postma, John '25 E
Punkari, Helgi V. '30 E
Putnam, George W. '18 G
Rankin, Dean W. '25 AE
Reck, Robert C. '21 ChE
Rezab, John J. '07 E
Riekman, Herman W. '17 C
Rolwes, E. A. '29 ChE
Rosenberg, Rahil A. '24 A
Rosenbloom, Abraham '17 M
Rosenthal, Paul '22 C
Rowell, Lester J. '29 M
Ruemmele, A. E. '12 M, '13 ME
Russ, L. A. '29 E
Russell, Winfred W. '23 E
Sandberg, Clifford H. '26 C, '29 MS (CE)
Sausen, Bert R. '13 M
Sawyer, Emerson D. '10 C
Scholz, Edmond H. '27 E
Schroeder, Clarence A. '26 E
Schulze, Leroy E. '27 E
Schwartz, Marcel '22 ChE
Sear, Arthur W. '23 M
Selander, Karl W. '22E
Sheekman, Harvey Z. '24 E
Simons, W. W. '16 E
Smith, Verna G. '25 ID
Somero, Waino M. '24 C
Sorenson, John E. '22 E
Sperry, Leonard B. '05 M, '08 EE
Staehle, Gilbert C. '20 C, '22 MS
Sternberg, W. M. '08 Ch
Strate, Thomas H. '01 C
Sundblad, Everts W. '27 E
Swanson, Carl W. '29 M
Swenson, C. Q. '17 M, '20 ME
Swift, George E. '23 E
Taylor, Richard G. '25 E
Thompson, Everett '23 C
Thompson, Harry T. '15 E, '16 EE
Trcka, Benjamin C. '24 E
Umbehocker, Frank '21 M
Waby, Delton '23 M
Wang, Harold S. '30 E
Ward, Alvin C. '23 E
Washburn, F. M. '17 ChE
Weber, Hanard P. '24 E
Wehlitz, Hubert F. '27 E
Wheeler, R. B. '27 ChE
Whiteley, H. O. '27 E
Wills, David C. '23 E
Winkenwerder, E. E. '25 E
Wyly, Lawrence T. '20 G
Zuckman, G. J. '27 C
**Chicago Heights**
Nichols, Browning '10 M
**Cicero**
Pavek, William J. '19 M, '20 ME
**Crystal Lake**
Anderson, Arthur P. '25 EE
**Decatur**
Elwood, Daniel H. '23 E
**East St. Louis**
Schmidt, Rolland L. '25 C
**Elgin**
Johnson, Carl A. '11C
Johnsen, Kenneth A. '27 C
Sprehn, George H. '24 C
**Evanston**
Bailey, Geo. R. '22 C
Berghs, Charles J. '26 C
Borrowman, Geo. L. '05 AC
Clark, W. G. '12 M, '13 ME
Jensen, Otto L. '26 E
Kelly, Raymond R. '26 C
Maney, George A. '11 C
**Geneva**
Kapphahn, Ernest H. '19 G
**Glencoe**
Berghs, Clarence J. '26 E
**Great Lakes**
Meagher, J. E. '25 E
**Highland Park**
Pardee, Charles A. '12 E, '13 EE
**Homewood**
Sommerfeld, Adolph A. '10 C
Teberg, Ernest J. '16 E, '17 EE
**Joliet**
Davis, Charles A. '05 E
McCoy, Ira C. '11 E
Merritt, Alva W. '22 E
Peck, Lloyd '23 C
**Marshall**
Amidon, Roger '28 C
**Maywood**
Peoples, John S. '14 M
**Moline**
Boucher, C. J. '31 M
**Oak Park**
Cottingham, George, Jr. '15 C
Forsmark, Ulrik E. '26 E
Kelly, Raymond R. '26 C
Wicks, John '04 E
**Peoria**
Berquist, Philip L. '24 C
Kastner, Roy W. '27 C
Pearson, Einar O. '27 C
**Riverside**
Williams, Arthur H. '19 M
**Rock Island**
Franks, Geo. E. '29 E
**Savanna**
Cowan, C. L. '31 C
Crippen, C. '30 C
Helseth, P. A. '29 C
**Springfield**
Braga, Felix J. '30 E
Gard, Donald L. '28 C
Norelius, Emil F. '08 M
Peterson, Neander E. '22 C
**Urbana**
Bauer, Esther E. '24 MS
Bergquist, John E. '13 C
Dietrichson, Gerhard '10 Ch
**Villa Park**
Larson, Peter L. '24 C
**Waukegan**
Acomb, William E. '02 M
Gill, Roscoe L. '29 E
**Westmont**
Kuefler, E. L. '29 E
**Winnetka**
Bruce, G. Norman '23 ChE
**Wood River**
Anderson, Alvin P. '25 Ch

## INDIANA

**East Chicago**
Spotts, Herbert '28 M
**Evansville**
Cope, D. S. '31 E
Johnson, Roy M. '29 M
Olson, C. Milford '24 C
**Fort Wayne**
Ellis, Carl E. '25 E
Fisher, Geo. '28 E
Langenberg, George W. '30 E
Lee, Alfred H. '28 E
Soderholm, Lauren V. '28 E
Warneke, Roman '29 E
**Gary**
Cotthingham, William P. '11 C
Frederickson, Hubert M. '22 ChE
**Gas City**
Cash, R. A. '19 M
**Indiana Harbor**
Merten, Howard V. '14 Ch
**Indianapolis**
Abrahamson, Arthur L. '29 E
Higburg, Wm. '17 ChE
Kodola, Hugo V. '30 M
Prentice, Robert S. '08 E
Skytte, Ernest E. '10 E
Wagner, Adolph '98 E
**W. LaFayette**
Heyer, Robert H. '29 M
**South Bend**
McCrady, A. R. '24 C
Mehandru, Behari L. '24 M
Muessel, Robert W. '21 C
**Speedway**
O'Brian, Maurice '30 M
**Valparaiso**
Lauritzen, Carl W. '24 E
Kuentzel, E. W. '17 ChE
**Whiting**
Malmgren, Richard C. '25 E
Rogers, M. '26 ChE
Selund, Robert B. '30 ChE

## IOWA

**Algona**
Young, Clifford L. '28 E
**Ames**
Countryman, M. A. '25 E
Willis, Benjamin S. '17 E
**Cedar Rapids**
Blomquist, Hjalmar '07 C
Stanius, Godfrey '21 E
Triem, Ralph H. '20 E
**Cresco**
Laub, G. R. '13 AE
**Davenport**
Auxer, William L. '25 C
Lanpher, Murray N. '24 E
McEwen, Alexander D. '25 E
**Dayton**
Harris, Clayton '09 E
**Des Moines**
Ash, J. Wesley '08 C
Kingsley, Norman W. '20 E
Reeve, Howard E. '23 E
Rome, Robert C. '22 E
Wallfred, John E. '27 M
Zimmer, William A. '06 E
**Dubuque**
McCully, James P. '25 E
Madden, Francis '03 C
Peterson, Lloyd L. '24 C
**Humbolt**
Christen, Ray L. '26 E
**Independence**
Dunlap, Geo. M. '24 E
**Iowa City**
Nelson, Martin E. '24 C
**Iowa Falls**
Cribbs, H. E. '23 C
**Janesville**
Wild, Carl D. '15 C, '16 CE
**Marion**
Christianson, Hilmer B. '15 C

Marshalltown
Weatherill, Cedric '14 C, '15 CE
Mason City
Paulson, J. B. '27 C
Sioux City
Antilla, George W. '30 C
Arzt, Emmanuel A. '97 E, '99 EE
Donauer, Max '18 ChE
Kab, Benjamin J. '30 C
McNeill, Lyle D. '27 M
Snodgrass, George F. '30 C
Williams, Wilbur S. '09 M
Waterloo
Nordenson, Willard '26 M
Waverly
McMeekin, Glenn D. '21 G

## KANSAS

Atchison
Hastings, Clive '96 M
Baxter Springs
Bisek, Peter P. '14 E
Kansas City
Rodert, Lewis A. '30 Ae
Manhattan
Graham, Eugene C. '02 B
Pittsberg
Woodman, Howard H. '97 C

## KENTUCKY

Ashland
Porter, Ralph E. '13 ChE
Louisville
Ernst, Robert C. '23 ChE
King, Harvey '18 A
Smith, Allan S. '26 ChE

## LOUISIANA

Baton Rouge
Fieger, Ernest A. '20 ChE
Marreno
Fleming, Douglas R. '08 C
New Orleans
Hilgedick, W. C. '26 E
O'Donnell, L. '25 M

## MARYLAND

Annapolis
Winslow, Harry J. '25 E
Baltimore
Billau, Lewis S. '05 E
Granbois, Kenneth J. '29 E
Grant, James A. '07 C
Kester, E. B. '23 MS Ch
Louks, Roger B. '27 C
Seestrom, Hjalmer E. '28 ChE
Rask, Olaf S. '17 Ch
Takoma Park
Roepke, Otto B. '06 E

## MASSACHUSETTS

Amherst
Markuson, Miner J. '23 A
Boston
Beckjord, Walter C. '09 E
Berman, Florence C. '28 ID
Damberg, Rheuben P. '21A
Eaton, Paul F. '27 A
Emery, George C. '19 A
Engstrom, L. '28 C
Groat, Benjamin '08 LLB, '11 LLM, '01G
Paulsen, Thorwald '22 C
Reuter, Peter T. '21 M
Walker, Frank B. '97 C
Webster, Harry M. '15 E
Woodward, Herbert M. '90 M
Cambridge
Arnold, Jerome H. '27 ChE
Cone, E. R. '31 A
Darling, Stephen F. '22 Ch
Fuson, R. C. '24 PhD
Ludwig, L. G. '24 Ch
Plowman, George T. '92 A
Sternberg, W. M. '18 PhD
Chicopee Falls
Briggs, Maynard K. '29 E
Franklin
Tomlinson, L. C. '04 E
Lynn
Freeman, R. C. '29 E
Lilja, Oscar L. '30 M
Norwood
Korslund, Harry J. '20 A
Peabody
Morrow, Leon W. '16 Ch
Pittsfield
Cederstrom, C. M. '29 M
Goodwin, Victor E. '04 E

Springfield
Jones, Ivor Vaughan '15 C
Westin, L. J. '30 E
Walpole
Forssell, William O. '22 G
Winthrop
McVean, Norman S. '21 E

## MICHIGAN

Ann Arbor
Badger, W. L. '08 Ch
Benson, Mons '28 C
Dow, William G. '16 E, '17 EE
Hammett, R. W. '19 A
Jakkula, Arne A. '26 C, '27 MS (CE)
Orbeck, Martin J. '11 C
Battle Creek
Scott, L. B. '30 ChE
Dearborn
Hoppin, Glenn H. '08 E
Detroit
Ascher, Raymond C. '23 M
Babcock, Vernon M. '23 E
Baldock, Fred C. '29 M
Bjerre, F. I. '25 M
Brewster, William E. '12 E, '13 EE
Brooke, Harold L. '18 E
Elmquist, Melvin L. 30 E
Dale, Dallas W. '24 M
Dedic, Richard J. '24 C
Everett, Erwin B. '30 E
Grisson, Aubrey '25 AE
Gutsche, Edward J. '04 Ch
Hamilton, Herbert C. '97 ChE
Huntoon, Milton B. '99 E
Koehler, Edwin F. '24 M
Loye, Benjamin W. '06 M
Lundquist, Reuben A. '05 E
Malmstrom, Axel L. '17 E
Nelson, Elmer A. '23 C
Peterson, Garvin E. '25 C
Richardson, Ralph A. '27 M
Riddington, Fred W. '22 ChE
Rovelski, L. A. '31 E
Shepard, Donald D. '11 E
Souba, John I. '25 M
Staehle, Haswell E. '24 M
Tuttle, S. B. '24 M
Walker, Geo. W. '09 Ch
Webster, Cora Helen '23 Ch
Wennerlund, Elias K. '99 M
Wilk, Benjamin '13 C, '14 CE
Flint
Anderson, Joseph A. '24 M
Murray, John H. '17 M
Rhame, Paul W. '20 M
Shuirman, Gabe '21 E
Simms, Charles G. '24 M
Grand Rapids
Lyon, Glenn H. '20 A
Mahoney, William L. '13 E, '14 EE
Nelson, Edwin W. '25 C
Houghton
Reed, Henry R. '25 E, '27 MS (EE)
Swenson, G. W. '17 E, '21 EE
Ironwood
Holmberg, Abner W. '15 M, 16'ME
Sears, Dow I. '14 C
Jackson
Briggs, William G. '21 E
Volkenant, Geo. W. '27 E
Wilson, A. W. '22 E
Kalamazoo
Blodgett, Chas. L. '24 M
Laurium
Swanson, Philip C. '23 M
Marquette
Alderson, Anthony D. '29 C
Midland
Allan, W. W. '31 ChE
Edmunds, Alvin M. '25 ChE
Lundquist, J. T. '30 ChE
Otis, L. B. '29 ChE
Muskegon
Olsen, Arthur O. '10 C
Pontiac
Pike, Jay R. '26 M, '27 MS (ME)
South Haven
Smith, Sidney H. '11 C
Two Harbors
Holmstrom, George '29 E

