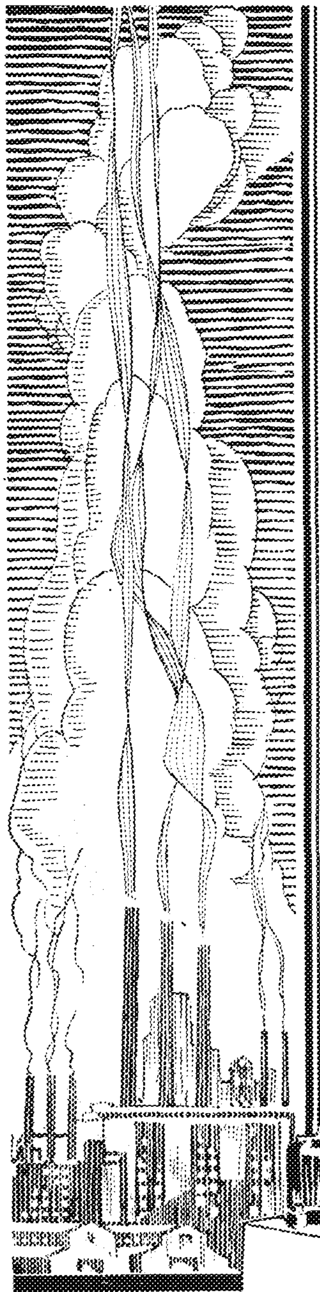
THE MINNESOTA TECHNO-LOG

Vol. XI OCTOBER, 1930 No. 1

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Compressed Air Is Now One of the Great Motive Forces of Industry



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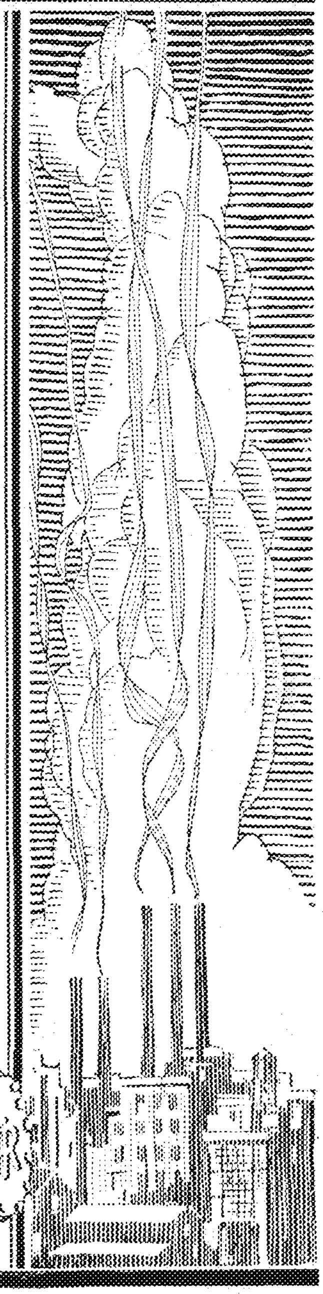

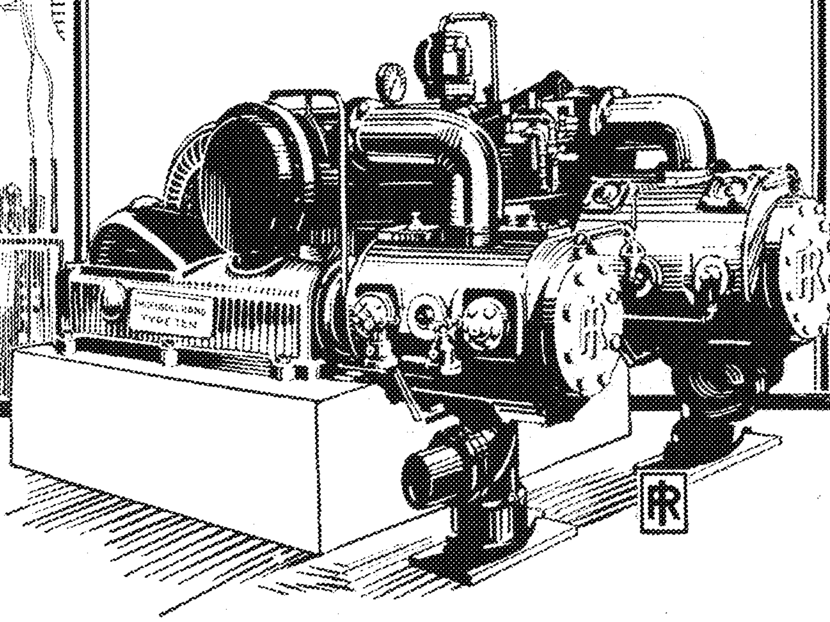

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N. E. C., the greater name in construction equipment, now unites great names which have long stood for quality and integrity—Koehring, Insley, T. L. Smith, Parsons, C. H. & E. and Kwik-Mix—for greater engineering, greater service and greater realization of quality.
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Mixers — Concrete, Plaster and Mortar.
Pardee Dam, California. Four 56-S Smith Tilters poured the 600,000 cubic yards of concrete shown here.
NEC
National Equipment Corporation
Milwaukee Wisconsin

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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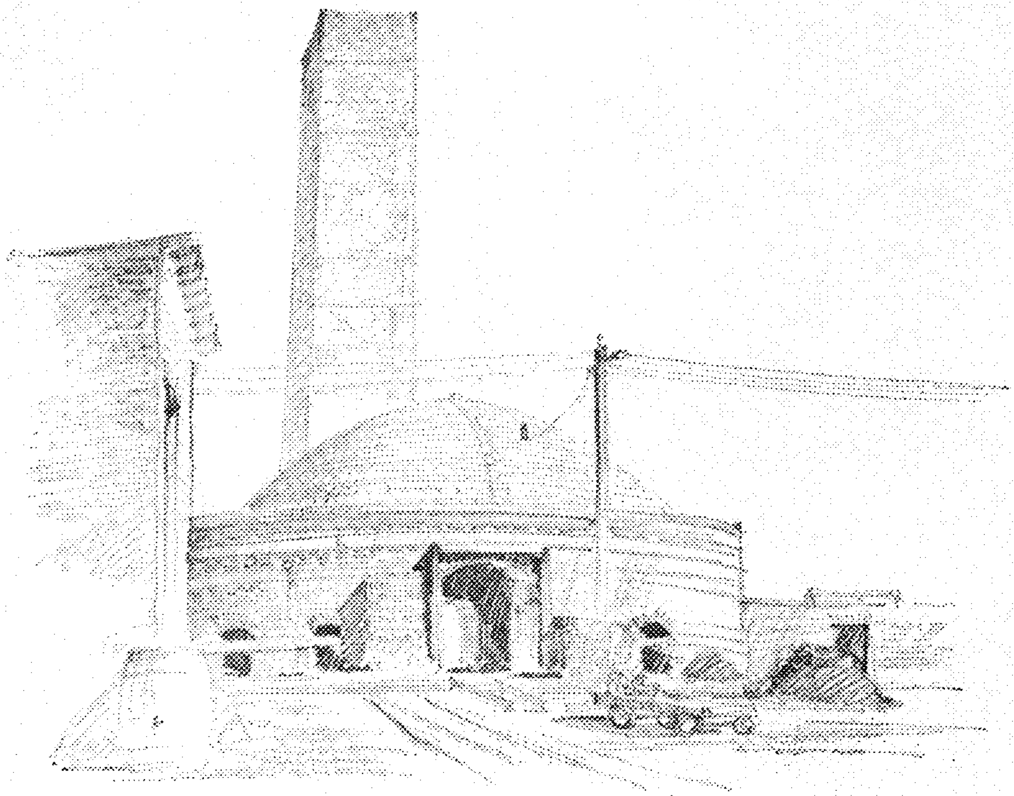

Postons Brickyard
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THE MINNESOTA TECHNO-LOG
UNIVERSITY OF MINNESOTA
Volume XI OCTOBER, 1930 Number 1

The Student's College Record as a Forecast of Success

By COLONEL R. I. REES,
President, Society for Promotion of Engineering Education

BUSINESS and industry are seeking, in constantly increasing measure, for men of trained intelligence. Because of the elimination process which goes on continuously through our educational system, industry looks to the colleges and universities of the country for ability and high capacity, and because many of our largest industries have to do with the applications of science in their production, engineering graduates of high quality are eagerly sought.

What are the fundamental characteristics which the employer expects to find in a graduate? Put in its simplest form, he expects to find a man able to think and to work. Contributory to these two small incentives, engineering education should, and does, develop trained intelligence, analytical ability and sound judgment based on fundamental knowledge.

Life on the campus and specific training also develop that important element necessary to success—cooperation in human relationships. A college education does much to assist the student in clarifying his life's objective, and in a well organized curriculum, such as engineering, in his senior year he has come a long way toward determining a specific career. All his college experience should develop power, vision, and clear thinking.

We may well ask ourselves whether there are elements in college experience which may indicate future success in life. If they could be discovered, they would be of the greatest value to both teachers and employers as indices of ability and fitness for the many fields of endeavor. As an indication of interest, the most significant, no doubt, are the course of study pursued by the student. A well ordered curriculum, aimed at a definite objective, is surely one of the best evidences of specific interest. Aside from the evidence of good judgment inherent in carrying out a well planned curriculum, consideration must be given to other elements in the student's experience, and those naturally are the time-consuming factors, namely, academic work, participation in extra-curricular activities, and the necessity on the part of many students, of contributing out of earnings to college expenses.

Many, no doubt, have read an article by President W. S. Gifford of the American Telephone and Telegraph Company, entitled "Does Business Want Scholars?", published in Harper's Magazine for May, 1928. The article presented a study of the relation of scholarship to progress in the Bell System. With fine cooperation from the colleges, scholastic records were obtained in four groups—one, those students graduating in the first tenth of their class, two, those graduating in the first third but not the first tenth, three, those graduating in the middle third of their class, and four, those graduating in the lower third of their class. The records of 3,806 men were studied.

In examining the progress of these graduates, the index of progress used was that of salary advancement. In a large organization like the Bell System, salary is an unusually accurate indication of responsibility and authority. Progress of several scholarship groups was plotted on the basis of salary in relation to years since graduation, and medians of each group used for bases of comparison. It is hardly necessary to say that the medians used represent the average of performance of men in the different groups, and that records of individuals in each group vary very widely from the averages. This means, of course, that there are individual exceptions—men who were poor students who are succeeding well, and men who were good students, succeeding less well,—but on the whole, the evidence is very striking that there is a direct relation between high marks in college and salary progress afterward in the Bell System. As an illustration, take the median salary of 498 men who stood in the first tenth of their class. At ten years after graduation, the median salary of this group was something over 10% more than the median salary of the entire group; at twenty years after, it was about 30% more than that of the median of the entire group; and at thirty years after, was 55% more than that median.

Without going into further details, the median of the first third at thirty years after graduation, becomes 20% more than the median of the entire group; the middle third at thirty years, about 5% less than the general median; and the lower third at thirty years becomes fully 20% below the median for the whole group studied.

It must be emphasized of course, that this study pertains to but one industry, but does it not fairly indicate that scholarship has some predictive value for success? This is a very brief summary of the conclusions in Mr. Gifford's article, and the charts accompanying it are interesting to study.

Studies of the influence of extra-curricular activities are very inconclusive. The progress of a substantial number of graduates was studied in relation to their participation in extra-curricular activities, on the same basis as scholarship. They are divided into three groups—those who had "substantial achievement," "some achievement," and "no achievement," and also as to type of campus activity undertaken, such as literary and editorial, managerial, social, athletic, and musical or dramatic. While definite conclusions could not be drawn from an analysis of the evidence, a few generalizations might be mentioned.

It can be safely stated, it is thought, that participation in extra-curricular activities has not as much good influence on the student's future as a good record of scholarship. As an illustration of this, in scholarship we find that men in the first tenth of their class, who constituted some 15% of the group studied, obtained a median salary of 40% more than the median of the whole group at twenty-five years out of college. Men of "substantial campus achievement" constituted 20% of the group studied at twenty-five years out of college, and obtained a median salary 20% above the median

(*Continued on Page 22*)

To Scrape the Sky

By EDWARD W. HANSON, Arch' 30

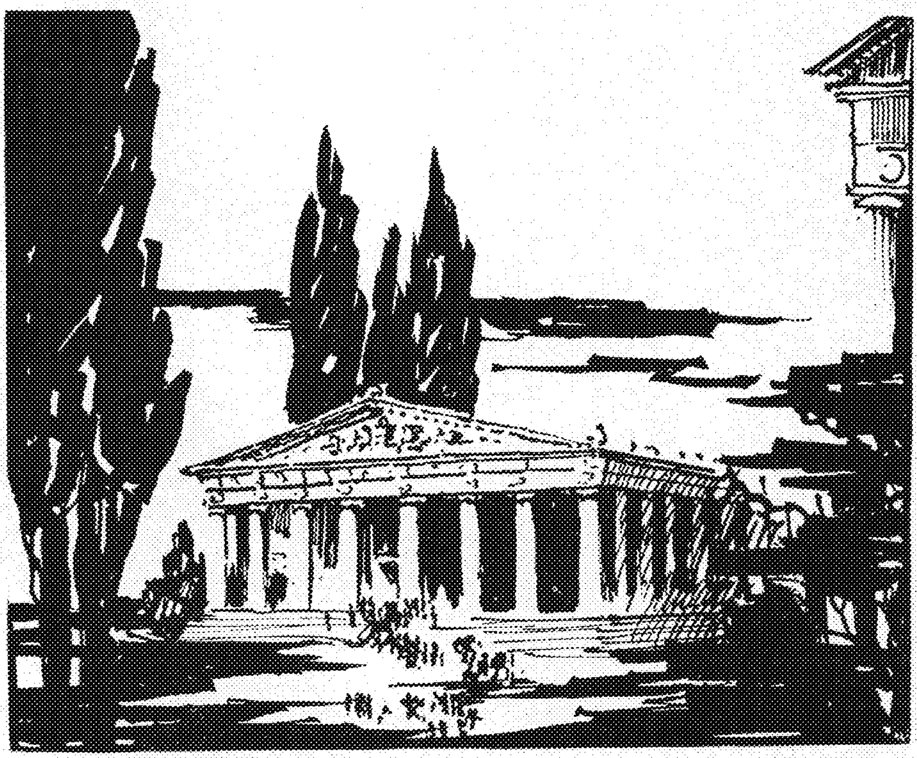
Illustrated by Robert Cerny, Arch '32

THE skyscraper is here, of that we are well aware, but possibly we may not be so well informed about its development. Why should all those vertical lines be there, with hardly a single horizontal line before it reaches the top? There must be some reason, some motive underlying this modern trend. Would you like to find it? Then come with me. We will find out together.

We are in need of a means of rapid transportation. Let us close our eyes for a moment. All right, our eyes are closed. Let us then allow our imaginations to run fancy free. We shall choose that mystical bit of our childhood—the magic carpet. What could be more advantageous if we are to delve into the mysterious origin and magical development of the modern skyscraper? Not only shall we be able to travel at will, but we may also turn back the hands of time to observe the ancients in the construction of some of our most precious monuments. Are we all safely aboard? All right, let us begin the quest. Whither it shall lead us we know not. But anyway it should afford an interesting interlude to the commonplace routine of life, to the rather tedious series of study periods, lectures, and recitations that appear so arduous,—and at times wholly boring. And then possibly we will come across something of unusual interest as we traverse Time and Space,—possibly we shall find something of far greater interest than advanced mathematics,—possibly we shall find something to increase our understanding of the why and wherefore of modern architecture.

We are in Egypt,—on the bank of the Nile. There is building going on before us, construction on a scale almost too stupendous for us to comprehend. But we can see that some sort of a temple is being erected, and that the simplest of building principles is being used, that is, the beam and lintel form of construction. Some primitive desert builder has found that by the simple process of laying one stone across two upright ones he has obtained an affair of fascinating possibilities. He passes the word on, and the parade begins. We see building after building, all the same. Each with its forest of columns, spanned by its tons of stone. Here is a principle of building that may well remain unshaken through the ages, until swept aside by the miracles of a golden age.

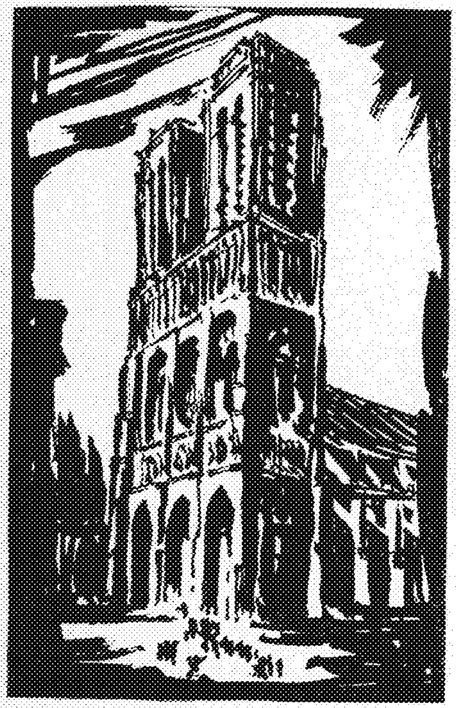
And now we are above Athens. Our magic carpet is carrying us with marvelous ease over a maze of beautiful white structures much like the ones we left in somnolent Egypt. That is, alike in that they have the same multitude of stone columns, spanned from column to column by the same stone lintels. But how much more simple, how much more beautiful, how much more vital are these white temples than the ponderous masses of stone on the Nile. One thing is observed in particular,—to be remembered after we have gone. The horizontal line is predominant, predominant in a perfection of balance. And the building is successful. Oh yes, we agree on that. We ask ourselves why, and are rather surprised that the answer is so simple. This ancient builder has a horizontal structure, and so, with a happy instinct, he emphasizes the horizontal, plays with it and dramatizes it. And the result? We can see for ourselves. Something fine has resulted. We are still admiring as we move on through time and space.



"Our magic carpet is carrying us with marvelous ease over a maze of beautiful white structures . . . . The horizontal line is predominant, predominant in a prefection of balance."

We have left Greece and are speeding northward, toward Paris. A great mass looms up before us. Ah, we are just in time to witness the raising of that splendid symphony of stone, the Gothic cathedral of Notre Dame. The scene seems to instill a restlessness in us. Can it be that coming from the static works of the Egyptians and Greeks, the dynamic force of this great structure has crept into us? We admit that we feel it, therefore let us remember it, as we remember all the rest we have seen. Remember, and pass on.

Familiar surroundings are coming up before us now, familiar and yet somehow different. Why is that? "I know," someone exclaims, "We are back where we started from, only it is twenty years before we left!" True enough. We are now in the average American city in the early twentieth century. What are we here for? To inspect the buildings,—the architecture. And what do we see? We see that something is vitally wrong. Something is missing in this design. Someone suggests that it is the third dimension that is lacking, and we immediately know that such is the case. The third dimension is missing, and we have not architecture, but sham. We feel this, as we float down the streets, and observe that the sides of all the buildings facing the street are beautifully ornamented and embellished, with expensive stone, or brick, or other materials. But the other three sides, ugh, they are horrible! And because they are horrible, they are the most conspicuous, with their flagrant signs, their crowning pent houses, and grotesque water tanks. Even the sight of familiar features from our travels through Egypt, Greece and France does not prevent us from leav-



"The scene instills a restlessness in us."

ing with an unpleasant taste in our mouths. And we should so like to end our travels with some startlingly beautiful edifice at which we might gaze with awe. Still, we have twenty years to go yet. Twenty years! Let us span them quickly, and see if old familiar forms will greet our eyes, familiar forms that have not been so poorly used as on streets we are leaving behind.

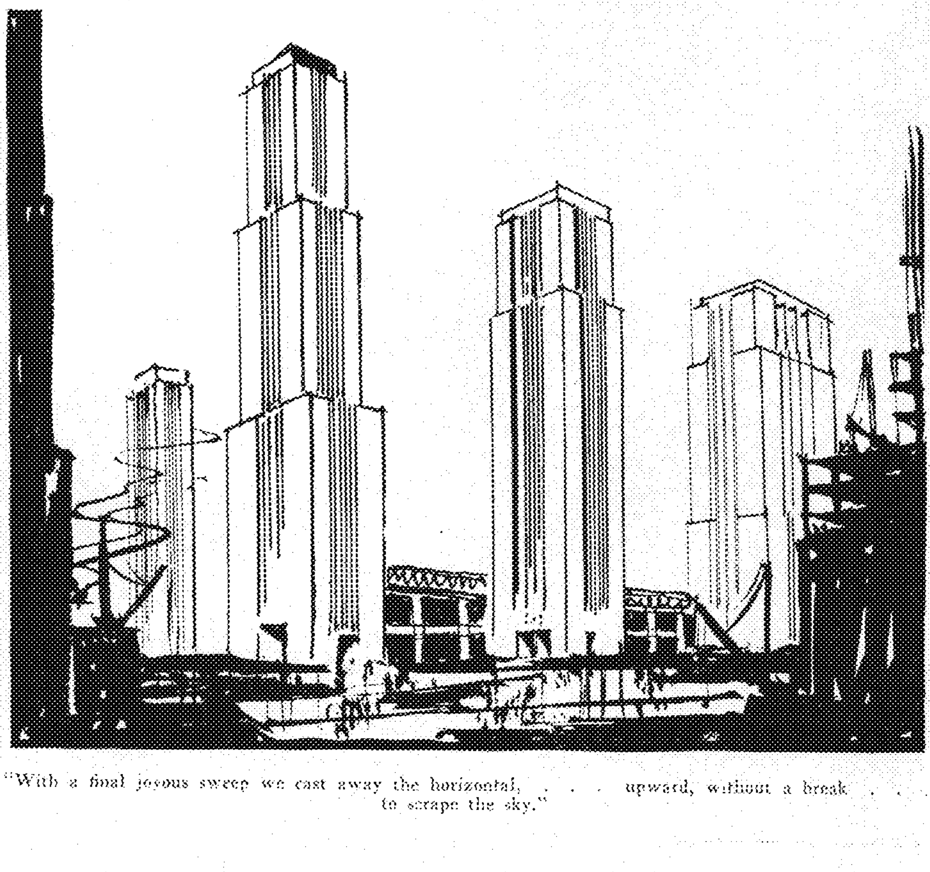
It is thrilling. Above the crowded streets of Manhattan we glide, through what someone has called the man-made canyons of New York. We shall stop here and observe this building, stop there and observe that one. We shall see enough to satisfy us, I feel sure. But shall we understand it? We have enough background, assuredly, to understand everything. Ah, here is a good subject. Why not stop here and begin to analyze?

This building before us, this skyscraper—it rises into the sky beautifully. Notice all those vertical lines that spring from the ground and travel unbroken to the very top, which is in the center, as you can see. Now notice how on the sides the building steps back as it goes up. Does it not force the eye up, ever up? Why is that? Think a moment. Think of that ancient Greek builder with the happy instinct. This building's designer has a structure of a mass that is predominantly vertical. Like the Greek, he has taken this vertical element and emphasized it. He has played with it. He has dramatized it.

Do we see any of the forms we found in our earlier travels on this building that represents the fabled modern age? No, not on the surface,—not to all appearances. Then of what good was all that previous study, pray inform us? Has it all been useless? Emphatically not. The spirit is there. The spirit of each one is there. From each we have taken something that we like, and cast away what displeases us. From the Egyptian we have taken what we call flat ornament, or flat carving. Instead of natural forms in this ornament we are using more and more machine-like forms, or the machine has crept into our lives to leave its indelible imprint. From the Greek we learned the priceless value of simplicity, of restrained ornament applied with commendable discipline, of beauty in stone that touches the heart. And from the Gothic builder we obtained a dynamic feeling that causes us to reach for the clouds. What matter that someone may say that the old is dead and the new is alive? We know that the new is a reincarnation of the old, expressed in a new and wondrous manner.

We have moved a little and are now at the foot of another of these famous skyscrapers. We are taking especial note of methods of construction. We see strange things. The old principle of beam and lintel construction has been cast aside. Someone has found a more useful and efficient method. Termed simply, it is called reinforced concrete. What wonders we can do with this new combination of materials! We are now able to erect structures that are practically monolithic in form. Monolithic? Oh yes,—all in one single piece. It is indeed fortunate to be able to make such long spans as this method enables us to, to concentrate so much weight in so few distributing points, to obtain such far reaching results at so little cost. And is it not particularly satisfying to find that these various points are expressed in the exterior, so that they result in a complete unity that is the essence of architecture itself?

The plan of these skyscrapers we find is fundamentally simple. We have so many columns spaced at a certain distance, carrying the load from above. Hardly interesting is it? No, it is not. But when we come to the exterior, the elevations and perspective—ah, that is a different thing. Have we not come back to the third dimension that was so lacking a few years ago? Why? The answer is, I fear, a trifle embarrassing. As the sky-scraper rose in height it became only too obvious that each side must be of almost equal prominence. No longer could we pretend that only the front would ever be seen. Therefore, there was only one thing to do, and we did it. We made all the sides of the building, whether they be four, six, or more—we made all the sides of the building beautiful. We began to work in the third dimension, and we stopped trying to work horizontal lines into a vertical building, to balance the horizontal and the vertical. With a final joyous sweep we cast away the horizontal, and raised our structures straight into the sky. Upward, without a break, without a stop—ever upward now we go, for our aim is to scrape the sky!



"With a final joyous sweep we cast away the horizontal, . . . upward, without a break . . . to scrape the sky."

The Engineers' Bookstore

The Engineers' Bookstore has declared dividends amounting to over $57,000 in the ten years of its existence

THE Engineers' Bookstore of the University of Minnesota is an example of successful student co-operation, based on service to its members through sound business management. In ten years the store has declared dividends to the amount of $57,213.06.

Twelve years ago the Engineers realized the actual need for a co-operative store. At first the Engineering Student Council purchased books and other supplies through the University Purchasing Department. Later the Council bought books through the Minnesota Co-op Co., thereby securing a discount of fifteen per cent. Under these systems it was impossible to supply the freshmen adequately, as the orders for books and equipment had to be placed far in advance. Upper-classmen bought outright from other stores in order to avoid the red tape and delay. Both of these plans were abandoned because they were indirect and inconvenient.

By 1919 the enrollment of the Engineering College had increased to such an extent that a more efficient system was imperative, and the Association of Engineering Students investigated the situation in an effort to determine the most successful methods of conducting student co-operative stores. Studies were made of the stores at Harvard, Cornell, South Dakota, California and elsewhere, and plans for the Engineers' Bookstore were then made in accordance with the lessons drawn from these other stores. In May, 1920, the first Board of Directors was elected for the new Engineers' Bookstore.

In May, 1921, after one year's operation the Engineers' Bookstore declared dividends of $2,127.98. The following year the Engineers' Bookstore established a branch store in the School of Business. This did not prove successful and was closed in the spring of 1925.

Annual dividends have been as follows:

1921	$2,127.98
1922	3,244.62
1923	4,814.09
1924	5,897.23
1925	5,317.24
1926	5,900.81
1927	6,996.91
1928	7,066.61
1929	7,663.96
1930	8,213.61
Total	$57,213.06

Membership in the store is secured by making a five dollar deposit which entitles the member to dividends on the total amount of his purchases. The five dollar deposit is refunded at the time of graduation or upon leaving school.

The Board of Directors consists of nine members: three from the faculty, five student representatives, one from each department, and the manager of the Bookstore. These men decide on the policy of the store and keep in close contact with the business and management through semi-monthly directors' meetings. The following men have been elected to the Board for the year 1930-1931.

H. Duncan Watson, Chairman, department of Mechanical Engineering.

R. C. Cady, Secretary, department of Electrical Engineering.

C. J. Olsen, School of Architecture.

Harold Graves, School of Chemistry.

Paul Staffeld, department of Civil Engineering.

Dr. C. A. Mann, School of Chemistry.

Prof. W. H. Kirchner, department of Drawing.

Prof. O. S. Zelner, department of Civil Engineering.

Harold D. Smith, Manager.

The Engineers' Bookstore has for its ideal, supplying to the students the exact materials needed in their courses, of proper quality, and at as low a price as is consistent with that quality. In drawing for example, the use of high quality material is urged; for notes and records a medium grade of supplies has proved satisfactory, while some things, such as scratch paper, should be as cheap as possible. The store policy concerning prices at which materials are sold has been to maintain a fair retail mark-up above original cost, thus avoiding criticism and trouble which would follow the adoption of a cut-price policy, but at the same time it is intended that store prices should in no case be higher than prices elsewhere for like material. Profits made under this procedure are returned to the store members as dividends as listed above.

For nine of the ten years of the store's existence the dividend rate has been 16⅔ per cent, and the accompanying income statement and balance sheet for the past year justifies the maintenance of this rate even though the total $8,213.61 is the largest thus far paid.

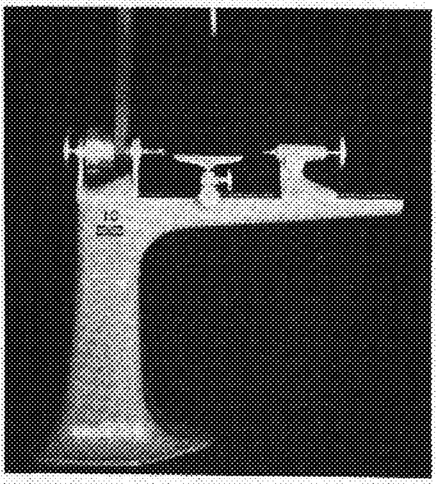
Annual Financial Report of The Engineer's Bookstore

PROFIT AND LOSS STATEMENT FOR THE YEAR ENDED MAY 31, 1930

Sales		$69,659.29
Cost of Goods Sold		51,693.01
Gross Profit on Sales		$17,966.28
Expenses		8,700.96
Operating Profit		$9,265.32
Additions to Income		
Cash Discount on Purchases	$ 410.70	
Interest Received on U. S. Bonds and Notes	643.79	
Other Interest Received	25.08	
Profit on Sale of Bonds	224.57	
Exchange on Checks	35.63	
Total Additions to Income		$ 1,339.77
Gross Income		$10,602.67
Deductions from Income		
Bad Debts Charged Off		2.42
Net Income for Period		$10,602.67
Surplus Balance June 1, 1929		11,112.12
Add: 1924 Dividends Cancelled		104.41
		$21,819.20
Less: 1922 Dividends Paid		7.64
1930 Patronage Dividends		8,213.61
Reserve for Cap and Gown Replacement		1,350.00
		$9,571.25
Balance May 31, 1930		$12,247.95

BALANCE SHEET AS AT MAY 31, 1930

Assets	
Current Assets	
Cash on Hand and in Bank	$1,549.23
Certificates of deposit	2,000.00
Accounts Receivable	1,016.65
Loans Receivable	175.00
Inventory	9,692.96
Total Current Assets	$14,433.84
Investments—U. S. L. L. Bonds	18,311.24
Fixed Assets	
Store and Office Equipment—Net Book Value	200.00
Cap and Gown Rental Costumes—Net Book Value	20.00
Total Fixed Assets	$220.00
Total Assets	$32,965.08
Liabilities	
Current Liabilities	
Vouchers Payable	$141.38
Deposits on Caps and Gowns	35.00
Patronage Rebates Payable	9,365.75
Total Current Liabilities	$9,542.13
Reserve for Cap and Gown Replacement	$1,350.00
Membership and Surplus	
Membership Paid in	$9,825.00
Surplus—Exhibit "B"	12,247.95
Total Memberships and Surplus	$22,072.95
Total Liabilities	$32,965.08



The new wood turning lathe designed by former Professor Shipley and Assistant Professor Richards.

The New Wood Working Lathe

By Assistant Professor W. H. RICHARDS
and RODNEY R. WOOD, M E '31

IN keeping with the progress of the University the Mechanical Engineering department has recently been equipped with a new type of wood-working lathe which is now in use in the pattern shops of the department. Designed and constructed in the University shops under the supervision of Mr. S. C. Shipley, former professor in the Mechanical Engineering department, and Professor W. H. Richards, the lathes already in use and those now under construction will equip the College of Engineering and Architecture with the best and most complete wood-turning apparatus of any college in the country.

In the design of this new lathe, three features were particularly stressed: first, safety; second, simplicity, and third, appearance. Several radical departures from the conventional design of lathes have given it decided advantages over the old types. The most noticeable change is that in the base; a single pedestal supports the lathe instead of the four legs which heretofore has been the most common type of support. When fastened firmly to the floor the new base rests very solidly becoming by its design more substantial than the four leg type can ever be. In addition, the one leg is situated on the left extremity of the bed giving the operator plenty of room in which to work without crowding. This increased operating room also tends to eliminate the possibility of accident. Furthermore the bases give the lathes a neat appearance. Taken as a group they permit a great saving in floor space and the reduction in number of legs facilitates sweeping.

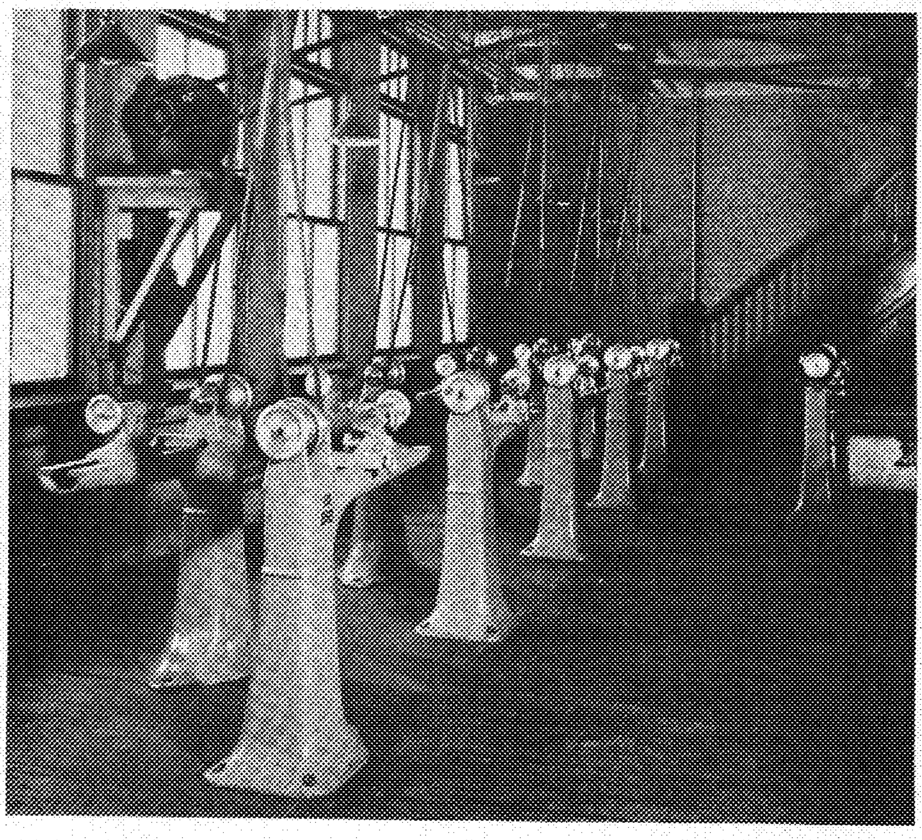
The lathe bed, like the base is cast in one piece. It is a hollow cast iron shell of cantilever construction, the top of which is machined to receive the tail stock and slide rest and into which the cone pulley support is built to make a complete unit. This bed is only four feet long, yet it will accommodate pieces which can only be taken by a longer bed of the old style. In keeping with the idea of solidity already emphasized in the base, the bed holds the tail stock and slide rest with such rigidity as to insure accuracy in turning long pieces. Again, with an eye toward neatness, this bed can be quickly cleaned of shavings by simply removing the tail stock and slide rest and using a single sweep of a brush; which is a very desirable feature, as much time is usually wasted in cleaning the corners of the old style lathes.

The simplicity of construction in the design of the moving parts of this lathe insures the operator against any possible injury. One can readily see from the photograph just how "fool proof" it really is. The three speed cone pulley is made of aluminum making quicker starting and stopping than could be obtained with the old cast iron pulley. Together with the aluminum handwheel, which is also a part of the head stock unit, it will give perfect speed control and enables the operator to check at will the rotation of the unit. The headstock spindle is mounted on ball bearings enclosed in dust proof cases which are held by a suitable support cast in one piece with the lathe bed. It is threaded on both ends making it possible to do face plate turning on either end.

In the design of the slide rest and tail stock, simplicity is again evident. The tool rest can be raised, lowered, or rotated and locked into place. The slide rest can be moved in two horizontal directions. Being fitted with a sliding eccentric clamp, it can be fastened in any desired position. The locking devices on both the tail stock and slide rest are of the hand-operated, quick acting type which eliminate the necessity of wrenches or other attachments in making adjustments. These parts, also designed to prevent the collecting of dirt, present round instead of flat surfaces to the falling shavings; hence they, too, are easy to keep clean. All handwheels and locks are of polished aluminum designed to complete the general idea of symmetry.

At the present time there are two motor driven lathes of the new type in the pattern shop. These have alternating current, four-speed motors mounted on the lathe bed in place of the cone pulley support. The motors were built specially for the lathe. On the left end of the

(*Continued on Page 20*)



Battery of eleven lathes in the Pattern Shop. Design and arrangement make for efficient operation.

The Technical Alumni Association

By PROFESSOR B. J. ROBERTSON, '14

ON May 31, thirty-two years ago, a newspaper column in a Twin City daily carried the following headlines:

ENGINEERS AT TABLE

Annual Banquet of the Varsity Crew at Holmes

At once the imagination pictures a racing shell crew composed of engineers, with a record covering their college with prestige. Reading further, the discovery is made that the college of that day was symbolized by a shell crew much as it is today by a football team, and that the real object of the dinner was to "keep alive the college spirit among the alumni of the College of Engineering, and that annual banquets were anticipated for this purpose."

For the information of the young reader, we are informed by Mr. E. H. Scofield that the Hotel Holmes was located next to the present Pence Building on Hennepin Avenue, the boiler room and power plant being located in a basement on the present site of the Pence Building. Mr. Scofield was night engineer there in '88, when the "Dynamo" was operated only until 12 midnight. Late prowlers were privileged to retire in the dark.

A copy of the menu is posted in the Secretary's minute book and bears the inscription:

THE
COLLEGE OF ENGINEERING
AND THE
MECHANIC ARTS
UNIVERSITY OF MINNESOTA

President Cyrus Northrop presided as toast master and Col. J. T. Fanning, Capt. A. V. Abbott, E. P. Burch, '92, H. B. Avery, '93, L. S. Gillette, '76, and Prof. G. D. Shepardson responded for Engineers and Alumni, while Adolph Wagner, '98, and H. A. Hildebrandt, '99, responded as representatives of the student body.

Among those present at that time were Mr. Max Toltz, Truman Hibbard, W. H. Kirchner, R. B. Fanning, F. H. Gilman, R. V. Wright, J. B. Gilman, Albert Graber, and C. H. Chalmers.

A permanent organization was formed, and L. S. Gillette, '76, was elected president, E. P. Burch, vice-president, and Prof. W. R. Hoag, secretary. The meeting adjourned with the singing of Auld Lang Syne.

So permanent was the organization that the next meeting was held nearly nine years later, February 18, 1907, when E. P. Burch was elected president, C. H. Chalmers, vice-president, H. B. Avery, secretary. T. L. Daniel was later appointed treasurer.

These officers were authorized to draw up and adopt a constitution, which they did shortly after their election. Article III of this constitution read, "Membership shall begin with a payment of a $1.00 life membership." Later in the year, a banquet was held in Donaldson's Tea Rooms, and we find W. I. Gray, E. H. Scofield, W. E. Brooke, Edw. E. Nicholson, W. H. Kirchner, Henry A. Erikson, F. W. Springer, H. E. Gerrish, J. V. Martenis, J. C. Vincent, H. A. Grow, and Albert Graber, among the guests.

A committee was appointed to confer with the legislators with regard to securing a $250,000 appropriation for engineering buildings. This committee was composed of W. I. Gray, Geo. A. Casseday, Geo. C. Andrews, C. H. Chalmers, Geo. W. Sublette, E. P. Burch, E. H. Scofield, and H. B. Avery.

They were assisted by committees of the Mineapolis Engineers' Club and the Civil Engineers Society of St. Paul, composed of men whose names are familiar, not only to the engineers, but to most of the people of the state: Geo. W. Cooley, F. W. Cappelin, Jas. G. Houghten, Wm. DeLabarre, Max Toltz, and others.

The secretary's record book also contains names and city addresses of all members of the Legislative Finance Committee. The Legislative Committee on University and University Lands and all members of the legislature from the Twin Cities are also recorded. A detailed account of the activities of the Engineering Alumni at that time would form an excellent code of activities for future alumni organizations, for we read that the legislature appropriated the full amount asked for, $250,000 for an engineering building and laboratory.

In reviewing the action of the State Legislature, the Minnesota Alumni Weekly calls attention to an appropriation for salaries larger than asked for by the Board of Regents and an appropriation for enlarging the campus, which the Regents had not endorsed, and gives credit to the alumni for presenting the needs of the University so ably. No important building funds were appropriated beside the $250,000 for the engineering buildings. Senator J. T. Elwell and Representative B. H. Timberlake were influential friends of the University on the Finance Committee of the Legislature at that session.

In general, a period of exceptional activity or over-exertion is followed by a calm. But this group of alumni were spurred on to *new* accomplishments.

On February 18, 1908, the following officers were elected: W. I. Gray, president; Geo. C. Andrews, vice-president; A. L. Abbott, secretary; T. L. Daniel, treasurer.

Mention was made of a deficit caused by the dinner given to the legislature, and other unusual expenses, but that, in response to an appeal, gifts had been coming in ranging from $15.00 to $1.00.

It was at this meeting that C. H. Chalmers reported that, in response to a request by the engineers, Governor Johnson had appointed Henry Hoveland, Mining Engineer, to the Board of Regents.

The next meeting was held May 1, 1909, and was really more of a farewell dinner in honor of Dean Jones than a meeting of the alumni. Business was evidently conducted in a very rapid and routine manner, all the officers being elected to succeed themselves.

About this time, the Government was getting ready to build the high dam in the Mississippi River, and the far-sighted alumni immediately sensed an opportunity to obtain an abundance of power for use at the University for experimental and routine purposes. A committee was appointed which was to endeavor to obtain water power rights for the University.

In the year 1910 no meeting was held.

In 1911 the meeting was called on February 10, with about sixty people present. J. B. Gilman was elected president, H. C. Bayless, vice-president, Truman Hibbard, secretary, F. B. Walker, treasurer.

The Treasurer's report was extremely interesting. There was no money on hand and no debts, but in order to put the Association on a good financial basis, the hat was passed and netted $47.25. (Those were the days when instalment buying had not come into its own, and we paid cash.)

On April 30, 1912, a meeting was held in the new Experimental Engineering Laboratory. J. B. Gilman was again elected president, T. L. Daniels, vice-president; W. T. Ryan, secretary; Albert Graber, treasurer.

The Committee on the High Dam, which had evidently been functioning since 1909, reported that the Government would consider the applicants for the power rights in the following order: 1) The Government itself, 2) The University, 3) The Twin Cities. Apparently, Henry Ford was a dark horse in the running at that time.

The need of a new Electrical Engineering Building was stressed, and this was probably the first in a series of public efforts which finally culminated in the construction of the new Electrical Engineering Building now on the campus.

On April 3, 1913, H. E. Gerrish was elected president, and the remainder of the officers succeeded themselves. Considerable discussion occurred at this time with reference to using the power from the high dam for the production of nitrogen.

The 1914 meeting was held in April in the Library of the new Main Engineering Building. The following officers were elected: Harry Gerrish, president, R. S. Carter, vice-president; Harry A. Grow, secretary, and A. S. Cutler, treasurer.

A very detailed report of the High Dam Committee was presented by W. I. Gray, chairman. This report covered the economic and technical possibilities of power generated there by the University. The manufacture of nitrogen, electric smelting of ores, and the development of hydraulic water wheels, etc., were outlined as important projects the University might carry out if it could make use of the power and water facilities at the dam.

The 1915 meeting numbered among its guests, President Vincent, Ralph Budd, Regent F. B. Snyder and J. A. L. Waddell of Kansas City. W. E. King was elected president, W. C. Beckjord, vice-president, and R. W. Otto, secretary-treasurer. Mr. A. L. Abbott, chairman of the Committee on the new Electrical Engineering Building, outlined the efforts being made by his Committee to have funds assigned for this purpose.

At the 1916 meeting, a new constitution, which had been prepared by a special committee in the interim, was adopted. H. E. Barlow became president, R. W. Otto, vice-president, and H. S. Loeffler, secretary-treasurer.

The attitude of the engineers during the period of the World War is ably expressed in a resolution adopted at the 1917 meeting:

"1. We stand to respond to the call of the country in ready and willing service.

"2. We undertake to maintain our part of the war free from hatred, brutality, or graft, true to American purposes and ideals.

"3. Aware of the temptations incident to camp life and of the moral and social wreckage involved, we covenant together as college men to live the clean life and to seek to establish the American uniform as a symbol and guarantee of real manhood."

The film, "Our Fighting Forces," was shown, and the following officers placed in charge of the organization: President, L. H. Cooper; vice-president, H. S. Loeffler; secretary-treasurer, R. C. Goebel.

No election was held in 1919, but a farewell dinner was given Dean Allen. A protest against the proposed use of the title, "Commercial Engineering," for a course in business to be given in the Arts College, was filed with President Burton.