## MINNESOTA

Aitken
Dungay, Herbert F. '25 C
Alberta
Schlattman, Edward C. '08 C

Albert Lea
Carlson, Chauncy M. '17 E
Dock, Chester '22 G
Larkin, Giles W. '31 C
Pless, Arnold '20 C
Sorenson, Russell L. '27 AE
Alexandria
McGhie, K. M. '31 CE
Watkins, S. S. '31 C
Annandale
Seegar, Franklin H. '28 E
Anoka
Haugsrud, S. P. '26 ChE
Reed, Arthur L. '06 C
Thurston, Harold H. '13 C, '14 CE
Atwater
Molin, Kenneth '29 C
Swenson, Charles A. '07 C
Austin
Dimmitt, B. S. '30 C
Mahachek, Ross '26 E
Bellingham
Strege, Henry '24 E
Belle Plaine
Groth, A. W. '28 E
Bemidji
Davison, Joseph H. '03 C
Brainerd
Anders, Milton '27 E
Beschenbossel, H. P. '31 C
Brakke, H. E. '31 M
Croswell, Leslie D. '26 C
Hendrickson, C. Edward '25 C
Jones, Harold W. '25 C
Breckenridge
Holmgren, Charles E. '09 M
Browerville
Bemis, R. I. '31 E
Butterfield
Roney, Donald '29 E
Cambridge
Bjorklund, E. E. '31 M
Carlton
Nickerson, Neal C. '18 C
Center City
Ringstrom, Geo. H. '27 E
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
Cloquet
Aronovsky, S. I. '22 ChE
Busch, J. S. '20 ChE
Carlson, Clifton C. '27 M
Glenn, Harry W. '24 ChE
Schlenk, H. '18 E
Stuart, Don N. '28 E
Cokato
Peterson, Richard M. '20 E
Cold Springs
Quinn, Ursula R. '25 C
(Mrs. H. N. McAndrews)
Coleraine
Battles, Leon E. '18 C
Downing, Frank E. '04 C
Comfrey
Carlson, Elner W. '27 C
Cromwell
Deegan, A. C. '26 C
Crookston
Englund, R. V. '30 E
Crosby
Wood, Victor R. '22 C
Delano
Brunkow, Herbert E. '12 ChE
Detroit Lakes
Chilton, Edw. G. '13 C, '14 CE
Duluth
Anderson, Milton J. '20 A
Bishop, Ira L. '11 M
Buck, Frederick W. '09 M
Burke, Roy L. '05 C
Butterworth, Allan C. '11 E
Clark, Carroll A. '29 ChE
Cosandy, Chas. '25 E
Dinsmore, Arthur T. '12 M, '13 ME
Dorsey, John G. '15 C, '16 CE
Fee, E. Franklin '07 M
Fredrickson, F. C. '29 C
Friedman, Edwin A. '23 E
Grahek, Rosabelle '29 IA
Gustafson, H. '28 M
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

Hopkins, A. F. '31 E
Hustad, Byron P. '10 E
Jaques, Robert '09 C
Johnson, Donald L. '18 Ch E
Kapphahn, R. J. '12 C, '13 CE
Kelly, Earl W. '07 C
Knutson, Harry '17 M
Kusnierek, Clenet J. '28 M
Larson, Victor F. '17 M
Lighter, C. W. '26 A
Luft, H. L. '24 Ch MS
McEachin, John L. '22 E
Matzke, W. W. '29 M
Melander, Albin R. '21 A
Mielke, W. C. '30 E
Mitchell, L. M. '14 C, '15 CE
Mork, Geo. W. '26 M
Nelson, Edward K. '24 M
Nelson, Einer '24 M
Olin, Henry A. '23 E
Osrouske, Arthur B. '28 M
Pawlak, Frank J. '30 E
Peterson, Floyd D. '30 AE
Peterson, George T. '08 M
Pokorney, H. F. '31 E
Porter, E. F. '31 C
Pulver, Richard F. '23 E
Quinn, John '08 C
Ringsred, Arthur C. '06 M
Rose, Norman W. '06 M
Ross, Russell H. '18 E
Roy, Milo C. '21 M
Saltwick, Andrew '24 M
Schradle, Juston E. '30 AE
Schwedes, Walter F. '06 E
Seemann, E. W. '20 C
Simmonds, Richard R. '21 C
Sneve, Jack S. '11 M
Spring, Willis W. '07 M
Stoebe, R. W. '31 C
Swift, Donald C. '24 E
TenBrook, Charles '29 M
Tennstrom, Carl H. '23 C
Tondell, Mandell [illegible]7 C
Turnquist, Axel A. '16 E, '17 EE
Waits, James G. '2[illegible] C
Weber, Eugene W. '30
Williams, Roy N. '23 E
East Grand Forks
Dahlberg, A. V. '05 AC
Elbow Lake
Boyce, E. R. '17 C
Elk River
Longfellow, Dwight W. '08 C
Normann, Rolf A. '24 C
Ely
Boccowich, Paul '27 E
Kauppinen, Heino '25 E
Pearson, Elmer A. '20 ChE
Roiko, W. A. '30 E
Eveleth
Kochevar, J. S. '31 E
Nastlund, Gustave A. '26 A
Ohman, Leo S. '28 E
Excelsior
Schneider, Frank M. '27 M
Schuck, Roy D. '25 E
Fairmont
Boyce, John '28 M
Coult, Lyman H. '25 ChE
Curtis, Thomas H. '12 C
Eustis, Irving N. '17 M, '18 ME
Evans, R. B. '27 M
Kasper, Walter '11 M
Kotz, W. E. '23 C
Krafft, Edwin A. '24 A
Starrett, Howard M. '09 M
Faribault
Crawford, Wallace '06 M
Klemer, Frank H. '01 C
Mabbott, L. E. J. '24 E
McKellip, Frank W. '98 E
Farmington
Brossard, Edward V. '23 M
Federal Dam
Poore, Orson B. '09 E
Fergus Falls
Christopherson, Arnold '28 E
Frankoviz, John J. '05 E
Hallan, Christian '02 C
Hultin, C. T. '31 ChE
Johnson, Carl J. '14 E, '15 EE
Shepard, L. S. '31 C
Steiner, Edmund F. '29 E
Straub, Wm. '29 ChE
Young, Jos. E. '21 G
Glencoe
Hankenson, John J. '92 C
Glenwood
Lee, I. H. '31 E

GRACEVILLE
Hartnett, John G. '11 Ch
GRAND MEADOW
Grimm, Raymond E. '28 E
GRAND RAPIDS
Campbell, V. R. '31
Skagerberg, Rutcher '15 E, '16 EE
GRANITE FALLS
Lende, Henry M. '20 C
GREAT FALLS
Gustafson, R. W. '24 C
HALSTAD
Forseth, George O. '25 M
HASTINGS
Solberg, Mirl C. '29 C
HENDRIKS
Larson, Maurice C. '29 E
HIBBING
Anderson, Alvin P. '25 Ch
Benesovitz, A. '28 E
Blomberg, Evar H. '16 E, '17 EE
Markus, Benjamin '17 Ch
Pan, Wen P. '16 C, '18 Ch
Reeve, Charles H. '19 E
Wilson, W. E. '24 C
HOMER
Ramslen, A. M. '29 Ch
HOPKINS
Anderson, Harvey B. '12 C, '13 CE
Dominick, E. H. '30 C
Knuth, Lloyd V. '30 Ae
Norman, Allan K. '28 C
Shellenbarger, L. R. '30 C
Smykal, F. J. '31 E
HUTCHINSON
Higgins, Elvin L. '92 C
INTERNATIONAL FALLS
Busch, John S. '20 ChE
Cantwell, Wm. F. '11 Ch
Efferts, Orman G. '30 E
Morris, Frank H. 24 M, '25 ME
Zeigler, A. B. '30 ChE
ISHPENING
Laugen, G. E. '31 ChE
Olson, E. J. '23 C
JACKSON
Berner, John A. '30 E
KEEWATIN
Leach, Edward W. '10 C
LAKE CITY
Martin, Curtis R. '21 G
Tews, Arthur W. '24 C
LAKE PARK
Watland, Maynard B. '29 M
LAKEVILLE
Weichselbaum, J. F. '31 E
LANESBORO
Ellestad, R. B. '24 MS
Quanrud, O. G. '31 E
LE ROY
Meyers, Clare '28 AE
LESUEUR
Crowell, Sidney '27 C
Weis, Wallace D. '21 C
LITTLE FALLS
Donahoe, Robert E. '21 E, '22 EE
Grettum, Walter '24 E
Ryan, Loiel S. '12 C, '13 CE
LITTLE FORK
Hoffman, J. R. '26 C
LONG LAKE
Kelley, William '22 C
MADISON
Clausen, Elmer W. '23 E
MANKATO
Gerlach, W. D. '26 A
Kleinschmidt, Armin R. '22 M
MANTORVILLE
Brossard, Henry F. '25 E
Meskal, George '23 C
MAPLE PLAIN
Compton, Milton '28 E
MAPLETON
Borchert, Oscar H. '25 E
MARBLE
Larson, F. H. '25 C
MARINE-ON-ST. CROIX
Gray, Wesley '29 E
MILACA
Johnson, Nels '23 C
Ramsdell, R. C. '31 C
MINNEAPOLIS
Aasland, Arne '23 C
Abbott, Amos H. '16 E, '17 EE
Adams, Edward H. '22 G
Adams, John W. '12 C
Akins, Clifford M. '27 M
Alexander, George D. '20 C
Algren, Axel B. '25 M
Alrick, Bannona G. '06 C
Amundsen, Leland R. '29 AE

Anderson, Clifford H. '26 C
Anderson, Emil '05 E
Anderson, Frank L. '16 E
Anderson, Hilder A. '18 M
Anderson, John G. '99 C
Anderson, Joseph W. '15 E
Anderson, Matthew '24 E
Anderson, M. M. '21 ChE
Anderson, Merle W. '29 E
Anderson, Nels S. '22 C
Anderson, Ole A. '93 M
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
Ayers, E. B. '25 Ch
Bachelder, William H. '24 C
Bachmann, G. A. '23 M
Bailey, Charles N. '31 M
Bachman, J. H. '31 ChE
Backstrom, Kenneth A. '27 A
Bailey, James G. '30 E
Bailey, John T. '29 E
Baker, A. W. '19 M
Bancroft, Henry K. '26 M
Barger, Harold L. '21 E
Barnes, James C. '28 E
Barstow, William F. '30 M
Bayliss, W. C. '29 A
Beal, John L. '27 ChE
Beck, Maud G. '13 Ch
Beckel, A. C. '19 Ch
Beery, Charles B. '09 M
Bell, Axel D. '27 ChE
Bell, Maurice D. '07 M
Ben-Ora, Samuel '29 A
Benson, Ikel C. '25 E, '27 MS (EE)
Berg, Swan P. '23 C
Bergford, Lester M. '23 C
Bergford, Rolf E. '23 C
Bergstrom, Marlow B. '22 E
Bevan, R. Louis '24 C
Beyer, F. C. '30 ChE
Biltz, F. J. '31 E
Bleecker, George W. '16 E
Bliven, Paul '27 M
Blosjo, Herbert '28 Ch
Blue, Clarence W. '25 C
Boehnlein, Charles '17 M, '19 ME
Boerner, Francis C. '11 C
Bordeau, Sanford P. '25 E
Boyce, H. J. '27 E
Boyce, Norman '27 E
Boyum, Irvin '17 E
Bowers, G. G. '31 E
Bowker, W. J. '31 AE
Bradbury, M. B. '31 IA
Braddock, Edward '24 C
Bradley, Byron H. '13 C, '14 CE
Brandt, Clifford A. '27 E
Braums, Cyril M. '29 E
Breding, Lucene A. '29 IA
Brenchley, Harry E. '08 C
Brinton, P. H. '16 PhD
Brooks, Leslie C. '19 Ch
Bros, Bernard M. '23 M
Bros, Chester W. '22 M
Bros, Ernest T. '17 M
Bros, Kenneth D '27 M
Bros, Raymond J. '19 M, '20 ME
Brown, Floyd W. '17 A
Brown, Homer '30 E
Brownell, Otto E. '10 C
Bruce, Hjalmar N. '16 C, '17 CE
Burch, Albert M. '96 C
Burch, Edward P. '92 E, '98 EE
Burlingame, Robert E. '25 E
Burnett, H. V. '14 C
Burris, Arthur '28 E
Burt, Paul R. '26 M
Burtis, Wm. '92 E
Cade, Arthur R. '17 Ch
Calloway, R. S. '11 ChE
Cameron, Lester W. '27 A
Campbell, Douglas M. '27 C
Capstick, Donald W. '22 G
Carlbom, Leonard H. '25 C
Carlson, Loraine A. '30 IA
Carlson, Clifton C. '27 M, '29 MS (ME)
Carlson, C. Philip '21 E
Carlson, E. F. '22 M
Carr, Harvey '03 C
Carsberg, E. C. '30 E
Carter, Robert J. '08 E
Carter, Ruth '29 IA
Case, G. F. '23 E
Caswell, Thomas B. '25 M

Caverly, C. E. '31 Ch
Cerney, Glen C. '20 M
Chadbourne, L. R. '23 ChE
Chalek, Isadore '30 E
Chalmers, Charles H. '94 E, '03 EE
Chernus, Maurice C.
Christensen, Arthur L. '25 E
Christoferson, E. W. '31 E
Clark, John S. D. '22 M
Close, Winston '27 A
Clousing, Lawrence A. '28 E
Clysdale, E. G. '31 M
Cohen, Lillian '00 Ch
Collins, Stewart G. '04 G
Colvin, James A. '14 M, '15 ME
Comb, Fred R. '10 M
Cooley, K. J. '31 M
Cooper, Leo H. '06 E
Cornell, L. Wallace '27 ChE
Corser, John '16 M
Covell, Paul L. '25 ChE
Cramsie, Kenneth J. '29 A
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
Danielson, Thomas Lester '00 M
Darin, R. L. '31 E
Dartl, H. S. '31 C
Davidson, Henry A. '27 AE
Davies, Edwin T. '07 ChE
Davies, Ralph M. '09 E
DeVaney, Grace M. '26 Ch
DeVay, Wm. T. '29 E
Deane, George B. '19 A
Deneen, Davis J. '19 A
Dewars, Allen G. '13 E, '14 EE
Diment, J. Morton '24 E
Doell, Charles E. '16 C, '17 CE
Doepke, Chris '29M
Donaldson, Frank A. '12 M
Doolittle, William K. '14 C
Dorrance, Albert P. '12 E
Douglas, Addison H. '17 C, '20 CE
Dresser, Harry S. '16 M
Dreveskracht, Wallace '28 C
Drinkall, Leon R. '19 E
Dunnavan, Ralph B. '23 E
DuToit, George A. '10 M
Eck, Lester J. '23 Ch
Eckley, William A. '30 M
Eckman, Adelaide M. '30 IA
Edey, Francis E. '29 E
Edgar, D. E. '23 Ch
Edlund, Ray C. '27 C
Eggers, E. B. '31 E
Eggers, Henry C. T. '15 E, '16 EE
Ehrenberg, Muriel L. (Miss) '26 ID
Ek, Gustaf A. '17 M
Ekberg, Carl E. '14 C, 15 CE
Ekman, Claes T. '10 C
Ellestad, R. B. '22 Ch
Elliott, A. Douglass '14 E, '15 EE
Ellsworth, Charles D. '20 E
Elmquist, R. E. '24 MS
Elsberg, Nels W. '09 C
Enger, Edward H. '11 C
Erickson, Vernon G. '31 AE
Erikson, Henry A. '96 E, '08 PhD
Erskine, Lawrence '25 M
Erskine, Robert K. '24 M
Ervin, Wilbur B. Jr. '30 M
Estabrooks, Clyde F. '24 M
Everett, William R. '13 E, '15 EE
Ewald, Earl '30 E
Fager, Simon R. '04 M
Farmer, John W. '21 M
Farnam, Julian P. '11 M
Fedders, Melvin P. '29 M
Felt, E. J. '31 C
Fenton, R. W. '30 E
Fergestad, Marvin L. '29 AE
Ferguson, K. R. '26 E
Firth, Charles V. '23 ChE
Fischer, Earl B. '19 ChE
Fischer, Harold W. '23 E
Fitzgerald, W. George '30 E
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
Foss, Arbie '29 M
Fossen, George '17 C

Foster, Kenneth W. '26 C
Fuller, Donald L. '29 ChE
Frantz, Willard F. '25 C
Fredrickson, Edwin '28 E
Frederickson, H. M. '23 ChE
Freeberg, George '25 A
Fridlund, Harold W. '30 A
Fruen, Arthur B. '08 G, '09 CE
Furber, J. Roscoe '24 E
Furber, Richard '28 E
Furber, S. L. '31 E
Gammell, John H. '14 M, '15 ME
Garber, Gabriel E. '06 M
Garthus, Ira B. '24 E
Garzon, Julian R. '24 C
Gee, Harry J. '19 G
Gernes, D. C. '31 ChE
Gerrish, Harry E. '05 M
Gilfillan, Donald N. '27 AE
Gillete, George L. '05 C
Gilman, James B. '94 C
Glasser, David '29 ChE
Godward, Alfred C. '10 C
Goldberg, Hymen '28 C
Goldstein, Milton M. '12 ChE
Goetzenberger, Ralph L. '13 E, '14 EE
Gould, Edward S. '20 C
Grant, I. G. '31 M
Grant, John W. '29 C
Grant, R. S. '26 M
Gray, William I. '92 E, '98 EE
Green, Chauncy L. '24 E
Greiner, Harry S. '24 E
Grover, R. L. '31 E
Grout, Frank F. '04 Ch
Guggisberg, Charles F. '17 M
Hagelin, Lawrence W. '22 E
Hall, John W. '27 M
Hall, John R. '30 M
Halladay, L. L. '21 C
Halvorson, Halvor O. '22 ChE
Halverson, L. C. '31 A
Hamlin, L. H. '21 M
Hammer, George F. '20 ChE
Hammer, Harold E. '25 E
Hammond, K. D. '22 Ch
Hammond, Laurence D. '14 M, '15 ME, '19 MB, '20 MD
Hankins, Nathaniel R. '24 C
Hansen, Edward W. '30 A
Hanson, Leslie P. '30 M
Hanson, Manfred P. '29 M
Harris, Nathan '20 G
Harris, Sigmund '05 M
Hartig, Henry E. '18 E
Hartkemeier, L. '23 MS
Hartzberg, Edward M. '19 M
Hawkins, Harvey C. '23 E
Hayden, John F. '90 C
Hearn, C. A. '31 AE
Heath, Donald C. '16 A
Heath, Owen M. '29 M
Heidelberger, Otto F. '23 E, '25 MS (EE)
Heidelberger, Roy J. '22 E
Heisig, Lucille K. '22 MS
Henry, Burt C. '21 C
Herberg, Sanford '24 C
Herrick, Carl A. '02 M
Herrmann, Raymond R. '12 E, '13 EE
Hertel, R. E. '30 C
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, R. W. '31 AE
Hirleman, Clark W. '12 M, '13 ME
Hobart, Walter B. '07 C
Holcomb, Harry S. '26 E
Hopkins, Joseph I. '04 Ch
Hopkins, Mark L. '09 E
Hotchkiss, Fred W. '18 E
Houlton, Amos D. '01 E
Hughes, Frank C. '03 M
Huhn, George P. '91 E
Hupp, Eleanor K. '30 IA
Humphrey, G. J. '24 Ch
Hustad, Andrew P. '09 C
Hustad, John C. '14 C, '15 CE
Hustrulid, A. '31 E
Irwin, M. '12 ChE
Jackson, Otto E. '14 E, '15 EE
Jacobsen, Arthur C. '25 E
Jacobson, Carl A. '29 E
Jacobson, Frank H. '24 E
Jacobson, Howard C. '21 G