The Association met in April, 1920, and elected Truman Hibbard, president; B. J. Robertson, vice-president, and Albert Buenger, secretary-treasurer. A typical treasurer's report was read, showing a *balanced account*, but balanced by the generosity of the president and secretary-treasurer, who had made up the deficit. The loyalty of various alumni is reflected by the repetition of their names in connection with the various active committees and offices of the Association, and by entry in the treasurer's books, from time to time, of various amounts donated by them in order that the Association might always end its year without a deficit.

With this record, the Engineering Alumni Association slept with its fathers until Dean Leland of the Engineering College appointed a committee to arrange for a joint Faculty and Alumni Dinner on Engineers' Day, May 16, 1930, at the University.

Mr. Harry Gerrish suggested that the old Alumni Association be aroused from its sleep and reminded of its ancient achievements. The dinner was accordingly made an official alumni meeting. R. V. Wright, who was present at the first meeting in '98, was brought from New York as speaker of the evening. Messrs. Max Toltz, C. H. Chalmers, E. H. Scofield, and E. P. Burch, who were also at that first meeting, were again in their places. Mr. Wright, President Coffman, Regent Wilson and Dean Leland addressed about 200 alumni and faculty members, with their ladies.

The reorganized Technical Alumni Association includes the College of Engineering and Architecture and the School of Chemistry, embracing at this time the following courses: Aeronautical Engineering, Agricultural Engineering, Architecture, Architectural Engineering, Interior Architecture, Landscape Architecture, Chemistry, Chemical Engineering, Civil Engineering, Electrical Engineering, and Mechanical Engineering.

R. J. S. Carter was elected president, I. Kvitrud, vice-president, S. A. Vaule, secretary-treasurer.

At the meeting, provision was made for a revision of the old constitution. The new board of directors will include representatives from all of the courses.

This was by far the largest engineering alumni meeting ever held, and the Rip Van Winkle of the Engineering College bids fair to come back, stronger, better, and wiser than ever, to find himself possessed of a large and enthusiastic family whose ambitions and needs have grown amazingly while he slept.

Past Officers of the Association

	President	*Vice-president*	*Secretary*	*Treasurer*
1898	L. S. Gillette	E. P. Burch	W. R. Hoag	
1907	E. P. Burch	C. H. Chalmers	H. B. Avery	T. L. Daniel
1908	W. I. Gray	Geo. C. Andrews	A. L. Abbott	T. L. Daniel
1909	W. I. Gray	Geo. C. Andrews	A. L. Abbott	T. L. Daniel
1911	J. B. Gilman	H. C. Bayless	Truman Hibbard	F. B. Walker
1912	J. B. Gilman	T. L. Daniels	W. T. Ryan	Albert Graber
1913	H. E. Gerrish	T. L. Daniels	W. T. Ryan	Albert Graber
1914	H. E. Gerrish	R. J. S. Carter	Harry Grow	A. S. Cutler
1915	W. E. King	W. C. Beckjord	R. W. Otto	Secy-treas.
1916	H. E. Barlow	R. W. Otto	H. S. Loeffler	Secy-treas.
1917	L. H. Cooper	H. S. Loeffler	R. C. Goebel	Secy-treas.
1920	Truman Hibbard	B. J. Robertson	Albert Buenger	Secy-treas.
1930	R. J. S. Carter	I. Kvitrud	S. A. Vaule	Secy-treas.

Noise and Its Control

NOISE! Noise! Noise! Street cars—the clang of wheels crossing switches, the ringing of gongs, the rumble of wheels against the hollow rigid street. Automobiles and the tooting of horns, the rumble of heavy trucks, the screeching of brakes, the chugging caused by loosened mufflers, all punctuated by the vicious put-put of fractious motorcycles. Airplanes buzz and hum overhead, riveters, newsies, fire departments with their screaming sirens, steam locomotives alternately wheezing and snarling,—steel against steel. That is noise.

And we must not forget the raucous medley made by human beings in the process of trying to enjoy recreation. They seem to delight in making noise—throwing wild parties, letting the radio loud speaker go full blast at night, making the proverbial whoopee. It is possible that they are only trying to get even with the noise of our modern civilization. It is certainly enough to stir the savage vindictiveness of even the most civilized at times.

Let us examine into the life of Mr. Average Citizen: He awakes from slumber first when he hears the people across the street come home around three o'clock in the morning. Most likely he manages to get to sleep after that just in time to be awakened by the tintinnabulation of the ash collectors on their rounds. He dozes off to the anti-lullaby of the milk delivery. Pretty soon the children in the apartment above stage a rough house that seems likely to bring the ceiling down on his head. Or maybe it's his own children who disturb him by popping into his room to tussle and romp,—anyway, he's wide awake now. Then he has breakfast and dashes to work. Whether he dashes on the street car or on the bus, or drives his automobile, he is subjected to just about the same degree of noise. He reaches his office, where he is subjected to the lusty clangs of typewriters, adding machines, and ventilating fans, or to his shop where he hears the constant whir and feels the vibration of machinery and the loading of trucks. (Of course, if he's a librarian, he can sit all day protected from the noise of the world by books, but so few of us are librarians.) By noon, he's quite ready for food and goes to a restaurant, where dishes clang and clatter in the full rush of lunch hour. Back to his work and special noises for a long noon hour. Then home through all the hustle and bustle of hurried throngs. There he may have peace,—and he may not, depending upon his family, his neighbors, the talk at the dinner table, and the conversational powers of the taxi drivers at the all night stand on the corner.

That noise is harmful is evidenced by the feeling of annoyance that it causes everyone, as well as by the fact that the abatement of noise has been given a great amount of attention by scientists of repute. From London comes the word from Sir Robert Armstrong-Jones who states that city dwellers are neurotic,—that sleep is indispensable to the neurotic who does the work of the world,—and the most disturbing noises to sleep are unusual and sudden horns, exhausts, drills, vibrations, whistles, milk cans, etc. The Noise Commission of London believes that preventable noise retards the efficiency of brain workers and that there is a great difference between the effects of street noises and industrial noises. Street noises are the more injurious because they are non-rhythmical, and the individual cannot become adjusted to them. They greatly add to fatigue by creating tensions that generate angry emotions.

The wide spread publicity recently given to the study of noise control and the great amount of research work conducted in the field have brought the subject to the attention of the thinking world in general and men of science in particular.

The accompanying article on noise and its abatement has been prepared in order to focus the attention of undergraduate engineers on this topic which will become one of the vital problems of all urban life within the next few years.

The TECHNO-LOG *is indebted to the Commission on Noise Abatement of New York City for much of the material that has been used.*

—EDITOR.

The Noise Commission of London further believes that neurosis may be attributed to noises,—just as in the case of shell shock. Similar observations have been made in Australia and Canada, where the chief journal speaks of this as the "Age of Noise" and adds that unless something is done quickly to check the greater volume of sound that assaults our ears, we may find ourselves deprived of a capacity for sustained work, clear thinking and energetic action.

The reaction to noise has also been studied by Dr. John J. B. Morgan of Northwestern University, who summarizes an experiment made on 50 men and girls who were reading a paragraph. When a noise is introduced there is an increased articulation on the part of the subjects in the attempt to keep their minds on their work. This causes an increase in breathing, and subsequently the speed of the reader decreases.

The reaction to noise of subjects working on typewriters was also examined. A noise was introduced and the pressure of speed and accuracy of the work compared with that done in silence was reported as follows, "The keys were struck with greater force during the noise." But this experiment was so arranged that the extra tension was not one due to voluntary effort to overcome the noise. Dr. Morgan summarizes his findings by saying that overcoming noise while working requires greater effort. There are some noises which seemingly are more disturbing than others, and, in the elimination of noise, those of high frequency should be especially considered.

The celebrated psychologist Poffenberger believes that Morgan judges the effect of noise too mildly, simply because efficiency is not markedly decreased by noise. And he adds that the ill effects of noise do not show themselves immediately because people never work up to their full capacity.

In order to save a lengthy dissertation on the psychological experiments conducted, it might suffice to say that countless medical men and scientists plead for the elimination of or diminution of as many noises as possible on the ground that: First, hearing is seriously threatened by continuous loud noise. Second, after a certain frequency of loud and recurrent noises, the accommodation muscles of the auditory system do not react. Third, it is not the steady roar of traffic, but its various noises which impose the chief strain on the ear. Fourth, Wittmaack has proved that some auditory organs are completely destroyed by prolonged exposure to loud noise, and he sees in this the positive development of deafness which often begins with an inability to distinctly recognize tones.

But aside from these effects, the abatement of noise is imperatively needed because it interferes with sleep. No argument is needed to the effect that every individual needs between six and nine hours of sleep. The vast majority are accustomed to take sleep during the night and for that reason at least, the hours from eleven to seven should be, so far as possible, entirely free of distressing noises. Growing children, many invalids, and all convalescent patients are in need of extreme quiet even during the day. Add to this fact, that many night workers, such as nurses and printers have to obtain sleep during the day, and we have another potent argument for the elimination of noise wherever possible. All street noises are directly harmful, because windows have to be closed and thus both the sick and the healthy breathe more vitiated air than they would if windows were kept open.

Furthermore the noise making of the streets interferes with attention and concentration, making the task of teachers and pupils more difficult. It is a far call from the days of Schopenhauer, whose chief complaint was of the intolerable noise made by the cracking whip as careless drivers passed through the streets, which interfered with the thoughts of man, to the present day of innumerable and intolerable noises of our many automobiles, motorcycles, street cars, elevated trains, and above all, of our riveting and excavating machines.

The foregoing account should serve to introduce us to the current opinion of experts as to the kinds of noises which are most harmful to the human organism, and the principal reasons why they are considered harmful.

Now let us see what has been done to eliminate noise in some of the larger cities.

In Berlin—the city that was once the example of the whole world for stately quiet—they have found themselves in these post-war years overwhelmed by modern noises not named in the old ordinances. The Berlin Chamber of Physicians has taken up this subject and after due study recommends that harmonious auto horns be used and that they be used sparingly both as to duration of sound and number of times tooted; that muffling devices be adequate and in constant repair; that motorcycles be especially constructed to avoid noise; that residence districts be thoroughly protected against traffic noise and in particular against night noise; that hospitals, sanitariums, and health resorts shall be guarded from encroaching noise; that health resorts shall do away with noise that interferes with the healing recreative nature of the place; that noise-making shops shall not be allowed to establish themselves in vacant apartments and private dwellings; that loudspeakers shall be used only at such times and under such conditions as tenants agree upon with their landlords —all this subject to police control. This is the program planned by medical men who have been roused by the modern noise in their once quiet city.

Now let us see what the Noise Abatement Commission has recommended for the City of New York.

Recommendations Concerning Noise Out-of-Doors

1. *Automobile Horns*

(I) The level of the emitted sound at the reference distance of 23 feet should be about 88 to 93 decibels. Levels in excess of this are unnecessary and objectionable. Levels less than this are insufficient to override the noise due to heavy street traffic.

(II) Fundamental frequencies between 200 and 300 cycles per second appear satisfactory. The overtones should be harmonics of the fundamentals. The energy should preferably be distributed approximately uniformly in frequency, with just enough energy in the higher frequency ranges to secure directive properties. A relatively large amount of energy in the higher frequency ranges causes the sound to have a sharp and disagreeable character. The presence of inharmonic frequencies in the sound wave causes the sounds to have a raucous character.

(III) Since an automobile horn must produce a rather loud sound in order to be useful as a signalling device, the use of horns should be severely restricted. In particular, the sounding of the horn should be prohibited when an automobile is one of a large number blocked in the street.

2. *Traffic Control*

Since the volume and the composition of street traffic largely determine the out-of-door noise at any particular place, all efforts should be made to keep traffic volume down and to restrict the type of traffic to that of the least noisy character. This can be done by traffic laws, by restriction of building heights to keep down congestion, and by multiplying thoroughfares. If it is particularly important to have quiet in a certain neighborhood, for instance near a school, a hospital, or a court, traffic should be so routed in that section of the city as to reduce the volume to a minimum in the immediate neighborhood under consideration and to keep commercial traffic away.

3. *Automotive Vehicles*

Other than horn sounds, the noises produced by a motor truck, bus, or automobile are due chiefly to engine, gears, brakes, chains, tires, and rattling loads; of these the engine exhaust is generally the most noisy. Adequate mufflers should be required, and the use of muffler cut-outs should be prohibited in the city. Power should be transmitted by gears, not by chains. Loose frames, windshields, tailboards, and loads should be prohibited. The noise of changing gears should be reduced. For the present, the goal should be to make motor trucks as quiet as the present passenger automobiles, and to keep all automobiles as quiet as the less noisy half now are. These improvements could be attained by the proper construction, care, inspection, and use of the vehicles and would reduce the average street noise level at most places in the city by 5 to 10 decibels.

4. *Elevated and Surface Electric Lines*

From the standpoint of noise on the street, elevated lines should be replaced by subways, and surface street cars by buses. These changes would reduce the maximum noise at most places on the streets involved by 7 to 10 decibels, and by 2 to 3 decibels, respectively.

The noise produced by an elevated train or a surface car may be reduced appreciably by so constructing the rails and rolling stock that sudden jolts and impacts are eliminated. A street car passing over a track crossing causes a noise about 6 decibels greater than that for ordinary track; and a street car moving fast over ordinary track causes about 7 decibels more noise than does a similar car moving slowly over the same track. Street cars should not be allowed to move rapidly over track crossings, and no crossings should be located in the immediate vicinity of a hospital or a school.

5. *Street Surface*

Since the noise due to a horse-drawn vehicle on an asphalt street was found to be about 12 decibels less than that for a street paved with cobblestones, a great improvement will result from the introduction of proper street surfacing in districts where horse-drawn vehicles are numerous.

By careful and constant repair, street surfaces should be kept free from irregularities which cause jolts to passing vehicles.

6. *Other Sources of Noise*

All vehicles, wagons, trucks, and carts, whether propelled by motors, drawn by horses or pushed by hand, should be provided with rubber tires, which should almost universally be pneumatic.

The ordinance already passed restricting the use of loud speakers on streets should be enforced; and attention should be given to loud speakers in homes which disturb persons living nearby.

The measurements indicate that the noise from a boat whistle in the harbor frequently attains such a level that conversation is interfered with in rooms as much as a quarter of a mile distant. A noise of this intensity occurring at night will often interrupt sleep. It should be possible to mitigate this nuisance by restricting the duration and the frequency of occurrence of whistle blasts; and it is not unlikely that measurements of the sound intensity required for proper signalling by boat whistles in the harbor would indicate that reductions of 10 decibels or more could in many instances be made. If the sound levels now caused by boat whistles are

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THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Human Engineering

THE unprecedented technical and economic developments of recent years have not only brought the human problems of industry into a position of critical importance but have rendered them more intricate and difficult. Educational institutions, and especially engineering schools, should take cognizance of these developments and alter their curricula so as to give their students as wide an understanding as exists at present of the human problems of industry.

Furthermore the human problems of industrial management have also acquired a new social significance due to the change in attitude toward social problems. For just as in medicine,—the last few years has seen a change in point of attack from one of relief or cure, to one of prevention. The internal conduct of industry is the origin, and therefore the point of proper attack for prevention and cure of a wide range of social problems.

It is strange that the social sciences have continued to look on industrial problems from without, and to study the consequences of industrial management without studying the managerial problems from which these consequences flow. Sociologists, for example, have studied the problems caused by the employment of women on night shifts, but have rarely studied the economic and manufacturing conditions of which the night work of women is a consequence. Greater correlation between the various sciences is needed before much progress can be made in the field.

For example, in the introduction of labor saving machinery there arise questions relating to several sciences; such physiological problems as fatigue, such psychological problems as capacity to learn, such psychiatric problems as the emotional effects of fear of loss of job, such social problems as the absorption by the community of workers thrown out of employment, and such economic problems as the absorption of increased output. These are but a few of the angles from which the sciences of human nature can contribute to the solution of the managerial problem of how labor saving machinery can best be introduced.

Coordinated study of such problems will not bring managerial formulae or precise solutions,—human problems, even in industry share the ineradicable individuality of human personalities. But such study will gradually develop an orderly and penetrating understanding and a scientific method of approach. This will assist engineering students to become adequately prepared for human as well as material aspects of their work.

But coordinated study will be productive tomorrow—not today. It is a process that requires time, and more time. Yet we find ourselves confronted with these human problems of industry today—the problems themselves are of the present, and we must endeavor to find an immediate solution. In order that engineers may not enter the world of industry under great handicap, it seems advisable that they be instructed in the human aspects of the work they plan to undertake. Why is it that engineers,—men who are frequently called upon to take charge of undertakings which depend for their success upon human problems, are so woefully lacking in a knowledge of the sciences of human nature? Simply because their education has been confined to a study of the material sciences. To produce the true engineer, then, we have need of a radical change in course of study. Let him be taught psychology, and physiology, and economics, and something of all the great sciences of human nature. Let educators, and students remember that "The proper study of mankind is Man."

All-Engineers' Day

ANYONE who is at all acquainted with the University of Minnesota knows of the day when all loyal engineers honor their Patron Saint. Yet few of the many who watch or take part in the exercises of the day visit or think of the Chemistry building and its exhibits. None of the sciences is more far reaching in its effects, yet most people are interested in some of its applications even though they may not understand the principles involved. Since Chemistry is of such importance in modern life, it deserves consideration. But in recent years this cooperation has been visibly lacking.

As a result, there has been much discussion in the School of Chemistry during the past few weeks and even the past months concerning the advisability of having a separate Chemistry Day. Plans were formulated for an extensive display of chemical equipment and for the demonstration of various industrial processes. The School of Chemistry is very fortunate in possessing a permanent display of ore samples and apparatus which is placed in cases in one of the first floor corridors. The School also has a large collection of engineering equipment which would prove of interest to students in other technical schools.

Its students, as well as other engineering students are kept very busy with classroom and laboratory work. The time necessary to prepare such an exhibit would seriously undermine scholastic records. Far better results will be obtained by whole-hearted cooperation with the other engineers, better for the students concerned, and better for the University. A little bit of thought on the chemists' part and a bit of consideration by the other engineers will assure an even more glorious day for His Irish Majesty.

Cooperation and coordination are the watchwords of success. Let far-sighted engineers see the many benefits to be derived from combining the efforts of the School of Chemistry and the other technical groups in order to produce a super-Engineers' Day,—in which all engineers receive a part in the work and reap a reward in the benefits.

Freshmen Hail!

ANOTHER large group of young people has been added to the roster of the University with the opening of the school year. They come from all parts of the world and from all walks of life. While members of the University, they are largely placed on a democratic basis of leadership based on demonstrated ability. The reasons for their coming are many and varied. To some, a University career is an end in itself; to others it is but a preparation for advancement in later life. The latter is, or should be, the rule for anyone who enrolls for a technical course. This is not to under rate the advantages beyond technical training which may accrue to engineering students by reason of their college life, but the primary aim should be as stated. If it be granted that the premise is true, it would be well for each new student to fix his attention on the question of how to obtain the maximum value from his course.

The old advice to a freshman to "Get started right, and get started early" has been repeated so often that it may be classed as a proverb. Time has demonstrated its entire truth. The mortality rate is high at the end of the first quarter for technical students. Perhaps no single cause contributes so much to this deplorable condition as does the fact that many new students do not adjust their activities to conform to the demands which the classroom makes on their time. If the freshman will heed the advice to get started right, he will have done much to insure himself of success. He will have budgeted his time to allow for ample study for each class; he will have formed habits of study which will permit the maximum intake of knowledge for the minimum output of time; he will have formed friendships and associations which will be helpful to him all through his college days; he will have decided upon a rational course in the matter of extra-curricular activities. If he gets started early, the adjustments will be much easier to make, and more fruitful of results than if done later. Perhaps it will be worth while to investigate a little further these advantages to be obtained from the proper start in the technical courses.

A common complaint is that the stiff schedule carried by technical students entails too much study, that there is insufficient time to prepare properly before each class period. This may be true where there is much wasted time, but can hardly be the case if careful use is made of the hours which are available for study. In this connection, it would be well to note that any condition which interferes with allowing a sufficient time for study, should be removed. No outside activity should be permitted to infringe on the study period, be it work, extra curricular activities, or pleasure. Having decided upon a schedule, all that remains is to adhere to it. Another prolific cause of failure or mediocrity in a college career is improper study habits. Concentration on the matter at hand will insure the student of gaining the knowledge in the minimum of time. Any condition which will interfere with concentration should be ameliorated if possible. A systematic attack on the problems to be solved is much more likely to meet with success than is a haphazard method. Neatness, good arrangement and accuracy should be striven for in the first draft of any written work, to reduce copying to a minimum. To obtain a thorough grasp on any subject, the fundamental principles should be mastered before attempting to apply any formula in the solution.

The friendships and acquaintances which a new student acquires will have a great bearing on his future. If they be with the right fellow students, they will be of great help to him and conversely. We are all largely guided and influenced by our associates, and consequently our intimates should be chosen with care. A friend may be the greatest single inspiration in one's life; he may point us to greater achievements. Once admitted, he should be accorded all respect and proper treatment. Many prominent men have declared that the greatest single benefit they received from a college career was the friendships and acquaintances formed there.

Lastly, we come to the matter of extra-curricular activities. Some have no desire to engage in such, others not the special gifts required, and others not the time. To those who have the opportunity, the field of outside activities offers opportunities to develop their personalities, to broaden their outlook, and to express their special interests. Often, too, such activity is a repayment to the University for the opportunities it offers. The idea to be borne in mind, however, is that the studies are of prime importance and must engage the first attention of the student.

Welcome, freshman engineers, may you merit all success and may such success come to you. With youth and health and enthusiasm, the world is yours to conquer; may you uphold the traditions of the technical campus and advance its ideals to new heights.

Stabilizing Business

THE efficacy of building construction as a means for overcoming the unemployment problem and of stabilizing business in general is shown by a recent report of Doctor Julius Klein, assistant secretary of commerce. Figures for the first six months of the current year show that $400,000,000 more has been expended during the first six months of the current year than was spent in the corresponding period of last year. A division of expenditures shows that $360,000,000 was spent this year for highway improvements, $200,000,000 for educational buildings, $105,000,000 for pipe lines, $130,000,000 for railway construction and $85,000,000 for bridges, making a total of $1,110,000,000.

In order to obtain an idea of the general benefits conferred by construction work, it is interesting to examine the construction of the new Department of Commerce building in Washington, which will soon be completed at a cost of $17,500,000. Materials, mechanical equipment and furnishings for this structure are coming from all of the forty-eight states. Beneficiaries of the work are the limestone, granite, marble, structural steel, hollow tile, lumber, wood finishing and sheet metal manufacturing industries, together with the manufacturers of rails, screws, locks, glass of every sort and many kinds of paint.

In the mechanical equipment of such a structure, a wide variety of appliances is included ranging from watchmen's appliances to thermostatic valves, from elevator interlocks to water softeners, from boilers to air-conditioning apparatus.

And to list the different classes that will be directly benefited by this one building would be a laborious task. A few might be mentioned: factory employees, quarrymen, miners, farmers, foresters, transportation workers, merchants and their staffs, engineers, architects, draftsmen, and innumerable laborers in the construction industries.

Work is the obvious answer to unemployment,—and building construction provides new jobs. The current experience with building construction as a means for relieving unemployment seems to indicate that most communities will find themselves justified in undertaking public works programs immediately that sooner or later must be carried out. Workers thus aided will be kept actively in the market as buyers; their resources will not be consumed, their spirit and morale will be effectively maintained, and the entire community will be able to enjoy the permanent benefits conferred.

The present economic condition of the country is undoubtedly as much a mental depression as it is a financial or material depression. The people have heard the cry of "Wolf" and have kept their money under lock and key. Mob psychology has come into play. Fear of impending catastrophe has gripped the country,—and until the mental set is changed, conditions will improve but gradually.

NEWS FROM THE TECHNICAL CAMPUS

Electrical Curriculum Changed by Committee

The findings of a committee especially appointed by Professor Bryant two years ago to study the curricula of the country's leading engineering schools, has resulted in several changes in the required courses for electrical students.

A great many schools, according to the findings of the committee, are giving a course in alternating current circuits in the junior year. Machine Design as a required subject for electrical engineers, has been eliminated, thereby permitting an enlargement of the major course. This is also in line with the opinion of other electrical engineering faculties as expressed in their curricula.

The course in Electrical Design will be given in the senior year as heretofore. Machine Design and its allied subject, Strength of Materials, have been previously given in the spring quarter of the junior year. These two non-major subjects comprised ten of the fifteen required credits. A four credit course in electrical engineering now replaces the three credit direct current machinery course formerly taught during the junior year. The new course includes an intensive study of alternating current theory in addition to that of direct current machinery.

Now by studying alternating current circuits in the junior year, seniors will be able to receive more advanced training in the theory of alternating current machinery and in the complex phenomena occuring in communication engineering.

Dean Leland Attends Educational Conference

Dean O. M. Leland of the College of Engineering and Architecture and School of Chemistry, left Monday, October 13, for Bethlehem, Pa., to attend a conference on relations of industries held in connection with the dedication of the new James Ward Packard laboratory of mechanical and electrical engineering at Lehigh university.

From there, Dean Leland went to New York City for a conference with Mr. H. P. Hammond, director of the Society for the Promotion of Engineering Education. This conference was held on Saturday, October 18.

Engineering Library Obtains New Books

The Engineering library recently announced a number of accessions obtained during the summer vacation. Books covering practically every field in engineering are listed among the additions.

Among those of special interest might be mentioned "Cost Finding for Engineers," published by C. Reitell in New York, which is one of the most recent and comprehensive surveys on cost analysis. A copy of Ricardo's "Engines of High Output" was also obtained. This volume is recognized as one of the most authoritative texts ever published on motors of this type.

Many other authoritative and instructive books were obtained, and the Librarian invites all those interested to examine the lists of recent accessions.

New Courses Required of Mechanical Students

Course in public speaking and surveying have been substituted this year for drafting courses 28 and 29 as part of the requirements for mechanical engineers. Production Factors, an elementary course in Industrial Engineering, has also been added to the requirements beginning this year.

Too great a portion of the student's time in the past has been spent on drafting and design, according to J. R. DuPriest, head of the Mechanical Engineering Department. It is believed that now that the precedent has been established many additional changes will be made in the future.

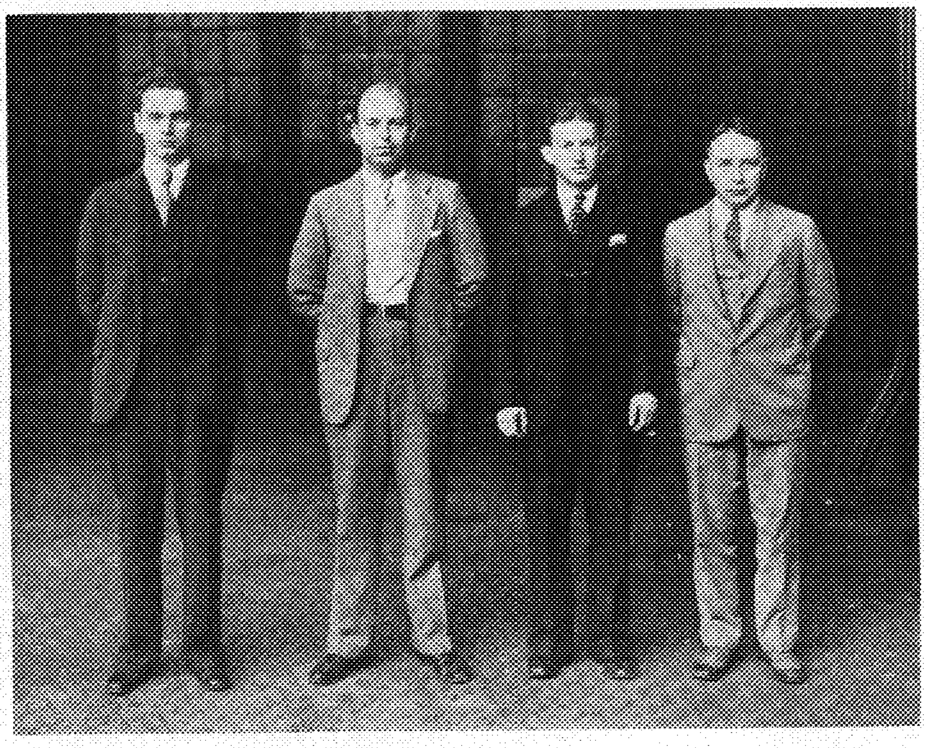
"Big companies," said Mr. DuPriest, "are becoming more interested in the graduate engineer rather as a possible future executive than as a draftsman. In former years the graduate engineer was almost invariably required to serve his apprenticeship in the drafting room. If he showed exceptional ability he was promoted to the position he seemed best fitted for.

"Today executive heads of various industries select mechanical engineers who show qualities of leadership and train them with an executive position as a definite objective. For this reason the curriculum should include those subjects which give the graduates of this department a broad background that will equip them better to fill places in industry other than as designers, builders, and operators of machinery."

Four Graduates Complete Westinghouse Course

Four students who graduated from Minnesota with the class of 1929 have recently completed the graduate student course of the Westinghouse Electric & Manufacturing company, East Pittsburgh, Pa., receiving the degree of commercial engineering. Reading from left to right they are: A. M. Fisher, D. M. Bohrer, and J. M. Millunchick who have been assigned to the Industrial Sales department and J. R. Ginnaty who is now in the Advertising department.

J. Robert "Jack" Ginnaty worked on the staff of the MINNESOTA TECHNO-LOG when attending the University and acted as Managing Editor during his senior year. He was very active in all campus activities, being co-author of the Arabs most recent production, "Enginferno," and one of the charter members of Alpha Tau Sigma, honorary engineering journalistic fraternity. Mr. Ginnaty was also elected to Plumb Bob during his senior year.



NEWS FROM THE TECHNICAL CAMPUS

Bookstore Adds Library of Modern Literature

This year the Engineer's Bookstore has added a library of popular priced modern literature to its shelves which formerly contained only scientific texts. The two types of books offered are the Star Series and the Modern Library.

The Star Series is a collection of full library size, cloth bound books of biography, history, travel, science and letters. The stamp of public approval has been placed on every title in the series, as they are best-sellers,—books which originally were sold at from $2.50 to $5.00 and are made available in the Star Series at the price of $1.00.

The Modern Library Books are a collection of 175 books by modern authors of the first rank supplemented by a group of books that, although they were written centuries ago, are still modern in the full sense of the word. They are of pocket size and sell for $.95 per copy. They range in scope from an anthology of American verse to Hemingway's "The Sun Also Rises," from "The Life of Jesus" by Renan to "Mlle. de Maupin" by Gautier. They also include a great number of books dealing with science, poetry, and the fine arts.

Experimental Equipment Designed During Summer

During the summer vacation, faculty members, graduate students and other interested parties have been busily at work in the construction of additional equipment for experimental work. Professor Boehnlein has designed a wind tunnel, while Professor Priester has completed the construction of a visual strain gauge, and Professor Rowley has devised an apparatus for testing the heat conductivity of woods.

The Aeronautic Engineering department now has a wind tunnel which will be used in the testing of model airplane members. The tunnel fills a good sized class room. The cross-section is an eight foot square, built around the class room in the form of a severed rectangle resembling a capital "C" laid horizontally. The electric motor which creates the wind and accompanying noise is rated at thirty horse power, and is connected directly to a four-blade propeller. The model to be tested is placed in the severed opening in the "C" across which the wind passes at speeds ranging from 37 feet per second at 1,000 r.p.m. to 75 feet per second at 1,700 r.p.m. The tunnel is almost structurally complete at present, lacking only the necessary baffle plates and wire mesh to make a consistent air stream across the cross-section of the opening. These plates have to be placed according to information derived from a complete study of the characteristics of the system at various speeds of the propeller. Professor Boehnlein, the designer, hopes that the set-up will be ready for service sometime late in the quarter.

The instrument designed by Professor Priester is based on the optical principle of polarized light. The light of nine 100 watt lamps is passed through a ground glass diffusing plate and reflected at the proper polarizing angle from the surface of a black glass reflector. Through a Nicol prism one is able to view a celluloid model placed in the polarized light. In this model the stress is made evident by shadows, such as

(Continued on Page 20)

radial lines about a perforation, caused by a strain of torsion, compression, or tension. The results of this procedure are purely qualitative but are of great value in the study of the more complicated mechanisms such as gear teeth and unusual bridge members. Professor Priester hopes to have in the near future the necessary equipment to photograph the evidence of the strain and also a projection outfit for the purpose of casting views of this on the screen for lecture work.

The American Society of Heating and Ventilating Engineers in cooperation with Professor Rowley is conducting an experiment on the heat conductivity of various types of wood. The equipment used in the experiment, a form of calorimeter with an elaborate system of temperature controls, was designed especially for this experiment by Professor Rowley. The work is being carried on for the National Lumbermen's Association. The study will probably continue well into next year, after which the results will be published by the Association.

Beneath this sod
Lies old man Ligger.
The gun wasn't loaded
So he pulled the trigger.

Course of Study Changed in School of Chemistry

Keeping pace with curricular changes made in the other branches of the technical schools, a number of alterations have been made this fall by the School of Chemistry.

Chemical German will continue to be a four credit course taken for three quarters, instead of a six quarter, three credit course. This plan was tried last year and proved to be so effective, that it was decided to incorporate it definitely into the program.

Unit Processes is now taken in the Fall rather than in the Spring of Junior year, thus giving chemical engineers an opportunity to taste real chemical engineering earlier than before. This arrangement also gives the Sophomore chemical engineer, a truly chemical course in the Spring of the year known as the Chemistry of Engineering Materials.

Other changes include the addition of a course in chemical engineering economics to be taken during the winter quarter of the Senior year, the lengthening of Chemical Calculations from a two to a three credit course, and the changing of Industrial Chemistry from the Fall and Winter of the Senior year to the Winter and Spring of the Junior year.

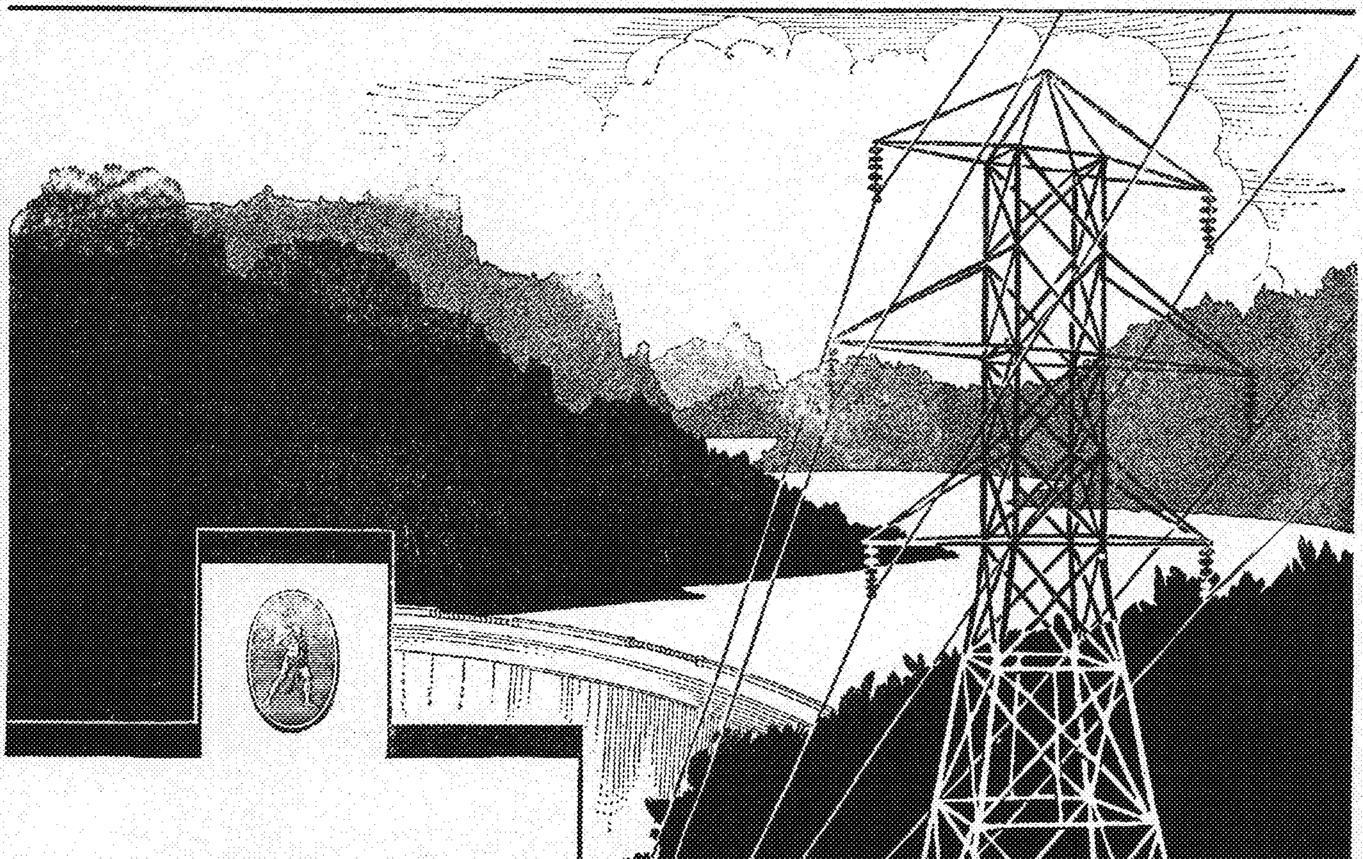
THE NEW LATHE

(*Continued from Page 9*)

armature shaft is fastened an aluminum handwheel with which the motor may be stopped instantly. The right end is equipped with a knurled lock coupling which facilitates the changing of live centers. The speed in revolutions per minute of the motors ranges from 565 to 3450, the slow speed being more for the turning of heavy work while polishing and touching up require the high. The rheostat is built into the lathe pedestal, the control being an aluminum handwheel similar to that on the motor, conveniently placed on the front of the lathe bed, directly above the pedestal.

As a machine the new lathe presents a pleasing picture. Every line signifies careful design and construction. At the first glance anyone who knows lathes will realize that its symmetrical and sturdy lines denote an ability to do the required work efficiently.

HOW HERCULES EXPLOSIVES ADVANCE CIVILIZATION



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The Student's College Record as a Forecast of Success

(Continued from Page 5)

for the whole group. On this basis only, it appears that "substantial campus achievement" does have some rather definite bearing on progress in the Bell System, but that its influence is not so great as that of high grade scholarship.

In comparing the results of participation in extra curricular activities of both engineering graduates and arts graduates, it would seem that "substantial achievement" is not as good an index for the future for the engineer as for the arts graduate. It may be that such indulgence in campus life detracts more from his scholastic effort. There seems to be something favorable in the situation of the group of engineers who had "some achievement." This may quite possibly indicate that some interest in campus affairs is more valuable to men pursuing engineering courses than too great an interest in such affairs.

Another generalization may be warranted but not vouched for, which is, that in the type of campus achievement, those who participated in the groups which required intellectual effort seem to make better progress after graduation. In other words, those in the literary, editorial, and managerial fields seem to have some advantage over those in social, athletic and musical or dramatic endeavors.

A study of those who found it necessary to earn part or the whole of their expenses through college, gave a negative result. The obligation of a young man to earn while he is in college, we might say, is no handicap to his future career, but might be considered a favorable factor. That is, his necessary sacrifices seem warranted, and what is lost of other varieties of college experience, is compensated for by the student's intensity of purpose.

Altogether, it would seem that this somewhat inconclusive picture is a normal one. Naturally, when an employer examines an applicant, the question uppermost in his mind is the man's record of previous performance. In giving weight to scholarship, he concludes that it is evidence of how well the young man performed on his previous job. The evidence is, that there are real values in this conclusion. Seekers of men of high equality have always given some consideration and weight to participation in campus activities as indicating some qualities of leadership and a development of the social instinct. Earnings indicate a young man's determination to get ahead in the world. All of these are indices, but should be evaluated in accordance with their importance. From the viewpoint of the student, it seems clear that he should so budget his time that he give his major attention and concentration to the important objective of his college life—education—and relate his other obligations in a proper balance to this main objective. This is an individual problem, but one to which teachers should give of their best, in counsel and advice.

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NOISE AND ITS CONTROL

(Continued from Page 13)

necessary under sea-going conditions, provision should be made for producing lower levels in the harbor.

Although the riveter as a source of street noise is less frequent and usually more remote than the motor vehicle, nevertheless the noise of riveting proved by measurement to be one of the most intense found in the survey, and it is generally recognized as one of the most annoying in type. Moreover, when a building is being constructed close to an occupied building, the occupants of the latter may for a considerable time be subjected to an extremely intense noise from a source much closer than the riveter usually is to the street. Consideration should be given to the possibility of reducing the radiated sound by mechanical or acoustical damping, and to the possibility of replacing riveting under some or all conditions by electric welding.

Considerable reduction of the high noise levels measured for steam operated pile drivers, shovels, and other machines used in construction and excavation should result from the substitution of electrical power for steam.

Adequate mufflers would largely remove the noise produced by stationary engines of the explosive type, such as are used in air compressors, pumps, etc.

7. *Night Noises in Residential Sections*

The audibility of a noise, and hence its annoyance, depends upon the background of other noises. The measurements indicate that this background level on a busy street by day may be 35 decibels greater than on a residential street at night; hence a noise which during the day might be inaudible on a busy street may be very disturbing at night in a residential district. Noise restrictions should therefore be far more severe in residential sections of the city at night than in the entire city by day. Since noise sources are less numerous at night, such regulations will restrict relatively few activities.

RECOMMENDATIONS CONCERNING NOISE IN BUILDINGS

1. *Characteristics and Plans of Buildings*

By proper treatment of wall surfaces and spaces between walls, and by proper selection of room furnishings, the transmission of sound may be reduced and its absorption increased. To diminish the cost, such treatment should, if possible, be included in the original designs.

To isolate noise, subdivide places of work; for example, have several one-desk offices rather than one office with several desks. Glass partitions should

(Continued on Page 26)

extend to the ceiling. Special rooms should be provided for conferences and interviews. Manual workers should be kept away from thinkers; computing machines and typewriters should be in different rooms from desk workers. Noisy factory operations should be segregated from others.

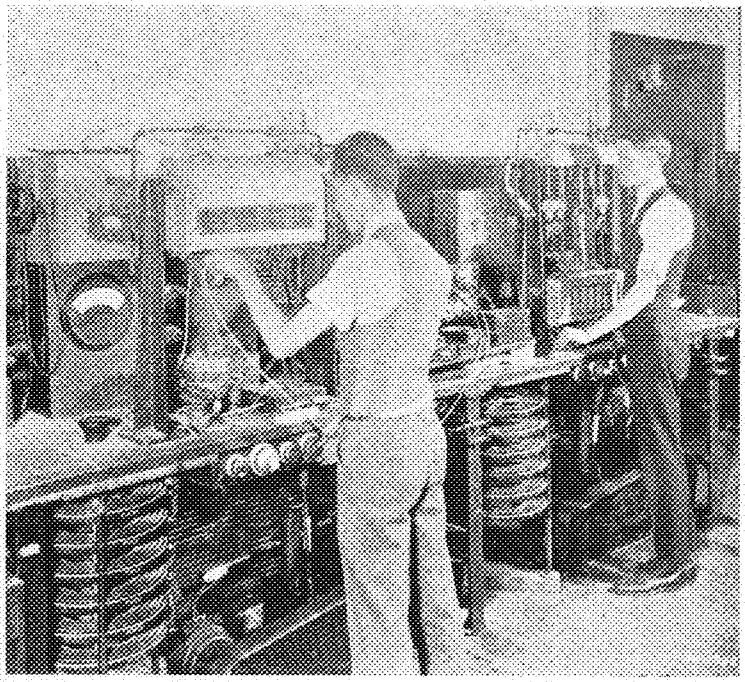
Windows and ventilators should be so designed as to reduce sounds coming from without.

2. *Treatment of Indoor Noise Sources*

In addition to isolation, already mentioned, indoor noise sources may in many instances be quieted by improvement in design, with especial consideration of noise. For example, the exposed surface of rotating parts in electric motors may be made less irregular, reducing the motor whine; electric fan noise may be reduced by proper motor selection and blade design; impact of metal parts in machines of many types may be eliminated. The communication of vibrations from machine to walls, shelves, and other effective sounding boards may be reduced by mounting machines upon massive, disconnected pillars, and in some cases by absorptive pads.

*

These are the recommendations of men eminent in the fields of engineering, medicine, neurology, psychiatry, human relations, building, law, and the automotive industries. But does not the whole matter simmer down to a question of using our common sense? We are readily able to discern what noises are unnecessary. Why not do all we can to avoid them? Why not develop a new etiquette—a new and more civilized behavior to overcome these noises? If things could be brought to the stage where a maker of unnecessary noise is as uncomfortable over his mistake as the man in the advertisements who used the wrong fork—then we will be making true progress in the abatement of noise. Furthermore the citizenry may ameliorate existing conditions by an appeal to the law when noise is being produced that constitutes an offense. But in the final analysis, the subject is a question of public opinion. As soon as that is aroused,—noise abatement will be well in hand.



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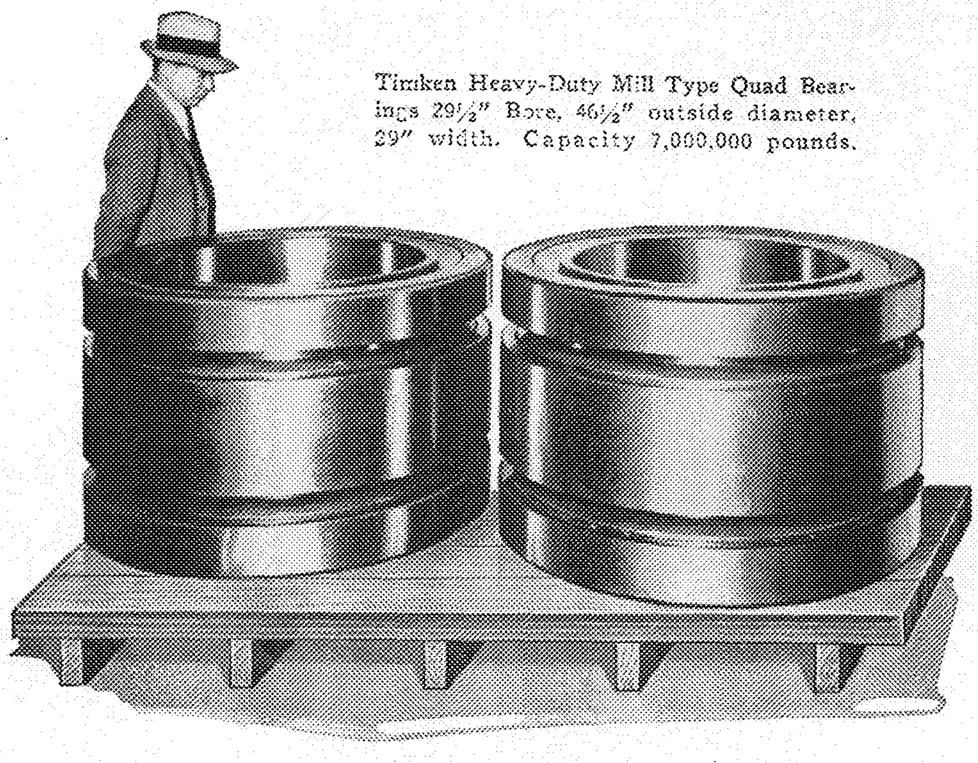

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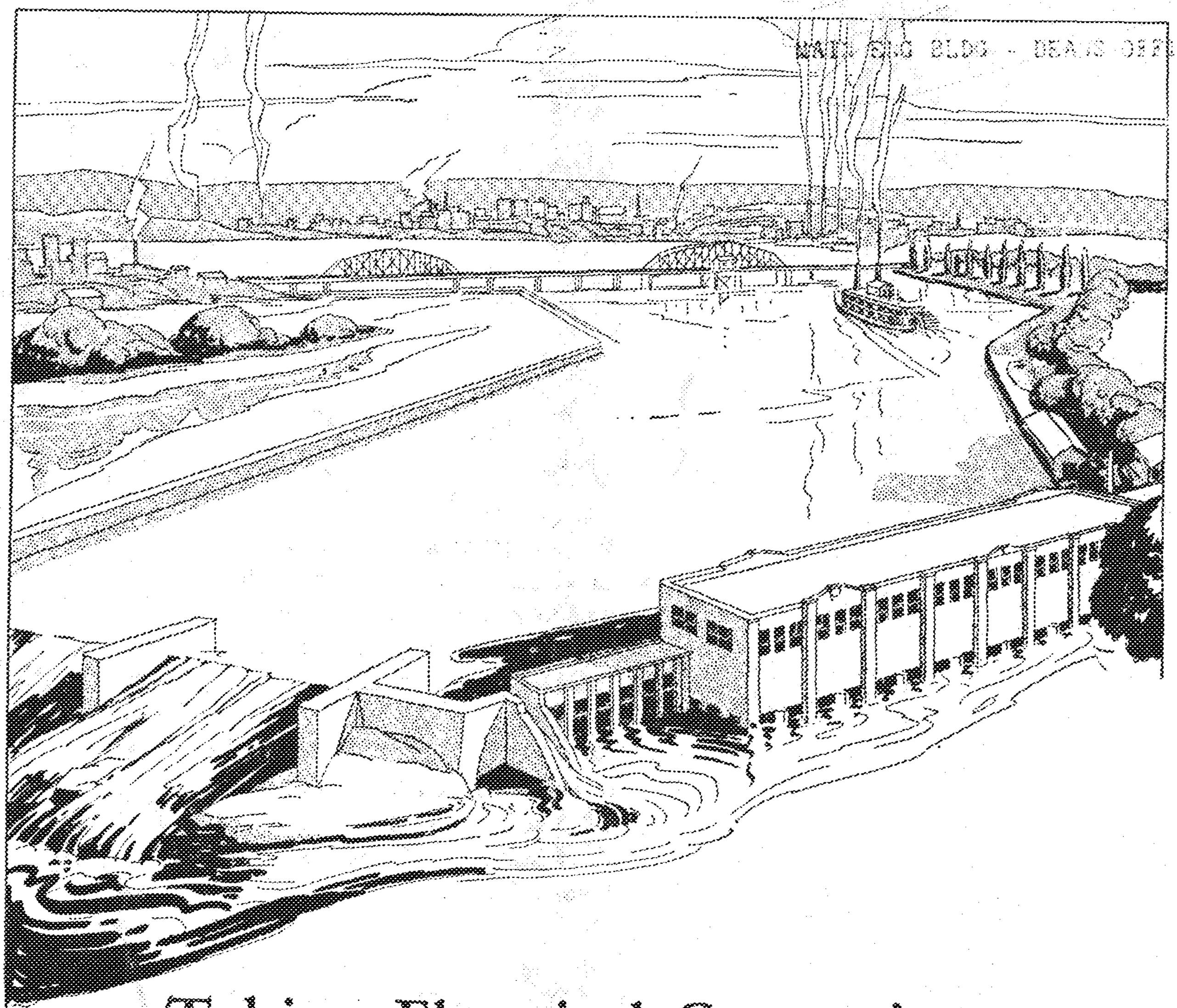

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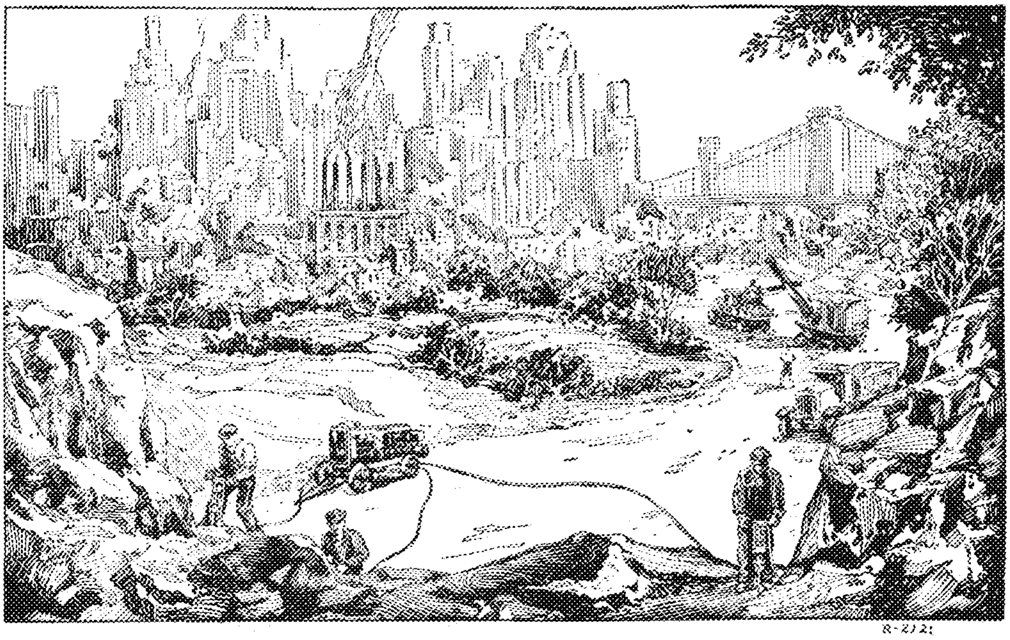
THE MINNESOTA TECHNO-LOG

Vol. XI NOVEMBER, 1930 No. 2

The Modern Way of Building Highways



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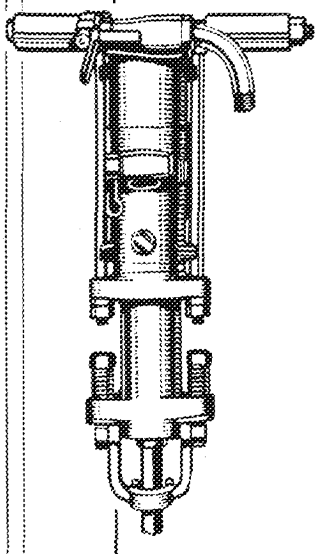

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THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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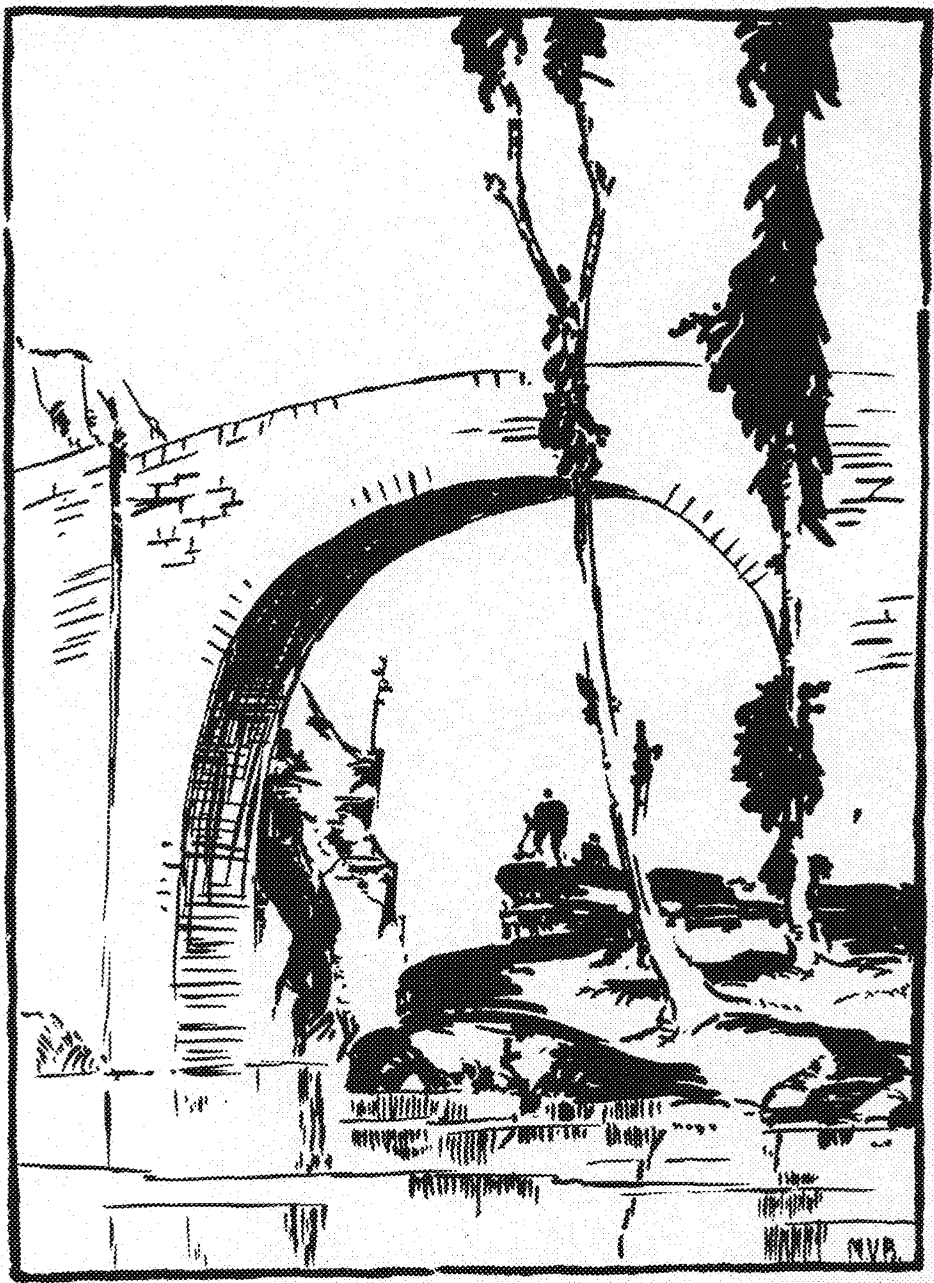


An Ancient Bridge

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Volume XI | NOVEMBER, 1930 | Number 2

Development of Electric Traction on the Pennsylvania

By H. A. DAHL, EE '22

THE extensive electrification program announced by the Pennsylvania Railroad in November, 1928, and supplemented by a later announcement in 1929, and which program is now well under way, marks an epoch in the development of transportation. The program includes electrification of the main line from New York to Washington and electrification of a low grade freight line from Trenton, New Jersey, to a point near Harrisburg, Pennsylvania. The Pennsylvania Railroad is well prepared to undertake such a program having pioneered in the development of electrification and types of electric motor power.

The first major venture of the railroad in the electrification field appeared in 1905 on the Long Island, a part of the Pennsylvania System. The work here consisted of electrifying a portion of the passenger service by equipment of cars for multiple unit operation. This installation has been extended until today all of the passenger traffic into Manhattan and Long Island City, amounting to an annual movement of 120,000,000 passengers, is handled by approximately 1000 multiple unit cars. The service is essentially rapid transit and is similar to the New York subway in that 600-volt direct current from a third rail is used. A year later, in 1906, the West Jersey & Seashore, another subsidiary operating between Atlantic City and Camden, N. J., was equipped with electric motor cars. The same method of electrification, namely 600 volts d.c. with third rail, was used.

From the year 1905 to the year 1908 the railroad built five experimental locomotives. These locomotives differed in the manner of drive as well as in other respects. Both a.c. and d.c. were used. As a result of these experiments the railroad was in a position at the time the New York tunnels were built to design and build the required number of electric locomotives. These tunnel locomotives, placed in service in 1910 and operating at the present time, embodied those features of the experimental locomotives which were considered advantageous, such as the American type of wheel arrangement and high center of gravity.

The tunnel electrification was the direct result of a special condition, namely, the necessity for entering New York City underground. The original installation which in extent remains the same today, runs from Manhattan Transfer through the Hudson river tubes to Pennsylvania Station and through the East river tubes to Sunnyside Yard on Long Island. To enable the Long Island electric trains to operate into the station the 600 volt third rail system used on the Long Island was extended into the station and there being at that time no well formulated plan for extensive main line electrification, the same 600-volt system was selected for the locomotives.

A few years later another special condition arose at the Philadelphia terminal. Traffic in and out of this stub end terminal had increased to such an extent that some measure of relief was necessary and electrification of a portion of the suburban traffic was decided upon. This step was taken in full realization of future possibilities of electrification and, accordingly, the initial installation at Philadelphia was constructed so as to fit into future plans for main line electrification. The Pennsylvania had by this time selected as its standard the 11,000-volt, 25-cycle single phase system which is now well adapted to handling the enormous concentration of load which will obtain when the present plans are developed to their full extent.

In 1915 electric operation of suburban trains was inaugurated between Philadelphia and Paoli over a distance of 20 miles and shortly thereafter between Philadelphia and Chestnut Hill, a distance of 12 miles. The initial operation commenced with a total of 93 motor cars, no trailers, each car weighing, completely equipped but without load, about 60 tons. The success of these early motor car equipments is attested by the fact that later service requirements have been filled with orders for essentially duplicate equipments, except for improvements in details, until there are today on this property at Philadelphia a total of 345 cars having generally similar equipment.

In the interim between the initial installation at Philadelphia and the initiation of the present program the railroad carried out a comprehensive locomotive development program looking forward to just such an electrification undertaking as is now under way. In 1917 the Pennsylvania and the Westinghouse Company built what in some respects is the largest freight locomotive in the world. This locomotive classified by the railroad as the FF1, is of the constant speed type operating normally at about 20 m.p.h. Built as a single unit it has a total weight of 516,000 lbs. and has a nominal rating of 4800 hp.

The war retarded electric lomotive development, but in 1924 three locomotives of a new type, the Class L5, were ready for service. One of these was placed in service on the Philadelphia a.c. suburban electrification to develop its possibilities and the other two were equipped with d.c. control apparatus and placed in regular service at the New York terminal. Subsequently 21 more locomotives of the same class were placed in service in the New York territory. The class L5 locomotive is so designed that, depending upon the ratio of the gears with which the locomotive is equipped, it can be used in either passenger, fast freight or slow freight service. This makes standardization possible. The locomotive is 3000 hp. (continuous rating) and weighs 400,000 lbs.

The next step in locomotive development was the construction of a number of switching locomotives known as the Class BB. Two units were placed in service at the Philadelphia terminal switching passenger cars, 14 units were placed in service on the Bay Ridge division of the Long Island, which is also equipped with an 11,000 volt a.c. contact line, and 12 units were equipped with d.c. control and placed in service at the Sunnyside yard in New York.

Following the construction of the Class BB locomotives just referred to, the railroad bent its entire energy toward developing locomotives suitable for the extensive main line electrification. Very little has been announced with regard to the character of these locomotives but it is known that they surpass anything built anywhere in the past in the way of capacity and speed.

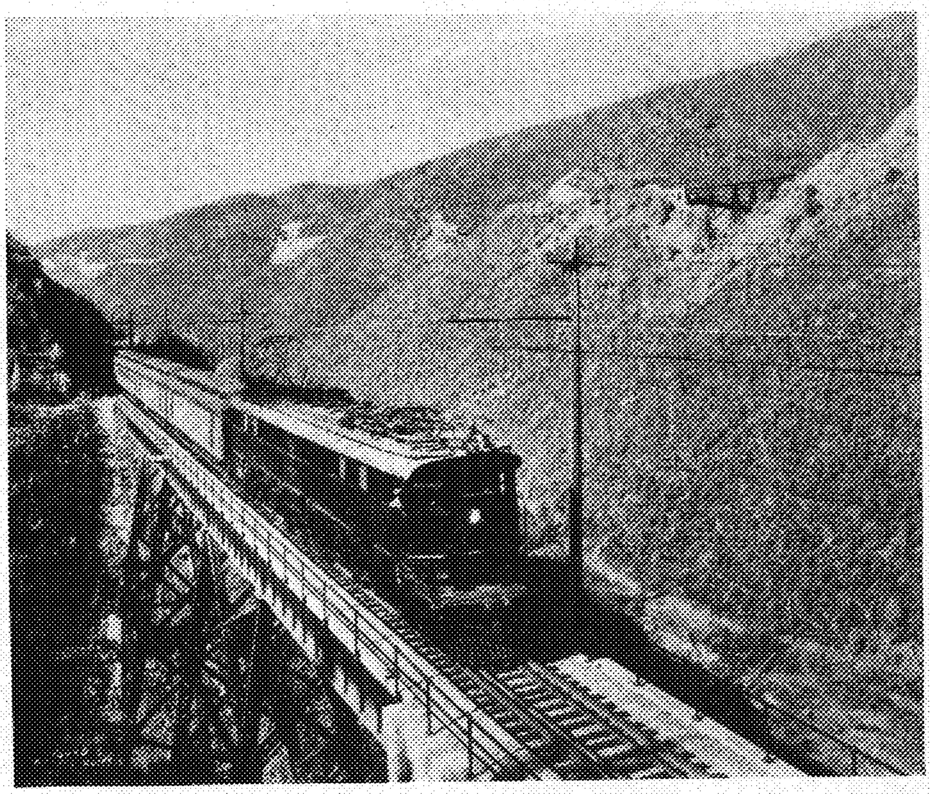
Returning again to the general situation in the Philadelphia territory, since the initial electrification from Broad Street to Paoli and Broad Street to Chestnut Hill, various other lines radiating from Broad Street have been electrified until at the present time the electric service is available from Broad Street to Wilmington, to West Chester, to Norristown, to White Marsh, and to Trenton, N. J., in addition to the two lines to Paoli and Chestnut Hill. The Sections between Broad Street and Wilmington and between Broad Street and Trenton are, of course, on the main line between New York and Washington and will form an integral part of the main line electrification.

The suburban traffic radiating out of Broad Street may well be said to be dense. In order to maintain this volume of traffic it is necessary to furnish the highest grade of service. A schedule speed of about 25 miles per hour is maintained making stops on the average of about every mile. An idea of what this means is obtained when it is considered that street cars ordinarily do not average more than 8 to 10 miles per hour.

The cars used are of the MP-54 Class which is the standard locomotive-hauled suburban car on the Pennsylvania. In fact, a number of the electrically equipped motor cars were recalled from steam service to be fitted with electrical equipment. This interchangeability is but a part of the far-reaching program which has been in the process of development since the first experiment with electric traction on the railroad.

All cars operating in the electrified territory are equipped with motors and control, that is, each car is a complete unit in itself and may be operated in any position in the train. The greatest advantage of this arrangement is found in the ability to make up trains of exactly the right number of cars, resulting in a minimum number of cars required and minimum total operating charges for the service operated.

Each car is equipped with two single-phase, a.c. commutator motors which are rated at 225 h.p. each. The two motors take their power from an air blast transformer mounted under the car. This transformer steps down the 11,000-volt trolley voltage to approximately 400 volts per motor for full voltage running while for acceleration and slow-speed running secondary taps are provided which give lower voltages. The low voltage secondary circuits are completed through a switch group which in the later cars has only seven electro pneumatic switches. Upon operation of the master controller the electro-pneumatic switches close progressively, thus increasing the voltage applied to the motors until full voltage is applied. The rate of progression is controlled by a relay, resulting in a uniform and rapid acceleration.


IN THE BITTER ROOTS, SHOWING UPPER SWITCH BACKS EAST OF FALCON, IDAHO, ON THE MAIN LINE OF THE MILWAUKEE ROAD

All multiple-unit cars are equipped with Westinghouse AMUE brake equipment. This equipment differs from the ordinary pneumatic brake in having electric control features which permit graduating the brakes on all cars of a train simultaneously. The operation of the brake, however, is not entirely dependent on the electric feature and in case of failure of the electric feature the brakes will be applied in the usual manner, that is by train line reduction from the front end of the train.

As an experiment a number of cars were built with bodies largely of aluminum. Also a number of pantographs were placed in service which were constructed largely of aluminum. An innovation in motor car control which was first placed in service on this property is the slip-cutout relay. This relay will, upon one pair of wheels slipping, temporarily cut out the control of its car. This will prevent overspeeding of the motors when the rail is unusually slippery, such as is liable to be the case in the fall when the rail may be covered with wet leaves.

The power supply to a system of this kind presents itself as a major problem. All power for the 11,000 volt lines of the Company is purchased from power companies. Power for the Paoli and Chestnut Hill lines, the first to be electrified, is delivered from the Schuylkill station of the Philadelphia Electric Company at 13,200 volts, 3 phase, to the Arsenal Bridge substation of the railroad from which point it is distributed to five substations at a potential of 44,000 volts, single phase. The 13,200/44,000-volt, step-up transformers at Arsenal Bridge are Scott connected, one phase of the two-phase side being connected to the Paoli line and the other phase to the Chestnut Hill line. Phase-balancer sets are installed at the Schuylkill Station of the Philadelphia Electric Company.

Prior to the recent extensions of the electrified territory a far-reaching program was set up which it is expected will provide for years of growth in traffic. All recent extensions are a part of this program and are capable of expansion in the most efficient manner.

A transmission line voltage of 132,000 has been selected. For the present two transmission lines have been installed on the main line between Wilmington and Trenton which is four track. Two transmission lines have also been installed on the line to West Chester which has both double and single tracks, except on the section between Lenni and West Philadelphia where only one line, capable of feeding from both ends, is used. The selection of this voltage makes possible the transmission of power over considerable distance and whenever desired shifting of load between points of supply. This together with the use of multiple transmission circuits will provide ample

AN ALL PULLMAN TRAIN CLIMBING A STEEP GRADE IN MONTANA CANYON

insurance against power interruption over a protracted time or area.

Each transmission line feeds one 4500-kv-a. transformer at each transformer station and there is no high tension bus nor are there any high tension circuit breakers at the transformer stations. In case of a transformer failure the transmission line to which the transformer is connected will drop out until the faulty transformer can be isolated by disconnecting switches. This scheme of operation, while differing from past practice, has the big advantage of eliminating high tension circuit breakers. Where more than one transmission line feeds a section the temporary outage of one line will scarcely be noted.

Another innovation is the use of high-speed breakers in the contact line circuits. Each step down transformer feeds a 11,000-volt bus through a standard breaker. Each contact line is sectionalized directly outside of the substation and fed in each direction through a high-speed circuit breaker. Thus on a four-track line there will be eight high-speed circuit breakers per transformer station or if the station is at an interlocking point there will be one or more additional breakers for island sections.

In order to obtain the full benefit of high-speed circuit breakers a system of high-speed relays has been installed. These relays and the high-speed circuit breakers are designed to interrupt the current to a fault in 0.04 sec. (1 cycle) after the relay setting has been exceeded. The relays will differentiate between ordinary service loads and short circuits and will not open any circuit breakers except those feeding the faulty section.

Power for the Wilmington, West Chester, Norristown and Trenton lines is purchased from the Philadelphia Electric Company. In this case the point of supply is about midway between Broad Street and Wilmington at the Lamokin substation of the power company. Here three-phase power is transformed to 13,-200-volt, single-phase, 25-cycle power by an installation of three 21,500-kv-a. frequency changers. The station is designed for an ultimate capacity of six 21,500-kv-a. transformers are connected to a Lamokin substation power is transmitted to the adjacent step-up transformer station of the railroad. Three 15,000-kv-a. transformers are connected to a ring bus at this point and transform the single-phase power from 13,200 volts to 132,000 volts, at which voltage it is applied to the transmission lines.

The means for bringing electric power from the substations to the train, namely the overhead contact system, has been in itself a subject for constant study and experimentation on the part of the railroad. The new construction is somewhat different from the original installation but certain features are outstanding in both the old and the new. Tubular poles are used almost exclusively except where special work is required. Also the type of construction on curves is that which is known as inclined catenary. Aside from the simplicity of inclined construction it, as well as the use of tubular poles, creates a system which is pleasing to the eye. The spacing of supports on both old and new construction is approximately 300 feet on tangent and on curves of small degree. The arrangement of wires on all lines consists of a messenger supporting an auxiliary contact wire which in turn supports the contact wire, this arrangement producing a smooth path for the pantograph. As far as possible non-corrosive material is used in both wires and fittings.

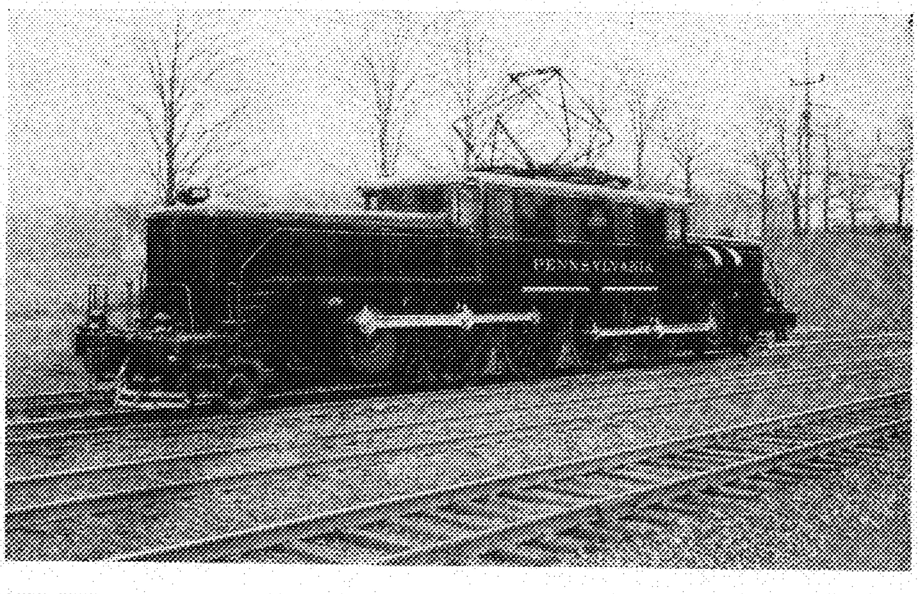
While not many details of the Pennsylvania electrification program have been announced, the program is known to be far reaching. In making the announcement, President Atterbury stated that it definitely plans for the traffic expected in 1935 and looks forward to the probability that by 1950 the metropolitan area of New York will embrace 30,-000,000 people in an area extending from New Brunswick on the west to well out on Long Island on the east. The problem of furnishing transportation to such an area will, if furnished by existing railway lines, require density of movement far in excess of present practice.

It is interesting to speculate on the possibilities of electrification. Freight trains of 125 cars are already contemplated at scheduled speeds twice the present train speeds and it is possible that speeds will be further increased. It is entirely possible at the present time to haul 125-car freight trains at from 30 to 40 m.p.h with one electric locomotive at the head end. Assume for the moment a 125 car train made up of cars averaging 40 tons each. Such a train weighing 5,000 tons would, at a speed of 25 m.p.h. on a one per cent grade, require a locomotive output of 8650 h.p.

Mineral trains run a good deal heavier and it is entirely feasible to assemble a 10,000-ton coal train which, if grades are heavy enough, would exceed the present limit of draw bar strength. However, on such sections the motive power can be divided between front and rear and the input to the whole train may at times run up to 20,000 h.p.

Passenger trains will no doubt also be

(*Continued on page 50*)



NEW TYPE HIGH SPEED PASSENGER LOCOMOTIVE PROVIDED WITH TWO MOTORS EACH CAPABLE OF DEVELOPING 1060 HORSEPOWER

The New Welland Ship Canal

THE new Welland ship canal which is now nearing completion brings to its finish the program laid down in 1913, when the Canadian government decided to improve the third Welland canal, which was in operation at that time,—and will continue to be used in part until the new ship canal is opened to navigation this coming spring.

The total length of the ship canal will be 25 miles or 27.7 miles between the outermost ends of Port Weller and Port Colborne harbors, and for all practical purposes of navigation it is a straight line throughout. The difference in level between lakes will be overcome by seven locks of 46½ feet lift each. The direct line of the canal down the face of the Niagara escarpment, and the topography of the lower plateau, permitted the adoption of these high lifts, which constitute a peculiar feature of the design of the canal, and has no precedent in actual construction for locks of their size. The canal will be 200 feet wide on the bottom, with two to one slopes and the sections of the work let by contract in 1921 have been excavated to a depth of 25 feet; the balance of the sections being excavated to a depth of 27½ feet. All structures, however, will be built for 30 foot draft, so that the canal, at any future date can be deepened by simply dredging out the canal prism and the harbor entrances. Both Port Weller and Port Colborne harbors, where severe wave action may prevail, are being dredged to an average depth of 27½ feet below standard low water level.

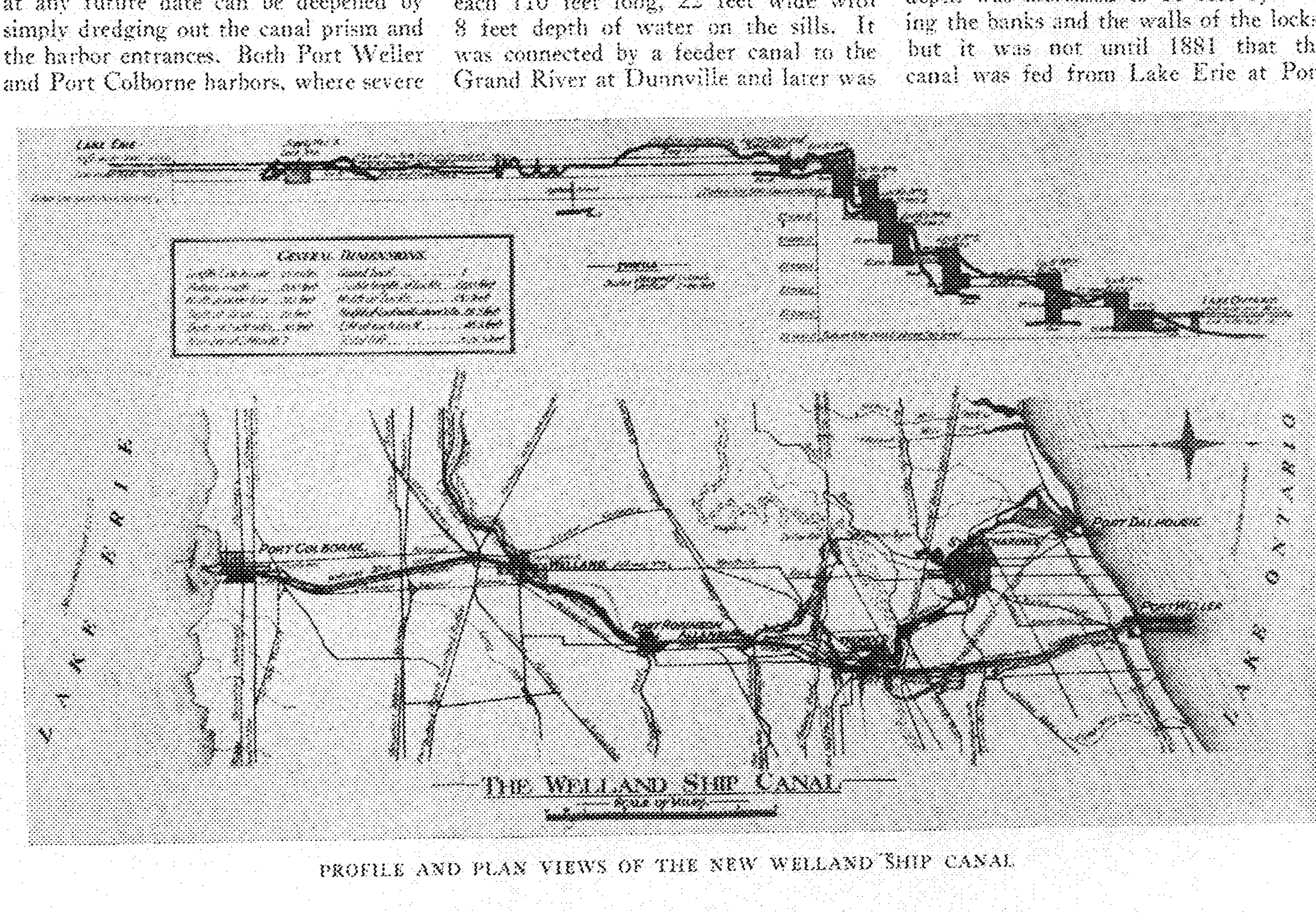
History

Previous to the construction of the first canal all freight had to be transported overland from Queenston on the Niagara River to Chippewa Creek and it was due to the foresight and energy of the late Honorable William Hamilton Merritt that this first canal was made.

On November 30th, 1924, there was unveiled at Allanburg, a cairn marking the spot where, one hundred years before, the first sod of the original Welland canal was turned by Mr. George Keefer, first president of the Welland canal company.

The first canal was built as a private enterprise by the Welland Canal company, formed by the late Honorable William Hamilton Merritt, and was completed in 1829, when two schooners, one British and one American, were taken through the waterway. It was built via the Twelve Mile Creek from Port Dalhousie, on Lake Ontario, to Port Robinson, on the Chippewa Creek. At Port Robinson, boats descended the Creek to the Niagara River, and thence to Lake Erie. It had 40 wooden locks, each 110 feet long, 22 feet wide with 8 feet depth of water on the sills. It was connected by a feeder canal to the Grand River at Dunnville and later was extended from Port Robinson to Port Colborne, on Lake Erie. This section was opened to navigation in 1833 and was located on what is now the site of the present canal, between Port Colborne and Allanburg (the summit level) but was fed from the Grand River. This canal was 27¼ miles long from lake to lake.

The second canal was begun in 1841, when the legislature of upper Canada purchased the canal and decided to enlarge it to 9 foot navigation and to complete the St. Lawrence canals, which were necessary to avoid the various rapids between Lake Ontario and Montreal. The forty wooden locks were, by increasing the lifts, reduced to twenty-seven locks, which were built of cut stone, each 150 feet long, 26½ feet wide with 9 feet depth on the sills. The Port Maitland, Dunnville branch was built at this time, and this route, or second canal, was opened to traffic in 1845. The section of the canal between the Feeder Junction (Welland) and Port Colborne was then enlarged and opened for navigation in 1850. This canal remained in operation after the present canal was completed being used for power purposes, and all its locks are still in existence. In 1853 the navigable depth was increased to 10 feet by raising the banks and the walls of the locks, but it was not until 1881 that the canal was fed from Lake Erie at Port



PROFILE AND PLAN VIEWS OF THE NEW WELLAND SHIP CANAL

The Fourth Welland Canal, known as the Welland Ship Canal, is now nearing completion at a cost of $120,000,000. The canal connects Lake Erie with Lake Ontario whose difference in elevation is 326½ feet, and forms one of the principal links in the chain of navigation extending from the Straits of Belle Isle up the St. Lawrence River and through the Great Lakes to Duluth at the western end of Lake Superior, a distance of approximately 2,339 miles.

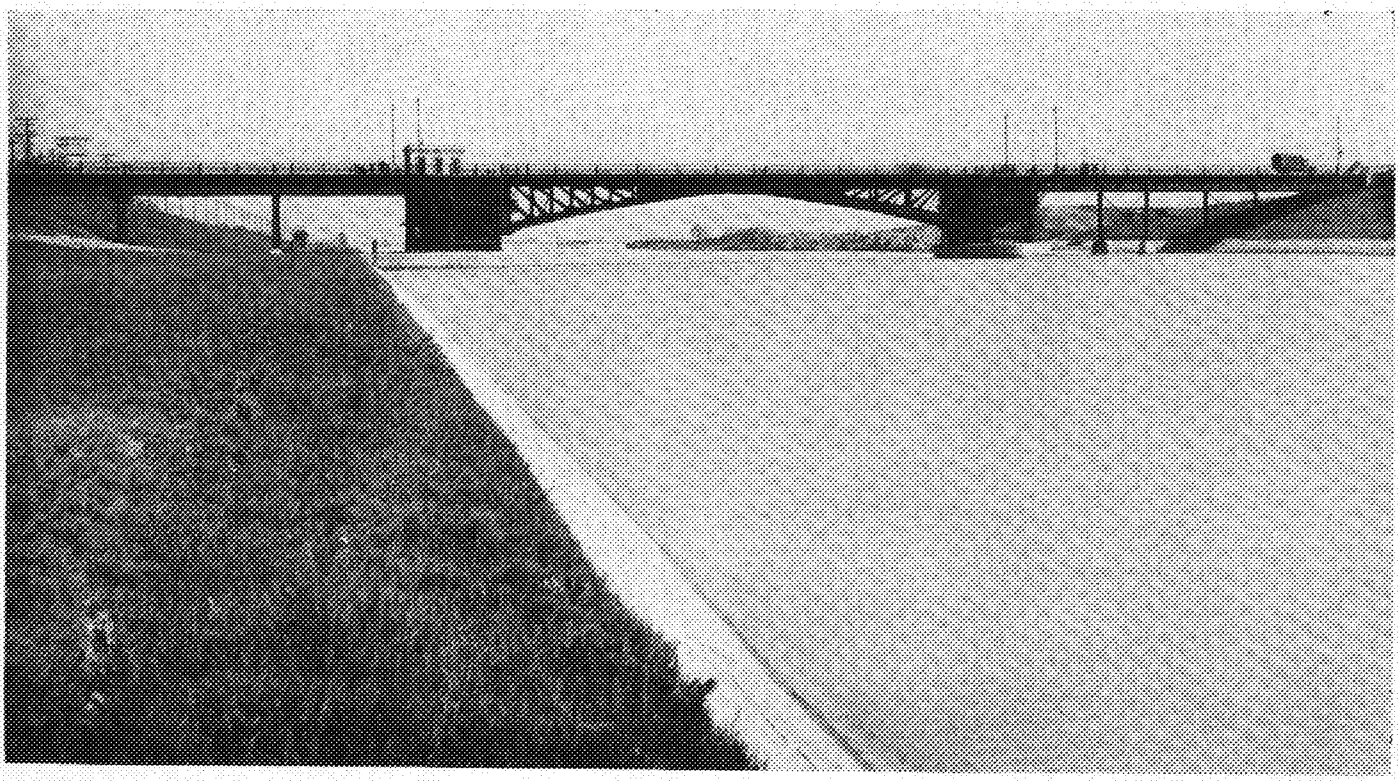
The accompanying article prepared by members of the TECHNO-LOG *staff is a timely review of the history of the previous canals, together with an analysis of the ship canal, its design, operation and construction.*

Colborne. The original cost of construction, including the first enlargement, or the total expenditure prior to Confederation (July 1, 1867) was $7,638,239.83. That portion of the second or old canal, as it is now called, between Alanburg and Port Dalhousie, ceased to be used for navigation about 1890.

The third canal was not commenced until twenty-two years after upper and lower Canada had completed the nine foot navigation between Lake Erie and Montreal. When the Dominion government took up the question of inland navigation, and the Commission of 1870 reccommended a uniform scale of navigation for the St. Lawrence route and the Welland canal with locks 270 feet long, 45 feet wide and 12 feet of water on the sills. This depth of water was later increased to 14 feet. The work of enlarging the Welland canal was carried on to these dimensions in the present canal which leaves Lake Ontario at Port Dalhousie and climbs the escarpment east of the second or old canal to Allanburg. From the latter place to Port Colborne it follows the route of the second canal. Its locks are built of cut stone, with lifts of 12 to 14 feet. It is carried over the Chippewa Creek at Welland, by a cut stone aqueduct. This third canal, 26¾ miles long, was opened to traffic for 14 foot navigation, in 1887, and the St. Lawrence River canals in 1901; when the Northwestern Steamship company of Chicago placed a fleet of four steamers (2,000 tons capacity) in commission between Chicago and Europe. On more than one occasion the boats were loaded to slightly over the 14 foot limit. The third or present canal up to the 31st of March, 1928, cost for capital construction and permanent improvements $33,-pairs and maintenance. These amounts include the cost and maintenance of the grain elevator at Port Colborne but not of the Port Colborne breakwaters. The St. Lawrence and Welland canals, between Lake Erie and Montreal, cost Canada, up to March 31, 1928, $82,675,-084.34 on capital construction and permanent improvements and $31,989,-925.14 for repairs and maintenance. These amounts do not include the aids to navigation between Port Colborne and Montreal, nor the expenditure to date on the Welland ship canal and the Montreal-Quebec channel.

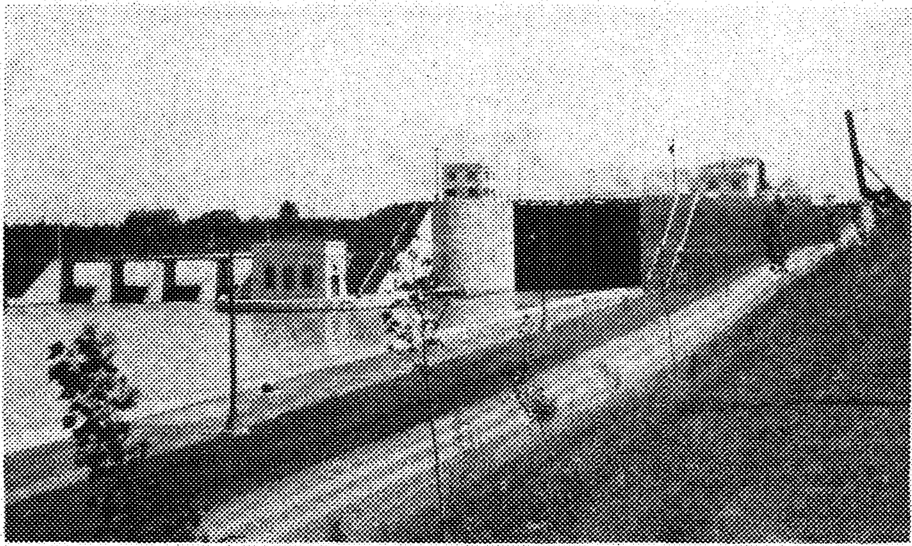
In 1901 the total tonnage passing through the Welland canal was only about 620,000 tons. In 1914, it had increased to 3,860,000 tons, indicating that since the completion of the 14 foot navigation system in 1901, the St. Lawrence route had gradually drawn more heavily, year by year, upon the Great Lakes Atlantic seaboard trade. As a result of the Great War taking many lake vessels into service on the high seas, traffic through the Welland canal fell off from 3,860,000 tons in 1914 to 2,200,000 tons in 1918-19, but since this latter time traffic has been growing rapidly year by year, with a new maximum annual tonnage record of 7,247,459 tons, established in 1927. This vast increase in tonnage in the last six years indicates that it is only a matter of a few years until the present canal will be taxed beyond its capacity.

The short sighted policy of 1870 left the Welland canal as much out of date in 1887 as it was when the improvements were begun in 1873, whereas a moderate increase in the length of the locks alone would have enabled a large part of the fleet of 1901 to descend to Montreal, instead of being confined to the Upper Lakes. These canals, locks and river channels are entirely inadequate for use by the Great Lakes steamers of today, and can now be considered as of little more than barge size. The improvement of the Welland and St. Lawrence canals to such dimensions as would accommodate ships of at least 25 foot draft, has been contemplated for many years. During the past quarter of a century, exhaustive surveys have been made to determine the feasibility



BRIDGE NO. 4 SPANNING THE SHIP CANAL

and cost of such a waterway and another has been carried out recently by the International Joint Commission. Following the opening of the St. Lawrence route in 1901 for vessels drawing 14 feet of water, the Canadian government began improvements to the Port Colborne entrance of the Welland canal, these consisting of deepening the harbor to 22 feet, constructing a million bushel modern concrete elevator (completed in 1908) and building large breakwaters. The execution of these works and public agitation for the building of a Canadian deep waterway via the Welland canal and St. Lawrence route versus the Georgian Bay and Ottawa route finally led to exhaustive surveys being made for a ship canal across the Niagara Peninsula and the adoption of the Ten Mile Creek location for the canal and the inception of the work in 1913.