MINNEAPOLIS

Jakkula, Arne A. '26 C, '27 MS (CE)
Jarchow, Theo. '28 E
Jennings, Gordon J. '31 C
Jensen, John A. '05 C
Jerabek, Henry S. '26 ChE
Johnson, Alphonse N. '21 C
Johnson, B. A. '31 A
Johnson, Clinton J. '29 M
Johnson, Edgar W. '14 C, '15 CE
Johnson, Elmer W. '14 E, '15 EE, '23 ME
Johnson, Enan C. '25 E
Johnson, Gustav A. '23 E
Johnson, Gustave F. '27 E
Johnson, G. V. '31 E
Johnson, Ira L. '16 M, '17 ME
Johnson, James P. '23 E
Johnson, L. '25 Ch
Johnson, Laurence E. '29 AE
Johnson, Laurence V. '27 C
Johnson, Marvin O. '30 E
Johnson, Paul (Laurence, Paul) S '12
Johnson, Robertson B. '25 E
Johnson, R. V. '24 C
Johnson, Theodore B. '29 C
Johnson, W. E. '31 C
Johnston, Charles K. '21 E
Jones, Edwin F. '17 M
Jones, E. J. '21 ChE
Jones, George R. '14 E, '15 EE
Jones, R. E. '31 E
Judd, Maurice D. '23 C
Kantor, Max '29 B, ChE
Kaplan, Seeman '18 A
Kappel, Frederick R. '24 E
Karageorges, George '30 E
Karatz, Lucian '12 Ch
Katter, Calvin K. '22 M
Kinsell, William L. '00 E
Kindseth, H. F. '31 M
Klass, Fred '19 E
Kline, Frank W. '24 E
Kline, Marvin L. '29 AE
Kloski, Leonard A. '30 E
Knauss, Edison A. V. '30 E
Knoll, Franklin O. '25 E
Knutson, Melvin I. '28 M
Kopplin, C. Donald '28 C
KranzFelder, Robert H. '26 AE
Krieger, Kenneth M. '28 E
Krefting, Arthur S. '26 C
Kroll, Arthur J. '25 C
Kritzer, Louis M. '28 E
Kronick, T. Gerald '26 A
Kuempel, Leo L. '29 M
Kullberg, R. E. '31 M
Kvitrud, Ingwald '11 C
Lagaard, Alex S. '13 E, '14 EE
Lagaard, Maurice B. '14 C, '15 CE
Lambert, Edwin M. '09 M
Lang, Charles A. '06 E
Langkammerer, Carl M. '29 ChE
Langland, Harold S. '19 E
Languth, Karl H. '27 Ch
Larson, Amandus C. '20 C
Larson, Carl '16 C
Larson, K. O. '30 AE
Laska, F. V. '31 C
Laurence, Paul A. '12 G
Lavine, Irwin '24 Ch
Leach, Stowel D. '29 A
Lebeck, Carl E. '20 C
Lebeck, Torarin E. '24 C
Lee, Melville R. '21 ChE
Lee, Oscar C. '19 E
Leegard, Clifford '29 M, '24 MS, (CE) '27 CE
Leerskov, Gerhard W. '21 ChE
Leonard, Thomas K. '15 C, '16 CE
Letson, D. E. '26 M
Lethert, Carl W. '30 E
Levens, Alexander S. '22 C, '24 MS (CE), '27 CE
Levin, Jake M. '18 E
Lewis, George R. '21 M
Lewis, J. G. '24 E
Liebenberg, J. J. '16 A
Lindstedt, Philip G. '26 C
Liu, Maolin '29 E
Lohn, Robert N. '29 C
London, William '29 E
Lowther, Wilfred W. '27 M
Loye, E. S. '31 E
Loye, Percival E. '21 E
Lund, Roy V. '24 C
Lund, Stanley D. '27 C
Lundgren, Carl W. '26 M
Lundquist, C. Vernon '25 M
Lutz, Richard E. '15 E
Lux, Lester L. '27 Ch
McClung, Karl '25 E
McCullough, Bruce M. '16 C
McDonnell, L. P. '27 E
McIlvaine, Wm. D., Jr. '29 E
McHugh, J. L. '31 AE
McKee, John B. '25 Ch
McKenzie, Leonard F. '20 E
McLeland, Lyle K. '24 E
McMillen, E. L. '23 Ch
McNally, Lee '28 C
MacGregor, Helen '25 ID
Malakowsky, Irwin R. '31 A
Manger, Henry J. '23 C
Mann, Fred M. '93 C, '98 CE
Manuel, Douglas R. '22 ChE
Markoe, James C. '12 M
Marshall, Chester R. '23 M
Martenis, W. W. '31 M
Martino, A. D. '25 M
Mattison, Oliver '05 C
Mayer, Harris J. '14 M, '15 ME
Meeks, L. D. '29 E
Meili, Rudolph E. '22 G
Merrill, Lewis E. '20 M, '21 ME
Merriman, John H. '30 E
Meyer, Herbert W. '14 E
Miller, Ervin J. '11 C
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
Morton, Harry G. '04 E
Moses, M. G. '27 E
Mowery, Clarence W. '08 C
Moyer, A. F. '10 M
Mullen, Francis E. '30 AE
Myers, R. M. '31 M
Nason, George L. '10 C
Nelson, Arthur '28 M
Nelson, Carl C. '25 E, '26 MS (EE), '30 EE
Nelson, Clarence E. '27 E
Nelson, Clarence H. '25 E
Nelson, Clarence L. '20 E
Nelson, Erling '29 A
Nelson, Gustaf A. '19 E
Nelson, Harry G. '18 Ch
Nelson, Lyle C. '29 A
Nelson, Nels B. '04 C
Nelson, Oscar B. '05 C
Nelson, Richard L. '21 E
Nelson, Robert B. '26 E
Nelson, Thorwald E. '10 M
Nemec, Frank L. '09 M
Nergaard, Leon S. '27 E
Neubauer, Loren W. '26 C
Newhall, William B. '00 M
Nicholson, Edward '25 E
Nickerson, Edward '25 E
Nielson, Eunice V. '23 A
Nier, A. O. C. '31 E
Nissenson, Phineas P. '29 E
Noble, John F. '21 G
Noble, Theodore G. '30 AE
Nordeen, H. E. '31 M
Nordenson, Arnold '22 M
Nordstrom, Milton E. '25 C
Nordvall, Glenn '23 E
Norman, Vernon R. '30 E
Norman, Henry '27 C
Norrbom, Oscar '26 M
Nygard, E. M. '21 Ch
Nyvall, Clifton S. '26 C
Olin, S. C. '31 E
Olmstead, Charles '22 M, '23 ME
Olsen, Leslie R. '15 Ch
Olsen, Melvin S. '08 C
Olson, Edwin E. '25 A
Oman, Lloyd L. '29 E
Orning, Harold '26 E
Orr, George M. '15 M
Osburn, Roy W. '27 E
Otterstein, Earl F. '13 Ch
Overholt, H. G. '10 C
Ovestrud, Melvin 13 M, '14 ME
Pagel, H. A. '23 MS Ch
Palmer, H. A. '31 E
Parker, Robert M. '24 C
Parten, Carl D. '27 M
Patterson, Donald M. '31Ae
Paul, Frederick T. '09 C
Perotti, John J.
Pesek, Cyril P. '25 AE
Peterson, Arthur P. '19 E
Peterson, Everett L. '25 A
Peterson, Harold W. '21 E
Peterson, Henry '13 ChE
Peterson, Lewis E. '25 E, '29 MS
Peterson, Marshall A. '22 ChE
Pilger, Clarence L. '27 E
Pratt, B. A. '15 C
Prendergast, Arthur '03 C
Prichard, Charles E. '25 C
Priedeman, George W. '08 M
Prues, Christian K. '27 C
Quiggle, Arthur W. '13 C, '14 CE
Quinn, Edward I. '25 C
Rademacher, Richard L. '23 ChE
Ramey, John M. '28 AE
Ramsey, Selmer '21ChE
Raugland, Arnold I. '20 A
Redmond, F. '29 A
Reidhead, Frank E. '93 E, '98 EE
Reiter, A. A. '25 Ch
Riley, Philip J. '21 Ch
Ritchie, John R. '16 M, '17 ME
Robertson, B. J. '14 E, '15 EE
Robertson, Haney H. '28 M
Robinson, Parke D. '25 M
Robinson, Rhea B. '12 Ch
Rockwell, Harvard S. '14 C
Roe, Harry Burgess '08 E
Roe, John H. '30 E
Rollin, Harold '26 M
Rollins, Milo F. '30 E
Roos, Frank T. '24 C
Rosendahl, Harold R. '22 M
Rudser, Melnor '30 E
Ryan, Robert M. '23 E
Ryan, W. T. '05 E
Rykken, Nordahl T. '29 C
Salisbury, Willis R. '10 G
Santo, L. W. '29 A
Sawyer, T. P. '31 M
Scandling, Joseph E. '25 ChE
Schavone, Anthony P. '28 E
Schaller, Louis M. '29 C
Schlafge, Wm. H. '26 ChE, '27 KE
Schlenk, John J. '23 C
Schow, Garfield G. '24 E
Schultz, Albert W. '27 E
Schumacker, Maurice J. '31 C
Sclarow, A. '23 C
Sedgwick, H. J. '31 E
Scott, Herbert L. '23 E
Sebo, Arthur O. '24 M
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
Shifflet, Glynne W. '29 A
Shippam, Willis '09 M
Shoemaker, Douglas H. '29 C
Sieberns, Joseph '30 E
Silverman, Emil '22 C
Silverman, Isadore W. '24 A
Siverson, Sigvel J. '11 C
Siverts, Samuel A. '09 C
Skanse, C. Theo. '29 M
Smeby, Lynne C. '28 E
Smith, Harold D. '25 E
Snyder, Dorothy E. '26 M
Solomonson, Lawrence D. '25 E
Sorenson, B. E. '24 MS
Soshnik, Edward J. '22 C
Soules, W. F. '31 E
South, W. A. '12 C, '13 CE
Sparrow, Hubert T. '30 E
Sperling, A. J. '27 C
Springer, F. W. '93 E, '98 EE
Sprung, M. M. '25 Ch
Steinberg, Israel H. 30 AE
Stephens, Clifford '23 C
Stephenson, Oliver H. '07 M
Sternberg, Heime A. '21 ChE
Stewart, John P. 30 E
Stevens, Everett B. '25 M
Stier, Ruth I. '25 Ch
Stolte, Sidney L. '27 AE
Stone, Charles W. '16 M, '17 ME, '19 MS
Stone, Leslie F. '23 ChE
Stoppel, Arthur E. '20 ChE
Sullivan, Betty '22 Ch
Sutter, H. M. '13 Ch
Svendsen, George P. '08 E
Swanson, Carl E. '27 E
Swanson, Carl E. '28 E
Swanson, Edwin W. '19 E
Swanstrom, Frank N. '08 E
Swedberg, M. Roy '11 C
Swenson, Gustav A. '20 G
Swenson, H. Seymour '12 C, '13 CE
Taylor, W. D. '31 E
Teske, Frederick C., Jr. '27 C
Thayer, Paul W. '14 M, '15 ME
Thorshov, Roy N. '28 A
Thorson, Stuart '19Ch
Thouren, Earl H. '30 AE
Tighe, James S. '26 E
Timperley, William D. '10 C
Tinkham, Willis M. '14 ChE
Todd, Milo E. '09 E
Torrance, Ell '09 C
Trask, Birney E. '90 C, '94 CE
Tronson, John L. '26 ChE
Tryon, Philip D. '17 C
Tucker, Carl W. '26 M
Tupper, Charles E. '15 M
Turner, Roy H. '15 E, '16 EE
Undine, Eugene A. '29 IA, '30 MS (A)
Ungerman, Carl M. '06 E
Untinen, August L. '25 E
Upton, Albert '25 E
Vartdal, V. K. '29 E
Vigness, C. Irwin '29 E
Vincent, Jay C. '03 E
Von Rohr, H. H. '21 M
Walby, Arthur C. '11 C
Wald, R. E. '30 E
Walker, George W. '08 C
Wall, Cyril T. '30 E
Wallace, Bruce V. '30 A
Wallfred, Carl L. '20 ChE
Walling, Benjamin B. '09 E
Wang, Clarence '30 Ae
Wanless, Lynn A. '12 Ch
Warren, Robert E. '30 E
Warrington, J. L. '30 E
Warrington, W. G. '30 E
Watson, H. D. '31 M
Watson, Fred O. '16 C
Webber, Fredrick W. '97 ChE
Weber, Ludwig J. '24 Ph.D
Webster, Cora H. '23 Ch
Webster, Donald W. '13 C, '14 CE
Weigel, Howard N. '14 C, '15 CE
Wentz, Walter W. '14 E, '16 EE
Werdenhoff, James H. '21 C
Wessel, Hans J. '30 A
West, Jane '29 IA
Westerberg, Carl George '21 Ch
Westigard, Glenn A. '25 E
Weyer, H. R. '29 E
Wherland, Fred C. '30 E
White, Robert H. '23 ChE
Whited, Oric O. '08 Ch
Whitney, Alfred C. '03 G
Wilcox, Hugh B. '14 E, '16 MS
Wilkinson, Gladness B. ID '27
Wilson, Charles A. '22 C
Windus, Ray F. '30 ChE
Witts, Seth N. '27 E
Winslow, Raymond M. '19 ChE
Woehler, William L. '07 E
Wood, Inez C. '30 IA
Wood, Leslie L. '28 M
Woodrich, Oscar '08 C
Young, Donald '29 M
Young, Edward F. '26 C
Zeidlik, William J. '25 Ch
Zeuthen, Victor C. '29 C
Ziegler, Mildred R. '15 Ch
Ziegler, R. Dale '30 ChE
Zima, Albert G. '24 ChE

MONTEVIDEO

Anderson, Nels S. '22 C
Hanson, R. M. '31 E
Hecht, Henry W. '24 E
Lewis, Berkeley R. '25 E
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

Dvoos, S. M. '31 Ch
Hanna, Cyril C. '26 M

MORRIS

Thompson, Claudius A. '22 C

NASHWAUK

Anderson, Olaf J. '31 M

NEWPORT

Arnesen, Herbert P. '11 C
Knight, Ralph J. '15 C

NEW PRAGUE

Marek, G. '30 M

NEW ULM

Bockus, Gerald H. '22 E
Robertson, Charles N. '08 C
Witt, Edward H. '29 E

NORTH HIBBING
Lundquist, John V. '23 E
NORTHFIELD
Barrows, Vera '17 MS
Cornell, Reuben W. '22 ChE
OAK TERRACE
Greene, Alfred B. '24 E
Lorens, Ed R. '26 C
Rathburn, George A. '24 M
OLIVIA
Kircher, Frank J. '09 M
Kircher, Geo. A. '09 M
OWATONNA
Buttock, R. '31 ChE
Hosfield, Raleigh '12 C
Soufal, R. N. '30 E
Sweeney, Frank C. '28 E
PELICAN RAPIDS
Ranger, Donald R. '24 C
PERHAM
Bauch, L. H. '31 E
Pancratz, Frank J. '08 E
PINE CITY
Peterson, Volgar '28 E
PINE ISLAND
Fahy, Francis M. '31 C
PIPESTONE
Anderson, Gordon S. '31 C
Odquist, C. '23 C
PLAINVIEW
Askew, Thomas A. '16 C
PRESTON
Hansen, C. C. '20 C
PROCTOR
Bohannon, George W. '26 M
Swanson, Clarence '30 E
RED WING
Cook, Harry C. '10 M
Gustafson, R. F. '27 A
Kanne, D. W. '31 E
Josephson, Eliot B. '10 E
Wieseke, Reuben C. '30 C
RED WOOD FALLS
Burmeister, Charles '27 E
Clipfell, Carroll D. '05 M
ROBBINSDALE
Dumberg, P. S. '22 A
ROCHESTER
Aldrich, Louis W. '23 C
Bross, Peter P. '25 A
Brataas, M. G. '17 C
Dindorf, E. '23 C
Heck, Frank J. '19 Ch, '24 MS
Leonard, Aubrey C. '23 C
Moe, H. O. '31 E
Nelson, Mark L. '24 A
Pagenhart, Clarence C. '12 C
Stromberg, Hans B. '29 ChE
RUSH CITY
Strom, Arthur '23 A
RUSHFORD
Engh, Harris S. '24 M
SAUK RAPIDS
Agather, Martin A. '31 E
Gross, Leon A. '26 E
SPRING VALLEY
Halbkat, F. J. '26 C
ST. CLOUD
Brouillette, T. R. '31 AE
Hoover, Lloyd H. '28 E
Jorgens, C. R. D. '12 C, '13 CE
Pelley, Lloyd L. '24 E
Wichman, Martin F. '22 E
ST. JAMES
West, John C. '15 C
ST. PAUL
Abrahamson, Howard B. '17 M
Albrecht, Ernest G. '25 EE
Anderson, Henry A. '27 E
Anderson, H. M. '20 M
Andrews, George L. '05 M
Angell, Glenn H. '28 M
Aure, Roy '22 M
Backe, Edmund '24 ChE
Baker, Russel E. '11 ChE
Banovetz, John A. '25 C
Barber, Edward W. '31 A
Barlow, Harry E. '03 C
Barnaby, William E. '09 Ch
Barrett, Joseph O. '22 ChE
Barthelemy, Carl R. '28 M
Beatty, L. E. '31 ChE
Beauden, Lawrence '28 C
Beek, Hiram D. '26 M
Beese, Harold U. '25 C
Bennett, John C. '26 M
Bennett, Walter J. '03 C
Bertossi, Clarence F. '25 C
Beseler, Herman F. '25 M
Bingham, Stanley E. '08 M
Biskup, Wm. F. '16 C