LOCK NO. 1, LOOKING SOUTH

The ship canal, as located, follows the valley of the Ten Mile Creek, between its mouth (Port Weller on Lake Ontario) about three miles east of Port Dalhousie, and Thorold, crossing the present canal (the third canal) below lock No. 2, where the water level of both canals will be at elevation 382.0 above mean sea level. The ship canal will again cross the present canal below lock 25 south of Thorold, where the water levels of the two will again coincide, at elevation 568.0. Between Thorold and Allanburg a new cut is being made for the purpose of straightening the alignment of the canal between these points. From Alanburg to Port Robinson the present canal and the ship canal alignments coincide, and here the ship canal is now completed, the present canal section having been widened to 200 feet bottom width, with a draft of 25 feet.

From Port Robinson to Welland the ship canal takes a much straighter and more direct course, to the east of the present canal, following closely the west bank of the Chippewa Creek, which is to be diverted, at several points. The aqueduct under the present canal for the Chippewa Creek is to be replaced with a much larger concrete structure under the ship canal, just north of the city of Welland.

From Welland to Humberstone, the present and ship canals again coincide, and here widening and depressing as between Alanburg and Port Robinson is being effected.

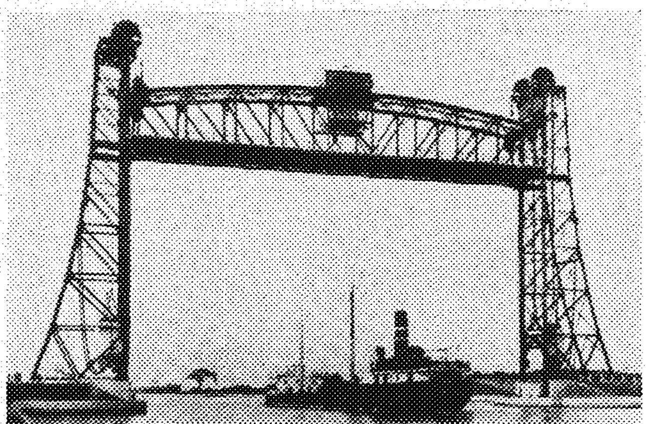
Leaving the present canal again just north of Humberstone, the ship canal continues a straight alignment into the harbor at Port Colborne—thus eliminating a very sharp curve in the present canal, known as Ramey's Bend. As it is desired to keep the summit, from Port Colborne to Thorold, at a regulated level of 569.0 a guard lock (No. 8) was established at Humberstone, through which vessels will be passed from the constantly fluctuating level of Lake Erie to the regulated summit level extending north to Thorold. This will effect a vast improvement in present navigating conditions existing in the present canal summit level, now subject to all the fluctuations of Lake Erie, which have occasioned a great deal of difficulty in the past.

Construction and Operation

For the purposes of construction, the canal has been divided into eight sections. No 1 Section is at the Lake Ontario end and No. 8 Section is at the Lake Erie end. During the fall of 1913, Sections Nos. 1, 2, 3 and 5 were placed under contract. On Sections Nos. 1, 2, and 3 are the seven lift locks. Section No. 5 embraces the deepening and widening of the deep cut on the summit level between Allanburg and Port Robinson. Owing to the European War, the work on the canal practically ceased in 1916 and, in 1918 the contracts let in 1913 were cancelled and the work entirely closed down. After the armistice, November, 1918, the Government decided to resume work on a small scale and arranged with the original contractors for the resumption of work on their former contracts for Sections Nos. 1, 2, 3 and 5. From January 1919 the work was carried on under a cost plus percentage basis in a more or less intermittent manner, due to labor troubles and other causes, until 1921 and 1922, when the cost plus percentage contracts were cancelled and the work relet under unit price contracts.

Port Weller harbor has been artificially formed by the construction of two embankments extending into Lake Ontario for a distance of nearly 1½ miles. The entrance is 400 feet wide and broadens out to a bottom width of 800 feet at the harbor. The total area covered by the harbor proper is slightly over 150 acres. The embankments, which were made with excavated material taken from the canal prism have been reinforced with broken rock protection.

Locks 1, 2 and 3 are on a gentle slope upwards from Lake Ontario. Each lock is provided with approach walls, regulating and waste weirs, timber unwatering gates, unwatering pumps, and inlet and discharge valves. At each end of all locks the equipment is operated electrically from the control houses from which the operators can see the entire lock. The control boards are equipped with signals to advise at all times as to the condition of all apparatus under the operator's control. Provision has been made for controlling the operations locally in an emergency and for manual operation. Alternating current at 550 volts is used for the motor equipment. The emergency sluices under the waste



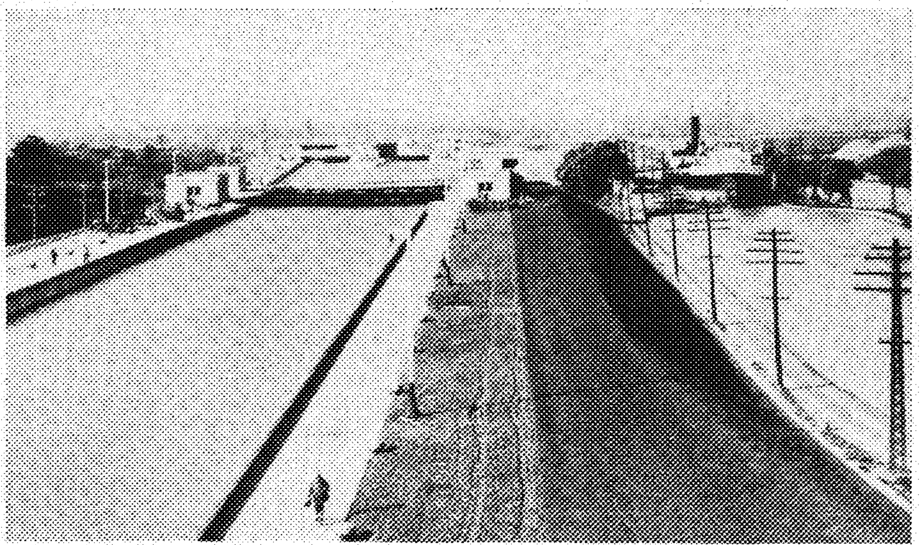
ELEVATING HIGHWAY BRIDGE IN OPEN POSITION weirs will open automatically if the pond for storing water rises much above its normal level. At several places there are bridges across the lock-approach channels to serve as a guard for the gate against ramming by a vessel out of control. At other points, where protection is needed, fender cables are provided. These cables are 3½ in. in diameter and are mounted on an arm which operates like a rolling-lift bridge. The cable is wrapped around a stationary bollard and is arranged to unwind from another spring-drum bollard which provides sufficient tension to check any vessel before it strikes the gate.

Water for filling the single locks is drawn through an intake located back of the approach wall in the pond above the lock, instead of from the channel directly above the gate, as is the more common practice. This arrangement does away with the objectionable currents created in drawing directly from the navigable channels. From the intake gates, the water passes down into the filling culverts in the canal wall, the water for the far side passing beneath the lock flow, and from these large culverts it is discharged at short intervals through smaller lateral openings at the floor level of the lock. In unwatering locks, the water passes out through the same ducts to discharge openings having rectangular bell mouths at opposite sides of the lock chamber below the gate. The energy of the discharged water is dissipated in the surge created by these two opposing streams.

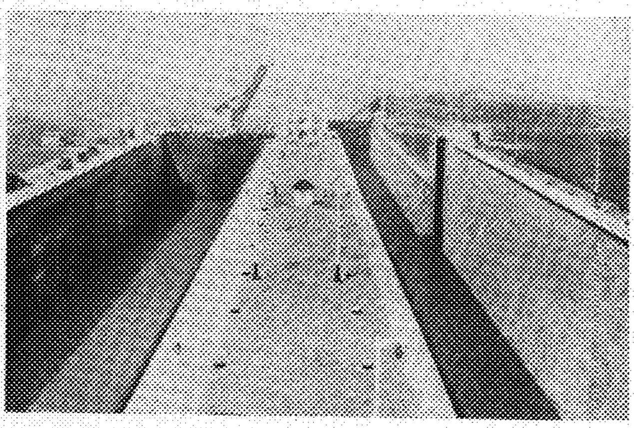
Locks 4, 5 and 6 are twin locks in one flight with a total aggregate lift of 139½ feet. They are quite similar to the Gatun locks of the Panama canal which, though of somewhat larger construction, have an aggregate lift of only 85 feet. The flight locks will be fed from a pond on the east side of the canal, which will be formed by an embankment about 3500 feet long having a maximum height of 80½ feet. When completed the pond will cover an area of 84 acres.

Lock No. 7 is located but a short distance from the flight locks, and serves to give the final lift up to the summit level. About a mile above lock No. 7 is a guard gate and safety weir which are necessary as a safety measure to hold back the water on the summit level should any accident occur to the gates on lock 7 or the flight locks.

Lock No. 8 situated near Port Colborne is 1380 feet long between the inner gates, is the longest lock in the world being approached only by the two on the American side at Sault St. Marie which are approximately 1350 feet long. This lock was put into service on September 16, 1929, when Captain J. J. Manley of St. Catharines, Ont., a veteran Great Lakes Master was deputed to pull the switches opening the lower gates, thus allowing four ships which were already in the lock, to pass down, the leading ship, the S. S. Medford of the Canada Steamship Lines breaking the silk ribbon strung across the lock. All the ships were decked with flags and saluted the opening with the customary tooting of their whistles.



LOCK NO. 1 AND FLIGHT LOCKS, LOOKING NORTH



FLIGHT LOCKS NOS. 5 AND 4

The work on section No. 6 of the canal, which extends from Port Robinson to Welland, offered many perplexing difficulties.

The work on this section was of a very involved nature as it was prosecuted without interference with traffic on the present canal and with the flow of water in Chippewa Creek, which it was necessary to divert at three places.

Chippewa Creek crosses under the present canal in a cut stone aqueduct. It was necessary to replace this by a concrete inverted syphon culvert, consisting of six 22 foot diameter barrel tubes with vertical end shafts, located just north of the present aqueduct and the river had to be diverted to correspond with the new location.

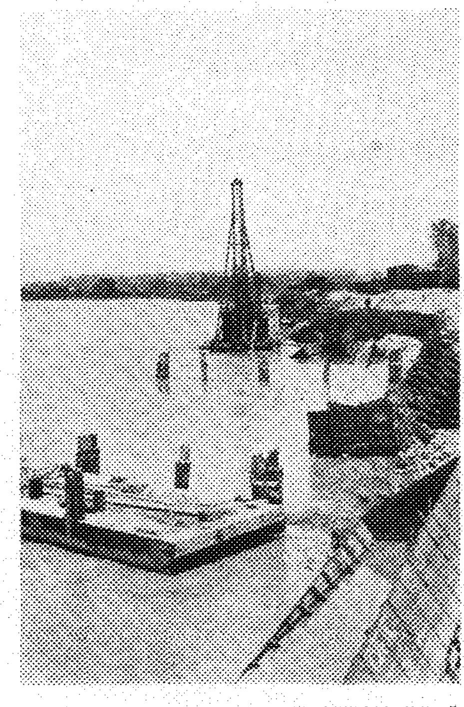
As the foundations of the new culvert are at an approximate depth of 75 feet below normal water level of the Welland canal, a special cofferdam was built with steel sheet piling driven in a series of cells interlocked with one another and filled with clay, enclosing the area in which the new culvert was built. As the traffic on the present canal could not be interrupted it was widened on the east side to give sufficient waterway past the cofferdam.

There was considerable difficulty in carrying out the work of building the new culvert, about 15,819,000 pounds of sheet piling, and 3,388,000 board feet of timber bracing being used to support the sides of the excavation.

At the site chosen for the new culvert, rock covered with a glacial clay lies at a depth of 100 feet below the ground level. The first scheme called for carrying the culvert under the canal through this solid rock, but, as that would have required placing the bottom of the culvert 170 feet below the surface, the scheme was abandoned in favor of a monolithic concrete culvert carried on piles in the clay at a depth just sufficient to clear the bottom of the canal. Early in the operation it was realized that the greatest difficulty would be encountered in controlling the saturated clay through which the excavation had to be carried, and consequently the area was subdivided into pits, which were carried down to subgrade successively in such a way as to permit the construction of the vertical shafts and horizontal sections in large units. An elaborate system of bracing for the walls of the pit was developed in the hope of taking care of the thrust of the surrounding clay, but even so,

(Continued on page 54)

Training the Big Muddy



EMERGENCY SHORE PROTECTION NEAR GLASGOW, MISSOURI, TO SAVE THE CHICAGO AND ALTON TRUNK LINE BETWEEN KANSAS CITY AND CHICAGO

THE Big Muddy, as the Missouri River is frequently called because of its peculiar sedimentary characteristics, drains an area covering about 540,000 square miles, or almost one-fifth of the United States. It includes over two-fifths of the entire Mississippi Basin and is extremely varied in its physical characteristics. It rises in Montana and has a total navigable length of over 2,300 miles from the head of navigation at Fort Benton, Montana, to the mouth near St. Louis, Missouri. Together with its principal tributaries and sub-tributaries it has a total length of over 20,000 miles. The basin extends into Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Iowa, Missouri, the extreme southwestern portion of Minnesota, and the extreme southern part of Canada.

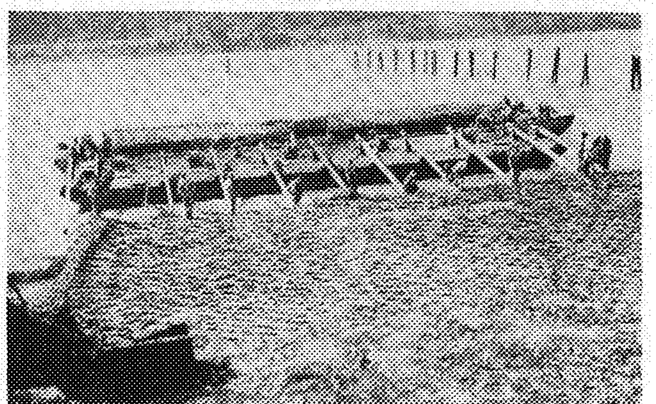
The maximum discharge of the Missouri at its mouth is about 500,000 cubic feet per second and the minimum low water discharge about 23,000 cubic feet per second. In its natural condition the river flows in a series of long, irregular bends with an occasional straight section. It contains numerous snags, shifting bars, and split channels; it cuts its banks, at times very rapidly, continually deviates from its course, and deposits sediment very rapidly when flow is retarded. Thus the Big Muddy has a bad reputation for shifting current and rapid erosion. Farms, houses, highways, railroads, and at times even small towns, along the banks are rumbled into the stream more rapidly than localized correction measures can overcome the aggravated situation. Frequently enormous expenditures are involved in unsuccessful attempts to keep the river within its course; workmen are often employed in shifts so that the operation for protection from erosion may be carried on continuously day and night.

In the spring of 1929 the Wabash railroad dumped about 80 freight cars into the river during high water at a particularly sharp bend below Kansas City in its effort to save the main line tracks which were about to fall into the river because of underscour. The river was over one hundred feet deep in this location. After large expenditures the railroad company's efforts were finally successful, although only a few feet more of bank erosion would have severed the road. One of the accompanying figures shows a view of some of the shore protection put in during the past spring by the Chicago and Alton railroad in its fight to save its trunk line between Kansas City and Chicago from toppling into the river. A large number of freight cars, railroad-tie grillage, and rubble rock were used in revetting the shore.

The stage of the river is usually low throughout the winter months until about April when the stream begins to rise as a result of melting snow and increased amount of precipitation. Flood stage is usually reached by about the last part of May or first part of June. This is caused by melting snow at the source and heavy precipitation throughout the drainage area. Infrequently it occurs that the river does not have a particularly high spring stage. This was true in the past year. However, ordinarily the fluctuation in stage between high water and low water amounts to about 20 feet, the actual variation, of course, depending upon the conformation of the particular section of the valley that the river traverses.

Steamboat navigation has existed on the Missouri as far back as 1819 when the "Western Engineer" went up the river as far as Council Bluffs, Iowa. However, the development of the western railroad systems resulted in the gradual decay of commercial navigation. The Government and contractors connected with government projects on the river are, at present, practically the only navigators of the stream.

The United States government first began the work of improving the Missouri River in 1876. Since that time much has been done toward developing various types of river structures and protecting certain river stretches, but a comprehensive program was first adopted in 1912 when Congress acted favorably upon a project for the improvement of the river between Kansas City and the mouth, a distance of about 400 miles, so as to provide a navigable channel having a minimum depth at low water of 6 feet over a breadth of 200 feet. This project was estimated to cost about twenty million dollars. Although the work was immediately undertaken and considerable progress made during the following few years, after 3 or 4 years operations practically ceased until about 1922. Since then, partly as a result of the Mississippi flood of 1927, interest has been revived in the regulation of the Missouri River and several Acts of Congress which were passed within the last few years made available large sums of money, both for construction and investigational purposes. A total of seven million dollars was authorized by Congress on January 21, 1927, for a study of all navigable rivers of the United States with the exception of the Colorado, in the combined interests of flood control, water power, navigation, and irrigation, while an additional five million dollars was authorized for engineering investigations of the Mississippi and its tributaries. (The Colorado is handled by separate funds through the Department of Interior while all other rivers are improved by the War Department). A large proportion of this sum is now being expended on engineering studies of the Missouri because of its importance as a tributary to the Mississippi.



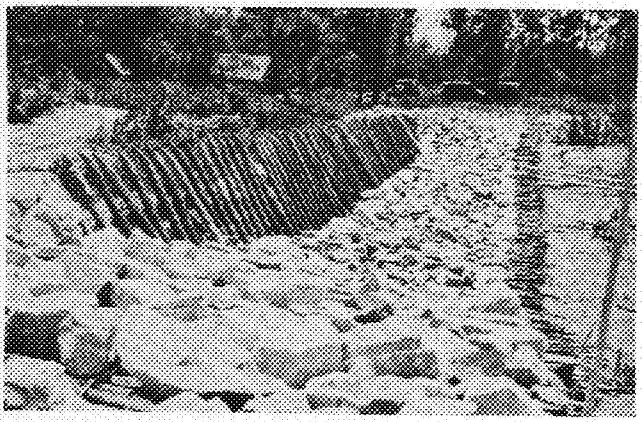
REVETMENT WORK IN PROGRESS WITH WILLOW MAT UNDER CONSTRUCTION

At the present time the work on the Missouri River is many-fold, consisting of special engineering investigations and a huge construction program. The latter incurs the expenditure of millions of dollars annually. The construction pro-

By DR. LORENCE G. STRAUB
Associate Professor in Hydraulics

gram involves principally the portion of the stream between Kansas City and the mouth where improvements are being made as rapidly as practicable for the development of a 6-foot navigable waterway at low water stages. During 1929 about $11,500,000 were spent on this portion of the project; monthly expenditures reached as much as $1,600,000. Thus, the Missouri River is one of the most lively sections of river and harbor work in the world at the present time. All of this construction work and also the engineering investigations are handled by the Kansas City district of the Corps of Engineers.

The general construction program for the Missouri River involves two processes at the present, although other work will be necessary later in order to obtain a maximum degree of navigability. One phase consists of stabilizing the banks by means of revetment and submerged mattresses; the other involves the construction of permeable groins and retards for the purpose of contracting the river section. The breadth maintained between contraction works is 1500 feet on the lower course of the stream. Eventually the river will probably have to be contracted still further, at least in the neighborhood of crossings or "reversed curves" where the river is naturally very shallow. After the river is once fixed in position and its shores protected from erosion, a great many refinements such as the introduction of sills, low water construction works, and the like, will make possible material increase in the depth of the navigable channel which will probably be held to a width of approximately 300 feet in the lower course.



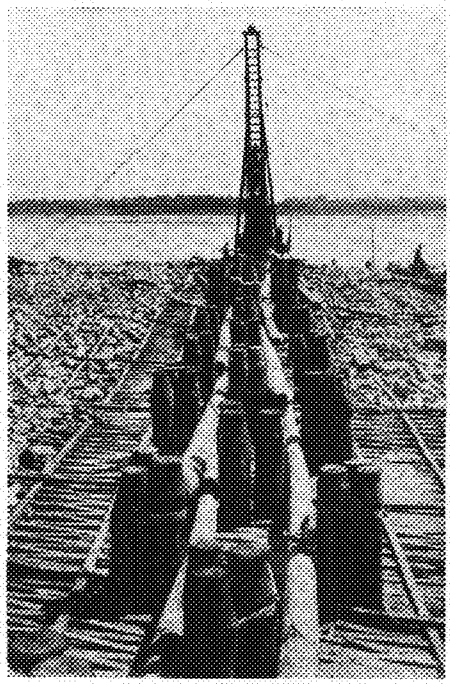
ABATIS CONSTRUCTION—A FORM OF PERMEABLE GROIN USED IN REGIONS OF SHALLOW WATER

Many of the structures used on the Missouri are very different from those which might be used advantageously on other rivers. This is particularly true because of the large amount of sediment which the river transports in suspension. Investigations made under the direction of the writer in 1929 and '30, showed that during high stages a maximum of 87 tons per second were transported in suspension past Kansas City or a total of 7,500,000 tons per day. The average for 1929 was 1,000,000 tons per day. Thus, the "Big Muddy" is one of the heaviest silt carriers in America and contributes most of the silt which is transported by the lower Mississippi.

The nature and the quantity of sediment transported by a stream, in a large measure, determine the deviation of its physical characteristics from those of other streams of similar size and slope. The silt problem, therefore, has been given a great deal of attention because of its vital importance in the proper design and maintenance of a navigable channel. In reality, the tremendous load of material carried in suspension by the Missouri is more of an asset than a detriment to the process of regulation, when its properties are correctly evaluated.

The construction work must be designed in such a way as to satisfactorily solve the silt problem and take advantage of the suspended load in building up new shores. Nearly all of the structures which are built into the channel for contracting the width of the waterway serve their purpose primarily by retarding the flow and thereby causing a large amount of the sediment to deposit. Various types of structures have been used for this purpose. Those on the Missouri include principally the "clump dike" which is made up of a series of piles tied together in clusters of three, the "frame dike" which consists of a series of pile bents having their center line transverse to the direction of flow, "current retards" consisting of brush held in place in lines transverse to the flow by means of cables connected to concrete piles jetted into the river bed, and "abatis," a form of permeable groin used in shallow regions or where overbank flow occurs during highwater.

The clump dike is the most frequently used structure in contraction works on the Missouri. It is constructed by driving wooden piles to a penetration of about 15 or 20 feet below the river bottom. The piles are driven on a slight batter and bound together near the top in groups of three by means of cable.



FORESHORE END OF A CLUMP DIKE IN THE PROCESS OF CONSTRUCTION

The clusters are ordinarily spaced at about 15 to 20 foot intervals, normal to the direction of flow and usually three rows of clumps are used, the rows being staggered and spaced far enough apart to allow them to be joined by horizontal stringers tying the system into a single structure.

Such dikes are ordinarily placed at intervals of about fifteen hundred feet normal to the stream and are extended far enough into the shore to protect the root of the dike from scour. In some instances in the past where the root of the dike has not been embedded satisfactorily the river has eroded the shore back of the dike causing the structure to fail in its purpose. For particularly well located dikes, the spaces between them are ordinarily filed with sediment within a period of one season. Thus they form a valuable construction system for a "plastic" river. Without the large load of suspended sediment transported by the Missouri, the process of building new shores would be extremely slow and expensive. Both the newly formed shores and the existing shores, where these are in the Alluvial valley and not adjacent to bluffs, will probably eventually have to be revetted.

The shores are stabilized by revetment consisting of willow mattresses below the low water level and rock pavement from this point to the elevation of the high water level. The willow mattresses serve to prevent undermining of the bank, while the rock pavement which is laid upon a slope graded to an inclination of 1 to 3, prevents destruction of the shore during high stages of the river. The accompanying figure shows a willow mat

(*Continued on page 50*)

AROUND THE WORLD WITH OUR ALUMNI

Architects

Recent letters have given us the addresses of the following alumni:

'05—A. V. Dahlberg, 372 South Ogden, Denver, Colo.

'08—W. M. Sternberg, Campfire corporation, Maywood and Cambridge, Massachusetts.

'17—Wm. Higburg, 4340 Winthrop Ave., Indianapolis, Indiana.

'29—Carlyle Linden, Hercules Technical club, Kenvil, New Jersey.

'24, '25MS—R. W. Krantz, 2945 Dodier Street, St. Louis, Missouri.

'22—Haines—Howard N. Haines recently changed his business address to 1115 Fourth avenue, Louisville, Kentucky. He is still with the architectural department of the Methodist Episcopal Church, South.

'22—Hahn—Paul Nelson, '26EE, recently saw Stanley Hahn in Chicago "wearing a gray tweed and very much tanned after a week in Northern Wisconsin."

'23—Anderson—Sending in his subscription to the TECHNO-LOG Winslow S. Anderson disclosed that he is still dean at Rollins College, Winter Park, Florida.

'26—Smith—While taking graduate work at Louisville University, which is being run by Robert C. Ernest, '21, A. S. Smith recently married Wilma Davis of Louisville. Mr. Smith is now chemical engineer in charge of the control instruments of the Atmospheric Nitogen company at Hopewell.

'27—John Beal and Don Benson, '30, are taking graduate work here as assistants in the Mines Experiment station. They were formerly in Akron, Ohio, with the Goodrich Rubber company.

'28—Roston—Rees E. Roston recently entered business for himself and then designed a large apartment at the new University of California at Westwood, California. His office is 531 Petroleum Security building, Los Angeles, California.

'28—Ekman—After spending two months traveling in France and Northern Africa studying architecture, Harold Ekman visited the campus. He has now returned to his home at 914 W. Portland St., Phoenix, Arizona.

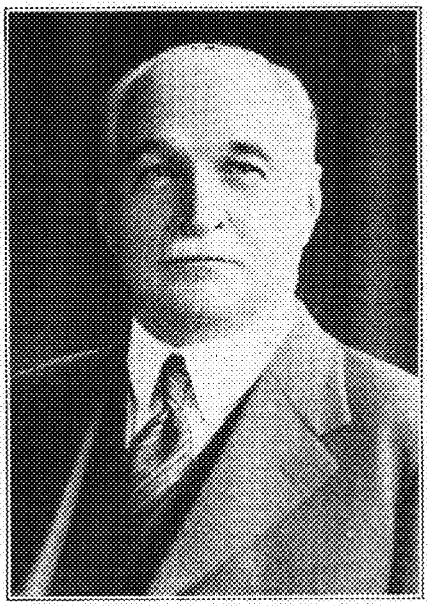
'28—Hanson—Back again in Minneapolis Theodore Hanson is taking a course with the Baking Institute at Dunwoody.

'28—Robinson—Marjorie Robinson is working for her M. A. at the University as an assistant in chemistry.

'29—Wolk—While working in the Patent Office in Washington D. C., Louis Wolk is attending the Georgetown Law School.

'30—Wood—Inez Wood is now a member of the home lighting department of the Northern States Power company in chemicals—Minneapolis.

'92—Plowman—Returning with perhaps one of the most varied careers of all Minnesota graduates, George T. Plowman, one of the two first graduates of the School of Architecture, recently visited the campus.



GEORGE T. PLOWMAN, '92 Arch.

Graduating in 1892 Mr. Plowman entered into architectural work; designing and superintending construction in various parts of the United States. In 1910 he dropped this work to study etching at the Royal College of Art, South Kensington, London, under Sir Frank Short, probably one of the best etchers known today. He spent three years in studying the technique of engraving. He always explains these three years by saying, "When I first began to etch I had to spend a great deal of time telling people what it was. The work is done on copper, a medium which requires a great deal of preparation. One has to learn a new technique and way of drawing. That is the reason I spent so many years at the Royal College."

Up to this time Mr. Plowman has made some three hundred plates. They cover most of America,—East as well as West—and England, France, Italy, and Germany. He is at work on several series of etchings. Two American subjects are the old covered bridges, built long before anyone thought of automobiles, and the old whaling ships. Among the work done in Europe are two other series, one of Oxford, and on of London churches. In the former is an etching of the Old Mill and Castle, the Castle being the oldest building at Oxford. One of the churches is St. Clements Danes.

Looking over his plates, we are whisked from Mount Hood in Oregon to the beautiful new Baker Library at Dartmouth; from there to the old crooked bridge in Lucerne; Rag Pickers' quarter of Paris; a bridge at Chateau Thierry which American troops had destroyed; Santa Lucia quarter of Naples, where the Santa Lucia song originated; Chamounix, the center for winter sports in the Alps, under three feet of snow; Passage des Patriarchs, a bit of old Paris where Victor Hugo imagined one of his characters living; and then Porta Negra, Trier, Germany, where the Armistice was signed; the ruins of the Soissons Cathedral just before it was torn down. His two best known pieces are the Hotel de Sens, Paris, and the Rue de Pretres St. Severine, Paris. These two were recently acquired by the French Government for the Luxembourg Museum. Mr. Plowman's works are also found in the permanent collections of the Smithsonian Institute and Congressional Library in Washington, Museum of Fine Arts at Boston, Fogg Art Museum at Harvard, Minneapolis Institute of Arts, and the British Museum in London. He works in all the graphic arts mediums,—etching, dry point, mezzotint, aquatint, soft ground, and lithography—and has written two books on the subject.

Mechanical Engineering

'07—Bell—Leaving the Washburn Crosby company M. D. Bell has opened an office as a consulting engineer at 1220 Flour Exchange, Minneapolis. He has been employed for a number of years as general superintendent of the Washburn Crosby company.

'10—Frear—J. B. Frear, 2515 Ashland avenue, Evanston, Illinois, with Professor G. Maney, a civil engineer of '17, attended the golden jubilee banquet of the A. S. M. E. at Chicago. Mr. Frear is still a designing and testing engineer for the Don Quill company of Chicago.

'17—Taylor—Duane L. Taylor, 315 Obispo avenue, Long Beach, California, is now aboard the U. S. S. Saratoga as a lieutenant in the U. S. Navy. He writes: "The Saratoga is attached to the Pacific Fleet which at present is combined with the Atlantic fleet on a four month winter cruise in the Caribbean. The Saratoga has visited Panama, Cuba, and Barbadoes and is now in dry dock in Norfolk." Mr. Taylor can be reached during the cruise by mail sent in care of the postmaster at San Pedro, California.

'21—Umberhocher—Frank Umberhocher, chief operating engineer for the State Line Generating company of Chicago, has changed his home address to 1744 84th street, Chicago, Illinois.

'21—Tuve—G. L. Tuve has returned to Minnesota in his text on "Mechanical Engineering Laboratory Practice" which is being used here this term. The book, published in March, is also being used at Penn State and Texas Tech. Mr. Tuve, now professor of Mechanical Engineering and head of the department at Texas Technological College, is living in Lubbock, Texas.

'21—Rosendahl—Harold R. Rosendahl, assistant superintendent of the Water-Genter company, has changed his home to 5128 35th avenue South, Minneapolis, Minnesota.

'22—Kelsey—Returning to Buffalo, New York, H. C. Kelsey has again taken up his work with the Machinery Sales department of Joseph T. Ryerson and Son.

'23—Ascher—R. C. Ascher is still with the Republic Flow Meters company, 5-138 General Motors Bldg., Detroit, Michigan.

'24—Koehler—Edwin F. Koehler journeyed westward this summer to find a wife. He was married to Miss Florence Slater June tenth at Del Norte, Colorado. Mr. Koehler is a safety engineer for the Standard Accident Insurance company of Detroit, Michigan.

'24—Cherne—Realto Cherne recently was given a promotion to assistant sales engineer of the Carrier Engineering corporation. "Pat's" work consists of designing and price estimating of central station air conditioning plants. His address is 532 Broad street, New York City.

'27—Spencer—J. Boyd Spencer, formerly at Fullerton, Pennsylvania, with the Fuller-Lehigh company, has moved to 1521 Union street, Allantown, Pennsylvania.

'27—Richardson—Ralph A. Richardson, now over two years with General Motors as research engineer, is living in Detroit, Michigan, at 714 Delaware street.

Electrical Engineering

'00 'EE—Kinsell—William L. Kinsell, 1900 has been appointed superintendent motive power and equipment of the Alaska Railroad, with headquarters at Anchorage, Alaska. The appointment was made early in the summer and Mr. Kinsell went to Alaska in July.

The Alaska Railroad is government owned and operated and extends from Seward on Resurrection Bay, to Fairbanks in the interior. It now has about 521 miles of standard gauge track and 43 miles of three-foot gauge. Its equipment includes 27 locomotives, 862 freight cars and 40 passenger cars. The port at Seward is open all the year and the primary purpose of the railroad was to develop the resources of the interior by affording a regular and adequate transportation service throughout the year. Alaska contains practically the only satisfactory steaming coal on the Pacific coast of North America and one of the principal purposes of the railroad was to tap these coal fields and provide fuel for navy, shipping and other purposes. There are, however, other large mining and agricultural possibilities in the interior which it was hoped to develop.

The present road includes the old Tanana Valley Railroad and the Alaska Northern Railway. It was authorized in March, 1914, but was not opened up to Fairbanks until 1922. The construction was difficult and expensive. The revenue from all sources for the year ending June 30, 1928, was $1,449,825, while the total expenses for rail operations and the boats which is necessary to operate on the river, were $2,292,625, making an operating deficit of $842,800. While this seems large, it is smaller than it was in previous years; indeed, it was not until the fiscal year ending June 30, 1927, that the deficit fell below a million dollars a year. Over against this, however, must be placed the possibilities involved in the opening up and developing of a country rich in mineral and other resources.

The task of operating the property during the winter months is a most severe one and it is believed that Mr. Kinsell's ability and ingenuity will be taxed to the utmost, since his department is charged with the responsibility of maintaining and keeping the equipment in good operating condition.

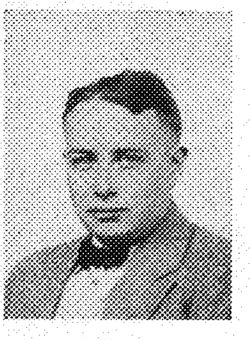
'14—Gagger—Professor A. W. Gagger, professor of chemical engineering at the University of North Dakota, spent several days with members of the chemical engineering division at Minnesota. Professor Gagger is vitally interested in the research work on the drying of ligoite, which is being carried on at Minnesota by Irvine Lavine, '24, who is on leave of absence from the University of North Dakota, where he is assistant professor of chemical engineering.

'23—Burrill—Charles M. Burrill recently visited the campus and told us that he had "moved from Schenectady, New York, in January when the General Electric company transferred their radio engineering department to the newly organized R. C. A. Victor company." He is living at 306 White Horse Pike, Haddon Heights, New Jersey.

Mr. Burrill has found E. W. Engstrom, '23, W. Hargrave, '24, and A. Haedecke, '24, working for Victor.

'25—Richardson—Philip E. Richardson, who is now married, is in Fort Wayne, Indiana, as a commercial engineer for the General Electric company. He has two children, Robert, 3, and Carol Ann, 1.

'27—Berglund—Erick B. Berglund is now engaged in development work of photophone equipment for the RCA-Victor Corporation at Camden, New Jersey.


J. R. GINNATY

'29—Ginnaty—A former TECHNO-LOG editor, writes a few lines. Jack was head of the '29 editions.

"Don Barker, '29, was married just a few months ago and now is at home at 429 Rebecca avenue, Wilkinsburg, Pennsylvania; and Bud Ficher, also '29, has but recently brought his wife back here too. And Rudolph Bierwagon, '29, now has a daughter which happened along late in the summer. Karl R. Heidmann, '29, was in camp for two weeks in July at Fort George G. Meade where I spent six weeks giving CMTC and ROTC boys technical instruction from June 16 to August 1. E. D. Meeks, '29, has been transferred to the Chicago office. Ed Kueffler is still here in East Pittsburg; and Sheldon Johnson, a former business manager of the TECHNO-LOG, is still in the advertising department."

Jack says that we may receive an article from him most any day now as he feels the "urge coming on."

'25—Class Reunion—Graduates of '25 gathered last spring around a Curtis hotel dinner table to eat turkey, talk, and see a few interesting movie views taken by Ralph Sprungman, a student, on a canoe trip through the territory along the boundary east of International Falls.

This meeting, arranged by Harold Smith and Louis Peterson, was the second annual reunion of the '25 electrical engineering class. It affords probably the only means for members of this class to continue their college acquaintances.

Many members who were unable to attend wrote to Mr. Smith telling him of their progress. These were R. G. Edwards, substation designer for the Southern California Edison company, Los Angeles; Allen Wurzbach, personnel work, A. T. and T. Denver; R. W. Keller, securities department of the Ohio Edison company, Springfield; H. R. Reed, Michigan College of Mining and Technology, Houghton, where he is with Professor Swenson; Karl J. Albrecht, United States Patent Office, Washington, D. C.; R. V. Ludlum, illuminating engineer for the General Electric company, Los Angeles; Charles J. Cosandey, Duluth junior college, Duluth; Kenefick Robertson and M. A. Countryman, Northern States Power company, Sioux Falls, South Dakota; and Henry F. Brossard at Mantorville, Minnesota. Mr. Brossard has been ill for some time.

Those that met at the Curtis are: Karl R. McClung, Glenn Westigard, and H. R. Weyer, Northern States Power company; R. E. Burlingame, Byllesby Engineering company; Ikel C. Benson, S. P. Bordeau, and George J. Shaver from the Electric Machinery company; L. B. Peterson, Northwestern Bell Telephone company; Art C. Jacobson, Century Electric company, and C. H. Nelson, Engineering Building, University of Minnesota.

Civil Engineering

'03—Smith—Leighton H. Smith has gone back to civil engineering in connection with real estate and lands in Klamath Falls, Oregon. Mr. Smith formerly owned an automobile business which he sold after nine years to take up his present work. His address is 1843 Oregon avenue.

'07—Swenson—Charles A. Swenson, Atwater, Minnesota, is combining engineering and law as county attorney at Willmar, Minnesota.

'08—Krauch—William L. Krauch, 1678 Lincoln avenue, St. Paul, has been made vice-president of the George J. Grant Construction company. He was formerly chief engineer.

'08—McCree—A. A. McCree, 1897 Summit avenue, St. Paul, Minnesota, is president of McCree and Company and of the Associated General Contractors.

'08—McCall—Harry J. McCall is still with the Northern Pacific railway at Pasco, Washington.

'11—Kvitrud—Now that winter has arrived Ingwald Kvitrud is busy. He is still manufacturing weather stripping. He loafed away a vacation up at Mille Lacs and Itasca Park, spending those sweltering summer days on the golf course.

'21—Svendrup—Leif I. Svendrup, who was formerly located in Jefferson City, Missouri, as bridge engineer for the Missouri commission, is now a consulting engineer. His office is at 202 Railway Exchange, St. Louis, Missouri.

'25—O'Brien—T. Earl O'Brien toured the West this summer. The rest of the time he spent playing golf and tennis and working on building plans and specification for the Illinois Bell Telephone company at Chicago. He is living at 57 Forest Avenue, Riverside, Illinois.

(*Continued on page 58*)

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Forward Ho!

THE world focuses its attention on the latest revolution in Mexico and the attempt to set up a new and better government in that turbulent country. People watch with avid interest the development of the newest divorce proceedings in Hollywood. The results of revelations and accusations in organized baseball are viewed by millions. Even the frothing outbursts of those who wish to establish a prohibition of tobacco in our states hold the rapt attention of multitudes. And while men argue and fight, scientists and engineers continue to go quietly about their work in producing new conveniences for mankind which make this world a better and more pleasant place in which to live. Less than a century ago, the photographic process was a new and most wonderful thing. Later on, in 1884, those famous words, "What hath God wrought?" were flashed from Washington to Baltimore by telegraphic code. Then, during the centennial of the American revolution, Alexander Bell made the first speech by telephone over a distance of two miles, and in more recent years, the radio increased still more the power of the spoken word.

But these inventions, marvellous in themselves, did not satisfy human cravings, and the television process was developed as a combined product of former efforts. This step would appear to be sufficient, but modern ingenuity has gone still farther and produced the talking moving picture, blind flying of aeroplanes, and other miracles beyond the wildest dreams of our most imaginative progenitors.

What the next century will produce no man can say, but it is certain that science has not reached its limit in reducing the size of the world for the benefit of the mortals who live and fight thereon.

"What a Man Reads"

IT is often said that one of the greatest aids to success in any profession is the constant reading of professional journals. In engineering this is perhaps even more important than in most other professional lines, for in engineering, new methods are rapidly being developed to take the place of older and less efficient ones.

In view of this fact, it is vitally important that the engineer carefully read and study the chief journals in his field—yet how many actually do?

The university is the proper place to form this habit of reading. The Engineering library subscribes to nearly all the important magazines, and no student is so busy that he does not have time to read at least two or three good articles per week.

Good articles concerned with various phases of science and technology are constantly appearing in the better class of popular magazines and even the newspapers now carry a great deal of news of interest from an engineering standpoint. It is true that they do not usually print engineering news in the most prominent place in the paper under large headlines, but nevertheless, sometimes even on page one, are stories telling of recent achievements, new plans and developments, proposed changes in civic structures, local and national in character.

The educated man is one who has acquired the habit of learning,—he is one who constantly searches for additional information,—he is one who keeps abreast of the times. Let engineers be the first to become familiar with new thoughts and trends that they may serve as the media for further dissemination of progressive scientific thought.

"When the Day is Done"

DURING the last few years, I have been conscious of the fact that several persons whom I knew quite intimately possessed various eccentricities. They did not seem to have a natural and easy way of doing things. They did not handle their cars smoothly. They were not particular about the appearance of their jobs, and most of all they did not seem to be aware of their mistakes. These things made me cross. I began to criticise many of their methods and eccentricities. I almost felt contempt for the persons themselves because they did not find better ways of doing things. I had no patience with their manners. I never thought that there might be a very natural reason for their inabilities.

But now, since I have mingled with others, I understand the reason: they have outgrown their keenest age. Being with them often, I was not aware of their increasing age. Physically they did not change, but their ability to do things diminished. Their period of usefulness will soon be over and I must respect them for what they have done. They have done as much in their place and period as we will do in ours. If we accomplish more, it is because of the advantage they have given us. I understand, now, that it is my place to overlook their eccentricities and inabilities for what they did accomplish.

—H.L.W. '34.

Mental Tilts

This issue of the Minnesota Techno-Log contains a column entitled "Mental Tilts," edited by that most famous of all engineers, Oscar Fegas.

Mental Tilts will contain various problems in mathematics, logic, and geometry. All have solutions, none will be so-called "catch problems."

Answers will appear in the following issue.

Frosh Capture Gonfalon in Annual Scrap

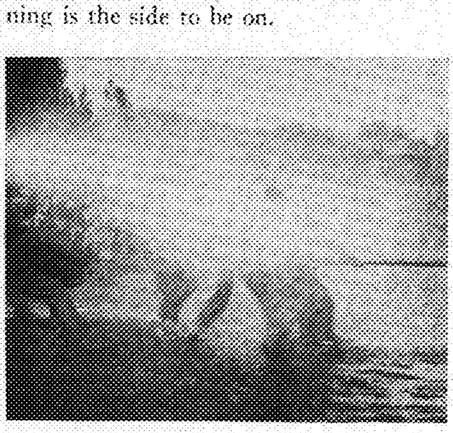
An avalanche of Green, tearing and hacking, biting and clawing, crushing the very life blood, repulsed the repeated efforts of the sophomore horde

By MAURICE NORTON, E '32

THE Engineers' Scrap, including the pushball, the sack race, greased pole tilting, and other events, amused its audience even more this year than ever before. There seemed to be more spirit evidenced than has yet been seen.

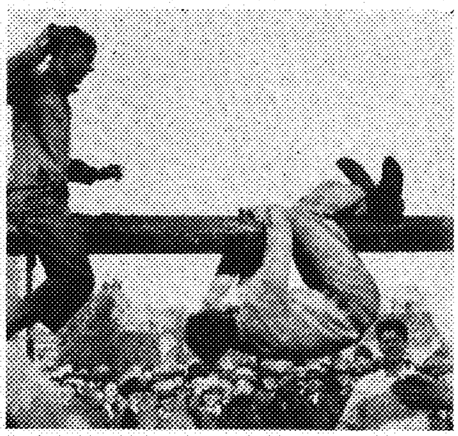
The Scrap this year was unique. There had been negotiations on the part of the college newspaper and the leaders of the event to have an inter-college tilt. The engineering participants had invited the sophomores and freshmen of the Arts College to test their mettle with the victors between the yearlings and sophomores of College of Engineering. There was a bit of disappointment in the hearts of the freshmen Engineers when, after scouring the whole campus and Folwell Hall in snake dance formation, they found no fighting men to champion the cause of the S.L.A. College.

The pushball event was, as usual, one big scramble wherein might was right. The sophomores were out-numbered two to one and, accordingly, lost the event, but only after one famous struggle. If one has never seen a pushball game, a race, or what-you-will, it has all the thrills that one looks for in a football game and sees in a race riot. The fact that there are so many in on the game (the number is unlimited), and that the pushball is so large that all in the audience can see it, even we with the less quick eye, who never know at football games who has the ball, can follow the play. The audience, usually a bloodthirsty one, seldom cares how the ball goes, but is fascinated by the side fights that develop after some man steps on another's neck. Class distinctions are removed. The freshmen start out with a bit of green tied on them some place, but after this event, the side that is winning is the side to be on.



SOPHOMORES DRENCHED BY TUGGING FROSH

The sack race is as good as a combination of Ringling Bros. and Barnum & Bailey's, with side-shows starring Dempsey, Carnera, and Daniels. The point is to get a water-soaked, straw-filled gunny sack across a goal line. The event takes place on a regulation football field. The sacks are placed on the 50 yard line. The



SLIPPING TO DEFEAT ON THE GREASED POLE

sacks are manned by four men from each team, four sacks, sixteen men in all, eight of which are held back until the gun is fired. At this point, the second eight join battle and it is a battle royal. The men pair off in little individual wrestling matches, each endeavoring to prevent the other from aiding the man tugging on the sack. The little side battles are quickly surrounded by the crowd, that they might enjoy to the fullest the thrashing tussles. The sacks in themselves present a task to handle. They are muddy and bulky, giving rise to no end of slapstick, comedy situations, at which the mob shouts loud and long for more.

The greased pole comes next on the program. Up until now, the horizontal pole, eight feet long and high from the ground, has stood rather deserted, but quite as ominous in appearance as the guillotine of the days of Dicken's "Tale of Two Cities." The pole is a piece of cast iron pipe eight inches in diameter, supported at each end, and lubricated with the foulest looking mess ever seen this side of a Model T rear end. The opponents mount the pole and are handed a small sausage-like shield of gunny sack filled with nice, harmless straw. On the signal, the buffeting begins. A man is usually vanquished because he reaches just a little too far, trying to place a good shot on his opponent's pate. A man is conquered only when he is on the ground as a result of his tussle, he may swing under the pole, hanging on by his feet, and regain his upright position, but to do so he must take an awful beating undefended, while he uses all his might and main to scramble to the top side again. After each tilt, the pole is well oiled again. The faces of the gamesters are usually quite strained as they arrive on their perch for the position, which as we can well imagine, is very precarious even though there are a number of friendly hands to catch the player should he fall.

The tug-of-war, through a firehose, however common place, is a wonderful drawing card in any such set-to as this. The sophs lined up manfully and took their end of the rope. They were doomed for a drenching, and they knew it. While the freshmen jubilantly took their places, two policemen, a fireman and some seniors of the college turned on and held the big brass nozzle that would soon be doing some high-class drenching. The gun, and they were off. It was a losing fight for the sophs from the first, but they hung on and much to the admiration of the crowd, made the freshmen pull them through the stream, down to the last man, seated flat on the ground and sloshing inevitably through the icy stream.

Success! The freshmen overwhelmed the sophs 400 to 100 in the final count. To crow a bit about their victory, they all joined in a ring about their leader, big Bill, and gave a few choice yells, and then departed home full of anticipation of the theatre party staged at one of the downtown theatres that evening.

BACK AND FORTH THE BATTLE SWAYED

NEWS FROM THE TECHNICAL CAMPUS

Athletic Awards Made At Annual Convocation

Engineers were called to a special convocation in the Engineering Auditorium on November 6, to witness the presentation of awards to the winners of All-University or All-Engineering athletic championships by the Intramural department and the Engineers Book Store.

Professor O. S. Zelner of the civil engineering department expressed his appreciation for the large turnout and introduced the speakers to follow.

Dean Leland, the first speaker, expressed his pleasure that so many engineers were present thus indicating that their interests were in the athletic as well as the technical.

"The partaking of sports should be encouraged and a more balanced program should be arranged," said Dean Leland, "so that the development of the student will not only be mental but physical as well."

Mr. Tad Wieman, head line football coach for the University, was the next speaker. He stated that athletic competition develops the mind and body. It produces coordination which when applied to any action of the muscles, adds grace and sureness. The demand for cooperation called for from each man in a closely matched game makes evident his preparation and ability to concentrate, the acquirement of which will be beneficial to him many times over.

Mr. W. R. Smith, head of the Intramural department and Mr. H. D. Smith, manager of the Engineers Book Store, presented the awards.

Gold keys were awarded to the following senior architects for winning the All-University diamond ball championship: L. W. Gustafson, W. J. Felt, A. E. Erickson, V. G. Erickson, F. E. Mullen, J. J. Dovelis, J. L. McHugh, J. A. Morrison, R. A. Nelson, L. Anderson, L. C. Halverson and L. J. Knuth.

D. H. Anderson was awarded a gold key for winning the All-University boxing championship.

Silver keys were presented to Ed Hanlon and Ray Kaplan, members of the electrical engineers touchball team, which won the engineering championship.

Silver keys were also awarded to E. Hill, H. Mackus, A. Johnson, and L. Olson, members of the civil engineering basketball team which won the engineering championship.

Charles Britzius and Bill Barstow were given silver keys for winning the tennis and golf championships respectively of the Engineering College.

DR. EDWARD A. SAIBEL

Saibel Goes to Carnegie

Doctor Edward A. Saibel, former mathematics instructor at the University, is now teaching at the Carnegie Institute of Technology, where he has been given an assistant professorship.

Doctor Saibel attended the University of Michigan during the past summer, where he carried on some very extensive work in the field of applied mathematics. After completing his work there, he toured the New England states for a few weeks and then returned to Minneapolis, where his marriage to Miss Lillian Howe of Alden, Minnesota, was solemnized. Mrs. Saibel attended the University of Minnesota before her marriage and is continuing her studies in the East. Shortly after their marriage Mr. and Mrs. Saibel left for Pittsburgh where they are making their home.

Doctor Saibel is in the department of Mechanics at Carnegie and teaches twelve hours a week—devoting the rest of his time to research work along various lines. He has recently prepared several treatises on mathematics and is at present in writing a polemical article on humanizing the engineer.

Mortar And Ball Pledges New Men

Mortar and Ball, national honorary artillery fraternity, recently entertained at a pledging luncheon at the Minnesota Union. Eleven new men attended the luncheon which signified their desire to become members of the organization.

Informal initiation took place on October 31, the work consisting of a mock camp night. Formal initiation will not be held until the latter part of November according to Charles Caverley, 1st Sergeant.

The new men are the following: Fortin Christopher, S. Dahl, Everett Ericson, Winfield Foster, Mirza Gregg, John Hodgens, John Mokres, Maurice Norton, Raymond Penney, and Donald Starr.

New Appointments Made to Faculty

A new addition to the faculty is Mr. Lorenz G. Straub, who was born in Kansas City, Missouri, June, 1901. His professional training was received at the University of Illinois. After graduating with honors in 1923, he continued studying for his master's degree which he received the following year.

From June, 1924, to September, 1925, he was associated with the Browns-McDonnell Engineering company in charge of work on reports and the design of water works and other municipal plants. He then returned to the University of Illinois as Engineering Fellow in structural and hydraulic research and received his doctor's degree in June, 1927.

Upon receiving this degree, the American Society of Civil Engineers appointed him as First Freeman Traveling Fellow for hydraulic engineering investigations in various European countries. Following his European travels, Mr. Straub was engaged in hydraulic studies of the Missouri river in the Kansas City district where he was in charge of "Special Studies Department." This was his last position before coming to the university this fall.

A teaching fellowship was awarded to Robert N. Lohn, B.C.E., University of Minnesota, 1929. Mr. Lohn was design draftsman for the E. J. and E. Railway Company from 1929 to the present time.

C. Irwin Vigness has been engaged as a teaching fellow in the department of electrical engineering. Mr. Vigness received a bachelor's degree in electrical engineering from the University of Minnesota in 1929.

Charles L. Brainard has been appointed instructor in commercial work and contracting. Mr. Brainard received his bachelor's degree in architecture from Kansas Agricultural College in 1930.

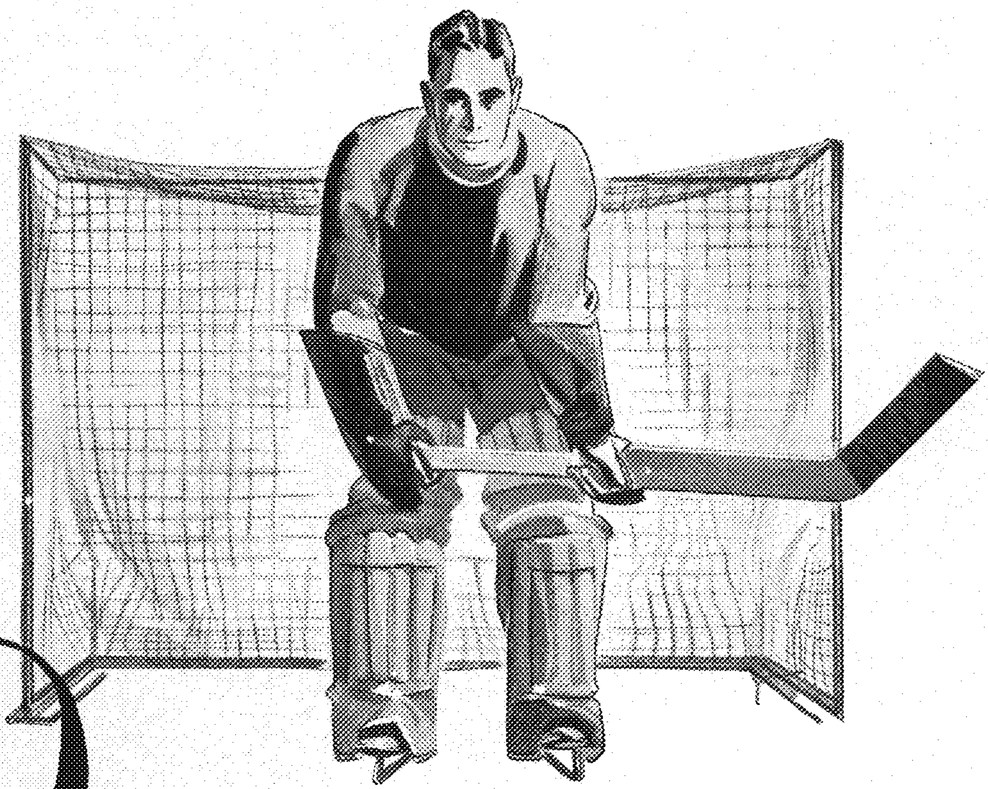
Albert L. Nowicki has been awarded a teaching fellowship at the experiment station. Mr. Nowicki was graduated from Marquette university in 1930.

Marvin O. C. Johnson, who received a bachelor's degree in electrical engineering from the university of Minnesota in 1930, has been awarded a teaching fellowship in that department.

Eldred B. Murer received a bachelor's degree in chemical engineering from the University of Minnesota in 1930. Mr. Murer was awarded a teaching fellowship in the Experiment Station.

Gordon Thompson is new at the Experiment Station this year. He was awarded a teaching fellowship. Mr. Thompson received his B. S. from the Texas Technological College.

(Continued on page 48)



ON GUARD!

S. F. Henderson
Armour Institute of Technology, 1926
Contract Administration

G. C. Saltzman
Carnegie Institute of Technology, 1923
Patent Department

Out in mid-rink, flying skates cut the glassy surface of the ice into powder amid the clatter of sticks and the hoarse, inarticulate cries of human beings in combat. Back and forth goes the puck, now dexterously propelled down the side-lines by a fleet forward, now shuttled rapidly to and fro amid a tangled mass of sticks and legs. Yet fast as it moves, it never eludes the watchful eyes of the two heavily-armored huskies who tend the goals. On guard, ready to thwart disaster with stick, skates, or any part of his body, the good "goalie's" work is ever vital, and often spectacular.

In a large organization like Westinghouse, there is need for a number of such expert "goal tenders." Occupying positions in the Accounting, Legal and Contract Departments, they carry on quietly their important work of guarding the resources, patent situations, and contractual relationships of the company. And among them may be found many younger college men, like those whose pictures appear on this page, who have found in this work an opportunity to secure recognition and worthwhile reward.

B. H. Hornbarger
Virginia Polytechnic Institute, 1925
Contract Administration

W. P. Swezey
University of Kansas, 1923
Patent Department

Among the important pieces of electrical work handled by Westinghouse in recent years may be mentioned the following:

Cascade Tunnel Electrification, Great Northern Railway; Network Protector Installation, Chrysler Bldg., New York; Hydro-Electric Generating Equipment, Coolidge Dam, Arizona.

Westinghouse

NEWS FROM THE TECHNICAL CAMPUS

(*Continued from page 46*)

Mr. Arthur R. Ford, M. S. (M. E.), Massachusetts Institute of Technology, is now in the Mechanical Engineering department as Associate Professor.

Harold K. Palmer, new Mechanical Engineering instructor, received a bachelor's degree in electrical engineering in 1930 from South Dakota State College.

Arthur C. Kurzwiel has been appointed instructor in drawing and descriptive geometry. Mr. Kurzwiel was graduated from Cornell university in 1928.

Nordahl T. Rykken, who has been with the Bureau of Public Roads, Washington, D. C., has been awarded a teaching fellowship at the Experiment Station. Mr. Rykken received a bachelor's degree in chemical engineering in 1929.

William H. Easton, B. S. (M. E.), University of Florida, 1928, has recently been appointed instructor in Mechanical Engineering.

In the Mathematics department J. D. Hutchinson, B. A., M. A., University of Illinois is an instructor.

R. C. Brinker has been appointed instructor in civil engineering. Mr. Brinker received a bachelor's degree in civil engineering from Lafayette College, Pennsylvania.

W. C. Griffith, new instructor in the department of mathematics, received an A. B. from Willamette College and an M. A. from the University of Oregon.

Freshman Architects Entertained at Dance

Upper classmen of the department of Architecture recently entertained freshman architects at a dance, their first party of the year which was held in the north studio of the Main Engineering Building.

During intermission Milton Hogland, president of the Architectural Society, introduced Professor Mann, head of the school, who welcomed the freshmen. Mr. Mann also announced the winners of prizes which were awarded on a basis of general scholarship. Earle Cone and Milton Hogland were presented with prizes for ranking high in their junior years while Gordon Wahl and George Townsend carried away honors for sophomore work.

Several members of the faculty were then introduced, after which Jack Tews entertained with several banjo and vocal numbers.

Committees in charge of the affair were: general arrangements, Milton Bergstedt and L. O. Anderson; refreshments, May Ohrbeck; entertainment, Rudolph Dahl; faculty, Francis Gorman; publicity, James Dorolis.

Frenkel Addresses Chemical Society

The local section of the American Chemical society introduced, as the first of its annual series of speakers, Dr. J. Frenkel, professor of theoretical physics at the University of Leningrad, Russia, who is at present giving a course of lectures in advanced theoretical physics at the University of Minnesota. Dr. Frenkel addressed the group consisting chiefly of students in chemistry and physics on "The Theory of Adsorption on Solid Particles."

The speaker, who rendered most of his material in a non-mathematical form, began with a summary of the pioneer work by Langmuir on the adsorption of gaseous molecules on metallic surfaces, discussing the conditions of evaporation and condensation on the latter, and briefly reviewing the mathematical results calculated by Langmuir from kinetic considerations.

After this review, Dr. Frenkel presented a report of some of the researches which he had performed with Semeroff and other collaborators, substantiating a theory that takes into account the fact that the evaporation rate is hindered by the interbinding of closely neighboring particles of the adsorbate, resulting in the formation of groups of two, three, and more rarely, of higher order.

Dr. Frenkel then discussed the application of his theory to the problem of adsorption of ions on colloidal particles, emphasizing the effect of charge distribution and magnitude of the dielectric constant on the adsorption.

Dr. Frenkel, besides being a frequent contributor to foreign scientific journals, is celebrated for his work on electrolysis of crystals, and especially for his "Introduction to Wave Mechanics." The latter, according to men of authority, is a treatise on one of the most complex fields of physics holding the attention of the scientific world of today.

MENTAL TILTS

Try One on Page 52

SOLUTIONS GIVEN IN THE NEXT ISSUE

Noll Questions Need of Laboratory Classes in Elementary Work

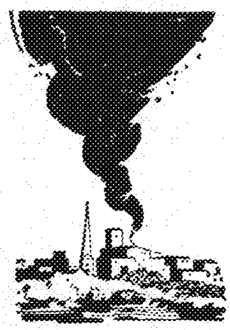
Whether or not the amount of laboratory work now done by students in elementary chemistry is necessary to their success in the course is the main question discussed by Victor H. Noll in his book, "Laboratory Instruction in the Field of Inorganic Chemistry," which has just been published by the University of Minnesota Press.

While Mr. Noll is careful to stipulate that further investigation is needed before his conclusions can be regarded as certain, his book contains a number of rather surprising observations, based on his study of chemistry classes at the University of Minnesota. He found, for instance, that the oral quiz and recitation, plus three hours a week of individual laboratory work, seemed to be somewhat more effective than a greater amount of laboratory work. He also discovered that girl students had no less "chemistry aptitude" than boys had, but that students majoring in chemistry made consistently better scores than those who were presumably less interested in the subject.

Dean E. M. Freeman of the College of Agriculture, Forestry and Home Economics, who writes the introduction to the book, expresses the opinion that Mr. Noll's study makes a forward step in the investigation of the laboratory requirement in elementary college chemistry. He believes that a smaller laboratory requirement would be welcomed by students who take chemistry for its informational value, and who do not need the technique or skill of manipulation which laboratory courses aim to give.

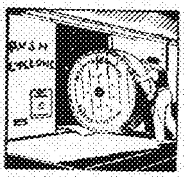
While he was conducting the study recorded in this book, Mr. Noll was an instructor in the College of Education at the University. He is now educational specialist with the National Survey of Secondary Education. His book forms the third volume of the University of Minnesota "College Problems" series. The first volume, "Problems of Science Teaching at the College Level," is by Professor A. W. Hurd, now of Columbia university. The second, "Curricular Problems in Science at the College Level," is by Palmer O. Johnson of this University. All three books have been published during the last two years by the University of Minnesota Press.

The Hoover Dam, for which $165,000,000 expenditure is authorized, has three purposes, namely, reclamation of arid lands, power development, and flood control.



It took something more than book learning to lick this cyclone

A cyclone twists its destructive way through the West . . . telephone lines go down . . . communication must be restored . . . page Western Electric! ℭ There's a real "kick" in meeting and *beating* such emergencies. It calls for scientific management, of course, the sort of knowledge you can get from books and training. But over and above that comes the sudden demand for resourcefulness, man-sized ability, sheer grit. ℭ To supply the telephone companies of the Bell System with everything needed to give service, Western Electric carries on a dependable, nation-wide system of distribution. A vast undertaking—yet only one of this company's varied functions.



Starting supplies on their way to the stricken area is but a matter of minutes

Like secondary defense Western Electric backs up the nation's line of communication

Western Electric

Manufacturers... Purchasers... Distributors

SINCE 1882 FOR THE BELL SYSTEM

ELECTRIFYING THE PENN.

(*Continued from page 35*)

increased in length and weight in the future. Passenger trains that can be taken into a terminal are limited in length by station platforms. However, on non-stop trains running between distant points it would be possible to combine two or three sections upon leaving the terminal, running them as one train with one electric locomotive and splitting up the train upon entering the destination terminal.

TRAINING THE BIG MUDDY

(*Continued from page 41*)

in the process of construction. When first woven, it floats on top of the water and must be firmly anchored during construction in order to keep it from being carried away by the current, particularly during periods of rising stage when considerable driftwood is being transported by the river. Rock is used to weight the mattress down as soon as possible during the construction procedure. Thus, one part of the mat may be submerged while the other part is still being woven. Because of the scarcity and expense of obtaining willows, boards are now being used to a large extent to replace the willows. These are woven into mattresses similar to those made of willows. One is shown in the figure of the clump dike. Mattresses are also invariably used to protect the bottom of pile dikes from erosion; otherwise, many of the piles would be scoured out, and drift down the stream.

Although the Missouri River will be open to navigation within one or two years, the final development will probably require work over a period of several decades. There is at present considerable agitation for a 9-foot waterway in order to conform to that of the Mis-

(*Continued on page 56*)

« « MENTAL TILTS » »

The Unknown Engineer

GIVEN: Four towns, A, B, C, and D, are located along a railroad. The distance from A to B is 100 miles, and the distances from B to C and from C to D are fifty miles each. There are three passengers on the railroad: Brown who lives at A, Robinson who lives at D and Smith whose residence is unknown. The train crew of the line consists of three men: a brakeman, a fireman and an engineer. They have the same names as the passengers,—i.e., Smith, Brown and Robinson.

The following facts are also known:

1) Railroader Smith can usually beat the fireman at pool.
2) The engineer gets a cash salary ⅓ of that of his nearest neighbor.
3) The brakeman's namesake (the passenger having the same name as the brakeman) gets a cash salary of $5,000.00 per year.

The foregoing facts are all essential in the solution of the problem.

REQUIRED: The Engineer's name.

The Lost Hunter

GIVEN: A young man while in northern Minnesota hunting deer was caught by an unexpected snow storm and was unable to find his way back to camp. Finally when nearly exhausted with the cold he stumbled upon a lonely cabin where he entered and asked for food and shelter. Not having any money, he agreed to give one link of a platinum watch chain to the housewife for every day that he remained. Not knowing how long the storm might last, the hunter wished to cut his chain in the fewest possible places. Now there were ninety-nine links in the chain, and as Fortune would have it, the storm lasted for exactly ninety-nine days. Each day it was necessary for the hunter to give one link to the housewife.

REQUIRED: The minimum number of times that it was necessary to cut the chain.

THE WELLAND CANAL

(Continued from page 39)

much difficulty was encountered in maintaining the cofferdam at the northeast corner where it projected out into the canal, and in several instances 18x18 inch timbers failed under the great pressure which developed.

In the foundations of the culverts 136,500 lineal feet of timber piling were used. The present canal traffic was diverted across the completed syphon culvert in December, 1928, and when the wing walls of the culvert and the new approach channels were completed, the river was diverted and the old stone culvert removed.

TRAINING THE BIG MUDDY

(Continued from page 50)

sissippi and Ohio Rivers. This seems entirely possible, but the expense will be considerably larger than that of the present 6-foot project. Eventually a 9-foot river route will probably be developed on the Missouri, thereby forming one of the main segments of the Mississippi valley navigation system, which will doubtless become the world's greatest inland waterway development.

There's no place like a fraternity house—thank God.

Electrical Engineering

(Continued from page 43)

'26—Feldman—Carl B. H. Feldman is doing test work for the Bell Telephone Laboratories at Phoenixville, Pennsylvania, where he expects to be for about three months. His address is 246 Fourth avenue.

'27—Edward L. Bottemiller, who is with General Electric company at Schenectady, N. Y., was recently transferred from the requisition department to development and rating work on industrial control devices. He is still undecided as to following sales work or straight engineering.

'28—Burris—Arthur P. Burris has decided that there is just no place like Minneapolis, and, acting accordingly, has accepted a position with the Electric Machinery company, located here. Art took up his new duties here on the first of February, and will henceforth be connected with the sales department. He was formerly attached to the Chicago sales department of the Westinghouse manufacturing company.

'28—Anderson and Fischer—Elwood C. Anderson and G. Lee Fischer are with the General Electric company at Fort Wayne, Indiana. Mr. Anderson is a commercial engineer and Mr. Fischer is an engineer in the apparatus division.

'28—Neill—C. L. Neill, according to recent rumors, has become engaged. He is with the traction apparatus sales department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pennsylvania.

'28—Cook—J. Marvin Cook has a heir, John Marvin, Jr. Junior hasn't learned to talk as yet, but from outward appearances he's another engineer.

'28—Johnson—Douglas O. Johnson, at present in the motor engineering department of the Westinghouse Electric & Manufacturing company, expects to be transferred this July to the Philadelphia plant. He intends to enter the oil industry division of the general engineering department in 1931. Sheldon F. Johnson is also with the Westinghouse Electric company. He is engaged in small power motor advertising and resale advertising.

'28—Grimm—Raymond E. Grimm is now in Chicago with the American Telephone & Telegraph company. He was formerly in Seattle, Washington.

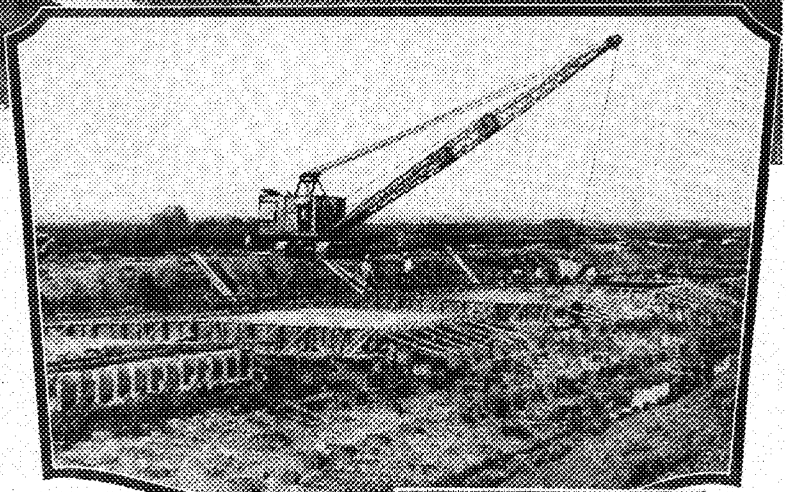
'29—Larson—M. C. (Larry) Larson recently completed the student course offered by the Cutler-Hammer manufacturing company, and celebrated this event by making a week-end visit to Minneapolis to see everybody in general, but one friend in particular. We predict that it won't be long now.

'29—Mayer—Francis L. Mayer is a sub-station designer for the Northern States Power company in St. Paul.

'29—Harris—Gordon C. Harris was recently ticket chairman of the committee in charge of arrangements for the nineteenth annual Christmas banquet held by the testmen at the Schenectady Works of the General Electric company. One hundred and twenty colleges and universities in the United States and 18 foreign countries were represented.

THE MINNESOTA TECHNO-LOG

Vol. XI DECEMBER, 1930 No. 3



TWENTY-EIGHT miles upstream from New Orleans a great flood gate known as the Bonnet Carre spillway is being completed. In times of high water this concrete dam on the east bank of the Mississippi will tap the flood before it reaches the city, diverting the dangerous excess into Lake Pontchartrain.

The Bonnet Carre spillway consists of a concrete dam and a pier-and-weir section about 7700 feet long. The weir sections, which are twenty feet wide between the piers, have timber needles on the crests at two levels — elevations 16' and 18' A traveling crane, on a bridge spanning the piers, removes the timber needles for discharge.

N. E. C. equipment played an important part in the construction set-up. Two Koehring Cranes handled aggregate at the material bins and a third Koehring placed the concrete with an Insley bucket. Two large Smith mixers mixed the 127,000 cu. yds. of concrete used on the project.

Wherever you find construction work in progress, you find N. E. C. equipment!

"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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Excavators; Concrete Placing Equipment; Cars, Buckets, Derricks.

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Mixers — Concrete, Plaster and Mortar.

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Milwaukee, Wisconsin

THE UNIVERSITY OF MINNESOTA

THE MINNESOTA TECHNO-LOG

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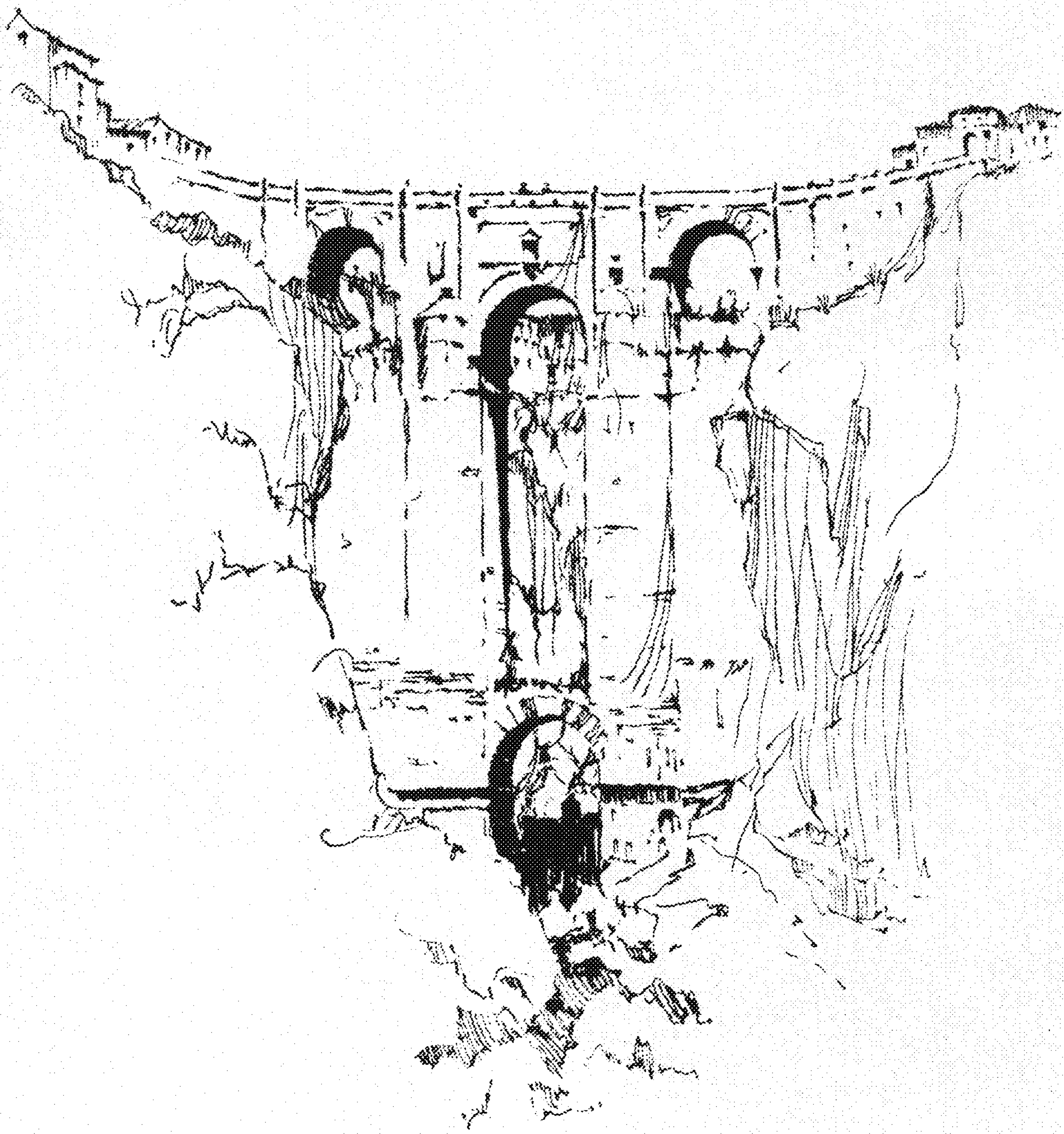

·THE·BRIDGE·AT·RONDO·(SPAIN).
AFTER·S.L·CHAMBERLAIN.

THE MINNESOTA TECHNO-LOG

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Russia

This vast country, two and one-half times as large as the United States, is the scene of one of the greatest social, economic, and industrial revolutions that the world has ever witnessed

By HENRY K. DOUGAN, C '08

Great Northern Railway

THE first contact between the Great Northern Railway and the Soviet government occurred last January, when we had on our hands a delegation of Russian engineers who came to this country to look over this thing and that thing. They looked over our equipment, and motive power, they saw our tracks and our docks, they inspected the elevators along the line and noticed how we handled our trains. It was all part of the plan of the United Socialistic Soviet Republics, which we commonly speak of as Russia, in making their plans for the extension and improvement of service on their railways.

In addition to the delegation that came over here, Mr. Budd, as one of the outstanding railroad engineers, was asked to go to Russia and make a report on their railways. In all, Russia has about 50,000 miles of railway and we traveled over about 16,000 miles while in the Republic. That constitutes about one-third of all the railway mileage. Compare that—50,000 miles in Russia, Siberia and Turkestan,—with our own 250,000 miles in the United States. Just about one-fifth as much, and yet that country has 2½ to 3 times the area of the United States. Furthermore, it has a greater population than we have in the United States, and you can judge pretty well when I say that the total traffic density is about the same as in our country so far as freight is concerned. Really, it means that per inhabitant about one-fifth as much freight moves. However, as far as passenger traffic is concerned, the railways of Russia are simply loaded down. They have nearly three times the passenger traffic that we have here. The result is that the trains are thronged with people and strangely enough these people carry their baggage. It is their habit to do that way. They come down to the station sometimes 24 to 48 hours ahead of the train with their baggage and children, fish and cucumbers, which they carry as food, and a small samovar and proceed to camp out on the station platform until they can get their tickets and the train.

We arrived at Moscow, after traveling about twelve hours from the frontier of Russia, and then proceeded to go into conference with the engineers of the Russian government, who told us what they could of their railways and then took us over the railways in Moscow. There are ten railway lines running into this city, which is about the size of Chicago, something like 2,500,000 people. It is completely circled by a belt line railway, almost a true circle, that takes the freight as it comes from one line and moves it over to the other line. It is practically the sole means of connection between these different railway lines that come into Moscow. I came pretty near saying "railway systems"—they are not railway systems, because all railways are owned by the government. They are divided into 22 separate railways, each running under a director, and each director having under his charge several superintendents.

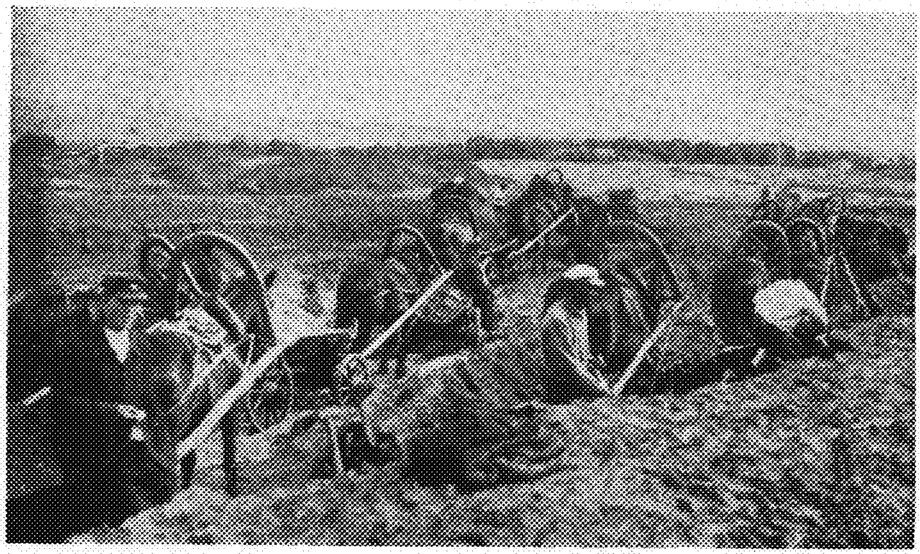
The accompanying article was prepared from a talk given by Henry K. Dougan, before the student branch of the American Society of Civil Engineers.

Mr. Dougan was one of the party of five Great Northern officials that visited Russia at the invitation of the Soviet government to study transportation conditions. The party consisting of Mr. Ralph Budd, president of the Great Northern Railway, Mr. Bassett, Mr. W. R. Wood, Mr. John Budd and Mr. Dougan traveled over about 16,000 miles of Russian Railroad which constitutes about one-third of all the railway mileage in the country.—EDITOR.

Their railways are a little better as to gauge than our own. They have a 5 foot gauge instead of our own 4′8½″ gauge, and I think that the additional 3½″ of gauge is desirable. There was a little coincidence as to that gauge. It was recommended by General Whistler, who was Mr. Wood's great uncle, so that two representatives of the same family have made recommendations as to the Russian railways.

The Railways are run on a different system than those of the United States. As most of you know, we in this country try to run as long and heavy freight trains as possible. It is the key to successful railway operation. We spend a great deal of money in reducing grades and balancing our motive power to fit the grades. That is, we put powerful locomotives where we have heavy grades, endeavoring to run, in so far as we can, full tonnage trains. For example, on the Great Northern, we can start out from Wenatchee, Washington, with 4,800 ton trains and continue this train without reducing the tonnage as it moves east. There are three points in between where we have to use pusher service and we can and do add to the tonnage for we can handle a 5,500 or 6,000 ton train over the Willmar Division, but through trains are not broken up between Wenatchee and the Twin Cities. One of the heaviest trains we run is in the ore service, where as a regular performance we have trains running up to 14,000 or 15,000 tons on the pull to Superior and Allouez from Hibbing. This loading is so regular that our average train loading is less than 1,000 tons below the maximum.

I speak of our loadings particularly because the system in Russia is entirely different. They have built their service up on the basis of the European train loadings—short trains, run on double tracks. They are not very particular about the grades, frequently using as maximum a grade of 8/10% where we on our lines generally use 4/10% grade. They have gone to 1½% grades, where we thought



GRADING FOR A RAILWAY TERMINAL SHOWING ANTIQUATED EQUIPMENT.

such grades unnecessary and where they might have cut the grade in half.

Their system is built on the use of a uniform type of locomotive with the idea that uniformity in type would produce economy. Since they have these uniform locomotives they might as well make the grades uniform even though the country traversed would permit light grades. They have this condition now—light locomotives, small freight equipment, and low tonnage trains. The heaviest trains that we heard of at any point were 2,000 ton trains and this train was used in a movement which would be somewhat comparable to our own iron ore movement on the Mesabi Range, where we use 15,000 ton trains. The result of these small trains is that with the increase in traffic it is necessary to increase either their motive power or build additional tracks. A good many of their railways are at present double tracked, but it means three and four tracks possibly, and it also means a great increase in the amount of terminal room, if the small trains are to be continued.

Their terminals are quite extensive—they have short terminals but many tracks in them, to correspond to their short trains. There was one thing that struck us the very first time we saw a terminal. It was crossed by overhead crossings. No place is there a main line, or two main lines, in Russia which cross at grade. All grades are separated. We passed over two places where there were three distinct levels of track, and two bridges, one above the other, built in order to accomplish grade separation. And if some of you will take pencil and paper and try to bring two double tracks together without having one track cross another track, you will see what complicated loops it will bring in order to avoid grade crossings.

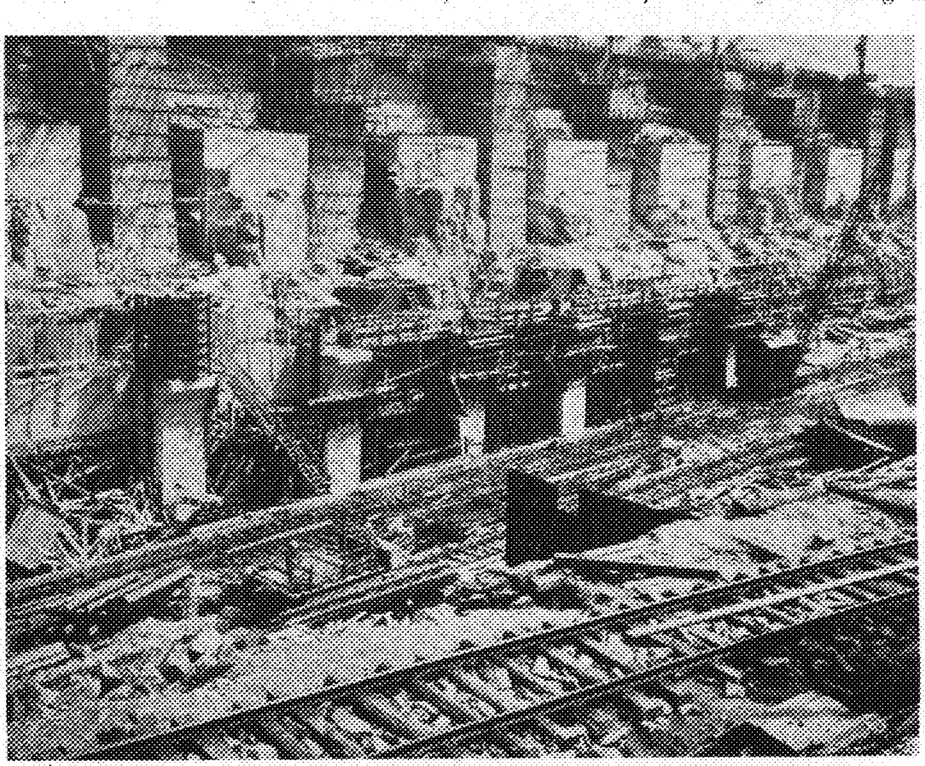
The freight equipment is very light—8 meter cars, that is, 25 to 26 feet long. The ordinary box car carries only about 16½ tons as compared with our 50 ton car. The flat cars generally carry only 10 tons. There are only a few of our standard box cars in Russia, about 7% being "Amerikanski" cars, as the Russians call them.

Except for a very few, the freight cars are not equipped with air brakes. In fact, only one-seventh of the cars have any brakes at all. On those cars with brakes there is a little platform out behind and a man they call the conductor stands there, sheltered only slightly from the weather—during the severe weather they have in the winter—and applies the brakes when he is told to do so. It is not a very effective means of stopping a train. If they do change to the large trains, as we think they will and should, they will have great difficulty in stopping them with these hand brakes, and one of their first problems is that of getting one-third to one-half of the cars equipped with air brakes.

There was another thing that was unusual to us—that was the type of coupling. They do not have automatic coupling, but instead they have a hook and screw link coupling. A man stands between the cars and tightens the coupling with a turn buckle until two buffers at the side of the cars are brought into contact with each other. It is the European type of car and coupling. There are not many accidents—although I don't know why, because in the United States we were forced to get away from the old link and pin coupling on account of the number of accidents, and the Russian type is even more dangerous because the man has to stand between the cars as they hit and dodge the two bumpers, which are about the height of his head, then duck under these bumpers to get out so that the train may move away. We believe that the first thing they must do for their railways is to install automatic couplings.

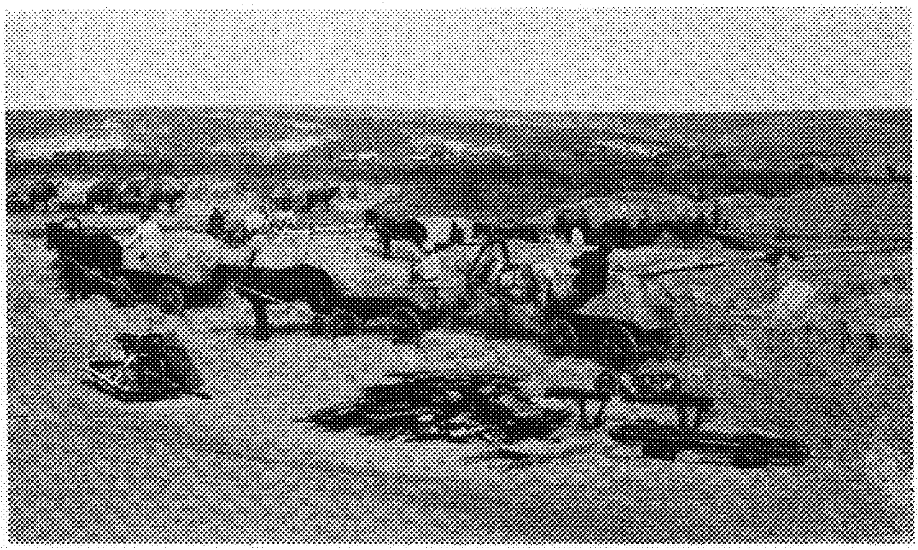
An increase in weight of motive power involves a great deal of work. It is not merely a matter of getting additional locomotives and larger ones, but as soon as they use larger locomotives they must have stronger couplings. In order to get the track in shape for the heavier locomotives it will be necessary to put in additional ties and eventually it means heavier rails; in short the replacing of practically all of their equipment.

Russia was particularly interesting to



THE DNEIPERSTROI DAM ON THE DNEIPER RIVER HAVING THE LARGEST ELECTRIC UNITS IN THE WORLD EACH OF WHICH WILL DEVELOP 33,000 H. P.

us as engineers on account of the great amount of construction work that is going on. As you know, the present Soviet government plans to industrialize the nation. It always has been largely a farming nation—mostly peasants and agriculturists, and very few factories—a few boot and shoe factories that were always of prominence, but generally Russia was not self-supporting as to factory made goods, and I do not believe it is now. The present Government, however, hopes to make the nation self-supporting. It seems to be bending all its energies to the construction of these great plants. There are now a great many plants going up and the policy is said to be to bring the peasant from the farm into the city. The result is, that Moscow, the chief city, has been growing tremendously for the last few years. Construction of buildings has not gone on as fast as people throng into the cities and at the present time government is putting up tremendous apartment houses, 5 and 6 stories high. One which we saw covered three or four of our blocks.



AMERICAN CONSTRUCTION WILL SOON REPLACE THESE PRIMITIVE METHODS.

In addition to apartments they are building factories and dams and are going in for irrigation projects. We visited one dam called the Dneiperstroi on the Dneiper River. Stroi means construction work so that Dneiperstroi is Dneiper construction work, and the name will be changed after the work is finished. Colonel Hugh R. Cooper of New York is Consulting Engineer on this very great dam. I think it is supposed to generate 850,000 h.p. They told us that they will have the largest individual electrical unit in the world, 85,000 h.p., 5,000 or 10,000 h.p. greater than at Niagara. This dam will be finished in 1933. Not only is the dam being built, but here at this point on the Dneiper River, where there was nothing but prairie a few years ago, they are building a city to house 100,000 people, with all its factories, the whole thing to be completed at the same time as the dam. It is not a matter of gradual growth, but of going out on the open prairie, planning and building all of these great works. It is quite typical of the work that is going on in Russia that they are not only planning—but are doing.

They told us what the freight tonnage was last year, occasionally they told us what it was this year, but more frequently would say that the freight in 1932-33 *was* so much—actually speaking of it in the past tense—they are so confident of the program going through. They are planning and building for the future. They have all of their figures worked out in detail. We were told of one line—it is under construction—not an ounce of traffic has gone over it—yet we were told they expect in 1939 to handle 50,000,000 tons a year on that line into the coal fields. That is equivalent to the amount that goes over all Northern Minnesota railroads reaching our iron mines. They are building on a tremendous scale.