Bohland, John A. '15 C
Borst, Wellington L. '24 M
Boss, Ronald W. '25 M
Bosshardt, Wilmert C. '22 E
Bowers, Raymond J. '28 M
Boyles, Ralph R. '15 M, '16 ME
Brockway, Royden R. '05 C
Brohaugh, Gustave C. '27 C
Brose, W. C. '25 C
Brown, H. E. '22 G
Brownell, Edward '26 C
Bruess, Edward C. '29 M
Buenger, Albert '13 M, '14 ME
Buenger, Edgar '19 A
Bumgardner, Louis T. '23 E
Burch, Cecil J. '29 C
Carlson, Arvid P. '17 M
Carlton, Richard P. '21 G
Chapman, Leslie H. '95 C
Chapman, Wilbur J. '27 M
Childs, James A. '09C
Christenson, E. J. '27 C
Christilaw, G. M. '21 C
Christlieb, Frank B. '23 C
Clark, Kenneth M. '27 C
Collis, N. Stuart '24 M
Comfort, Clifford E. '26 M
Corl, Cady S. '21 Ch
Crawford, Allen S. '12 M
Crimmins, John E. '30 A
Curry, Ezra Benham '20 M, '21 ME
Dahl, H. A. '22 E
Dahlen, Miles '24 ChE
Darrell, James E. P. '23 C
Daum, H. Arne '12 E
Davidson, John E. '28 AE
Davis, Gilbert M. '04 M
Dawson, John W. '22 A
Del Plaine, C. W. '21 C, '22 CE
Dehn, Eltor '21 C
Deschner, Richard E. '29 M
Deutsche, Richard E. '18 C
DeWitt, Joseph H. '10 Ch
Dills, Lyle A. '21 G
Dimond, Grover W. '12 C
Dimond, Harvey G. '14 C
Dougan, Henry K. '08 C
Dunnigan, M. H. '16 Ch
Dunning, Robt. M. '28 M
Duvall, Arndt J. '25 C
Edgell, Earnest E. '30 E
Edwards, W. H. '27 A
Eggleston, Smith '25 M
Ellison, Jay '09 C
Elmburg, John C. '28 E
Engquist, Victor E. '20 E
Erickson, Clarence P. '25 A
Erickson, Hugo '28 C
Erickson, Lloyd R. '28 C
Fahland, Frank, Jr. '22 M
Felion, Elmer T. '13 Ch
Finley, Joseph E. '05 C
Fiske, Frederick W. '09 C
Fleming, Frank R. '08 M, '09 EE
Flygare, August L. '12 C
Ford, James M., Jr. '30 M
Forsberg, Elmer J. '21 M, '22 ME
Francis, Paul E. '18 M
Fraser, Carlisle G. '22 C
Frenzel, Herman '26 A
Fryhofer, W. W. '31 C
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
Gille, Willis H. '29 E
Gilstad, Arthur '23 M
Ginnaty, J. Robert '28 E
Goebel, Rudolph C. '13 E, '14 EE
Goffstein, A. A. '31 E
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
Guesmer, George O. '24 C
Guesmer, Marie W. '26 ID
Haberle, Edward '12 C, '13 CE
Haeberle, E. H. '06 E
Haima, Mark '25 C
Halvorson, Henry A. '11 Ch
Hamilton, Sam '28 E
Hansen, Christian '10 E
Harris, Harold R. '14 E, '15 EE
Hartigan, James J. '29 C
Hatch, Lloyd '23 ChE
Hauge, Morris J. '30 E

Havens, Paul M. '27 A
Hayden, C. E. '24 C
Heck, Frank J. '19Ch
Hedenstrom, Ernest A. '12 E
Hedke, H. A. '31 E
Heinemann, G. '29 ChE
Hella, U. M. '31 C
Hendricks, Clifford '25 C
Hendrickson, Norman '16 C
Hennessy, Hugh J. '11 Ch
Hewett, Maurice W. '13 C, '14 CE
Hill, Hibbert M. '23 C
Hiner, Walter G. '23 C
Hoff, Christopher '06 E
Hoffman, Henry J. '12 Ch
Hoffman, W. H. '29 M
Hoffman, Michael J. '11 C
Holien, G. '28 A
Hoisveen, Leonard '25 M
Holder, Laurence E. '24 C
Hosmer, Orville H. '23 C
Houston, Geo. S. '02 C
Hovden, Conrad D. '12 E, '13 EE
Hovik, Lawrence E. '29 A
How, Francis W. '27 C
Irons, George '26 E
Irons, R. C. '27 M
Jenson, Theodore B. '29 C
Johnson, Carl A. '21 M, '22 ME
Johnson, Einer '11 Ch
Johnson, Elmer W. '30 AE
Johnson, Floyd M. '30 E
Johnson, James R. '26 C
Johnson, Ralph '28 C
Johnson, W. S. '31 C
Jones, Gurdon '28 AE
Kastner, Arthur H. '27 A
Kearney, Adrian A. '23 E
Keeler, Jasper F. '22 C
Kennedy, Wm. W. '07 Ch
King, Lawrence W. '09 C
King, Wesley '05 C
Koch, Arthur Louis '19 ChE
Koch, Karl L. '23 E
Kochendorfer, Milton J. '05 E
Kopp, David '28 C
Kopper, Edward '14 M, '16 ME
Korba, A. '29 E
Krauch, William '08 C
Kryger, Edward R. '21 Ch
Kugler, Joseph H. '26 ChE
Kuhfeld, Frank W. '31 C
LaBonte, Anton '25 C
Lambert, F. T. '02 C
Lang, Fred C. '08 C
Larsen, S. S. '31 M
Larson, Albin '14 C
Larson, Martin S. '11 M
LeBlond, Edmond J. '05 E
Lewin, Sherman W. '26 C
Lewis, Edward B. '05 M
Liese, Herbert W. '24 C
Lilly, Clarence W. '17 E
Livermore, Harry J. '22 ChE
Lockhart, H. A. '29 E
Loeffler, Henry S. '14 E, '15 EE
Logue, John F. '24 M
Lohmann, Ann N. '27 Ch
Lostrom, H. W. '26 E
Lovering, Harry D. '13 C, '14 CE
Lux, Arthur E. '16 E
McCartney, Floyd A. '13 M
McConnell, J. R. '29 ChE
McCree, Andrew A. '08 C
McCubrey, Everett J. '21 C
McLean, M. D. '21 G
McMahon, J. S. '31 A
McMiller, Paul R. '11 Ch
McMillan, G. H. '31 C
McNerney, George W. '30 AE
McPherson, William B. '02 E
Macgowan, Irvin '25 C
Mackintosh, William S. '21 C
Mailand, Marjorie J. '30 IA
Maiser, W. L. '23 C
Malloy, Charles J. '06 C
Malmberg, Victor '20 C
Mangney, Hilding O. '24 E
Manson, Philip W. '26 C
Markson, Christian O. '22 C
Mattson, Dewey F. '22 C
Mayer, Albert F. '20 E
Mayer, Francis L. '29 E
Mayhugh, Ben F. '28 M
Meixner, Bernard A. '10 M
Mertz, Karl J. '14 E
Meserve, R. H. '23 E
Methven, Clyde '11 C
Miller, George W. '20 E
Miller, William C. '16 M

Miller, William J. '24 E
Mintz, Nathaniel '22 E
Mitchell, John B. '09 C
Mohr, D. F. '31 C
Moisesku, Wm. '29 M
Molstad, Arnold R. '31C
Moore, Gordon B. '27 E
Moore, John H. '24 M
Moorman, Albert J. '18 A
Moorman, Frank S. '22 A
Morton, Harold S. '12 M, '13 ME
Motl, Charles L. '10 C
Muller, Carl C. '18 M
Nasvik, Adolph '26 C
Nelson, Edward S. '09 C
Nelson, N. N. '27 AE
Netherly, George '29 ChE
Neville, Earle L. '20 C
Nichols, F. A. '31 M
Nicholson, H. G. '22 ChE
Nolan, George C. '27 E
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, Arthur O. '11 Ch
Olson, Clarence E. '22 G
Olson, M. L. '31 M
Oltman, Charles A. '03 C
Ott, Leonard E. '15 C
Otto, Robert W. '04 M
Owens, Leo E. '11 M
Palda, Charles H. '22 C
Pappenfus, Clarence M. '30 M
Parkin, Guy G. '12 Ch, '13 Ch
Pause, Harold A. '23 E
Peckham, Harold E. '23 M
Pemble, Alice S. '30 Ch
Pennock, Ed M. '05 AC
Person, Otto '24 AE
Peters, Walter C. '22 M
Peterson, A. M. '14 E
Peterson, Gerhard C. '30 A
Peterson, Harold R. '18 G
Peterson, Harold C. E. '25 C
Pinska, Lawrence F. '22 C
Poulsen, George F. '17 A
Powell, L. H. '24 C
Ralphe, W. W. '30 C
Rauen, Theodore '26 ChE
Rauscher, Paul F. '27 E
Reardon, John M. '22 C
Redin, R. K. '26 AE
Reichow, W. A. '30 M
Reinbold, R. E. '31 E
Riedesel, George M. '17 A
Rigg, Alvin E. '25 A
Ringstrom, Ivan G. '12 BS, '13 EE
Ringwood, James '28 C
Rockwood, Ralph H. '12 Ch
Roe, Chas. P. '29 CH
Roehrich, Victor '09 ChE
Roth, Lewis M. '11 C
Rufsvold, Olaw M. '15 C, '16 CE
Sandness, E. '30 C
Santelman, Ralph H. '27 C
Schaller, Geo. C. '23 C
Schoeffler, J. L. '31 C
Schroepfer, Geo. '28 C, '30 MS (CE)
Schwager, O. J. '30 M
Shepard, George M. '09 C
Sickel, Edwin C. '23 E
Slade, Loring '22 C
Smith, Sheldon H. '10 ChE
Snow, Clarence J. '14 M, '16 ME
Sonnen, C. G. '31 C
Souther, M. Edwin '12 C, '13 CE
Speer, Paul B. '27 E
Spehr, Peter E. '27 M
Stanton, Raymond E. '04 M
Stewart, C. H. '03 C
Streich, Harry C. '12 E
Swanstrom, A. E. '31 AE
Swenson, G. W. S. '28 Ch
Swenson, Theodore J. M. '12 E
Tallmadge, Everett S. '14 E, '15 EF
Tauber, Jos. '28 C
Teberg, Lawrence E. '22 C
Tews, Arthur W. '24 C
Thian, Helen M. '30 IA
Thomas, Theodore W. '28 C
Thomas, William A. '17 E
Thompson, Niles J. '27 E
Thompson, Theodore S. '24 C
Tierney, Festus P. '22 C
Toncheff, Stanil T. '15 Ch
Toogood, L. S. '31 M
Tuebesing, Norman F. '27 M

St. Paul
Turner, Leslie E. '09 E
Vievering, Wm. A. '25 Ch
Villaume, Walter F. '23 C
Waldor, Ted N. '25 C
Waterous, Fred A. '20 M
Weinke, Ernest '16 C, '17 CE
Welin, Arthur G. '12 C, '13 CE
Wellisch, Walton '23 E
Weom, Laurel A. '27E
Whaley, F. J. '31 M
Whitman, Edward A. '00 C
Wielde, John A. '28 C
Willard, A. C. '22 E
Williams, Fred J. '17 E
Willis, Roy '08 C
Wilson, Frank W. '23 E
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
Yager, Louis '07 C
Youatt, Glenn B. '29 AE
Youngquist, Eder B. '25 C

Slayton
Price, John R. '14 C

Sleepy Eye
Hansen, Theodore '28 Ch

Stevenson
Quine, William M. '26 E

Stewartville
Beach, Geo. H. '27 E

Stillwater
Ageton, Edwin O. '26 E
Englin, Charles F. '06 E
Reutiman, F. R. '29 M
Webber, Clyde '27 E

Taconite
Maney, James E. '26 M

Tintah
Doleman, G. H. '31 E

Twin Valley
Croswell, Daniel R. '16 E
Croswell, Thomas L. '15 C
Nilson, Wilhelm '02 E

Two Harbors
Johnson, A. G. '05 M

Tyler
Johnson, Anton A. '24 A

Underwood
Aune, Albert W. '31 E

Virginia
Kendall, D. B. '30 E
Sannicolo, Joseph F. '22 E
Staff, C. E. '31 E

Wabasha
Berry, George F. '24 M

Wadena
Imsande, Fred '25 C

Waseca
Johnson, Edgar F. '21 E
Zimmerman, Louis P. '08 E

Wayzata
Hill, Erwin G. '30 C

Wheaton
Heggen, Reuben '24 E

White Bear Lake
Grossman, F. R. '28 A
Tierney, N. J. '30 ChE

Willmar
Rivkin, S. M. '31 E

Winona
Boyum, Benjamin O. '10 C
French, William O. '25 M
Grettum, Leroy A. '23 E
McAndrews, Harry '25 C
Miller, Archibald T. '24 E

## MISSISSIPPI

Clarksdale
Rydden, J. '28 C

Jackson
Kroeze, Herbert A. '19 G

Laurel
Nee, Harold E. '24 E

University P. O.
Woolett, Guy H. '10 Ch

Vicksburg
Olson, Clarence E. '28 C

## MISSOURI

Gasconade
Chapman, Burton L. '10 C

Jefferson Barracks
Sullivan, Frederic V. '25 C

Jefferson City
Espenett, Edward L. '22 C

Kansas City
Etem, V. '26 E
Glass, Clifton A. '98 C
Halden, Herbert O. '23 M
Johnston, C. L. '25 Ch
Kiesner, Frank C. '24 M
Langman, H. R. '24 M
Louk, Frank '30 C
Luedeman, Clarence H. '23 AE
Swanson, Clifford L. '22 C
Tibbling, Ernest F. '14 Ch
Wright, Harris H. '09 M

Knob Lick
Rydeen, Francis G. '05 M

Macon
Doneghy, William V. '30 A

Marshall
Pettijohn, Earl '11 Ch, '12 Ch, '19 PhD

Mt. Grove
Hummell, Carl A. '26 E

New London
Glascock, Henry H. '06 E

Rolla
Eyberg '29 C

St. Louis
Beck, V. S. '10 E
Brick, B. R. '29 Ch
Fiske, Harold C. '22 E
Grabert, Harold T. '30 E
Grant, Ellberth R. '24 C
Haines, Allen K. '13 E
Johnson, Noah '94 C
Hawkey, H. K. '19 ChE
Krantz, Rudolph W. '24 ChE, '25 MS
McCann, Realino V. '27 A
Nortner, Sylvester E. '16 C
Pehrson, Elmore L. '30 E
Oscarson, Gerhard L. '22 E
Read, Leland B. '29 M
Sverdrup, Leif J. '21 C
Thwing, George '28 C

Springfield
Acker, Sid H.