They are putting in irrigation plants. Near Tashkent Mr. Davis, an American engineer, is in charge of an irrigation project as consultant. This irrigation project is feasible. They will get it done and will be able to raise cotton in the surrounding country. Whether they will be able to do as they hope—raise enough to supply the Russian people with all of the cotton they require is a question, but at any rate they have a great irrigation project at Tashkent.

One project recently completed is the Turk-Sib Railway on which the rails were connected last May. It won't be all ballasted until the first of the year, and when we went over the line in July some of the track was on a temporary grade. But they have built an 850 mile line through sparsely inhabited country, where it was hard to furnish supplies and have handled the construction work fairly rapidly. It really was a remarkable piece of work.

Possibly you would like to have me tell you something of living conditions in Russia. They are very different from our own. In fact, it is hard to make anybody here understand just what the conditions are. Housing conditions are bad. Everybody is cramped, but the Russian people always were cramped. Whole families lived in one room from time im-

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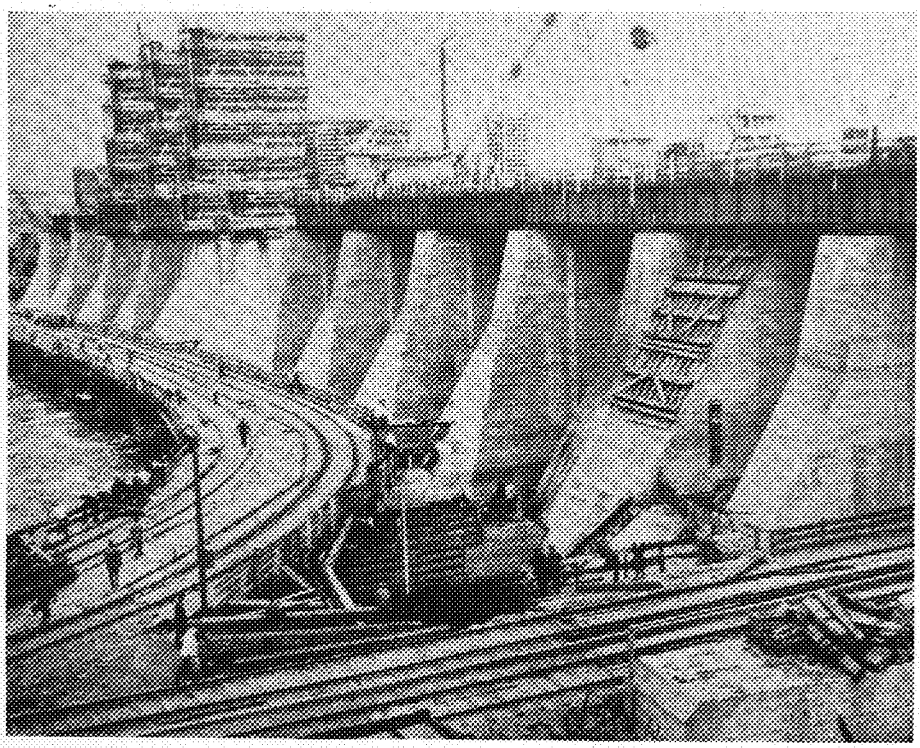

ANOTHER VIEW OF THE DNEIPERSTROI DAM WHICH WILL PRODUCE A TOTAL OF 850,000 H.P. WHEN COMPLETED.

This Skyscraper Business

By GEORGE R. BAILEY, C '22

IN the October number of the TECHNO-LOG, there appeared an article on skyscrapers. This article dealt with the historical development of the modern skyscraper and carried to the reader what might be termed the romance of these structures. This side of the subject quite naturally has the greatest interest and appeal so far as the public is concerned but there is another angle to this skyscraper business which warrants the deepest consideration. Unless these great structures are designed with all due consideration of the economic principals involved, they are practically certain to turn out as financial flops. There is no major American city today but boasts of at least one office building which stands a mute evidence of wasted possibilities. These towers of frozen mistakes are far more frequently encountered than is generally supposed. A fitting inferno for their designers would be one where in they were required to perpetually scrutinize the annual statements of these unhappy commercial misfits.

You students of architecture beware of your responsibilities. When commissioned to design and direct the modern skyscraper do not look far afield for inspiration to bear fruit in the form of new effects but turn first to the local real estate situation and study it with the aid of conservative renting and operating men. There is a great difference between striving for beauty in an economically designed building and striving for economy in a structure designed for beauty. The average return on the investment in the nation's skyscrapers is not over three per cent and so small a matter as the location of a few elevators, the depths of rentable areas and the location of the building entrance will spell the difference between success and failure. Study the designs of those architects who have proven themselves capable of incorporating beauty in our commercial structures which have designed to be primarily successful and secondarily beautiful. Better by far that an indifferently pleasing but successful building be erected than a graceful, leaping, lovely thing that brings gasps of wonder to the lips of the public and gasps of despair to the owners.

It is safe to say, in refutation of the thought that these statements are idle words of caution, that every property management agency in the cities of New York and Chicago can point out one or two office buildings under their direction which might have been designed to yield two to three times the net income actually being obtained. Some of the largest and most imposing structures in Chicago's loop and in upper and lower New York City have defaulted and been taken over and usually when a building must pass through bankruptcy once and sometimes twice to get the succeeding investment down to a point where the project will pay out, it harks back to faulty design and unwise development.

In view of the small return obtained, it is often asked "Why build an office building?" There are three principal reasons. Either a large business such as a bank, corporation or insurance company wants an outstanding home and builds for that purpose or an owner of valuable property builds to hold real estate values and carry taxes or a promotional syndicate launches a project for profit to the syndicate.

> *In a recent issue of the* TECHNO-LOG *there appeared an article on the historical development of the modern skyscraper which carried the romance of these structures to the reader. But there is a great difference between striving for beauty in an economically designed building and striving for economy in a structure designed for beauty. In view of the fact that the average return on the investments in skyscrapers is not over three per cent, the economics of construction are of paramount importance.*
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> *In the accompanying article, Mr. Bailey discusses the economics of skyscraper construction and mentions some of the pit-falls that have frequently led to the erection of "these frozen towers of mistakes . . . which stand a mute evidence of wasted possibilities."*—EDITOR.

Just as an illustration of what may and for that matter what has happened in the case of ill advised projects, let us follow through some of the steps that precede dismal failures, all the more deplorable because competent firms of architects, of which there are hundreds throughout the country, could each and every one of them have avoided these failures, had they been given the commission.

Take for example a typical city of twenty-five thousand population in the United States. There are three office buildings already in the city which average about fifty thousand square feet of rentable area each. They are all pretty well occupied, each in excess of 95 per cent. They are also, let us assume, located relatively close together in the heart of the business district.

A local insurance company, occupying space in one of the three existing office buildings is faced with the problem of expansion due to increase in business. At a directors' meeting it is decided that the time has been reached when the company should erect its own building, not only for convenience but for advertising purposes. The company already occupies twenty thousand square feet of space for which it pays forty thousand dollars a year rent. It is decided that rather than build a structure just ample to accommodate the present needs of the firm with provision for future extension of the building, that the company will build an office building in the hope of deriving enough profit from the outside firms accommodated to carry the building and thus yield the insurance company its space rent free. The larger building will also lend advertising prestige.

One of the directors has a nephew who is an architect. He has studied abroad and has built several very commendable buildings in the city, including a church, a school and several private homes. He is called in and asked to sketch an idea of what he thinks might be done. Being well primed he brings a group of excellent renderings of existing office buildings. He has interior views of beautiful private offices such as might be finished for the members of the directorate in their other capacities with the company. He speaks glibly in terms unfamiliar to the directors and leaves the meeting practically in possession of a commission to prepare plans for the new Yokel Insurance Company building.

At succeeding meetings of the building committee, composed of directors selected because they have built their own homes and consequently know the office building business, it is decided to erect a structure of one hundred thousand square feet which will overshadow all present buildings. Since American cities seem to support on the average about seven square feet of office space per person of population they should have been warned that there would be difficulties in filling the new structure by increasing the office space to 250,000 sq. ft. in a city of 25,000 population, for a ratio of ten sq. ft. per person.

They next decide to build on a triangular shaped lot which faces the business district proper from across the city square. This will give the building great prominence and the architect sees no reason why the offices cannot be made quite attractive especially since the converging walls will not be seen from the square. Furthermore the land is cheaper, which makes it appear a rare bargain. By crossing the square with the building the directors condemned all future tenants who might have business with firms in the existing buildings to a two block walk and in accepting the triangular lot they assumed a huge rental hazard, for tenants desire square offices, or at least rectangular ones and odd shaped lots can seldom be developed economically.

The architect understands from certain sources that an office building can be built for 50c a cubic foot. He shows the building committee that the proposed building will have 2,000,000 cubic feet and will therefore cost $1,000,000. There will be 100,000 square feet in the structure which at $2 per square foot per year will yield $200,000 plus $20,000 extra because of a $4 rate on the 10,000 sq. ft. of first floor space plus $13,200 of miscellaneous income representing 6 per cent of the rental income, a percentage figure that he understands the city buildings use. With an annual income of $233,200, the picture is as follows: heating, cleaning and mechanical maintenance 50c per square foot per year — $50,000, insurance $1,500, taxes $10,000 and manager's salary $3,000. This makes a total expense of $64,500. The 6 per cent interest on the cost of the building amounts to $60,000, and thus there is $233,200 minus $124,500 or $108,700 available for prepayments and as a return on the value of the land. This is a very rosy picture and the architect is authorized on the basis of this representation of his to spend a bit more money and make the building truly outstanding.

During this paragraph the building is being built and the building committee is beginning to realize how little they know.

It has now been discovered that the 50c per cubic foot cost quoted, did not include foundations or architect's fees. The necessary increases bring this unit cost up to 60c after also adding the cost of subdivision which had not been included. The cube of the building remained the same so the cost increased to $1,200,000 on this basis. In addition the architect had added some imported marbles and various statuary groups and the final contract cost lined up at $1,400,000 without extras.

During the building period the owners discovered that such things as carrying charges accrue in connection with a skyscraper. Interest during construction, taxes during construction, renting commissions, advertising, legal fees, guarantee bonds, extras and miscellaneous expenditures increase the cost by $210,000 and the completion cost rises to $1,610,000.

During this paragraph the architect spends two summers in Europe and the building committee of the Yokel Insurance Company spends two years of hell.

They have discovered that what with stairways, stacks, meter closets, corridors and wall thicknesses that their architect's rentable area has shrunk from 100,000 square feet to 85,000 square feet. This would indicate a rental of $170,000 per year at $2 per square foot but the three older buildings reduced their rates to tenants thinking of moving and pointed out many, many times the inconvenience of walking continually across the city square not to mention the difficulty of fitting furniture into an office with walls on an angle. The cement floors in the new building also proved a mental hazard to the local tenants who were used to wood floors. As a result of all this, concessions had to be made which brought the square foot rental average down to $1.80 and as it was found impossible to rent the building more than 90 per cent, the annual rental income shrank to $137,700. The extra store rental never materialized as stores desire locations in the heart of things and furthermore the architect had largely killed the show window possibilities with his treatment of the exterior walls. It was also discovered that most of the miscellaneous income figured on, is derived in city buildings from the resale of electric current, the sale of waste paper, ice, etc., and the Yokel Insurance Company building was forced to give these services free of charge in order to get tenants. The annual gross income straightened out therefore at $140,000.

The operating expenses did not increase unduly over the estimated expense as these had been figured on a 100 per

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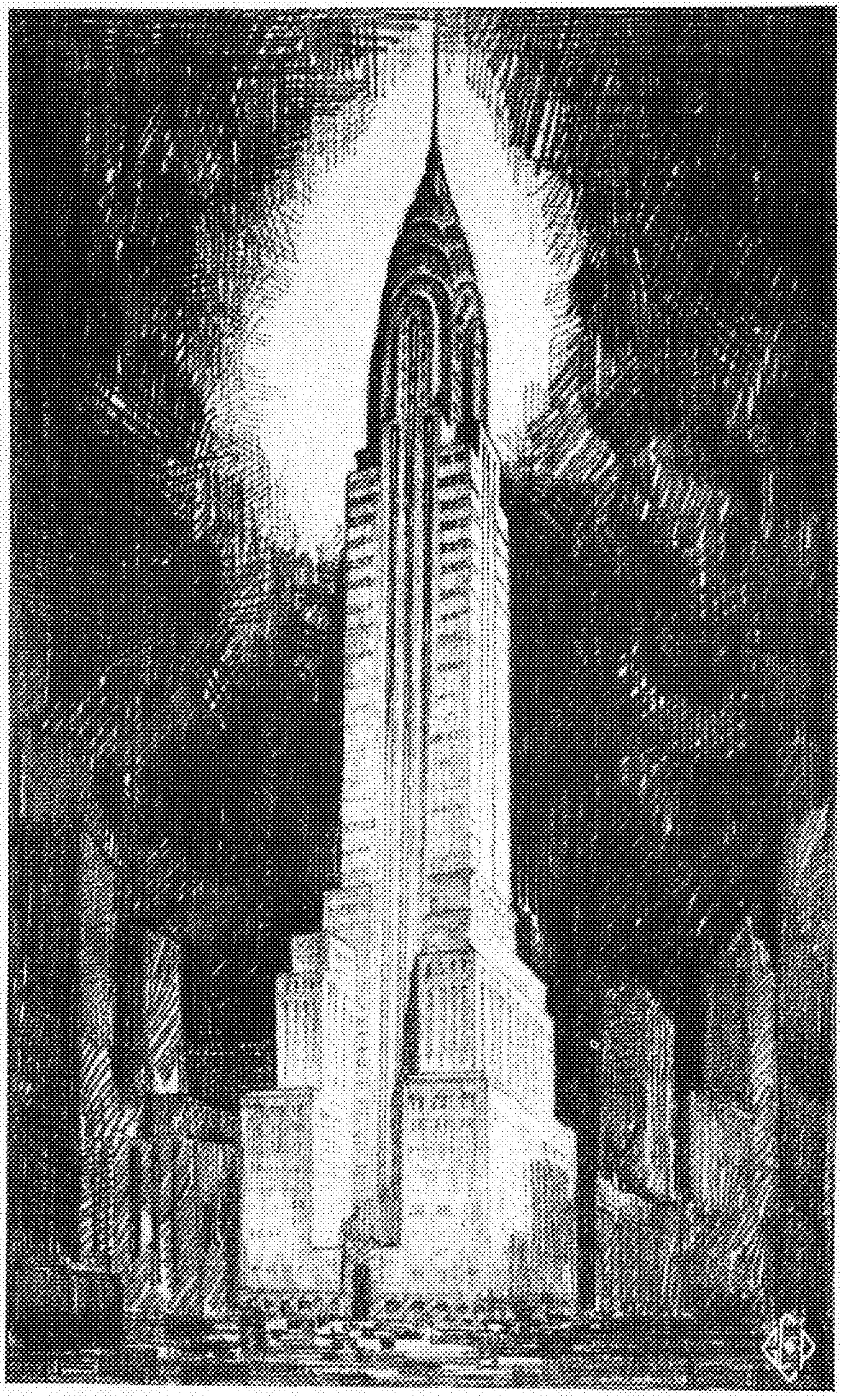


THE CHRYSLER BUILDING TOWERING INTO THE SKIES

The New Air Drier

An invention that may revolutionize the agricultural industry

By LAURENCE M. WHITING, Ag E '31

THIS summer I had the opportunity of seeing the demonstration of a machine that was designed primarily as a green forage drier but which will also dry any similar substance than can be carried by a hot air blast.

Brewer's malt and ensilaged pea vines were dried, the malt entering as a wet sour mash, being dried and coming out the collector a dry cool product. The vines were also easily dried.

It was a very striking picture to see this new invention, in operation, which will no doubt become as great a help to the modern farmer as Eli Whitney's cotton gin was to the cotton growers. There were men from all parts of the United States in the group watching this strange machine, a man from Louisiana, one from Tennessee and also a very much interested Californian.

There are two oil burners to furnish the heat and a conveyor carrying the forage to be dried up from the hopper to the big slowly revolving steel drum. At the rear over the collector, the evaporated water rises, a tremendous cloud of steam, and at the bottom the dried product comes out. The man from Louisiana takes a handful of dried pea vines, looks at them, feels of them, then turns to Mr. Arnold with a smile and nods his head. Yes, the vines are dry; at last the farmer can dry his forage crops. Another engineering feat has been accomplished, one that will do as much towards the industrializing of farming as any other invention that has been perfected for the harvesting of the farmer's crop.

The following are the facts as to the construction and operation of the machine which has made it such a phenomenal success.

1st: Its multiple concentric cylinder construction with a large cross-sectional area and a corresponding decrease in gas stream and feed velocity from intake to discharge end of machine.

2nd: Cut up feed is fed through a rotary valve or charger (which permits very little air to enter) into the hot gas stream and carried into a comparatively small center cylinder. As the machine revolves the longitudinal flights carry material toward the top of the inside cylinder and repeatedly drop it through a gas stream, the advancement through the drier coming almost entirely while the material is in suspension. The material is wet and heavy when it first enters the drier, and will withstand a much higher temperature than when partially dry. It is necesary to have a high speed velocity where you have a high temperature, and a lower velocity as feed gets drier to keep from injuring the product. In the small cylinder where feed is wet and heavy, the lift is for short distance and being closest to center of gravity of revolving drum, takes less power to make drums revolve.

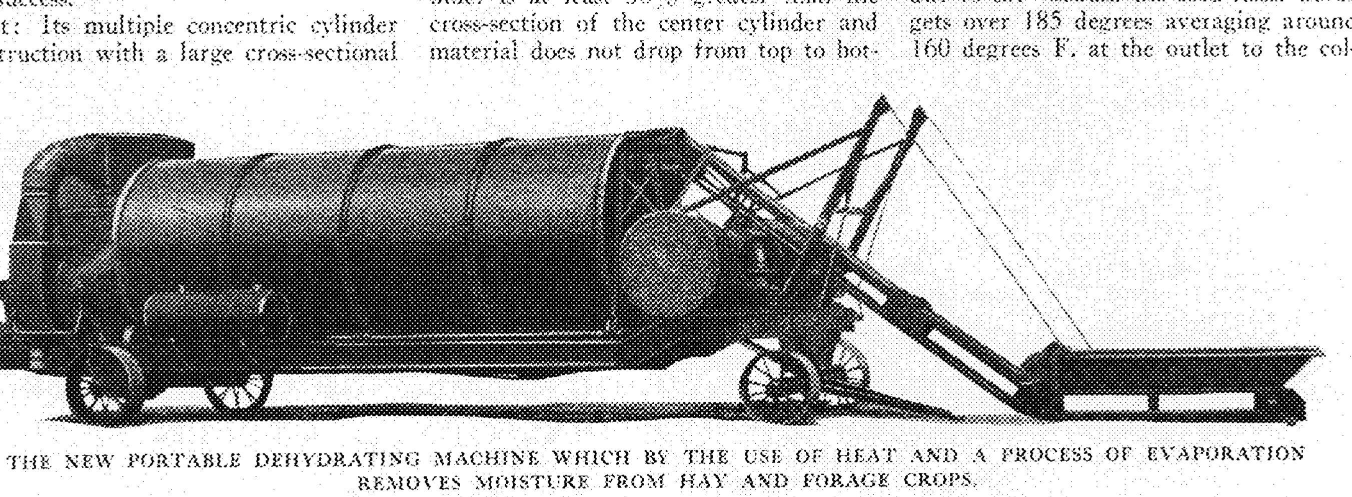
Regardless of how heavy or wet the material is that is to be dried, the machine will not plug. There are no baffles for material to collect on or lodge against (except one on each end where gas current and feed flow change directions, but the area is decreased at these points about 200 per cent and the velocity increased accordingly), making it impossible for the machine to collect material at any point until the gas current or feed flow is stopped.

3rd: When feed passes out of the first cylinder, it is returned back toward the intake by a second cylinder outside of the center cylinder. The cross-sectional area between the center and succeeding cylinder is at least 50% greater than the cross-section of the center cylinder and material does not drop from top to bottom of the second cylinder, but is sifted down over its surface. This enables the feed to use the radiated heat of center cylinder as well to balance the load, as feed falling down on the advanced side of the drum will drop on the back side of flights and will partially lift the feed on the lifting side of the drum. This operation is repeated in each succeeding outside cylinder from which the feed is discharged.

No baffles or worms to advance or retard feed, or gas flow through machine, permitting high efficiency and to no moving parts in drum, means durability.

In the Ardrier the material only has to pass through one slow speed suction or exhauster fan making it possible to get material dry without grinding leaves to powder as is the case when feed goes through several high speed blowers. Where it is desirable to feed when dried it is much better in feeding ruminants to not have feed ground fine. The process is a method of dehydration rather than evaporation. This conclusion has been drawn because the machine takes more moisture out of material than is possible to evaporate with a given number of B.T.U.'s with 100 per cent efficiency of evaporation.

The material and gas is drawn through the drier by an exhauster fan located at the outlet end of drier. The drum is very nearly air tight so that the material is dried under a 4" and 6" water column vacuum. With this partial vacuum and concentric cylinder and decreasing velocity arrangement, it is possible to use very high initial heat (1200 to 2000 degrees F.) which increases the capacity. On the other hand, due to the vacuum the feed itself never gets over 185 degrees averaging around 160 degrees F. at the outlet to the col-



THE NEW PORTABLE DEHYDRATING MACHINE WHICH BY THE USE OF HEAT AND A PROCESS OF EVAPORATION REMOVES MOISTURE FROM HAY AND FORAGE CROPS.

lectors, and 100 to 125 degrees in the bin or sack.

The thermostat on the outlet pipe regulates a variable speed transmission by an hydraulic pressure damper that automatically varies the amount of material fed into the machine and another damper that operates an air inlet letting in more or less outside air into the mixing chamber. This excess outside air not only lowers the temperature at the drier intake, but advances material faster or slower, as it opens or shuts. These controls are both of the floating type permitting the temperature to be kept constant at the outlet where the thermostat is located, producing a product that is uniform and dried to a predetermined water content.

Sufficient oxygen is burned out of the air so that it is practically impossible to have a fire inside of the drier. However, by the time the feed is dry enough to ignite, the gas is so loaded with moisture and the temperature so low that it makes ignition impossible.

In any rotary drier the smaller the cylinder, the more evenly the feed can be distributed in dropping. In the new machine where feed is wet and heavy, the diameter is small and as it gets drier the dropping is for a less distance, as well as at a lower velocity, to keep the feed from being advanced too fast.

In all old conveyors or rotary type dryers using a counterflow air or gas current and direct or indirect heat, the capacity is very limited. This is caused primarily by the fact that heated air entering the drier on the discharge or outlet end must be of moderately low temperature or it will set the material on fire, and if the capacity is to be increased by using more heated air, the drying chamber has to be very large, or the air current will carry the lightest and best feed off with it. In either case the cost of the drier due to its size or power required is prohibitive. Furthermore because of the low temperature at which it is necessary to operate this type of machine it is very inefficient.

In the new machine, the material is subjected to heat under partial vacuum for such a short time and the material itself is discharged at such a low temperature, that the vitamins are not destroyed by the process as is true of most other driers having a long exposure and high temperature of feed at the dry end of machine.

The per cent of moisture in the forage crop when cut only means that there will be that much water to evaporate and will not bother in the drying, except to take a slightly longer time.

With the way now in use in harvesting forage crops the farmer is dependent upon the sun to dry the hay and often the sun is behind a cloud, or it is raining. However with this new drier he can dry the forage crop regardless of weather conditions. The mowing and cutting up of the hay can be handled in one operation and the cut up forage crop elevated into a wagon or truck and hauled to the hopper, at the drier.

With a succession of different forage crops the machine can be kept busy the whole season. Some of the crops that can be harvested to an advantage, in succession are, winter and spring grain for feed, alfalfa, hay, sweet clover, pea vines, second crop of alfalfa, hay, beans, corn and third crop of alfalfa.

The final product of the drier is chemically richer than the sun-dried crop of the old sun-wind-take-a-chance method. It is higher in protein and fat content and lower in fibre content according to the tests and analyses of several agricultural laboratories, and found to combine the following superior qualities:

1. Natural Color.
2. Excellent Analysis
   a. High in Protein
   b. High in Fat
   c. Low in Fiber
3. Digestible and Nutritious
4. Permanently Keeping
5. Excellent Aroma
6. Palatability
7. Small Storage Space
8. Replaces Summer Pasture
9. Weed Seeds and Bacteria Killed
10. Vitamines Retained

The reasons for this are clear. Cutting of the crop in the early stages of green maturity and its prompt conversion into dried food, instead of allowing the crop to mature into a sun-drying stage, and the cut-crop to bleed and weather away its value for several more days, assures that the food elements of the growing leaf and stem are permanently retained in their entirety for some future feeding time. When the growing plant is cut and processed at once none of the leaves are lost and all of the food elements of the growing plant are preserved regardless of unfavorable weather. In other words it has the whole feed value of the plant in the field. The leaves, the most valuable part of the crop, are not lost as when the material is sun-dried.

Furthermore by this process the feed obtains an aroma which makes it palatable to the dairy herd, and retains its natural color forever, it is much richer than ensilage made from the same crop, even in consideration of compared water content. Ensilage deteriorates from the day it is cut and stored, while the new product keeps intact its sweet-dried goodness for an unlimited duration of time.

Mr. G. D. Arnold is the inventor who has given the American farmer this new machine to dry his forage crops, regardless of the weather conditions. He operates a farm of his own and has always wanted to get a drier for his own use but there being no such a machine that could economically and satisfactorily dry forages. So he conceived his own idea of what would be a successful drier. One was built, used last summer, and proved to be a success.

Mr. Thomas D. Campbell, one of the largest farmers in the United States, says this about the agricultural engineering field. "It is the greatest field open for the technically trained man of today. Some day we may have a United States Farming Corporation as big as the United States Steel Corporation and the agricultural engineer making this possible."

Coal Stripping in the United States

The rapid growth of the coal stripping industry in the United States—seventeen fold in the last fifteen years and now totaling 4 per cent of the total bituminous production, is probably the most outstanding development in coal mining since 1914. Especially is this tremendous expansion significant when consideration is given to the introduction of gas and oil in competition with coal for fuel.

Undoubtedly the World War demand for coal with consequent high prices was the impetus for a rejuvenation of the coal stripping industry. But after that start, operators and equipment manufacturers were quick to sense the importance of stripping with the result that real engineering methods were applied to this branch of mining.

Huge 12- and 16-yard power shovels, new applications of the dragline in removing the coal, coupled with the introduction of more economical explosives and larger and better locomotives were developments which presaged the advance of the coal strip industry.

With these mechanical and engineering improvements has come another vitally important development,—better cleaning of the coal. The days of dirty and impure coal are past. Today the public demands coal practically free from impurities,—and the strip mines recognize this. The coal seams are cleaned by scrapers and wire brooms.

Three Themes

Moving Pictures

By HENRY FROMMELT

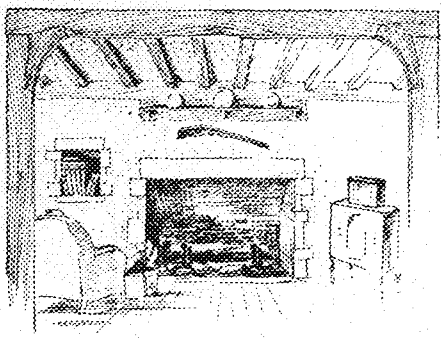
FOR many years the moving pictures have been highly successful as financial investments. Millions upon millions of dollars have been taken from the pockets of the great American public to fill the purses of Hollywood producers, directors, actors, and technicians. The end of the moving pictures is near. No longer will we have to stand in line for hours to see Norma Talmadge in "Throbs and Throbs," for in the future looms the possibility of attaching a television apparatus to the ordinary radio set.

Imagine yourself in 1939, sitting at home in an easy chair, smoking the "old pipe." Little Oswald is perhaps playing on the floor, and Ella is darning your socks. Will 1939 bring something like this?—

"This is television station OKMX. This program is coming to you through the courtesy of the Amalgamated Corporation of Incorporated Grocers, Incorporated. To night we are showing 'Trials and Tribulations,' the great college melodrama. So on with the show!"

We focus our television. We see the interior of an old log cabin. A family is at dinner. They are very poor. There seems to be a depression—a sad atmosphere. Immediately we sense that something is wrong. There is a daughter; she is a beautiful blonde. Then of course there are the usual father and mother. The daughter, we learn, has made some grave mistake. She has taken the wrong path—probably she has chosen the wrong fork with which to eat her lettuce.

"Oud from mine house!" shouts the father with a decided Irish brogue. "You



iss nod effer to gross mine dreshold once more!"

The next scene shows her tripping lightly over the treacherous ice floes with her pet poodle in her arms. The snow is coming down in great flakes. The scene flashes back to her home. Father is persuaded by mother to follow their little Gretchen. He turns off the radio, blows out the candles, and dashes out to his new Fackard.

"Just to remind you," breaks in the voice of the announcer, "This program is coming to you through the courtesy of the Amalgamated Corporation of Incorporated Grocers, Incorporated. Did you see that radio? That is the new Milco—the new extra superdyamic, screen grid, television radio. Amalgamated Grocers sell them. And those candles. Remember you want candles for that Christmas tree. Obey that impulse—buy Hook's candles, pure, wholesome, and good for the kiddies. Then folks, don't forget that new Fackard. The automobile for the best people. Costs no more than an ordinary automobile and lasts much longer! On with the show!"

We see Gretchen dashing through the woods with her lunch under her arm. Her father is close on her trail. She hears the thunder of the horses' hoofs. Nearer and nearer it comes. "The hound," she hisses in a stage whisper. Here the soft music of an orchestra comes to our ears. Gretchen stops, breathes heavily two or three times, and opens her mouth.

"She uses Keepsodent," says the announcer at this moment. "Keepsodent is provided in three sizes — small, medium and large. Truly the best toothpaste for the growing boy or girl. Use Keepsodent and see the dentist twice a year. On with the show!"

The orchestra is still playing. We know the tune; it is "Daddy, Won't You Please Come Home?" Gretchen, with her mouth wide open, shouts "Boop-boop-a-doop!" Now the hero enters the scene. His name is Gotgelt. He sings as soon as he sees Gretchen. The orchestra plays "Piccolo Pete" while Gotgelt struggles through the "Pilgrim's Chorus" from "Tannhauser." He doesn't know the words, so he hums the tune—which is just as well.

As he finishes, the announcer breaks in. "Just to remind you, folks, that this program is coming to you through the courtesy of the Amalgamated Corporation of Incorporated Grocers, Incorporated. All these late song hits which you have just heard can be purchased at George's Music Emporium. Also—our hero, Gotgelt, smokes Old Molds. 'What a whale of a difference!' says he. In a cigarette it's taste. Try our simple test at home. Surprise your friends. Send for our little outfit whereby you can test for yourself whether—"

What? Don't you enjoy the moving pictures of 1939? Aside from a few twists in plot, twists due perhaps to static, aren't they very much like the movies of 1929?

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

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

A Midnight Companion

By VERNON LINDBERG, Ch.E., '33

THIS was the life! I was now realizing the day I had so long anticipated. A day in the wilderness was an adventure, indeed. Until this very moment, I had not thought of the time. Four o'clock! And yet the watch told no lies. Eight hours to come and four hours to return was poor judgment. The impossibility of it stunned me; nevertheless, it must be done. For the amateur to be stranded in the wilds at night would probably prove to be a doubtful adventure.

Already the trees began to cast long shadows, and the near hills to fade in blue dusk. My thoughts turned to the

hour when there no longer would b light to guide my footsteps. With thi in mind, I doubled my pace. The resul was to find myself flat on the ground, m feet tangled in brush and my face presse close to mother earth. Time was takin the lead! Far to the west, the deep re sun was sinking in its purple grave. Se

(*Continued on page 88*)

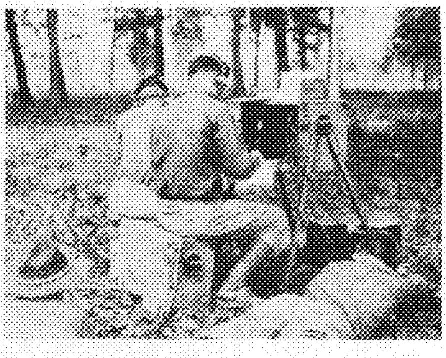
Signal Corps Invades Fort Sheridan

By GERHARD QUANRUD, EE '31

Assisted by Suggestions from Lieutenant R. W. Minckler

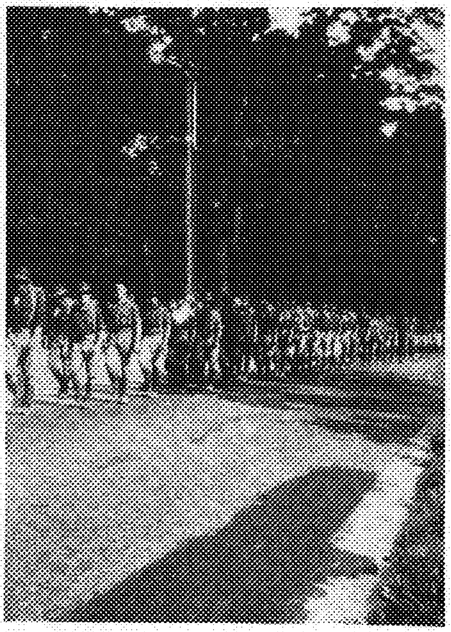
WITH memories of camp stories told by the departing seniors, the 1930 invasion of Fort Sheridan began. Several took the bumps from here to camp aboard buses, a few felt wealthy enough to "ride the rails," but for the most of us, just getting there was an accomplishment. Fords and other rattle-traps furnished the necessary means of transportation. One brave party started out from Minneapolis in one Ford, got mixed up in a junk pile and arrived in camp with another model. A different group spent a night on the road waking innocent farmers, asking them if they had a wrench to fit the rear connecting rod of a 1921 Ford. Given time, all of the men arrived intact. Our own party, namely: Buchak, Moe and myself, was unfortunate enough to encamp a day early, for which we paid with a sense of loneliness and hunger, as no one at the Fort knew the whereabouts of the R. O. T. C. Finally we located Lieutenant Minckler and he directed us to the showers and mess hall. Our first impression of chow issued by the Army was excellent, and upon leaving camp most of us still held the same idea.

The first morning we were lined up and ordered to undress, put our "civies" in barrack bags and proceed with the transformation process. First a thorough medical exam and then measurements for our OD's. At this time we were issued enough clothing to last six months, let alone six weeks. Lieutenant Minckler stood at the end of the line and inspected each new soldier as he finished his processing. Being through early with this duty, a good natured sergeant from Ohio found odd jobs for me, such as painting waste receptacles and raking the company street.



TYPICAL BRIGADE RADIO STATION EQUIPPED WITH SCR-130 SET

We were next assigned our tents and tent-mates, with no choice as to the latter. The entire company composed of university men from Wisconsin, Illinois, Michigan, Ohio State, and Michigan State, were arranged in alphabetical order and assigned tents in that arrangement, with four or five fellows to each one. In this way, cliques from any one school were prevented, and in the end, more friends were made and a better understanding grew up between the schools represented.



FORWARD TO THE GREAT LAKES

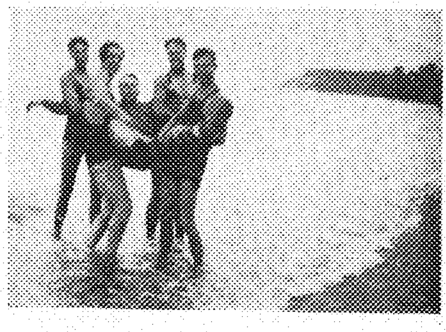
Duties the first couple of days were confined to straightening out the camp so that a good start on our summer's work could be made on Monday. It did not take long to get acquainted with the mainpoints of our time table. Reveille at 5:45 a. m. or 4:45 human time, breakfast at 6:45, duty at 7:30, dinner at 12 noon, and field work at one p. m. Retreat at 5:00, and mess again at 6:00. Lights out at nine, which was incidentally before total darkness with the Chicago daylight saving time in effect, and then taps and bed check at eleven. Four nights a week were devoted to getting in on time for bed check, while the other three nights, namely: Wednesday, Saturday, and Sunday nights we could obtain late permits. For those who wanted them, week-end passes were given out Saturday noon, good until late Sunday night.

Camp life was made very pleasant for us from the very start. The hostess at the Fort arranged a dance for us the first Tuesday night, at which all good cadets honored the ladies with their attentions. These events followed week after week, until Tuesday became one of the most popular days at camp. Another attraction of our first week there, was when the whole battalion of R. O. T. C. men was taken to Chicago on a special train to see the U. S. Army military tournament and exposition held at Soldier's Field. Headlines of the show were: aerial demonstrations, cavalry drill, a cook wagon race, artillery demonstration and a realistic attack on a fortified village.

Attendance at a singing fest was required once a week, but in reality it was such a pleasure that it need not have been compulsory. College songs from all the schools were favorites, everyone joining in to sing each other's songs with as much enthusiasm as if they were their own. By a revision of words many popular numbers were made to fit the life at camp. It finally became a habit to boom out in song every time a company was on the march.

Lake Michigan, with its wide sandy beach, helped to fill our leisure hours. Especially on free afternoons, those that cared to, could sun themselves and explore the lake front to the north and south. Justice is dealt out severely in the high order of the Signal Corps' Kangaroo court. Such is the proof of one illustration. The man who is about to receive a slow immersion in the lake was caught putting salt in several bunks during a bit of his spare time while on K. P.

For those from the north, who had never become acquainted with Chicago, week-ends were spent roaming her streets and inspecting public buildings of fame such as the Art and Field Museums.



THE KANGAROO KORT EXECUTES SUMMARY JUSTICE

Thus far it appears that the Signal Corps was well taken care of in regard to pleasure, but the army also has its

(*Continued on page 80*)

Machine Design as a Career

A sport, fit for the kings, that demands imagination and offers as a reward infinite variety and self-satisfaction

By JOHN FLODIN
Assistant Professor of Machine Design

DURING the last decade or two machine design, viewed as a possible career, has been in the doldrums, and few college men have cared to consider it as a desirable field for their energies.

There are many reasons for this situation, the most important probably being the changing emphasis in our industrial life. When John Ericsson built the Monitor, the problem was 90 per cent design, and although the public regards Ericsson as primarily an inventor and a builder, the engineer knows that he was fundamentally a designer. When Goethals built the Panama Canal, the job was probably 90 per cent organization. We are apt to see the Goethals, but the Ericssons are too dim figures for our vision.

Another reason for the all too common slighting of the possibilities in design is due to a confusion of terms. The designer is regarded as a draftsman, and we have been thoroughly imbued with the trite saying, "Once a draftsman, always a draftsman." The charge is not true, and yet the implication is justified, for the would-be designer who sees only the drafting problems and not the design problems, is not likely ever to advance from drafting to design. The chroniclers of Ericsson's work on the Monitor say that "Charles W. MacCord was his draftsman," but it is also on record that on a much earlier job "Ericsson had put in some 200 days of drafting work alone, which his assistant, Riley, inked in." In both cases we know only the names of the draftsmen Ericsson hired, and we may assume that they were faithful workers who occasionally contributed valuable ideas. But they were still only draftsmen—unless Riley was only a tracer—while Ericsson, the figure of international importance, was the designer.

Hand in hand with our confusion of drafting with designing comes the question of probable money reward. What pay can a draftsman expect to get? Perhaps up to $75 or $80 a week, with a possible maximum of around $125 a week for very exceptional men under very exceptional conditions. The upper figure might perhaps seem appealing enough, but the more conservative rates would hardly be a reasonable inducement for men of education and ambition. Men engaged in design, as differentiated from drafting, whether they are called designers or development engineers or whether they ensconce themselves behind some other title, demand salaries that compare quite favorably with the pay received by men carrying equal responsibilities in other fields of work.

In speaking of designers we naturally think of the men who are in charge of the design work for the larger units, the things that stand out conspicuously in the Sunday papers and the popular and semi-popular magazines. A new super-airplane or dirigible, a record-breaking *Bremen*, a double-acting reversible Diesel engine—achievements of this sort make us ponder on the design problems involved. They are real problems if, again, we differentiate between design and drafting. The work—the game is a better term—of conceiving the first idea, of nursing the infant along to a stature that makes it possible to subject it to the test of the natural laws that are fundamental to all design, of modifying and remodeling it until it becomes technically or commercially as nearly perfect as it can be made, finally to hand it over to a draftsman who with his helpers and under the designer's supervision will make the necessary drawings—that is a sport fit for a king. It is a sport that makes you forget the pay check, and the more you forget the pay check, the bigger it is likely to be.

> *The present decade may possibly go down in history as the age of the production engineer,—for to-day the production executive has it in his power to assist or retard to a hitherto unthought of extent the success of his company.*
>
> *But on the other hand there are numerous other considerations besides production which enter into the creation of a machine and leading all of these is design. For lacking good design, it would be impossible to produce at reasonable cost the parts embodied in the complete machine.*
>
> *When responsibility for final success rests with the designer,—the honor attained must likewise be rested upon his shoulders.*
>
> *—Editor*

But there is another phase to design, which is at once the product and the cause of the new industrial era. It is not concerned with the building of the conspicuous things that figure in the newspaper headlines. Rather, it is concerned with the painstaking labor of building the relatively small units that integrate into more than a mere engineering achievement. Collectively they are causing a social revolution of greater magnitude and more far-reaching consequences than the bloodiest conflict the world has ever known. It is the building of the tools of industry which makes it possible to place within reach of every human being the benefits that accrue from scientific research and discovery. Consider the incandescent lamp, which has wrought such an enormous change in our ability to work and to achieve, and in our ability to enjoy our leisure. If it were not for the work of the designer in producing the machines by means of which these lamps can be made at a cost of only a few cents each, Edison's invention would today be one of the quaint things that lecturers in physics would revel in displaying and demonstrating to their audiences.

Not that the design of any but the simplest of machines is ever brought to a point of reasonable perfection at the first attempt. In most cases there is first a period of cut-and-try. Then there is produced a scientifically built machine that will perform its task satisfactorily but not with the best possible economy. Finally a modern designer, who combines with his design skill some of the functions of the production engineer and of the research man, constructs a machine that will satisfy not merely the mechanical but also the economic requirements.

The task is not an easy one, for the factors that the modern designer must bear in mind are many and complex. Better economy in almost all cases means higher speeds, with rapidly multiplying stresses on machine parts, which must be met by more careful analysis, perhaps by balancing, perhaps by the use of different materials. Higher speeds may also mean an increased danger of spoilage of the work, which may necessitate redesigning the product itself, or perhaps changing the material used for the product. Such changes require careful study, both from the mechanical and the economic point of view, and often it is impossible to find even a reasonably satisfactory solution without laboratory research.

The complexity of tasks of this kind, troublesome though it often is, not only lends to the work of the machine designer that charm of infinite variety which means sustained interest, but also gives him the satisfying feeling that his job is worthy of all he has to give it.

Embryo Engineers at Cass Lake

By FRANK LASKA, CE '31

IN ORDER to obtain a degree in Civil Engineering one of the many courses which are required is one known as summer camp. This course is offered in the last half of the summer between the junior and senior years, at which time the men gather in the Chippewa National Forest on Cass Lake, in Northern Minnesota.

The camp is out of doors and embodies all the characteristics of a construction field party. There are no frame buildings. The men and equipment of all kinds, including culinary, are sheltered by tents which have permanent wooden floors. The instructors, Mr. Cutler, Mr. Boone, and Mr. Zelner, members of the faculty in the College of Engineering, assume the role of chief Engineers in order to give a more realistic spirit to the camp. The student quarters are taken care of by a row of tents, which the men equip with bunks and rustic furniture. Each tent houses about four men. Separated from these is the business end of the camp, which consists of a combined mess tent and kitchen, a motor tent for the three outboard motors, an instrument tent, computing tent, office tent and instructors' quarters.

The camp day starts at 5:45 a. m., at which time the mess gong, a large circular saw, is sounded. This gives ample opportunity for everyone to be ready for breakfast at 6:00. Mr. Cutler calls roll in front of the dining hall, and then everyone troops in to a meal served in tin dishes. After breakfast, the three instructors give detailed instruction to the individual parties for the day. With advice still ringing in their ears, the party chiefs check out the necessary equipment and lunches. Some of the jobs are as much as 10 miles from camp, but even then the rule is "be on the job and ready to start work at 7:00."

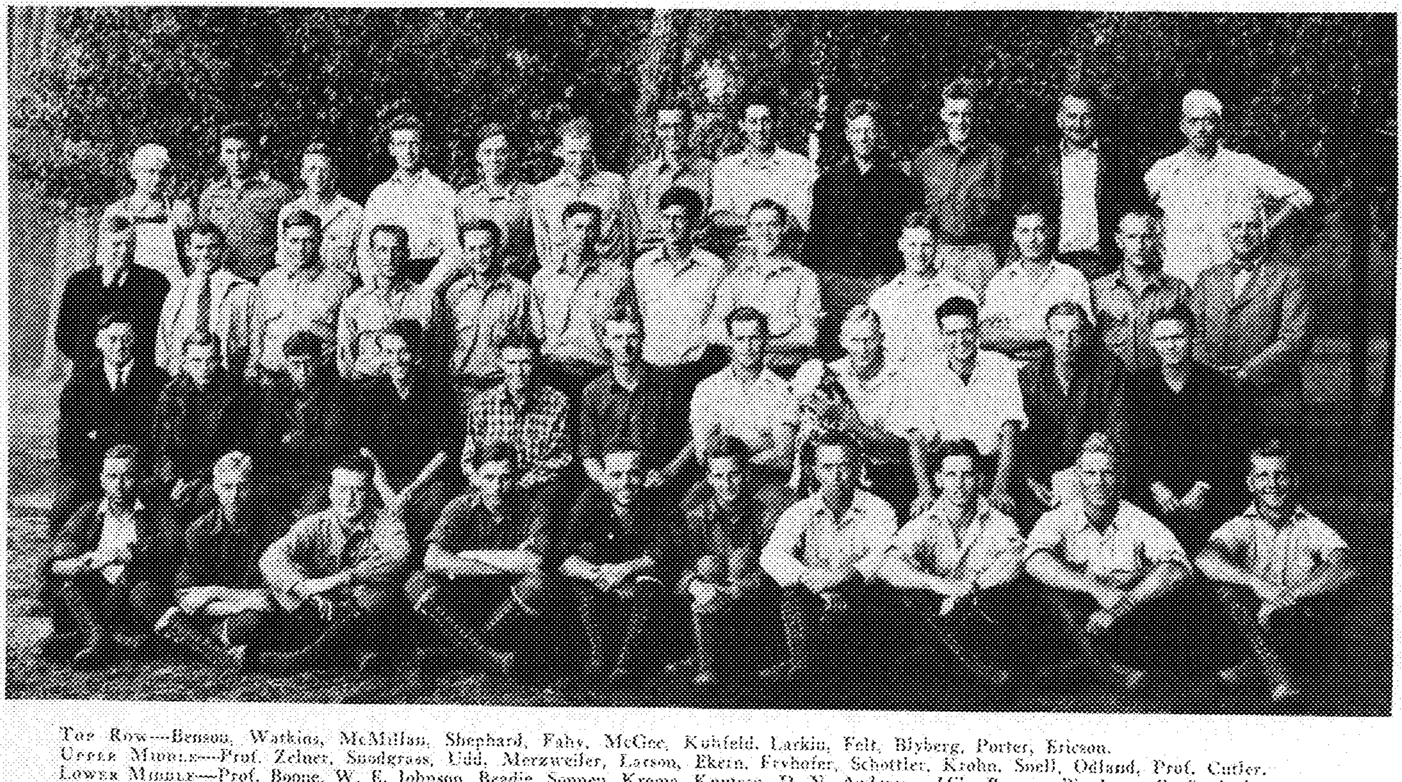
During the day, Mr. Cutler and Mr. Zelner visit the parties of which they have charge. Mr. Boone lends a guiding hand to those few who are confined to work in camp. On arriving from the field, a written report of the progress is required from the chief of each party. Dinner is served at 6:00, and even afterwards the school spirit is not lacking. About 50 per cent of the men have something to do pertaining to the day's work,—notes must be copied, analyses made, and computations completed, so that they will be ready to hand into the office files by 7:00 a. m. the following day. During the evening the faculty go into conference to decide the personel of parties for the following day, a list of these is posted and viewed by all with some expectancy.

The location of camp offers facilities for various types of work, about eighteen in number, all embodying the basic principals of surveying. As a result, most every day brings up a new type of work, a different problem, with a new group of men. With this system a student can ascertain his deficiency or adaptability in any special branch of surveying. Of course, in the limited time, each man does not work with every other man in camp, but the rotating system is adhered to as closely as possible. The serious atmosphere, however, is not maintained at all times, especially in the evenings. When the urge for work is no longer present, groups congregate in tents or in nearby cities to discuss various incidents which are not always connected with the major problem at hand.

To say which type of work is the most interesting would be impossible. However, some mention should be made of the various types of work.

Cass Lake and the adjoining territory is dotted with triangulation stations. Some of the hubs have been set by the Mississippi River commission, while others have been set by this and other preceding camps. During the last year, some new observing towers and stations were added and a few abandoned. It was also found that by rebuilding one old tower, constructing a new one, and introducing a new base line, a few more distant stations could be seen, thus offering a possibility to connect the system on Pike Bay, a port of Cass Lake, and the system on Cass Lake. This new

(Continued on page 82)



TOP ROW—Benson, Watkins, McMillan, Shephard, Fahy, McGee, Kuhfeld, Larkin, Felt, Blyberg, Porter, Ericson.
UPPER MIDDLE—Prof. Zelner, Snodgrass, Udd, Merzweiler, Larson, Ekern, Fryhofer, Schottler, Krohn, Snell, Odland, Prof. Cutler.
LOWER MIDDLE—Prof. Boone, W. E. Johnson, Beadie, Sonneu, Krema, Knutson, D. N. Anderson, Hila Roscoe, Bingham, G. S. Anderson.
BOTTOM—Moore, Swanson, J. A. Johnson, Cowan, Staffeld, Laska, Brown, Swenson, Farin, Holton.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Speech!

MUCH has been said and written about the need of training in speech in the technical schools. The engineer is proverbially strong in the solution of problems, and weak in the presentation of that solution.

Speech is the mechanism by which the engineer succeeds or fails to bring others to execute his plans. The value of his service must ultimately be judged by non-technical men. To gain their appreciation of the value of his work, and of his own ability, the engineer is dependent upon speech.

The engineer is ridiculous who is trained to high proficiency in the application of technical knowledge and yet is unable to express that knowledge correctly or intelligently.

If engineering is to be universally accepted on an equal plan with the other professions, engineers must display an ability to speak clearly and forcefully.

In recognition of this fact the American Society of Mechanical Engineers in New York recently started a class in speech. The enrollment was large and has increased rapidly since that time. This lead has been followed by branches of the Society in other parts of the country.

This year, at the University of Minnesota, speech has been added to the curriculum of the mechanical engineering department as a required subject. Will the Mechanicals be alone in acknowledging the necessity of undergraduate training in speech? We predict that speech will soon be an indispensable part of the curricula of Chemistry, Engineering and Architecture.

One Word More

IN a recent issue of the Techno-Log there appeared an editorial under the caption "All-Engineers' Day." Many technical students may have gained the impression that the School of Chemistry intended to sever relation with the other engineering groups in regard to Engineers' Day. Since this is exactly opposite to the intention of the chemical engineers, a word of explanation is desirable.

A Chemical Exposition is being seriously considered, which will parallel the Electrical Show and will not detract from the cooperation of the School of Chemistry in the annual Engineers' Day. It will in no way involve a split between the chemical engineers and other followers of Saint Patrick. The proposed show would not be held more often than once every two years and would serve to demonstrate the progress in and the applications of the science of chemistry and chemical engineering. Regardless of the outcome of present plans for a Chemical Show, the other technical groups can feel certain that the School of Chemistry will participate in Engineers' Day to the greatest possible extent.

Engineering Education

IN medicine, in law, in dentistry and in agriculture the educational tendency of the past fifteen years has been to increase continually the requirements for cultural background and preparation before a student is permitted to take up technical training. A generation ago a boy just out of high school was regarded as ready to begin his medical course,—but now he must have pre-medical cultural training of two to four years. To a certain degree this is true of the other professions mentioned.

In engineering, on the contrary, the last twenty years have shown no progress whatever in this matter. A green country lad just out of a small town high school has been presumed to have practically enough of culture, of civic consciousness, of altruistic vision to go out as a leader of men and a planner of the great modern projects that make life livable for all. A three hour course in rhetoric and composition for a single year has been assumed to be sufficient training in literature, in expression and in general culture.

To be graduated from most agricultural colleges a student must take nine hours of rhetoric, five hours of public speaking and three hours of argumentation. Contrast with this the engineering requirements. Have engineers been educated only to become draftsmen, surveyors and mechanics under orders from some one who knows how to buy their labor cheap and sell it to his own advantage?

In spite of this handicap the number of engineers who are leaders in their business and in their community attests to the caliber of men who enter this profession. Engineers worthy of the name will welcome an introduction of increased requirements in cultural subjects.

Junk and Progress

"MEN in charge of a manufacturing enterprise must be willing to junk things," according to Dr. Julius Klein, assistant secretary of commerce, in his radio address on the subject "The Menace of Obsolescence" over the Columbia network recently from station WMAL, Washington, D. C.

"Our American junk piles have never been so high as they are now," said Dr. Klein. "If you are a superficial observer, you probably regarded these junk piles as signs of profligate waste. Doubtless you have seen them through train windows, as you whirled through factory districts. And if you thought about them at all, you may have been repelled and shocked.

"But if so, you were wrong. These piles of discarded machinery, of cast-off equipment, are impressive monuments to American progress! They are because factory managers, in general, prefer to have the junk piles outside their factories instead of inside and in use."

NEWS FROM THE TECHNICAL CAMPUS

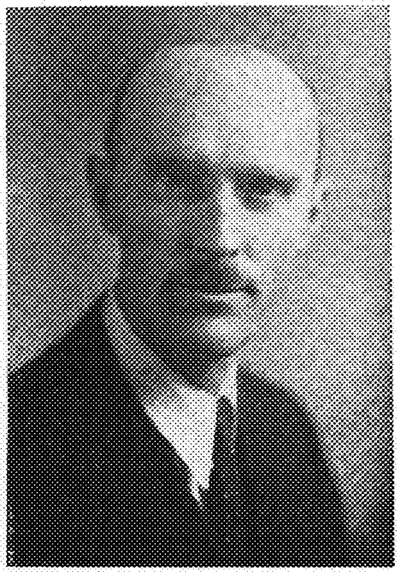
Leon Archibald Named Frosh Hockey Coach

Leon Archibald, assistant professor of drawing and descriptive geometry in the College of Engineering and Architecture, has been appointed to the post of Freshman hockey coach. He is a native of Nova Scotia "where they learn to play hockey as they learn to walk." His debut in organized hockey was with Arnold, a preparatory school in Halifax, Nova Scotia. In 1906, his second year at Arnold, he was made captain of the team.

From 1906 until 1910, Professor Archibald played for Acadia University of Wolfville, Nova Scotia, and also with the Wolfville town team. In 1909, when he was captain, the Wolfville team obtained the championship of the Nova Scotia Hockey League. While playing for Acadia, Mr. Archibald had the distinction of being a member of a team picked from the Provincial universities to introduce hockey as a major sport at Harvard.

After leaving school, he played for Regina and Prince Albert in Saskatchewan until the war broke out in 1914. When Mr. Archibald returned to Nova Scotia in 1918 he found that five members of the Wolfville team had been killed in action, while he had been wounded three times. Speaking of the Wolfville team, Professor Archibald said, "They were a fine clean team, without the slightest trace of professionalism or the least taint of money in their game."

PROFESSOR LEON ARCHIBALD



FRANK B. LINDSAY

Lindsay Now Teaching at Colton, California

Frank B. Lindsay, former instructor in mathematics at the University of Minnesota, is teaching this year at Colton, California.

Mr. Lindsay is giving instruction in three courses,—integral calculus, surveying, and astronomy. In addition, he teaches a night class for adults in astronomy. These lectures in astronomy require a great deal of time to prepare according to Mr. Lindsay, as they are popular in character and it is necessary to omit all mathematics. A new observatory is in the process of construction at the school which will be provided with a 16-inch reflector. Mr. Lindsay says that the college is liberal with appropriations for reference books, slides and apparatus.

Architectural Fraternity Pledges New Members

Four new members were recently pledged by Tau Sigma Delta, honorary fraternity in architecture and its allied arts. The group differs from those of the past, since three of the number pledged are girls.

Members of the pledge class are Miss Clarice Berg, of the TECHNO-LOG staff, Milton Bergstedt, art editor of the TECHNO-LOG staff, Miss Elizabeth Cargill and Miss Rossie Moody. The present active members of the organization are Earle Cone, Milton Hoglund, Arthur Monthey, and Howard Wee.

Eligibility to the organization is based on scholarship, and on examination, with architectural subjects being weighted more heavily than others.

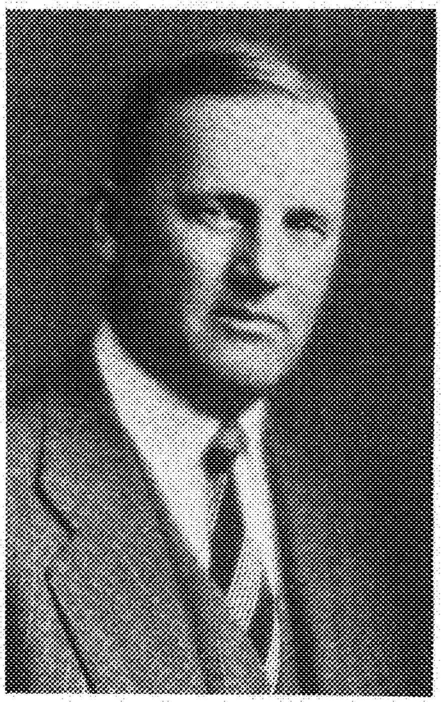
Washington Alumni Honor Dean Leland

Alumni of the College of Engineering and Architecture and the School of Chemistry who are located in Washington, D. C., arranged a dinner in Dean Leland's honor while he was in Washington attending the annual meeting of the Land-Grant Colleges and Universities.

The dinner was held on Thursday evening, November 20, with former Professor Jansky acting as toastmaster. Dean Leland spoke on the development and changes in the College of Engineering and Architecture and the School of Chemistry. Professor Ryan, who has just returned from Europe and who was in Washington at the time, was present.

The following alumni attended:

I. Louis Walk, Ch. '29; Henry Berk, Ch.E. '27; Maurice W. Levy, Ch.E. '30; George R. Ofelt, E.E. '27; Wilbo Kallio, E.E. '30; Donald T. Stevens, E.E. '28; Lloyd V. Berkner, E.E. '27; Paul Bliven, M.E. '27; R. R. Trexler, M.E. '27; Erling B. Saxhaug, E.E. '29; Frank A. Daly, C.E. '28; O. K. Normann, C.E. '28; Karl J. Albrecht, E.E. '25; B. J. Peterson, C.E. '13; Alois W. Graf, E.E. '26; J. Edwin Coates, M.E. '27; William J. Darmody, M.E. '24; R. E. Backstrom, M.E. '25; D. M. Stuart, M.E. '28; F. M. Hakenjos, Ar. '29; William E. Norley, M.E. '29; Leo Smilow, M.E. '29; Robert K. Zeese, C.E. '30, and Milford A. Juten, Jr. M.E. '30.



DEAN O. M. LELAND

(Continued on page 80)

The Signal Corps Invades Fort Sheridan

(*Continued from page 75*)

time for work. Instruction the first week was confined to the classroom. Practice radio nets were formed, using lung power for broadcasting. Minature telephone systems were installed so that when field problems were assigned the company could go ahead with confidence. As another part of our course, lectures on Army organization were given by the company commander.

Development of ground to plane communication and vice versa are part of the present day research work being carried on by the Signal Corps. An army observation plane from Scott Field, St. Louis, equipped with a SCR-159 radio set soared over Fort Sheridan for about an hour one day, exchanging messages. The ground crew used a SCR-109 set. Both had transmitting wave lengths from 300 to 500 meters and receiving wave lengths of 300 to 1100 meters. Our ground set used an umbrella antenna of six wires, while the plane's antenna consisted of a lone trailing wire. The SCR-109 and SCR-159 vacuum tube radios providing three means of communication: undamped wave radio telegraphy, buzzer modulated radio telegraphy, and radio telephony. The Signal Corps sent a message by a layout of large panels, and in turn received an acknowledgement from the plane by means of pyrotechnics (rocket flares). The plane was then directed in its movements by radio. After dropping a written message, the visitor returned to its home field.

Our regular field exercises took up most of the time through the summer. Tactical problems were given to a group from one of the universities and it was its duty to conduct the work for that day. Construction crews, division and brigade signal personnel were assigned to various tasks so that when the zero hour approached everything was in readiness for the proposed attack. Division headquarters, rear echelon, 1st and 2nd brigades were typical command posts. Each one had a telephone switchboard, two radio stations, buzzer service and a message center. The construction outfit took care of laying the wire and tying it into the main terminal boards. It was their duty to take care of the advance wiring in time so that a command post could be moved to a new location without a break in the service. Each post had its message center clerks, radio operators and telephone switchboard operators. It was a source of constant delight for the Signal corps to be able to carry on their work beneath shady trees and enjoying a refreshing lake breeze while the Infantry units crawled, dug and perspired.

Towards the close of camp the Signal corps gave a demonstration to the Infantry units illustrating the organization of a company of signal men and the execution of a field problem. A signal officer takes charge, with the assistance of a company commander, of the headquarters platoon, operating platoon and the construction platoon. These are in turn divided up as folows: The first named is split up into an administration section and supply section, the second into the message center, telephone and telegraph, and radio sections, and the third into the horse and motor construction sections. This method is widely different than the usual squad formations that the Infantry uses.

For nearly three days one's ears were subjected to the sharp reports of the Colt 45's used by the Signal corps. The occasion was the annual target practice held on the beach. Minnesota scored high, considering that many of the men had never before handled a weapon of this type. Captain Parsons had his own way of percentage classification. To those with a score of 60% or higher went the honors, while everyone between 50 and 60% were placed in the "threatened to qualify" column. A "rock thrower" was a holder of a record not lower than 40% and the ones that fell below this mark were designated as in the "couldn't even throw rocks" class.

On the last Monday the entire R. O. T. C. battalion hiked to the Great Lakes naval training station, twelve miles north. Equipment carried in our packs included one half of a pup tent, stacks, a tent pole, several blankets and toilet articles. Besides this the Infantry sported their rifles. Noon found us at the doors of the seamen's mess hall. That afternoon, we spent in lounging around our impromptu quarters and in examining the grounds and the radio station. The next morning the army was awakened from its pup tent slumber and by six-thirty the hike towards our own post was begun. This journey should have come earlier in the summer for then it would have increased our respect for our own cooks.

The same evening saw us in possession of very little of the government's clothing and by the middle of the next day everyone had received his pay, had been examined for any battle wounds that might have been procured while there and had been honorably dismissed. The rides home were said to be still stranger than the ones to Fort Sheridan.

NEWS

(*Continued from page 77*)

H. C. Richardson Speaks to Alpha Tau Sigma

"More English for Engineers" was the topic discussed by H. C. Richardson, professor of English in the Engineering College, who was the chief speaker at a recent meeting of Alpha Tau Sigma, honorary engineering journalism fraternity.

The meeting, which was held on Friday, November 14, was the first of a series of monthly dinner meetings to be held by the organization in conjunction with its local alumni body.

"Employers," said Professor Richardson, "have long complained that their engineers have been unable to use correct English in writing and speaking. Incorrect English promotes inefficiency and places the engineer on a plane of inequality with other professional men whom he must meet in his business life.

"This condition has been fostered by the prevailing custom of requiring but a single year of three credit English of engineering students. At Minnesota the required courses are given in the Freshman year. By the time the students are ready to graduate, many of them have evidently forgotten what the English Courses were all about. They revert to type and the result is a group of engineers sadly lacking in one of the most important requirements for the successful practice of their profession.

"More attention to English throughout the four year course would be a step in the right direction."

Tau Beta Pi Announces New Scholarship Prize

The Minnesota Alpha chapter of Tau Beta Pi, national honorary engineering fraternity, announces the establishment of an annual prize of the value of $25.00 which will be granted to a freshman in the College of Engineering and Architecture, the School of Chemistry or the School of Mines.

The award will be made through a committee consisting of representatives of the faculty and active members of the chapter. The committee will interview eligible men and base its decision chiefly on scholastic standing, although extra-curricular activities, outside work, and personality also will be taken into consideration.

The prize was established for the purpose of encouraging good scholarship in the freshman class by recognizing and rewarding meritorious work. The winner will be announced some time in May.

(*Continued on page 84*)

RUSSIA

(*Continued from page 67*)

memorial. You must remember that their ancestors 70 years ago were out and out slaves and were bought and sold. Although they were freed in 1861 they did not have all the liberty in the world under the czars.

As far as food is concerned, they are restricted as to some kinds. They have food cards which allow them to purchase only a certain quantity of meat per day. You don't find white bread in Russia—but I doubt if these people ever had white bread. Butter is very scarce. One thing they should have is vegetables, but in the cities these are scarce. There are cucumbers galore, but other vegetables are scarce on account of lack of facilities for handling them properly. We have fresh vegetables here twelve months of the year. You can transport refrigerator cars from any point in the United States to Minneapolis or St. Paul within eight days at the outside. All winter we get tropical fruits and vegetables, due to our excellent refrigeration service. In Russia there is not enough refrigeration service and vegetables can be shipped only a comparatively short distance, and are liable to spoil because of bad handling.

The condition of the American engineers over there seems to be very good. At Dneiperstroi Dam we visited with Col. Cooper's assistants. They had fruit, meat and vegetables, all in good shape. I think they live very comfortably.

Among some of the people in the larger cities there is probably a scarcity of the proper food, but I did not see evidence of a lack of enough food.

As to the country itself, Russia is a tremendously vast country, 2½ times as big as the United States. In an air line from the point where we entered to Vladivostok where we left the distance is about the same as from here to Warsaw in Poland. Russia covers nearly one-half of the distance around the world—160° of longitude between the furthest points. Our travels were over one-third of the way around the world, and all within Russian territory.

Now, we always think of Russia as a cold country. It has a climate a good deal like Minnesota, around Moscow. We moved south into Turkmenstan, north of Persia and Afghanistan, where it was 107° and 108° in our car, and the week after we left we heard the temperature was 176° in the sun. The day we were there it was warm enough to fry eggs on a bridge girder, on which I inadvertantly placed my hand. We also saw territory in Siberia where the ground is perpetually frozen—it will thaw out during the summer to a depth of seven or eight feet, but below that is perpetual frost to 600 or 700 feet in depth. We went into a coal mine and picked ice out of it.

This territory was interesting to us on account of the railroad problems. The track heaves as much as 3 feet. Piling cannot be kept in the ground. It is pushed out by the frost. Fence posts won't stay in the ground. We saw shops built of masonry, the walls of which were badly cracked from settling. The shops had been in about 7 or 8 years and the masonry walls had been raised and lowered because placed on an ice foundation which melted when the heat of the house warmed the ground. We were told that a timber grillage worked fairly well under such conditions. We were shown a bridge that moved or tilted in the winter time and came back to approximately its original position in the summer. The worst problem was that of furnishing water supply to the railways through this territory. The streams freeze to the bottom except in deep holes. There was no end of difficulty in getting water to begin with. Then before it could be put into the water tanks it had to be heated to keep it from freezing. You can't do things over there as we do here, allow the pipes to remain filled with water, but you have to drain what water there is in those pipes to prevent them from bursting. It makes a very interesting problem. They have solved it in a number of ways—one was to put in dams. At one place they put in a concrete dam on frost, the only foundation they had, and as they put in the concrete it froze and then the frost melted and the dam went out.

This territory where the perpetual frost is extends about 1,200 miles,—not a great proportion of the distance across Siberia, as compared with the 7,000 miles from Leningrad to Vladivostok, but it is far enough to constitute a very difficult railroad situation.

We spent in all about 73 or 74 days in Russia and then sailed from Vladivostok to Tsuruga, Japan, and spent 4 days there. We were on pleasure only, but we had time to note carefully the concrete work that Japan has put in—even went out one afternoon and looked at one of their shops near Tokio—one of the prettiest, cleanest, most orderly shops I have ever seen in my life. And they had another thing there that I wondered if we could not copy. They had sections of all of the different parts of their equipment—air brakes, refrigerator cars, and track equipment in a little museum which is open to school children who may go there and play with these toys—not university students, but ordinary school children—and learn about the parts of a railroad. We found the Japanese very efficient in everything that they do, and I think this little exhibit of which I have spoken is one of the marks of their efficiency and good workmanship.

CASS LAKE

(*Continued from page 75*)

base line is about 8,500 feet long, probably the longest and best of any used by similar groups throughout the country. As most of the stations are accessible only by boat, triangulation is one of the most popular occupations at the camp.

The Soo Line and Great Northern railways both run within a short distance of camp, which makes possible an extensive course in railroad work, including a good survey. Even the town of Cass Lake has its use in a curricular way, namely, town sight survey by plane table, transit, and chain. The country adjacent to the camp is of such nature as to afford a "tough workout" for anyone.

There are only two nights of field work. Both of these are occupied in making observations on Polaris. During the first half of camp, an observation is made and computed by the hour angle method. The other is an observation and computation of eastern elongation. These observations form the basis for computation of the azimuths of the numerous courses.

Most of the work is laid out on former courses, because of the practice these problems afford. Each year, however, some new problems are undertaken. This year a survey was made of a box factory property, a topographical survey of Cedar Island in Cass Lake, and a Nursery survey with transit and level for computation of earth work.

The Cedar Island survey was a "tough problem" done in a very satisfactory manner. The North shore is nearly completely covered with reeds and water, in some places the water is three feet deep. The Island proper is covered with heavy underbrush, but there are no Cedar trees.

Although a field check is made by each man on the job, there are nevertheless numerous opportunities for error. However, when a resume is made of the results obtained by each man and the group as a whole, a striking harmony can be seen in accuracy. The reason for the accuracy is partially due to the fact that each man considers himself personally responsible for the conduct and effectiveness of the party.

The camp this year was certainly a success insofar as the students were concerned, and whenever this group meets again, the discussion will surely turn back to the time when all gathered at Cass Lake to gain further knowledge and increased confidence. The remembrance of many camp incidents will not be readily removed from memory,—and in the future when engaged on some construction job, the memory of those weeks spent at Cass Lake will fill many a lonely moment with enjoyable recollections.

University Will Conduct Special Summer School

Under the auspices of the Society for the Promotion of Engineering Education and with the co-operation of the University of Minnesota, there will be held here next summer a Summer School of Mathematics, especially for those who are concerned in the instruction of engineering students. The School will open on Monday, August 24, and will close on Saturday, September 5. In the following week, the American Mathematical Society and the Mathematical Association of America jointly will hold their summer meeting here.

Dean Leland will be the local director of the School with Professor Herrick as secretary. The remaining members of the local committee are Professor Brooke of the department of Mathematics and Mechanics and Professor Brink of the department of Mathematics in the College of Science, Literature and the Arts. The Mathematical Society and the Mathematical Association will co-operate in this project through a national committee appointed for the purpose, consisting of Professors E. R. Hedrick of California, J. W. Young of Dartmouth, E. V. Huntington of Harvard, G. D. Richardson of Brown, W. D. Cairns of Ohio and Dr. T. C. Fry of the Bell Telephone Laboratories. Professor Brink of the department of Mathematics is chairman of the local committee on arrangements for the meeting of the Mathematical Society and Association.

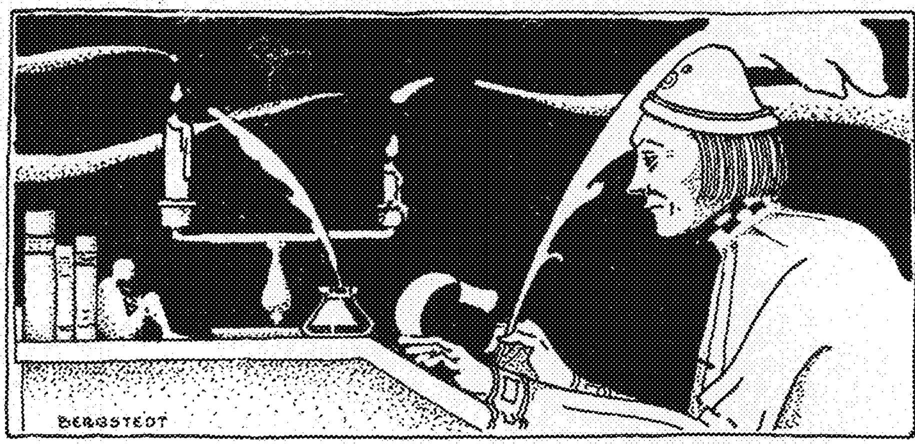
The Summer School for teachers of mathematics will be attended by teachers who register for the course. They will live together and form a single class. Many prominent mathematics teachers and specialists in allied engineering fields will form the teaching staff. Members of the University faculty who will participate are President Coffman, Dean Haggerty of the College of Education, and members of the department of Mathematics and Mechanics in the College of Engineering and Architecture and the department of Mathematics in the College of Science, Literature and the Arts.

Electrical Show Plans Progress Rapidly

Plans for the 1931 Electrical Show which will be held on the campus some time during the spring quarter under the auspices of the student branch of the A. I. E. E. are rapidly being completed. Martin Agather who is in charge of the arrangements promises one of the finest Electrical Shows the University has ever had. This will be the tenth gathering of this kind to be held at the University for the purpose of acquainting friends of the University with the work of the students in the electrical department.

Many new features have been planned for the affair, including illuminated steam, television, and the talking arc. The student operated radio stations WLB and W-9XI will be open for inspection. An attempt is also being made by the committee in charge to secure a portable talking moving picture machine from the General Electric Co. Some of the students have promised to boil eggs on ice and accomplish other bits of electrical magic for the benefit of the friends of the University.

Alfred Neir, Howard Nichols, and Ralph Beightol have been chosen to represent the senior, junior, and sophomore classes, respectively. Kirk Buchak, secretary, and Richard Kady, treasurer, are the other officers who will help make the show a success.



How Many?

GIVEN: A certain person is given a sum of $100.00 and is required to spend i by hiring 100 people to work for him one full day each. He furthermore must em ploy men, women, and children and must pay the men $10.00 each per day, th women $3.00 each per day and the children each 50 cents per day.

REQUIRED: The number of men, women and children respectively that h must hire.

Who Shaves Whom?

GIVEN: A barber shaves all the people in a certain town who do not shave them selves, and he shaves only those who do not shave themselves.

REQUIRED: Does he shave himself?

The Unknown Engineer*

GIVEN: Four towns, A, B, C, and D, are located along a railroad. The distanc from A to B is 100 miles, and the distances from B to C and from C to D are fift miles each. There are three passengers on the railroad: Brown who lives at A Robinson who lives at D and Smith whose residence is unknown. The train crew of the line consists of three men: a brakeman, a fireman and an engineer living a B, D, and C respectively. They have the same names as the passengers,—i.e., Smith Brown and Robinson.

The following facts are also known:

1) Railroader Smith can usually beat the fireman at pool.
2) The engineer gets a cash salary ⅓ of that of his nearest neighbor.
3) The brakeman's namesake (the passenger having the same name as th brakeman) gets a cash salary of $5,000.00 per year.

The foregoing facts are all essential in the solution of the problem.

REQUIRED: The Engineer's name.

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* The accompanying problem was stated incorrectly in the November issue. It is herewith reprinted

Answer to last month's problems:

1) The Unknown Engineer is Smith.
2) It was necessary to cut the chain four times.

THIS SKYSCRAPER BUSINESS

(Continued from page 69)

cent occupancy basis but they totaled $75,000 instead of $64,500, largely because an expert building manager had to be obtained at a salary of $7,000 and because of minor expenditures not foreseen. During these two years before the building was well rented there also occurred annual deficits, which when added to the cost of the structure along with $50,000 worth of shades, tools, fire-extinguishers, furniture, scaffolds, ladders, mop-trucks, etc., brought the final building cost up to $1,750,000.

The annual statement now staring the directors in the face is as follows:

Gross Income		$140,000
Operating Expenses	$75,000	
6% Interest on $1,750,000	95,000	
	$170,000	170,000
Annual Deficit		$30,000

This little story, gentlemen, happens many, many times and because of it we reiterate our statement that this skyscraper business is primarily one of economics and secondarily one of searching for beauty.

"Kto bila to Kobieta stoba fezoraj viecor?"
"To niebilia Kobieta; to bila moja Zona."

Lady: (To baby on the street car) Drink your milk Horace and keep quiet or I'll give it to the conductor.

"Co to bulo zadirku co ja te vidvel shi vicar?"
"To nebula Diuka; to bila moja Zona."

Don: How much do I owe?
Joe: Not a penny, are you going to pay your debts?
Don: No, I'm going about to see if I've overlooked anybody. Lend me five until Saturday.

THREE THEMES

(Continued from page 72)

ing this last remnant of day fade was like parting with a dear friend.

Darkness fell, with the heavens blanketed in heavy clouds. Unconsciously I began to cast glances this way and that in search of—what? Forcing myself to be calm, I tried to dismiss the feeling of danger; but try as I would, I could not. The thick carpet of pine needles under my feet dulled my footsteps; protecting me from listening ears. From the south came the uncanny call of the loon, a wail that made my flesh creep. It meant something; I was nearing the lake on which I had camped. I was silently rejoicing when suddenly a twig snapped behind me, shattering the silence. I whirled, searching the black wall to the rear. My eyes—or was it my imagination—met two green balls of fire, glowing in the darkness. To say that I was surprised would be putting it mildly. I was terrified! My blood froze. Wheeling I started on a mad run in the general direction of camp. Brambles clutched me. Tees blocked my path. All was for hindering a quick getaway. Ahead, I dimly saw a clump of bushes, willows they seemed. My only hope for clear passage was to plunge. A plunge it was, but instead of landing on terra firma as I had expected, my feet met nothing but space—then water. An icy plunge an a short swim seemed also to be on th program. I had blundered through th fringe of bushes bordering the lak Stumbling out, I completed my retrea accompanied by those haunting eyes peer ing at me from the rear. The sight o my cabin, cuddled away in the pines, di not greet me any too soon for my over wrought nerves.

Once secure behind the heavy oa door, I breathed freely again. An ad venture like this may seem rather tam to you, but to me, well, it was "food for my diary.

Sleep

By C. C. Barnum, Arch. '33

COOL sheets, dreamy blissfulness soft yielding springs—these ar mine for eight hours. Then at fatal hour every day that terrible cla ion, that herald of approaching disaste the alarm clock, with its staccato ring drags me out of the land of nod into th world of strife. But the land of no does not give in so readily; it does no relinquish its hold on me, but stubbornl fights to the finish to retain me. The does it offer to me its sweetest induce ments, its most blessed restfulness. Bu equally hard does the land of strife tea and tug to reclaim me. So equal is th

(Continued on page 90)

struggle that the deciding factor falls on me. I am torn between my responsibilities as a man of the world and my failings as a mere mortal.

Oh, that I could expend in real life the mental energy that is utilized to calculate the time I can still stay in bed! My calculations soar to the ethereal heights of higher mathematics, and accuracy to the fourth decimal place is demanded.

When my conscience no longer permits me to recline in the arms of Morpheus, my physical battle begins. My right foot, which is most sensitive to temperature, ventures out from under the covers, but is quickly retracted. This action somewhat stimulates my brain, and I raise my head, my first real conscious response. But this effort so fatigues me that I sink back again temporarily overcome.

Apparently this last desperate effort of the land of nod to hold me is its last: the attacks of the land of strife are telling. I make a bold, courageous resolve to throw back the covers and spring from the bed. The first part of the action is carried out with firm resolve, but the action is stayed in mid-air and I fall back to the shelter of the covers, temporarily defeated. Then comes the final effort, the agony of it! but it brings me to my feet, cold, shivering, and groping blindly for my clothes.

"Pia ito i Kiria me Tin opian isthe?"
"Den ito Kiria; ito i gyneka meu."

Margaret B.: I'd like some rice. Let me see, how much do I need?

Grocer: Wedding or pudding?

Who's the lady I saw you with last night?
That was no lady; that was my wife.

Civil—"Didja take the intelligence test yesterday?"

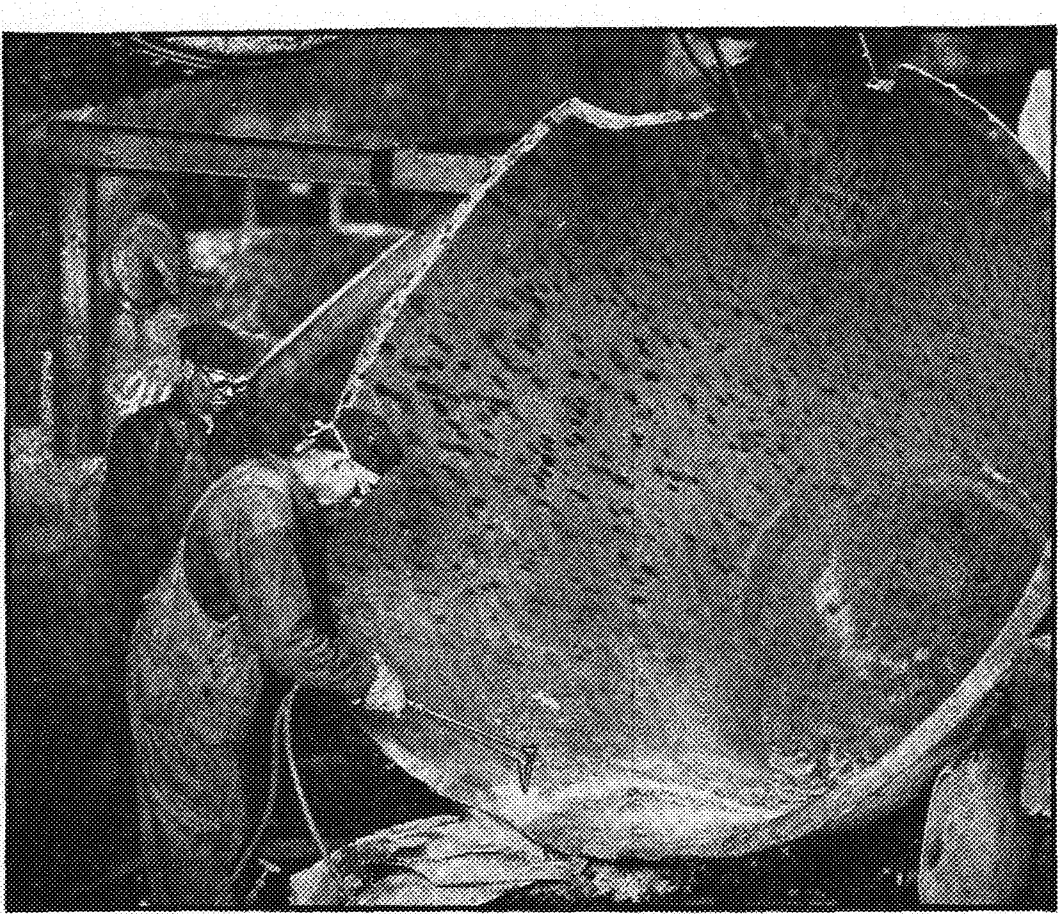
Elec.—"Sure, but I fooled them."

Civil—"How come?"

Elec.—"I answered all the questions wrong."

And then there's the man who is so narrow minded he has his hat blocked on a lead pencil.

"Chi era quella donne che io te vide comminare assieme iere sera?"
"Non era una donna; ma era mia moglie.



Oxwelding for Economy

Through the use of oxy-acetylene welding for maintenance and repair, substantial economies in operating costs can be effected.

In almost every scrap-pile there are thousands of dollars' worth of damaged or worn tools and equipment, much of which could be welded into perfect condition and restored to service at a fraction of its replacement cost.

A foundry, realizing this, now saves $72,000 a year by oxwelding cracked pipe flasks that were formerly discarded.

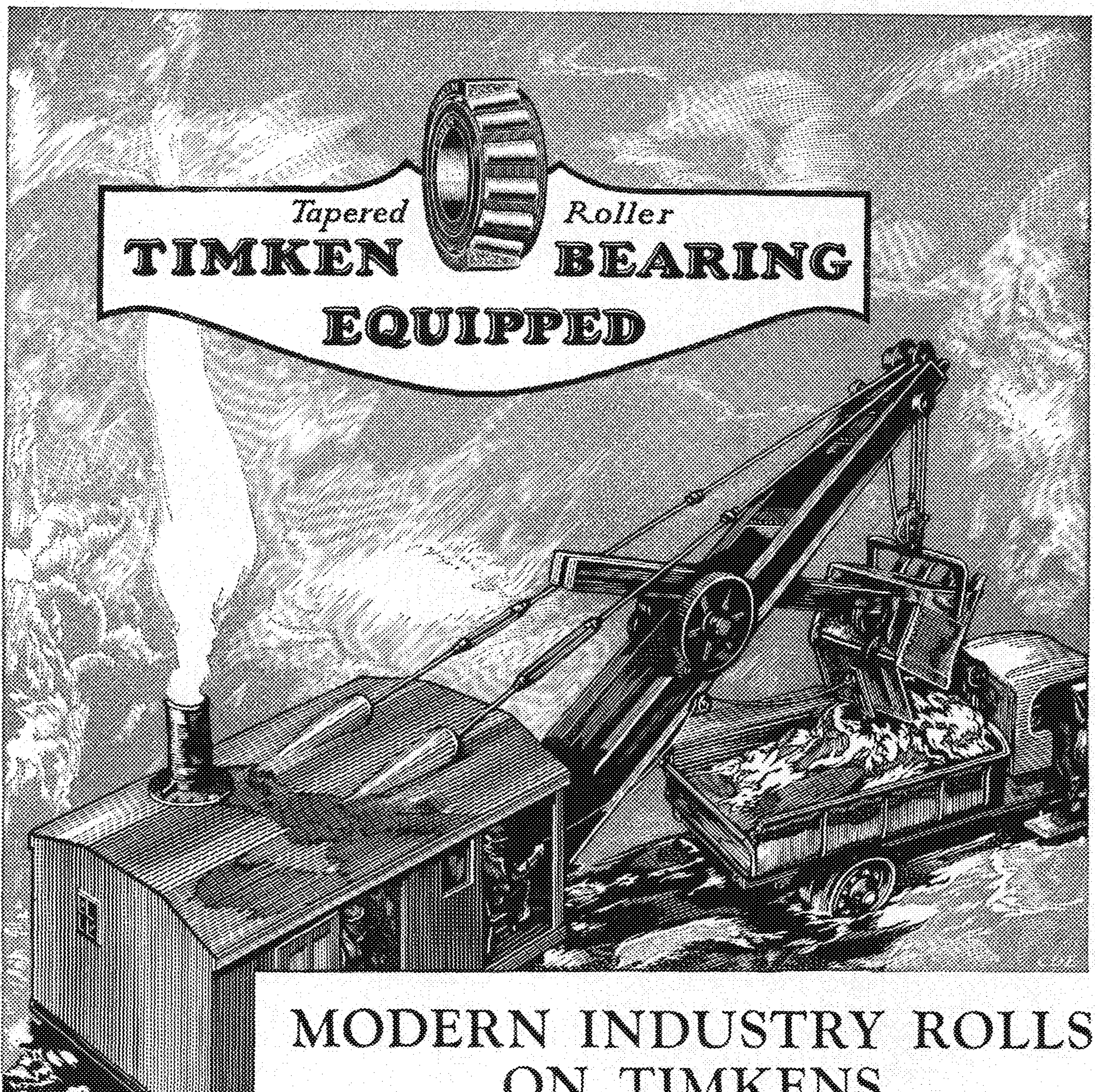
Such a saving, while large, is not unusual. It can be duplicated in practically every industry that uses metal. Investigate the possibilities of oxwelding. It will pay. We shall be glad to furnish you with further information.

THE LINDE AIR PRODUCTS COMPANY, THE PREST-O-LITE COMPANY, INC., OXWELD ACETYLENE COMPANY, UNION CARBIDE SALES COMPANY,

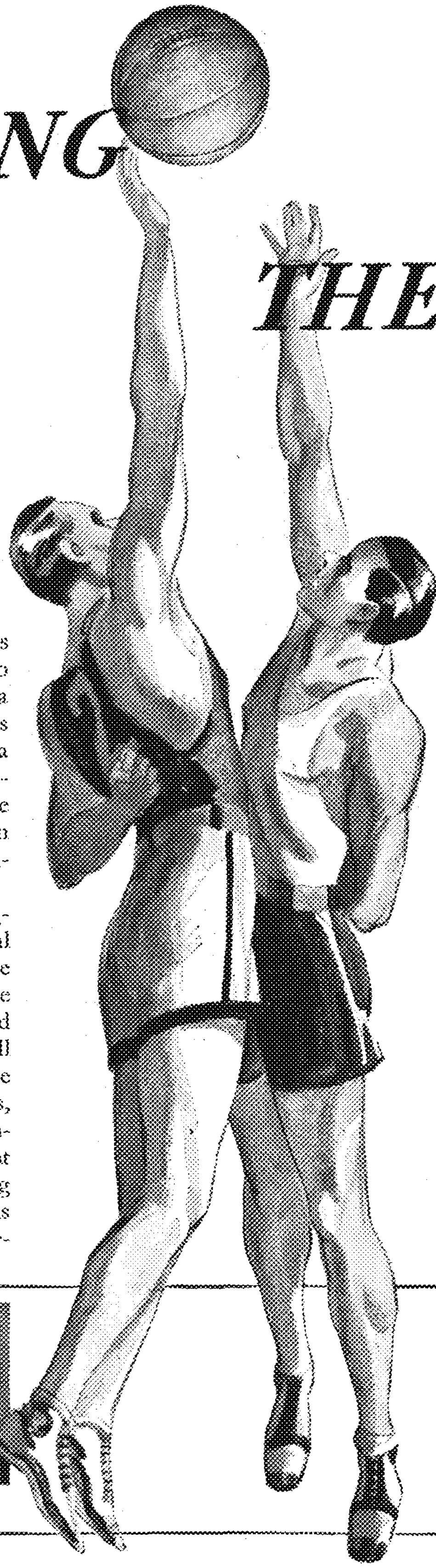
Units of UNION CARBIDE AND CARBON CORPORATION

General Offices...New York UCC Sales Offices...in the Principal Cities

65 Linde plants, 48 Prest-O-Lite plants, 174 Oxygen Warehouse stocks, 156 Acetylene Warehouse stocks
42 Apparatus Warehouse stocks, 245 Union Carbide Warehouse stocks


Tapered Roller
TIMKEN BEARING
EQUIPPED

GETTING THE JUMP



The referee's whistle blows. Up goes the ball. The opposing centers leap into the air and one, a little more alert, a little better endowed by Nature than his adversary, tips it into the hands of a waiting team-mate. So it is in basket-ball — and so it is in the vastly more important game of life which starts in earnest after text-books and examination papers are finally laid aside.