Troy
Ball, Hampton B. '20 M

Willow Springs
McDanield, Loran '28 C

## MONTANA

Billings
Anderson, Donald N. '31 C
Berg, Karl A. E. '20 C
Coleman, Frank D. '05 E
Corbett, T. R. '26 M

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
Schoepf, A. W. '08 E
Stussy, William '00 E

Glendive
Adams, Benjamin W. '10 C
Ainslie, Arthur F. '11 C

Great Falls
Dow, James C. '00 E
Fagan, E. T. '16 MS
Hougan, Sander '21 E
Sheire, James B. '28 E

Helena
Kivley, Warren O. '16 C

## NEBRASKA

Crete
Hawlek, H. I. '19 C

Grand Island
Melkus, L. A. '30 A

Lincoln
Eggan, C. M. '29 C

Omaha
Bunce, Paul F. '06 E
Christensen, Edgar W. '19 E
Eddy, Horace T. '95 E, '96 EE
Ellefson, S. '16 E
Schneckloth, Harry H. '25 E
Teal, Clarence W. '24 E
Weeks, Leonard H. '27 E
Wilcox, Halsey H. '15 E
Zimmer, William A. '06 E

University Place
Japs, Barney G.

## NEW HAMPSHIRE

Berlin
Burningham, F. A. '17 ChE

## NEW JERSEY

Bloomfield
Robinson, Lawrence T. '26 EE
Widell, E. Gideon '17 ChE

Burlington
Jewett, R. H. '31 AE

Camden
Berglund, Erick '27 E
Corson, Benjamin I. '17 Ch
Engstrom, E. W. '23 E
Hargrave, W. A. '26 E
Koch, Winfield R. '25 E
Painter, William H. '30 E

Cliffwood
Sharpless, Wm. M. '28 E

Deal
French, Edwin C. '30 E
Friis, R. W. '30 E

East Orange
Wright, Roydon V. '98 M

Harrison
Wyman, I. R. '22 Ch

Jersey City
Mikesh, Martin A. '12 M, '13 ME

Kearney
Aultfather, David H. '22 EE
Dowd, Archie J. '19 M
Eddy, Clarence J. '22 M
Franzen, Roy O. '25 E
Larson, H. O. '29 E
Peterson, Vance C. '20 E
Steffens, Robt. A. '22 E

Kenvil
Kurtz, Kerwin K. '28 ChE

Monmouth
Hoorn, Frederick W. '12 E, '14 EE

New Brunswick
Moore, Norman '25 C
Von Kuster, Edith I. '07 Ch
(Mrs. W. Johnson Kenyon)

Newark
Burke, James '28 M
Dahl, Paul E. '28 E
Frederickson, Harry B. '11 E
Fritzberg, Hilding L. '28 M
Johnson, Welton V. '26 E
Maffert, G. H. '30 C
Rose, Anton R. '04 Ch

Paulsboro
Kurtz, K. K. '28 ChE
Nygard, Edwin M. '21 Ch
Petry, T. '29 ChE
Shabaker, H. A. '29 ChE

Paterson
Cassel, Norman S. '23 ChE
Lundquist, W. G. C. '28 M

Perth Amboy
Johnson, Lester L. '25 ChE
Kohlhase, Arthur H. '21 Ch
Paulson, Paul M. '23 ChE
Temple, Sterling N. '05 PhB

PRINCETON
Shortley, George '30 E
Ringer, Adolph G. '30 M
RAHWAY
Johnson, L. L. Ex '29
RED BANK
Feldman, Carl B. H. '26 E, '28 MS
ROLLA
Eyberg, C. J. '29 C
ROSELLE
Boyd, Thompson '29 ChE
Jones, Ivor V. '15 C
WESTFIELD
Anderson, Fayette C. '24 E
WEST NEW YORK
Veltz, Clarence '24 C, '30 CE

## NEW MEXICO

ALBUQUERQUE
Gilman, Gaylord '25 E

## NEW YORK

ALBANY
Bauer, Roscoe W. '24 C
ATTICA
Anderson, Ed I. '17 M, '19 ME
BAY SHORE
McCullough, Robert T. '23 E
BROOKLYN
Daly, Richard T. '21 C
Egilsrud, F. S. '20 M
Ely, Irving R. '05 E
Moe, Claude P. '20 Ch
Stoppel, Ernest A. '11 Ch
Sushan, Harry M. '19 C
BUFFALO
Bakken, Adolph C. '23 Ch
Boyd, Paul M. '15 M, '16 ME
Fawcett, R. B. '28 ChE
Hammer, G. E. '20 Ch
Holmes, Roland W. '25 M
Jules, Harold A. '20 E
Luft, O. W. V. D. '17 Ch
Pendergast, Webster G. '25 M
Sverdrup, Edward F. '26 ChE
Swanson, Oscar E. '15 C, '16 CE
CANAJOHARIE
Mastin, M. F. '13 Ch
CHENANGO FORKS
Harshaw, John R. '12 Ch
FULTON
Korfhage, Roy F. '20 Ch
ITHACA
Barr, John H. '83 M, '88 MS
Fraser, George '19 A
KENMORE
Shannon, H. R. '29 M
LONG ISLAND CITY
Plumber, Clayton '20 Ch
MASSENA
Heath, Arthur C. '25 M
MT. VERNON
Hiers, Charles R. '24 M
NEW YORK CITY
Abbott, Arthur L. '97 E
Allison, Ralph E. '30 E
Backstrom, Emil F. '24 A
Barnum, M. C. '11 M
Bauer, Ruben B. '20 E
Benner, R. C. '02 Ch
Berg, Samuel A. '21 BA, '21 E, '22 EE
Bierman, George H. '18 M, '19 ME
Bierman, Harry C. '14 ChE
Bolme, Ole N. '10 C
Bonner, Arthur L. '27 E
Boman, Carl E. '05 E
Bouman, Bernard M. '04 E
Brattlof, Clifford '27 C
Brayden, Giles W. '27E
Buhl, John E. '09 M
Burns, Harvey L. '02 E
Cameron, Grace '27 I
Cannenberg, Walter E. '23 E
Cheney, Edward J. '04 E
Cherne, R. '29 M
Clark, Charles J. '29 E
Cooley, Gilbert '22 E
Cooper, R. Conrad '26 C
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
Eckberg, Curtis '24 E
Eddy, C. J. '22 M
Ellestad, Irwin M. '22 E
Elmer, Lloyd A. '21 M
Emerson, Lynn A. '11 E
Field, William J. '30 E
Finch, J. B. '30 E
Gannett, Danforth '16 E, '17 EE
Gerlach, Henry C. '22 A
Gilman, Howard B. '17 A
Gregg, Treshame D. '05 G, '06 CE
Hansen, Oliver S. '29 A
Harwood, S. G. '08 M
Hastad, C. Jerome '30 E
Heins, Harold '25 E
Hendrickson, C. T. '30 E
Hilferty, Charles D. '96 M
Houts, Guy J. '01 E
Hubbard, Henry A. '09 C
Ireland, Ray R. '03 E
Isaacson, Arthur M. '27 M
Johnson, Elving L. '23 A
Johnson, John E. '11 E
Kannenberg, W. F. '23 E, '25 MS (EE), '28 EE
Koepke, Walter E. '13 C, '14 CE
Koerner, W. M. '28 E
Kuhlman, Rudolph H. '23 M
Laird, Lee R. '03 E
Landeen, Arvid G. '10 E
Lehnert, Walter E. '30 E
LeTourneau, Edward H. '05 E
Lieb, Janet '29 IA
Lockwood, Raymond '20 E
Luger, Karl E. '22 ChE
McKay, Earle D. '15 C, '16 CE, '28 MS (CE)
Markuson, Oscar S. '11 E
Mathes, Robert C. '12 E, '13 EE
Millunchick, John W. '29 E
Mitchell, Alexander C. '20 E
Morris, John E. '09 M
Mowry, Harry W. '06 E
Mueller, Robert '29 E
Myers, Mortimer '97 E
Nelson, Chester '29 M
Norcross, Arthur F. '07 E
Nygaard, Herman '30 E
Olson, Richard H. '19 E
Olstad, Oscar A. '11 M
Otto, Frederick A. '04 E
Pagnucco, Jn. W. '26 ChE
Pangburn, C. G. '22 E
Poss, John A. '29 AE
Rankin, Renville S. '14 C
Reichow, William A. '30 M
Robertson, Phillip W. '01 M
Rohrman, F. A. '27 ChE
Sanders, Paul F. '29 M
Schottler, George J. '23 E
Sharpless, William M. '28 E
Skidmore, J. G. '30 C
Smith, Donald C. '18 E
Stowe, George E. '30 E
Strothman, Russell A. '20 E
Swenson, Karl P. '06 G, '07 MS
Thordarson, Wm. '23 ChE
Thorne, Donald '23 E
Thuros, Albert L. '12 E, '13 EE
Thyberg, Clarence W. '25 E
Vye, George P. '27 M
Wahlquist, Hugo W. '21 M, '22 EE
Weeks, W. C. '94 C
Wentz, Clarence A. '27 C
Wheeler, Herbert H. '17 E
Wiggins, Gerald G. '06 E
Williams, Fred M. '05 E, '09 EE
Woodman, J. C. '11 M
Zimmerschied, Clarence R. '23 E
NIAGARA FALLS
Buehl, W. M. '30 ChE
Dobrovolny, Frank J. '24 Ch
French, Edwin L. '02 E
Jackman, R. E. '29 Ch
Marr, Horace S. '19 Ch
Paul, K. F. '24 ChE
Schermer, Oscar C. '21 Ch, '22 ChE
RIVERHEAD
Braaten, Arthur '28 E
ROCHESTER
Eaton, Wentworth Ch E
Matthews, Glenn E. '20 Ch
Nietz, Adolph '15 Ch
Savage, Edward S. '97 M
Seymour, M. W. '21 Ch
SCHENECTADY
Allee, David A. '02 C
Anderson, Lowell W. '26 E
Beardmore, Albert '21 E
Boe, Lester L. '25 E
Bottemiller, Edward L. '27 E
Cady, R. C. '31E

**Schenectady**
- Danielson, Ellsworth H. '30 M
- Dunham, Roy O. '14 E, '15 EE
- Edgar, Robert F. '27 E, '29 MS (EE)
- Fallon, Eugene L. '14 E, '15 EE
- Fiene, Marcus '26 E, '28 MS (EE)
- Forsberg, Peter W. '11 E
- Gogins, John F. '30 E
- Grobel, Lloyd P. '24 M
- Harris, Gordon C. '29 E
- Hartley, Lowell J. '26 E
- Hathaway, Herbert F. '28 M
- Heinemann, John R. '19 E
- Marshman, Irving H. '24 E
- Mears, L. A. '30 E
- Mittag, Albert H. '11 E
- Orth, R. W. '31 M
- Rask, Louis G. '03 E
- Redding, James '27 E
- Sheppard, Raymond '30 M
- Thorson, H. L. '31 E
- Tunnell, Clement R. '25 E
- Warren, Laurence C. '24 E
- Williams, W. Glenn '29 E
- Wiltgen, Edward '00 E
- Wyman, LeRoy L. '23 ChE

**Staten Island**
- Grimes, David '19 E
- Temple, Sterling '17 PhD

**Syracuse**
- Jones, Robert A. '15 E, '16 EE
- Moyer, Malcolm B. '09 M

**Troy**
- Huchthausen, W. '28 A

**West New York**
- Velz, Clarence '24 C

**Yonkers**
- Rice, Edgar W. '02 Ch

## NORTH CAROLINA

**Charlotte**
- Palmer, Roy A. '21 E

**Duke University**
- Haines, Howard N. '22 A

**Finesville**
- Peterson, Clifford E. '23 Ch

**Greensboro**
- Little, Alice V. '22 A

**Raleigh**
- Anderson, W. S. '23 Ch
- Halvorson, John Oliver '07 Ch

## NORTH DAKOTA

**Carrington**
- Lee, Albert C. '27 E

**Elkton**
- Kelly, William J. '26 E

**Fargo**
- Grafsland, Geneva '27 I
- Jones, Paul W. '28 A
- Juvrud, Edwin C. '17 E
- Luethi, C. F. '27 C
- Mikesh, Edward S. '22 M
- Peterson, Albert L. '14 BS, '15 M
- Petrick, Edward D. '30 AE
- Sheffield, Fred W. '09 C
- Stoutland, Oliver A. '22 C
- Tarbell, William P. '22 C
- von Sien, Ruth '28 ID

**Grand Forks**
- Anderson, Edward X. '08 Ch
- Gauger, A. W. '14 Ch
- Kilpatrick, Porter W. '27 A
- Mayer, Joseph S. '24 E
- Schulz, Elton A. '16 E

**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

**Wilton**
- Gerow, Theron G. '20 M

**Williston**
- Jackson, Myron B. '05 A. C.

## OHIO

**Akron**
- Benson, D. G. '30 ChE
- Morris, Vlon N. '26 PhD
- Peterson, Roy C. '29 M
- Pettersen, Wilber E. '28 M
- Rehfeld, Harold '29 ChE
- Tronson, John L. '26 ChE, '28 MS

**Arborton**
- Straub, William '29 Ch

**Barberton**
- Jordre, W. S. '31 M

**Canton**
- Edmunds, A. M. '25 Ch
- Hektner, Joel '17 M
- Lang, George M. '27 E

**Cincinnati**
- Harrington, Marzy V. '24 C
- Langman, Harley R. '24 M
- Peterson, Randall '28 E
- Whitten, Robert C. '25 M
- Young, Truman P. '26 C
- Strain, Bruce '30 ChE

**Cleveland**
- Ackermann, Robert W. '28 EE
- Anderson, Oscar P. '10 E
- Arneson, Lloyd O. '21 M
- Briggs, Hiram K. '19 G
- Conley, Wilfred E. '10 E
- Conrad, Gordon '30 M
- Cowin, Clifford Cecil '21 G
- Crane, Eugene C. '12 M, '13 ME
- Dawson, I. R. '30 AE
- Dever, Francis A. '20 C
- Drinkall, John F. '19 E
- Heidmann, K. R. '29 E
- Hinman, Charles H. '24 A
- Johnson, C. S. '21 C
- Johnson, Leonard T. '10 E
- Larson, Walter J. '20 E
- Lee, Albert A. '26 E
- Lund, Jeffery L. '25 E
- Miller, Andrew L. '21 E
- Nelson, Edgar M. '24 E
- Ronning, Norman B. '27 E
- Salstrom, Paul S. '26 E
- Schilling, T. F. '24 E
- Sillman, Paul W. '28 C
- Tuve, George L. '20 M, '21 ME
- Wald, Joseph H. '27 E
- Yngve, V. '13 Ch

**Cleveland Heights**
- Merriell, Elmer W. '12 E, '13 EE

**Columbus**
- Berzelius, Carl E. '29 AE
- Moffat, George N. '19 M, '20 ME
- Robinson, Richard B. '27 E
- Youngquist, Eder B. '25 C

**Dayton**
- Coates, J. Edwin '27 M
- Cote, Rhoda (Mrs. J. P. Barton) '25 ID
- Forbes, Henry C. '22 E

**Findlay**
- Nelson, G. '23 C
- Tholstrup, H. L. '26 E, '28 MS EE
- Robison, Archer R. '09 E
- Uzzell, G. W. '07 E

**Hubbard**
- Meyerdick, C. C. E. '26 C

**Ivorydale**
- Cassel, N. S. '23 ChE
- Hamlin, Lehan H. '21 M
- Jewett, Ernest E. '25 ChE
- Krantz, R. W. '25 MS
- Nelson, L. W. '29 ChE
- Shirk, Loren H. '26 ChE
- Slaggie, Eucharius L. '26 E

**Kent**
- Pettijohn, Earl '19 PhD

**Lima**
- Cutter, Francis C. '05 M

**Mansfield**
- Kotchevar, Jos. F. '28 E
- Langseth, Axel O. '22 ChE
- Lee, Paul R. '27 E
- Schliep, Carl J. '28 E
- Wieland, Willard '25 E

**Marion**
- Barron, John H. '26 E

**Novelty**
- Madsen, Olav '20 G

**Orville**
- Specht, J. E. '29 E

**Salem**
- Rosing, Donald C. '27 C

**Sidney**
- Moore, N. R. '25 C

**Springfield**
- Keller, Raymond W. '25 E

**Toledo**
- Buckhout, Donald H. '17 A
- Feeney, Wayne '23 E
- Nyquist, Roy A. '27 AE

**Van Wert**
- Platzer, George J. '27 C

**Willoughby**
- Taylor, Lyman D. '13 E, '16 EE

**Youngstown**
- Birnberg, Zingel C. '09 M
- Buhl, Paul S. '07 M
- Elmburg, LeRoy '25 AE
- Lee, Walter J. '20 E

Leider, A. E. '27 E
Ramm, Theodore D. '13 E
Schilken, Donald R. '29 AE
Van Cleve, Horatio P. '07C

## OKLAHOMA

BARTLESVILLE
Stauffacher, Edward L. '24 M
FAIRFAX
Burns, Dwight T. '25 C
Gobeli, Arthur W. '25 C
NORMAN
Swearingen, Lloyd E. '26 PhD
OKLAHOMA CITY
Montgomery, Albertus '19C
OKMULGEE
Paul, Karl F. '24 Ch
PONCA CITY
Nelson, Ernest W. '20BA, '24 ChE
TULSA
Ellingson, Elmer '16 C
Fortune, Harry G. '20 M
Thompson, Warren L. '26 Ch

## OREGON

CLAMATH FALLS
Smith, L. H. '03 C
CORVALLIS
Martin, W. H. '10 M
FOREST GROVE
Taplin, George C. '24 E
HARRISBURG
McAfee, Allan L. '08 E
HOOD RIVER
Smithson, John E. '07 E
MAPLEWOOD
Sterling, Faith '09 Ch
MERRILL
Bogue, Nathan H. '04 C
MEDFORD
Brockway, Alvah E. '09 E
Waldron, R. E. '20 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
Cotton, Richard J. '30 E
Couper, George B. '93 M, '02 ME
Doeltz, William F., Jr. '08 C
Felthous, Donald G. '29 M
Hubbard, Fred A. '09 C
Juvrud, I. O. '14 Ch
Meany, James M. '07 M
Nelson, Donald O. '20 C
Nichol, Frank E. '25 C, '26 MS (CE)
Rawson, Ralph H. '07 M
Rockwood, Fletcher '14 E, '15 M
Stoddart, Hugh A. '24 C
VERNONIA
Knauss, Archibald C. '16 C, '17 CE

## PENNSYLVANIA

ALLENTOWN
Reque, Styrk G. '01 E
AMBRIDGE
Washburn, Delos C. '93 AE
BELVIEW
Smith, Cedric B. '14 BA, '18 C
BETHLEHEM
Jensen, Cyril D. '21 C
Luce, A. W. '21 M, '23ME
CHESTER
Hawkinson, Conroe F. '30 M
DARTMOUTH
Swanberg, John H. '25 C
DONORA
O'Connell, Thomas C. '13 Ch
EAST PITTSBURGH
Blackmore, Frank E. '28 M
Burt, Fred R. '16 E
Brown, Louis M. '16 E
Farmer, Herbert F. '27 E
Finnell, Thomas C. '29 E
Gehring, L. G. '27 C
Gemmell, Robert W. '26 E
Gibson, Charles B. '05 E
Kaplan, Eugene V. '10 M
Knudson, Manches E. '30 E
Levesconte, L. B. '26 E
May, Darwin R. '14 ChE
Schweppe, Walter A. '26 E, '28 MS
Sjoberg, Roy H. '26 E
Spicola, J. A. '30 E
Stark, John '29 E
Thompson, William F. '30 E
Viebahn, William W. '30 E
EMPORIUM
Butler, Clifford T. '29 ChE
ERIE
Bill, Earl M. '12 E
Brightfelt, John C. '29 E
Cass, Hoyt R. '24 E
Downie, John M. '22 E
Gibson, Robert '27 E
Jacobs, Wm. A. '30 E
Rath, Harvey C. '23 E
Sturtevant, Percy G. '08 E
FULLERTON
Spencer, J. Boyd '27 M
HARRISBURG
Didriksen, Philip H. '20 E
Morse, George H. '93 E, '11 EE
HOLTWOOD
Marcroft, H. C. '24 E
JENKINTOWN
Louie, John M. '08 Ch
MARSHALLTOWN
Flaaten, P. H. '26 C
MONT ALTO
Bolton, John M. '28 C
MOORES
Fisher, Addison '29 E
Powell, Knox H. '20 M
NEW KENSINGTON
Edwards, Junius D. '12 ChE
Frary, Francis C. '05AC
Pippel, Herbert A. '20 Ch
Taylor, Cyril S. '13 Ch
NORRISTOWN
Dunnum, O. E. '22 E
PHILADELPHIA
Baskerville, Ralph J. '30 M
Childs, John C. '06 C
Cross, Roland E. '23 M
Currie, Neill, Jr. '08 E
Fairchild, Albert R. '07 E
Furber, Pierce P. '08 C
Guppy, Richard H. '30 M
Hunt, Gates E. '20 E
Irwin, V. H. '13 E, 14 EE
Johnson, E. L. '30 E
Jordan, Wallace E. '26 ChE
Madden, J. S. '30 E
Nelson, Carl H. '10 E
O'Brien, Raymond J. '11 E
Parsons, Sydney A. '25 E
Pearson, Charles W. '21 E
Peterson, Harold L. '16 C, '17 CE
Sartell, Page M. '24 M
Satori, Roy H. '21 E
Sime, Theodore L. '23 A
Stone, L. F. '22 ChE
PITTSBURGH
Anderson, Arnold O. '29 E
Anderson, M. M. '21 ChE
Blackshaw, Joe L. '28 M
Bleifuss, Donald '20 C
Frazee, L. M. '24 E
Joesting, Frederick D. '26 E
Kester, E. B. 'Ch
Luft, Hans Lawrence '24 MS
Nash, Russell O. '23 E
Rosenthal, Oscar '19 C
Selvig, Walter A. '09 Ch
Souther, Benjamin L. '16 Ch
Swanberg, John '25 C, '29 MS (CE)
Tanner, Elo C. '29 M
Taylor, Carl A. '10 Ch
Towle, Neal C. '12 E, '13 EE
Von Stocker, Selmer '28 M
SCRANTON
Eberhardt, Otto I. '03 E
SHARON
Brauch, Harold N. '29 E
Steinert, Emil '25 E
Wentz, Edward C. '26 E
STATE COLLEGE
Gjesdahl, Maurice S. '21 M
Tebo, Frank A. '28 C
SWISSVALE
Tunnell, Robert H. '24 E
WILKINSBURG
Bierwagen, Rudolph W. '29 E
Johnson, Douglas O. '28 E
Johnson, Sheldon '28 E
Locklin, R. B. '29 E
WILLIAMSPORT
Briggs, Luard E. '27 C

## RHODE ISLAND

PAWTUCKET
Knapp, Lester H. '12 E
PROVIDENCE
Tappan, Ruth W. '22 Ch
(Mrs. Joseph Dowling)
Vaule, S. A. '21 M

## SOUTH CAROLINA

CHARLESTON
James Grant '07 C
GREENVILLE
Kilburn, Elsie I. '27 MS

## SOUTH DAKOTA

ABERDEEN
Edman, J. H. '31 M
Odegaard, Harold T. '20 M
BROOKINGS
Mark, Reuben A. '11 C
Mark, Walter J. '09 M
LIGHT CAP
Blake, Henry B. '01 E
MITCHELL
Giese, H. D. '31 M
Miller, Ralph Harrison '13 Ch
RAPID CITY
Dimmick, Merton A. '26 E
SIOUX FALLS
Boyce, Leonard F. '12 M
Gran, C. L. '29 E
Hult, George A. '16 E
Johnson, Ellwood L. '30 M
Ransom, Ralph W. '23 M
Robertson, Kenefick '25 E
WALTERBORO
Mitchell, Lloyd S. '23 C

## TENNESSEE

BRISTOL
Butterworth, Russell I. '16 E, '17 EE
CHATTANOOGA
Knox, Chas. '28 C
Wannamaker, Homer F. '26 C
Withee, Warren '15 C
DUCKTOWN
Breeden, James R. '26 C
COPPERHILL
Hayward, Lawrence W. '21 E
Karns, C. B. '15M
GUILD
Irwin, Frank H. '16 E, '17 EE
ISABELLA
Anderson, E. G. '27 Ch
MEMPHIS
Grochau, Earl H. '21 C
Slocumb, Mary G. '25 ID
(Mrs. Lawrence Tvedt)
Tvedt, Lawrence A. '24 AE
NASHVILLE
Hansen, Arthur A. '25 C

## TEXAS

AMARILLO
Bolnick, Harry W. '27 C
Smith, A. S. '26 ChE
AUSTIN
Ferguson, Geo. '28 C
Helwig, Wm. F. '23 E, '27 MS (EE), '30 EE
BEAUMONT
Bernhagen, Lewis O. '06 A. C.
BROWNSVILLE
Sherwood, Edward B. '20 C
CLIFTON
Gustafson, G. '31 ChE
DALLAS
Chestnut, Geo. L. '97 E
Dahl, George '21 B. S. (Arch)
Fernald, Frank O. '04 C
Rounds, Fred M. '95 E
Smith, Donald T. '05 C
GALVESTON
Honey, R. K. '31 M
HOUSTON
Bakke, Oliver M. '03 Ch
Crane, Fremont '86 BS, '87 BCE, '98 CE
LUBBOCK
Kleinschmidt, Floren A. '20 A
PAMPA
Kernkamp, L. F. '30 AE
Wolfe, George E. '24 E
PORT ARTHUR
Ost, Roland E. '22 C
Weetman, Bruce '26 Ch

## UTAH

SALT LAKE CITY
Ashworth, Roy H. '11 E
Beyer, Theodore A. '03 C
Jones, Watkin W. '11 E

## VERMONT

ST. JOHNSBURY
Stillman, Marcus H. '09 E

## VIRGINIA

FORT EUSTIS
Grow, Robert W. '16 C
HAMPTON
Wagner, John W. '24 M
HAMPTON ROADS
Joachim, Wm. F. '20 M, '21 ME
LANGLEY FIELD
Rollin, Vern G. '29 M
PETERSBURG
Morris, T. C. '08 M
RICHMOND
Cornell, George M. '25 C
Jones, Noel W. '30 AE
Richardson, Wilbur P. '99 M
Riegel, Louis F. '11 E
QUANTICO
Strong, Frank D. '17 Ch
UNIVERSITY
Anderson, Lawrence B. '27 A

## WASHINGTON

CAMAS
Glenn, H. W. '24 ChE
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
NAPOLEON
Longworth, Fred '05 AC
NO. YAKIMA
Gilman, Nicholas A. '07 M
OLYMPIA
Olaison, Clifford E. '15 E, '16 EE
OROVILLE
Norelius, Lewis M. '06 C
PASCO
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Benedict, Geo. F. '03 E
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Jenkins, Clifford H. '25 M
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Kobe, A. K. '28 ChE
Linton, James H. '97 ChE
McKenzie, Lauren F. '09 E
Magnusson, Carl F. '96 E, '97 MS, '05 EE
Markhus, Olaf G. F. '97 E
Nelson, Geo. A. '25 C
Pearce, John Henry '07 E
Petrick, Alfred C. '19 C
Quense, John '01 C, '02 ME
Shuck, Gordon R. '06 E
Silliman, Henry D. '97 M
Stermberg, Carl '07 E
Stewart, Geo. A. '22 A
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Wiesner, F. E. '06 C
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Kaplan, Donald J. '30 E
Lindfors, Onni '30 E
Swart, R. H. '21 ChE
BRUCE
Buhr, Leo '23 C
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Weston, Wm. S. '02 C
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Peters, Chas. M. '27 E
Swanson, R. H. '23 C
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LA CROSSE
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Harrington, Russell '24 E
Lieske, A. W. '30 C
Meader, Glenn '26 E
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Hubbard, Robert T. '06 E
Jewett, C. L. '31 ChE
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Brown, Glendon '28 E
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Clark, Fred '27E
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WEST ALLIS
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## WYOMING

SHERIDAN
Pearson, Geo. '28 AE

## CANADA

COUTTS, ALTA.
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FT. FRANCES, ONT.
Hass, Paul O. '26 M
FORT WILLIAM, ONT.
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MACOUN, SASK.
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NEW TORONTO, ONT.
Jones, Idris V. '15 C
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Joselowitz, G. '18 Ch
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Loo, Pank Chuk '28 AE
Wong, Jee K. '16 M
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Williams, E. H. '03 M
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## CUBA

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FELSTEAD, ESSEX
Tronson, Carl A. '10 Ch

## GERMANY

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Hovey, B. K. '27 E

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Morris, Geo. E. '27 C
SAN JUAN
McKeson, L. J. '27 E

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### Brazil

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SAO PAULO
Nierling, Grant C. '25 E

### Chile

CHUQUICAMATA, CHILE
Knowles, Everett H. '20 E
TOCOPILLA
Carlson, Victor H. '20 E
Liese, Carl R. '26 C

### Nicaragua

MANAGUA
Johnson, Byron F. '20 C

### Venezuela

MARACAIBO
Gerdes, Carl H. '25 B. S. (C. E.)

# Power Plant Surveys

*(Continued from page 207)*

fines can be determined quickly is dispersing the soil sample in a 1000 c. c. graduate filled with water and timing the settlement of a calibrated hydrometer through various time intervals up to 24 hours. As the particles settle out, the density of the suspension becomes nearer unity, and the hydrometer settles. This, coupled with a sieve analysis, can show very closely the classification of the foundation soil.

In the application for the preliminary permit, a statement must be made as to the possible power to be developed at the dam. This calls for a stream flow measurement survey. From such a survey is computed the backwater curve and the elevation of the severance lines of the project area, also the time of acquiring a full head and the time of discharge of the reservoir. It is a well known fact that the elevation of the water surface of the reservoir formed by impounding a stream varies along the longitudinal center line. As one goes upstream, the elevation of the pool rises slowly until at some distance away from the dam the elevation of the stream is again normal. This phenomenon is known as the "backwater curve" and is dependent upon the energy gradient of the water impounded determined from the rate of flow through various stations along the stream in the reservoir area prior to the construction of the dam. Also a thorough knowledge of the inflow of the reservoir must be had to determine the power than can be developed.

To obtain such knowledge of the stream behavior, a series of stream gauging stations are established before the survey are started, at known distances apart along the stream. When a station is established, two general methods are used to obtain the flow of the stream; one is the meter and the other is the float method. The gauging stations should be established along straight sections of the river where the current is least turbulent. If the accuracy desired be high and time can be spared, two and sometimes three sections are located close together at each station. The cross-section of each station is determined by sounding, and the area divided into panels of equal width.

The field data as outlined above is sent to the office; the engineers gather it and compile the application for the license.

## ATTENTION ALUMNI

A year's subscription to the Minnesota Techno-Log will be given for each of these numbers of the MINNESOTA ENGINEER, as they are needed to complete our files.

| | |
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# THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

October, 1931 — Volume XI — June, 1932

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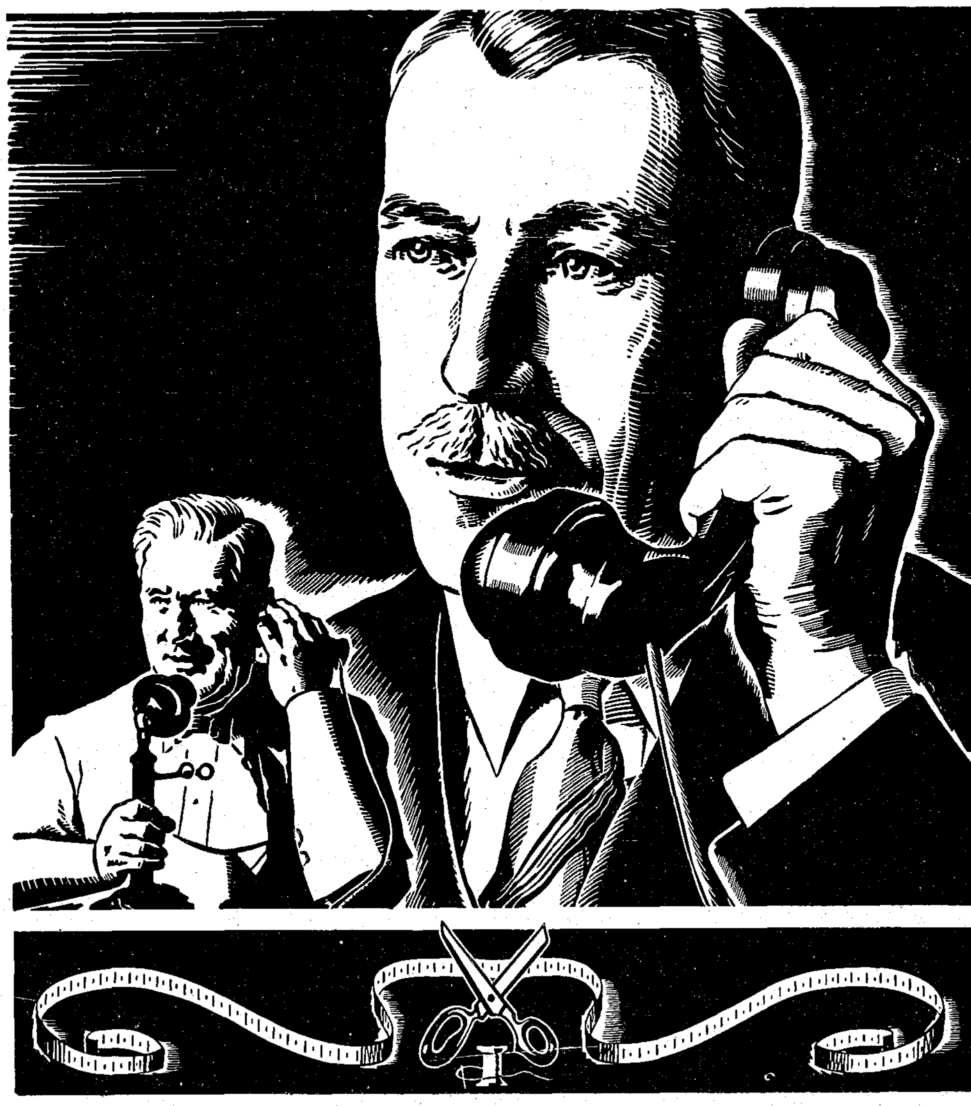

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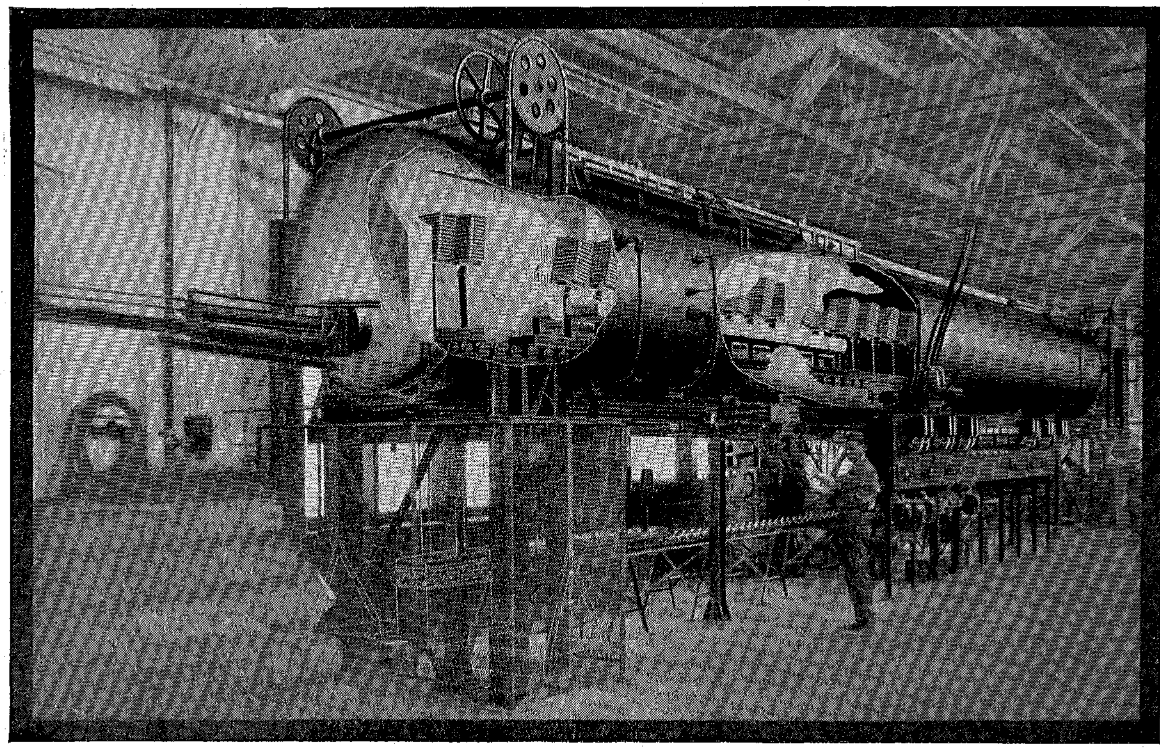

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