In the sales departments of Westinghouse, as with other great national organizations, are many younger college men — graduated within the past five or ten years — whose alertness and ability are winning them no small measure of reward. Not only in the sale of electrical goods to dealers, jobbers, and power company stores, but in important negotiations for equipment with central stations, railroads, shipping lines, governments, industrial concerns and building contractors, success depends on the extending of contacts and the ability to "get the jump" on competition. And because of their exceptional engineering training and background, Westinghouse representatives are regarded less as salesmen than as expert consultants in electrification.

The men whose photographs appear on this page are but a few of many who, with college memories still fresh in their minds, are helping Westinghouse to maintain the contacts which keep it busy doing so generous a portion of the world's electrical work.

* * *

The following are but a few of the more outstanding examples of recent Westinghouse jobs, in the negotiation of which younger college men have played a part:

Turbine-Electric Drive, New Dollar Line Passenger Ship · Electrification, New York, New Haven and Hartford R. R. · Steam Turbine-Generators, Duke Power Company.

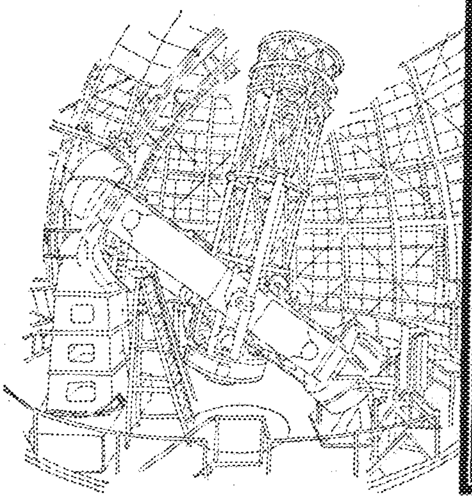
F. E. Uhl
Cornell '24
Transportation Div.
New York Sales

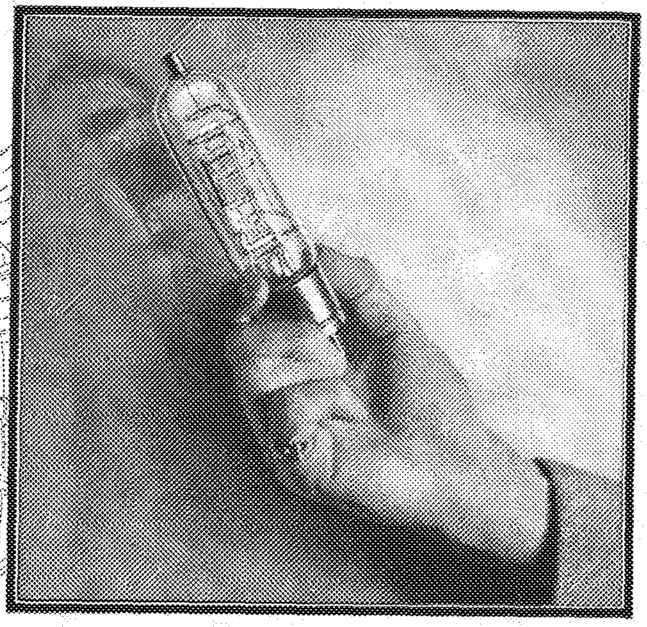
R. D. Lawlor
Tufts College '23
Industrial Salesman
Springfield, Mass.

J. C. Frink
Syracuse '27
Marine Salesman
New York

M. S. Angier
Univ. of Ill. '24
Sales Manager
Johnstown, Pa.

Westinghouse





The new G-E low-grid-current Pliotron tube capable of measuring a current as small as 10^{-17} ampere

This Little Tube Measures Stars Centuries of Light Years Distant

BY MEANS of a new vacuum tube called a low-grid-current Pliotron tube, astronomers can gather the facts of stellar news with greater speed and accuracy. In conjunction with a photoelectric tube, it will help render information on the amount of light radiation and position of stars centuries of light years away. It is further applicable to such laboratory uses as demand the most delicate measurement of electric current.

So sensitive is this tube, that it can measure 0.000,000,000,000,000,01 of an ampere, or, one-hundredth of a millionth of a billionth of an ampere. This amount of current, compared with that of a 50-watt incandescent lamp, is as two drops of water compared with the entire volume of water spilled over Niagara Falls in a year.

General Electric leadership in the development of vacuum tubes has largely been maintained by college-trained men, just as college-trained men are largely responsible for the impressive progress made by General Electric in other fields of research and engineering.

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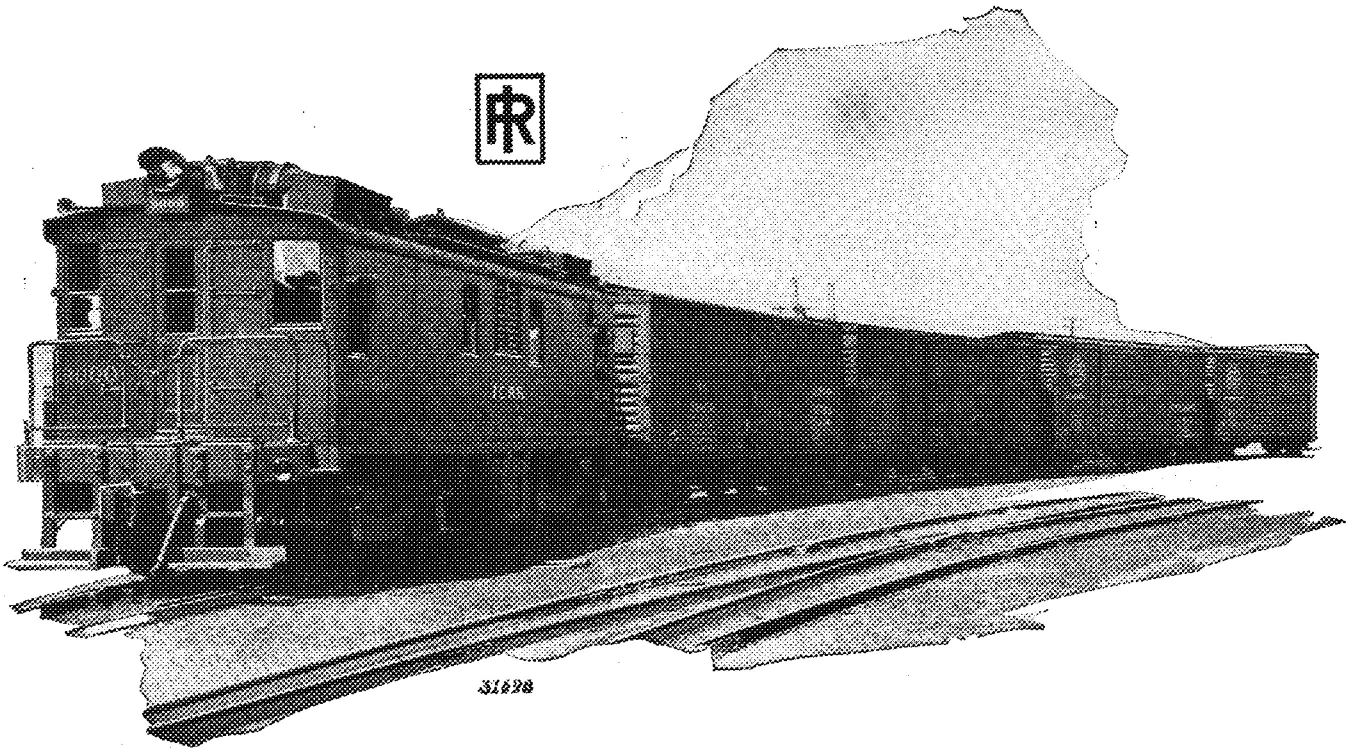
THE MINNESOTA TECHNO-LOG

Vol. XI JANUARY, 1931 No. 4

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



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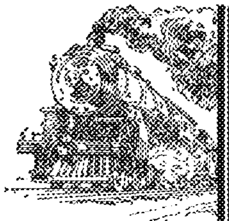

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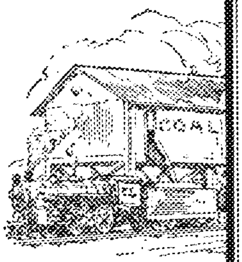

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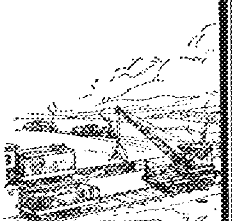

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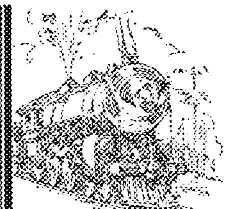

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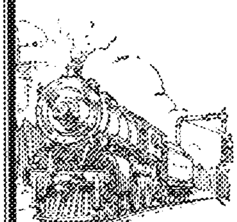

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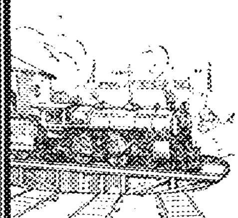

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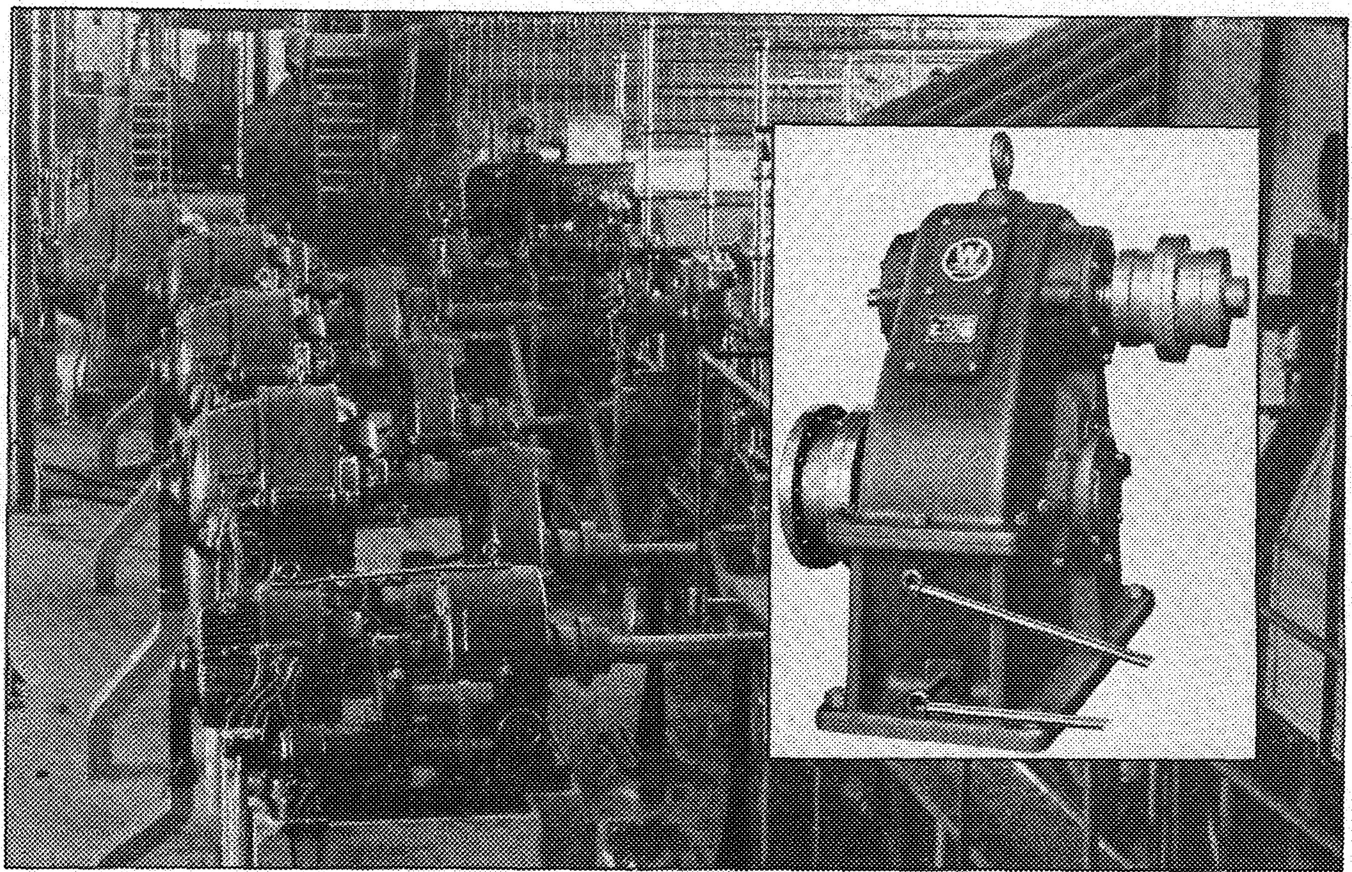

THE MINNESOTA

TECHNO-LOG

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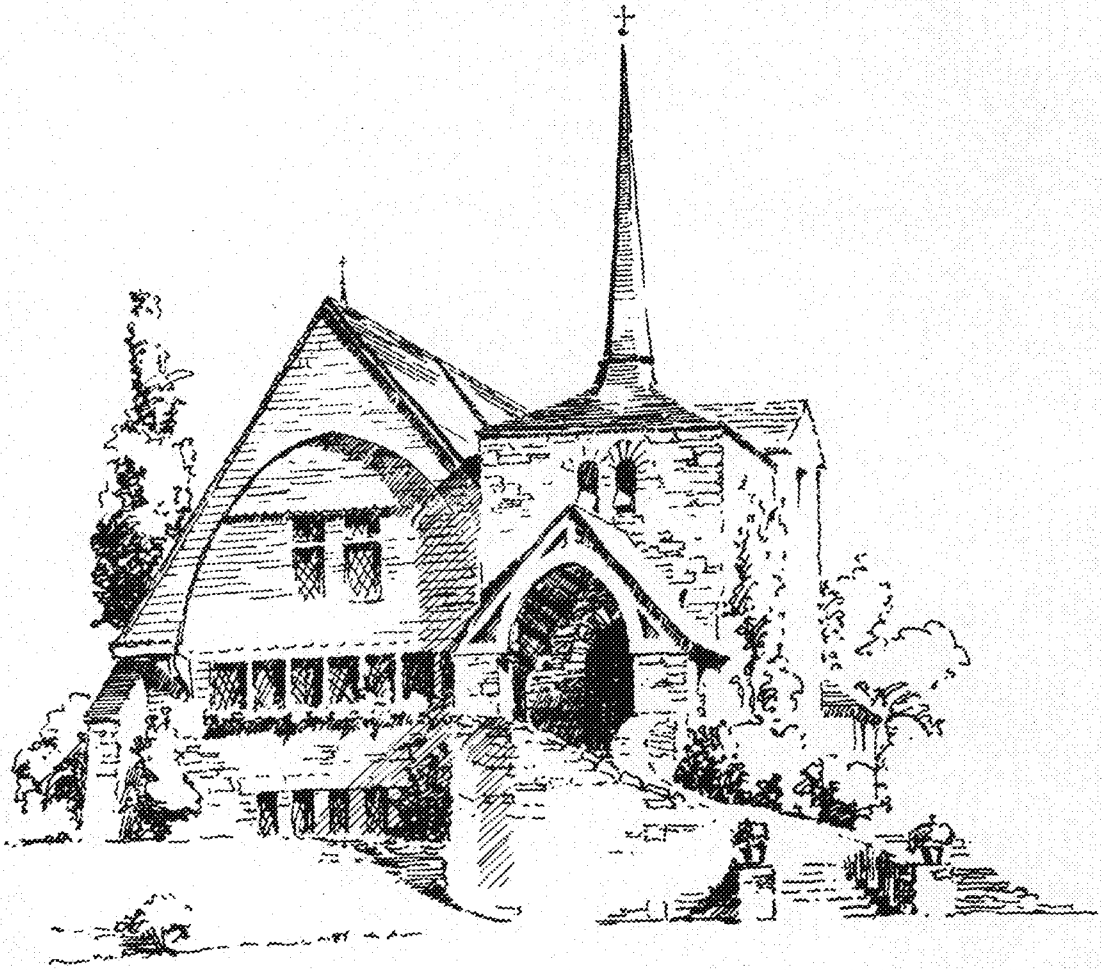


A Small Chapel—

St. Paul, Minnesota

THE MINNESOTA TECHNO-LOG
UNIVERSITY OF MINNESOTA
Volume XI JANUARY, 1931 Number 4

Humanizing the Engineer

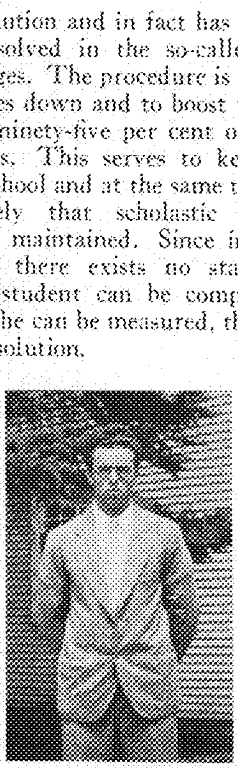
By DR. EDWARD A. SAIBEL

IN this day and age when the reputation of a school is measured by the number of graduates it can turn out per year, it behooves each college administration, so it would seem, to devise methods for increasing the enrollment of its respective college. Were this all, alas, how simple the duties of an administration would be. An ambitious athletic program, an All-American or two, a stadium, and a beautifully matched set of buildings would turn the trick in a trice.

But the real feat has still to be performed after the enrollment has been built up. It consists in keeping as high a percentage as possible of this large enrollment in the temple of learning for four years. How else would it be possible to dispense certificates of the college's importance in the world? And it is undeniable this vast horde of gullible youths must have some recommendation of their fitness to compete in the struggle for existence against messenger boys, bank clerks, and other not to be too lightly rated competitors. We must bear in mind that in the engineering fields the competition is even more severe,—the graduate engineer must defend his existence against a countless group of former graduates whose positions and salaries bear a decided resemblance to that of an elevator boy.

Let us examine briefly the causes which may lead to a student's withdrawal from college before the hall mark of approval is stamped on him. If the cause is voluntary, it may include such reasons as a poor football season. This involves the element of luck to a fair extent and may be remedied in part by new coaches, more pep rallies, a good band, etc. It may be that the student is just disgusted or disappointed with his work at college. Well, there is no accounting for tastes and such disagreeable material may well be dropped. Involuntary reasons include sickness, remedied by a competent staff of physicians; financial difficulties, which can be adjusted by such expedients as scholarships, part time employment, etc.; moral turpitude which we shall not discuss here; and scholastic difficulties.

Now we reach the essence of the problem. Scholastic difficulties drop by far the greatest percentage of students. This would seem to admit of a comparatively simple solution and in fact has been fairly well solved in the so-called liberal arts colleges. The procedure is to whittle the courses down and to boost the marks up until ninety-five per cent of the students pass. This serves to keep everybody in school and at the same time prove conclusively that scholastic standards are being maintained. Since in the liberal arts there exists no standard to which a student can be compared and by which he can be measured, this affords an ideal solution.



DR. EDWARD A. SAIBEL
Assistant Professor in Mechanics at Carnegie Institute of Technology formerly of the department of Mathematics and Mechanics at the University of Minnesota.

When one examines the records, it is really remarkable how much alike students and classes are from year to year. There is the same distribution of grades year after year in class after class. One finds just so many A students, B students, etc., and the inevitable five per cent who go under for the glory of their alma mater's standards. What a blow this is to an a priori mathematics of probability. One might have been tempted to imagine that at times a collection of brilliant students could be assembled in a class room and that at other times one might run into a class of poor students, but statistics disprove this very strongly. And who are we to cast aspersions and doubts upon statistics compiled by very learned schools of education whose prescience is so remarkable that they can foretell to half of one per cent just how many students will fall into the various categories, A, B, C, etc.

In the technical schools however it is another matter entirely. A physician's ability, training, knowledge can be fairly well estimated by the way he handles a case or performs an operation. An engineer can be appraised by his design of a structure or solution of a problem. The technical school graduate has to measure up to definite standards which can be set a priori. The medical and dental schools have long recognized this fact. They have picked the select few, trained them thoroughly and have graduated a product that will stand the test that public safety demands. Fortunately no amount of administration seems capable of destroying the high standards the medical and dental schools have established.

The engineering colleges are in a different situation. As low as their standards are now, it seems they must be still further lowered to parallel the mass production policy of the arts colleges. Sundry devices have been developed to do this.

One ingenious expedient is the large class. Its economic advantages are seen at once. It is also admirable from the point of view of mass production. Consider a class in elementary mathematics for example of about seventy-five. The instructor knows he must make a showing with his class or else be exposed to the criticism that he is a poor teacher. There is the vague but definite feeling in the air that if he knows what is good for himself he had better make a showing with the class. So he resorts to tactics like drilling his students on a type problem until he is pretty sure they have it so that they could solve the type mechanically at least one day after the drill—then they are given a problem of that type for the quiz on the following day. If enough students have not made the grade, part credit can always be fixed up to pull them through. Then the instructor gives the final away, perhaps not in just so many words, but by innuendo and drills on the problems of the final with perhaps a figure or two changed. Again the part credit will pull a lot of them up, and as a last resort one can always make twenty per cent the passing standard and count the final anywhere from one hundred per cent to

(Continued on page 108)

Recent Progress in the Soviet Union

By PROFESSOR J. FRENKEL

IN order to understand the present status of the Soviet Union and to make a correct prognostication for its development in the nearest future, one must have at least a superficial acquaintance with Russia's history since the Revolution of October, 1917. This history can be divided into three periods. The first of them, 1917-1920 inclusive, is the period of civil war (and also partially of war with foreign foes supporting the Russian counter-revolution). Revolutionary Russia won this war but came out of it bleeding and ruined. When in the beginning of the year 1921 I returned to Leningrad (then Petrograd) from Crimea, I found the air of this city—one of the largest industrial centres of the country—as pure and free of smoke as that at the best mountain resorts for tuberculosis; practically all factories came to a standstill. At the same time the young Soviet government, under the pressure of war needs, took under its control the whole of the remaining industry and trade, completely eliminating the private capitalists—big and small—and thus creating a state of affairs denoted as "war communism," which means a premature socialism without material basis.

The second period, from 1921 to 1927, is the period of healing the country's wounds, of restoring that rather scarce material basis which was left by the old regime. This period is characterized by a "new economical policy" or briefly "NEP," stimulating the private entrepreneur to co-operate with the State in the production and distribution of goods, that is in industry and trade—with the exception of foreign trade which remains the State's monopoly—and introducing the usual capitalistic methods in the relations between the various state industrial and trade organizations. Another characteristic of this period is the belief that Russia cannot be successful in its attempt to build up a new social order, Socialism, unless a world revolution will grant her the support of other economically more advanced nations—hence the stress laid upon this world revolution, propaganda activities abroad, etc.

The second period has been a period of growth both material and spiritual from childhood to maturity. Toward the close of it, Russia's industry, by far the largest and most important part of which was owned by the State, reached the prewar level; the well being of the population both urban and rural was restored and even raised to a somewhat higher level (which is proved by a 30 per cent decrease of mortality). At the same time the Russian government—or rather the ablest leaders of the Russian Communist party underlying it, arrived at the realization of the idea, that Russia must not and needs not rely upon a world revolution as a condition for a successful achievement of Socialism, but that she must and can achieve for herself and by herself, without any other help on the part of industrially more advanced countries except that which can be obtained by the usual commercial relations, and not necessarily implying a sympathetic attitude with respect to her goals.

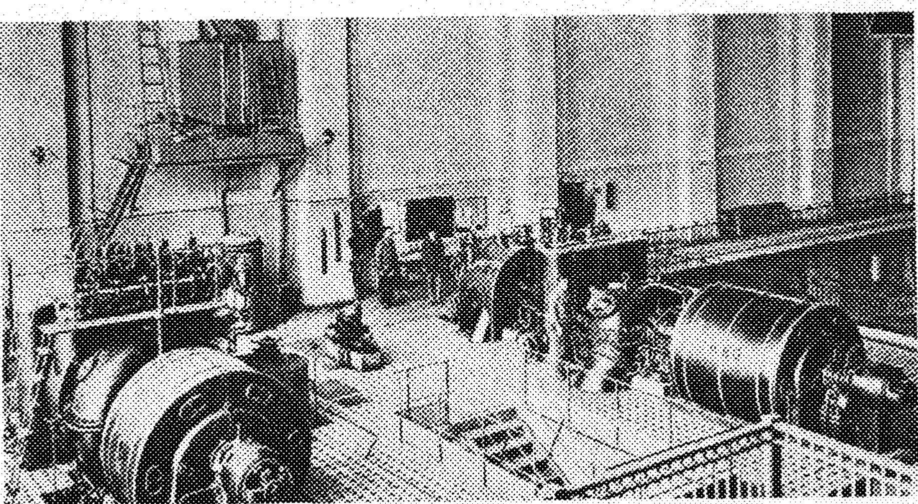
With this slogan: "Socialism in one country" Russia started on the third period of her revolutionary history, the reconstructive period as it is called, or the period of the "five year plan," which means a plan of socialistic reconstruction of the country for the next five years (it being by no means admitted that this reconstruction should be completed within this period). The center of gravity of the five year plan lies [in] the realm of economics, since it is t[he] fundamental principle of the Marx[ian] theory and practice that economical rel[a]tions form the basis of social ones. T[he] main goal of this plan is Russia's indu[s]trialisation, that is its transformati[on] from a very backward agricultural cou[n]try with an embryonic industry, into [an] economically powerful and self sufficie[nt] country with industry and agricultu[re] on the same level at least as in the mo[st] developed capitalistic country, the Unite[d] States. This goal has been briefly e[x]pressed by the slogan (slogans being [in] Russia a very efficient instrument f[or] stimulating and co-ordinating the activi[ty] of the masses): "to outstrip America[."]

It is self-understood that Russia's i[n]dustrialisation had to proceed, not in th[e] line of the capitalistic countries, where [it] is due to the enterprise of private ind[i]viduals, but in a socialistic line, implyin[g] the enterprise, planning and control [of] the State.

It may be noticed in this connecti[on] that the essence of Socialism, which [is] the common goal both of Russian Co[m]munists and of socialists of other cou[n]tries, is the abolition of private proper[ty] on producer's goods (not consumer's) and the monopolisation of these goo[ds] by the State, representing the interes[ts] of the whole people, and not those of th[e] producers alone—the government havi[ng] no interests of its own.

Hence one of the characteristic fea[t]ures of this third period was the elim[i]nation of the private capitalists, that du[r]ing the second period had been tolerate[d] and allowed to co-operate with the go[v]ernment in industry and trade. Mo[re] than that. Until 1927 the governme[nt] did not make any serious attempts [to] spread its control on agriculture. At t[he] beginning of the revolution the big [es]tates of the landlords were divided b[e]tween the peasants, and the latter we[re] left to themselves, the interference [of] the government being limited to ta[x]ation: the peasants were compelled [to] deliver to the goverment at a fix[ed] price (which was much lower than th[at] of the free market) part of the surpl[us] of their crops; this part being used [by] the government for the needs of t[he] city population.

The efficiency of an agricultu[ral] household—that is of a farm—is, as [a] rule the lower, the smaller the hou[se]hold. This has been particularly t[rue] with respect to Russia where the sma[ll]est farms belonged to the poorest a[nd] most ignorant peasants, who used t[he] most primitive means of farming. [In] the pre-war time the larger part of [the] marketable grain in Russia was produ[ced]



Experimental power plant at the All-Union Thermo-technical Institute which studies the methods and means of rationalizing power supply and the proper utilization of fuel.

VLADIMIR ILITCH LENIN

who defined communism as the Soviet power plus the electrification of the whole country.

by the comparatively small number of big estates owned by rich landlords. After their elimination in 1917 the marketable amount of grain and other crops decreased, partially thanks to an increase of the peasant's own consumption, but mainly due to the decrease in the efficiency of small scale agriculture. Most efficient were of course the farms of the richest peasants, the so-called "kulaki," who could be considered as landlords in the making. The government did not want, of course, to further this process, and it accordingly heavily taxed the kulakis, thus not only depriving them of any impulse to increase their crops, but on the contrary actually (against the government's own desire) forcing them to reduce these crops.

This policy if continued should lead to a deadlock and put the cities under the threat of famine, to say nothing of the fact that it deprived the government of one of the main objects of foreign trade in pre-war times, i. e., grain, and thus reduced the purchases of the goods required for the reconstruction of the country's industry.

In setting forth the plan of the socialistic reconstruction of industry and agriculture, the Soviet government started from necessity to eliminate the private capitalist both in the city and in the village. Hence the slogan "The liquidation of the kulaki as a class." The elimination of the private capitalists presupposed of course their replacement by other organizations, run directly by the government or under its control. So far as industry and trade were concerned this was an easy matter, most of them being already concentrated in the hands of the government. This was a much more arduous problem with respect to agriculture, where until 1927 practically nothing had been done. The method devised by the government and embodied in the five year plan was to create large scale farms (that were to replace the big estates of the landlords as well as the smaller farms of the kulaki) of two types:

1. State farms directly owned by the government.

2. Collective (or co-operative) farms, formed by the fusion of a great many (hundreds, sometimes thousands) of small farms belonging to the poor and middle peasants and more or less controlled by the government.

Farms of both type had to be equipped with modern agricultural machinery, with scientific agronomical supervision and economical organization—in short, with all the means insuring them the maximum productivity, utterly unattainable on the primitive small scale farms.

These were the main features of the five year plan with respect to agriculture. As to industry it laid particular stress on the development of the basic industries, that is the big scale industries of producers' goods (power plants, mines, steel and other mills, machine building plants, etc.), the industries of consumers' goods, which to a great extent depend upon the former, being considered as of secondary importance.

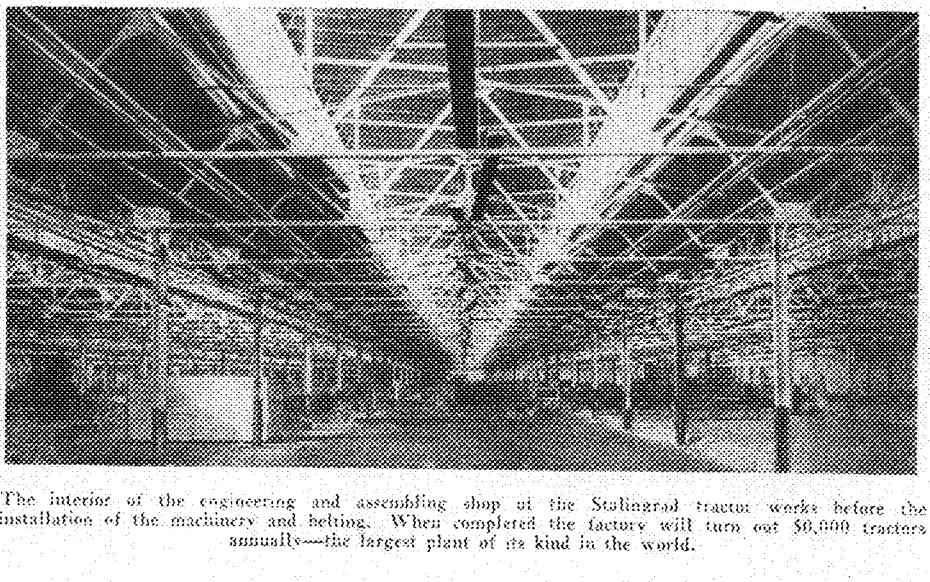
Although the five year plan did not pretend to "outstripping America" it was conceived in such a bold way, as to make it seem entirely Utopian not only to foreign observers, but even to a great many Russian Communists. Hence the struggle within the Russian Communist party, which has been going on until now, that is during the first two years of the working of the five year plan.

These two years however have plainly demonstrated that the plan was perfectly sound and real, more than that—that it has been an underestimate of the results that can be achieved by a nation in a constructive effort wisely organized and directed by a body of men striving for its welfare. For the original schedules of the five year plan have not only been carried out, but in many lines by far exceeded, to the extent of making the achievement of the original plan possible within three years with respect to agriculture and four years with respect to industry. It will be no wonder then if at the end of the five year period the whole world will stare with amazement at the fact that America has been actually outstripped by Russia in many respects.

Turning to concrete data and figures we can summarize as follows the results, achieved within the first two years of the five year plan or more exactly since the beginning of the reconstruction period in 1927.

Industry. The total output of the Soviet State industry has nearly doubled in the three years 1927-1930, thus being at the present time twice as large as it was before the war. While the original schedule for the increase of the big scale industry (producers' goods) for the first two years of the plan period (1928-1930) has been assigned to 59 per cent over 1927-1928, the actual increase has been 75 per cent; the increase of the small scale industry (consumers' goods) for the two years has been 40 per cent, which is very close to the original schedule, although somewhat less with respect to the revised and enlarged figures issued at the end of the first year under the plan. The increase during the last year alone (second year of the plan) was on the average about 30 per cent over the preceding one. Of this, 40 per cent falls on the big scale industry (producers' goods) and 20 per cent on the small scale industry (consumers' goods). A number of new hydro-electric plants, scores of steel mills, machine building

(*Continued on page 116*)



The interior of the engineering and assembling shop of the Stalingrad tractor works before the installation of the machinery and belting. When completed the factory will turn out 50,000 tractors annually—the largest plant of its kind in the world.

Constructing the New Northwestern Bell Telephone Building

By H. J. PIERCE
Chief Engineer of the Northwestern Bell Telephone company

THE new building of the Northwestern Bell Telephone company at Minneapolis, on which work was started in the spring of 1930, presents many unusual problems in design and construction and a like number of equally interesting solutions. Construction will be completed in 1932 at an estimated cost of approximately $3,500,000.

The problems, in brief, were:

(1) To design a new building which, complying with the Minneapolis building ordinances, would meet present needs of the telephone business with adequate provision for the future, and which at the same time, in construction arrangement, finish and general appearance, would be in keeping with the aims and objectives of the telephone company;

(2) To erect this building on a site then occupied by one three-story, one five-story and one nine-story building, utilizing such part of the nine-story structure as might practically be so used, and,

(3) To complete construction and occupation of the new building without interruption or impairment of the telephone service furnished through operations in the three buildings which already occupied the site.

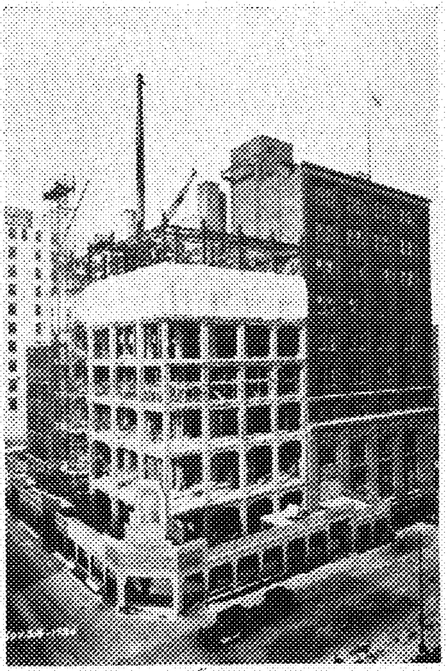
As now designed, this building will be 24 stories in height with 13 stories over the entire property, which is 132 feet by 157 feet, surmounted by an 11 story tower having two setbacks. There will be three basements.

The height of this building, however, will be equivalent to that of a 30-story office building. In designing telephone structures, a minimum allowance of 12 feet 6 inches clearance is made for those floors which are to house equipment as compared with a ceiling height in the ordinary office building of from 10 to 10½ feet.

The total height of the building will be 346 feet 6 inches. The strength of the building will be such as to carry 150 pounds live load to a square foot. The ordinary office building has a capacity of about 75 pounds per square foot. Particular attention has been given, also, to telephone distribution, adequate provision being made in the floors and walls for telephone cable which will provide telephone service throughout the building.

Much thought was given to the selection of materials for the exterior. Due to the need for material which is durable, has a satisfactory appearance and can be matched for future extensions, stone was selected as a facing for this building. The stone is Minnesota granite from Morton for the first floor and Minnesota limestone from the vicinity of Kasota for the remaining floors. The Minnesota limestone is of a light buff color with a pinkish cast and harmonizes well with Minnesota granite.

The entire construction will be of steel and reinforced concrete, fire resisting, and the granite and limestone exterior treatment will be used on all four sides.



The old Telephone building as it appeared during December with the work on unit number one under construction.

It may be of interest at this point to note that the building was designed by Minneapolis architects, that it will be built by Minneapolis contractors using local labor and Minnesota materials in construction as far as it is possible. In other words, the building is being constructed by Minnesotans with Minnesota material to serve Minnesota people.

Particular interest is attached, also, to a special problem raised by the fact that the telephone company had, on the same site, other buildings which it occupies and one of which is to be utilized in the new building.

The telephone buildings in down-town Minneapolis consisted of a nine-story, a five-story and a three-story building at Third Avenue South and Fifth Street and a three-story building at Third Avenue South and Sixth Street. These four buildings had a total floor space of 116,000 square feet, 65,000 square feet of which were contained in the nine story building.

The three-story and five-story buildings were old, lacked adequate strength and ceiling height, and could not be expanded. It was decided, therefore, to raze these two old buildings adjoining the nine-story building and this necessitated making arrangements for the temporary accommodation of the equipment and personnel which occupied them.

The nine-story building, erected by the company in 1920, was suitable for permanent use. It was decided, therefore, to make it, with certain modifications, a part of the new structure and occupy it while construction was under way. By leasing approximately 48,000 square feet of space in the Hodgson building at Second Avenue South and Fourth Street for the Minnesota Area administrative offices, space was made available in the nine-story building for the temporary accommodation of the equipment and personnel which had occupied the three-story and five-story buildings. The nine-story building is entirely used or reserved for central office equipment and operators' quarters. It houses the Main and Atlantic dial offices and all of the Long Distance equipment for the entire city, including a new Long Distance switchboard which was recently placed in service. This nine-story building is to be made a part of the 24-story structure by adding four stories to it, by refacing and rearranging its exterior to correspond with the design and appearance of the new portion of the building and by some interior reconstruction.

The total usable floor space of the new building will be 237,000 square feet including the 65,000 square feet of space in the nine-story building as compared with 116,000 square feet of floor space in the four buildings previously described. The building will have a main entrance on Fifth Street and an employees' entrance on Third Avenue. The entire first floor of the Fifth Street side, approximately 60 by 125 feet, will be used as the public's space and will be designed and equipped in such manner as to secure the best possible use, both from the standpoint of convenience to the public and from the standpoint of appearance and economy.

The core of the building will have provisions for nine elevators and three stairways with adequate space for wash rooms, vents, pipes, wiring, etc.

Quarters will be provided not only for the traffic, or operating force, but for the other departments. There will be an assembly hall which will accommodate 400 persons and accommodations will be provided also for the Minnesota administrative offices, for the installation forces of the Western Electric company and for all equipment and offices required by the Long Lines department of the American Telephone and Telegraph company in Minneapolis.

The lower thirteen floors have been designed for equipment and operating room purposes, but will be usable for temporary office quarters. The floor levels of the first nine floors of the new construction will correspond to those in the existing nine-story building which is being made a part of the entire structure. The floors above the thirteenth are designed for office purposes only.

The ultimate use of the floors will be as follows: Four floors for the local business office and local exchange equipment; nine floors for long distance switchboards and associated equipment; eleven floors for administrative offices.

In order to comply with the ordinances and to permit operation within the nine-story building without interruption, it was necessary to build the new structure in five units as follows:

Unit No. 1—that portion of the new structure, up to the height of the nine-story building, on the area occupied by the three-story building.

Unit No. 2—structure of corresponding height on the area occupied by the five-story building.

Unit No. 3—new structure in the space occupied by the rear stairway and chimneys of the nine-story building.

Unit No. 4—new structure within the space occupied by the elevators and lobby of the nine-story building.

Unit No. 5—that part of the new structure from the tenth floor up over the entire area.

The new building as it will appear when completed in 1932.

In order to provide sufficient exits with stairway and elevator accommodations at all time for the personnel in the nine-story building, it was necessary to erect the fundamental structure of units No. 1 and No. 2 and install temporary elevators and stairways in them before wrecking that portion of the nine-story building in which Unit No. 4 is to be constructed. Construction of Unit No. 1 to the eighth floor was completed late in November and wrecking of the old five-story building was started to permit construction of Unit No. 2.

Provision for three basements under the entire structure also presented several interesting problems. It necessitated the demolition and removal of all the basement walls and floors and the footings under the two old buildings and further excavation to a depth of 45 feet below the surface of the street with column footings extended to a depth of 22 feet below the third basement. This placed the bottoms of the caissons for the footings ten feet below the surface of the Missisippi river above the dam.

Under Unit No. 1, 30 caissons were blasted through rock to that depth and a seam carrying a veritable underground river was encountered a short distance below the river level. To complete the sinking of the caissons below this level necessitated pumping from 1,000 to 1,500 gallons per minute continuously and the same experience is anticipated in excavating under Unit Uo. 2 which will have 16 caissons. Incidentally, many interesting and some rare fossils were found in strata from 40 to 50 feet below street level.

Another of the problems encountered in the work of excavating was the terrific street pressure exerted on the street side of the pit. This was solved by open cribbing so spaced as to permit the placing through the apertures of the column footings and steelwork.

One of the interesting developments on this project, also, was the use of delayed charges of dynamite in excavating. Because of the danger of interruption and impairment of telephone service by jarring or vibrating the thousands of sensitive relays in the equipment housed by the nine-story building, it had been decided to do all excavating through the rock strata by the "plug and feather" method—a much slower and more expensive method, ordinarily, than blasting. It was found, however, that by detonating a charge of dynamite at inter-

(*Continued on page 110*)

Famous American Architects

THOMAS JEFFERSON

By MILTON V. BERGSTEDT, Arch '31

Illustrated by ROBERT CERNY, Arch '32

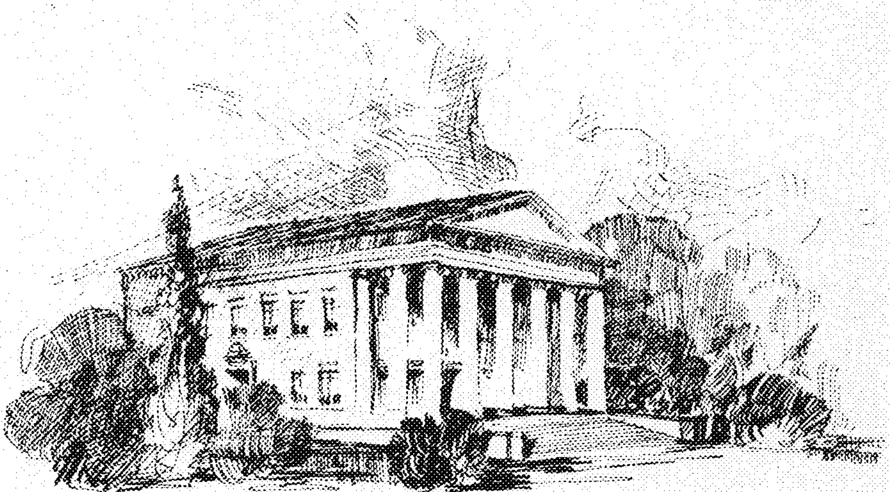
THOMAS JEFFERSON is often referred to as the "Father of Arts in America." Whether or not he deserves this title is a question debated even to this day, but that is not what concerns us just now, for the fact remains that Jefferson was the first prominent early American architect.

He was born in Albemarle County, Virginia, in 1743 the son of a well-to-do planter. While he was quite young his father died leaving him a large estate and provisions for a liberal education. Most of his youth was spent among the upper strata of society where he was able to absorb and develop that culture so frequently found in Southern gentlemen. He was graduated from William and Mary College well versed in the languages and sciences.

His early knowledge and interest in architecture were certainly not acquired at college, for they taught no architectural subjects and had extremely few architectural books. No doubt his conversations with cultured and travelled people from Europe who so frequently visited his father's estate did much to stimulate his interest in European history, civilization, and architecture, and it is said that he was intimately acquainted with William Byrd at Westover who had one of the most complete libraries in the vicinity including several architectural volumes of special interest to Jefferson.

The first indications of his architectural ability were the plans which he made for his estate in the hills of Albemarle overlooking the sea. Although he was still in college, his intent was so serious as to cause him to have the grounds surveyed and plantings started many years before his complete dream could be realized. This estate of Monticello which he finally completed was his first job and remains well preserved today as one of the best examples of early American architecture. It shows great foresight in design as well as construction and solves in a unique manner many problems in arrangement, fenestration, ventilation and other details which still baffle our present day architects.

We cannot claim Jefferson as being principally an architect, for he was a man of many talents and architecture was but a sideline with him. He is better known as the writer of the Declaration of Independence and third President of the United States. He was also twice governor of Virginia and served for three years succeeding Franklin as minister to France, but desired to be known first as the founder of the University of Virginia. His fondness for architecture was not from any innate artistic urge but rather from his profound scholarship, his inquiring mind, and his extensive travelling. He had a natural historic bent, was an inveterate reader, and a firm believer that free thought could determine a logical solution whether in architecture or any other subject.



Early design for Virginia State Capitol by Jefferson.

Architecture at that time was largely in the hands of craftsmen and showed a lingering mediaevalism that these men brought with them from their native lands. Jefferson scorned this Colonial architecture and embraced the classics and Palladianism. His works were marked as "Jeffersonian simplicity" and thus stressed that great truth that the supreme merit in architecture lies in geometric simplicity and proportion.

His reputation as an architect was firmly established when he designed the capitol of Virginia which was modelled after the Maison Carrée at Nimes, France. He also designed many of the buildings at the University of Virginia all of which have definite classic inspirations but each of which is touched by Jefferson's own genius which ex presses a true creation in brick an stone of our native land. He wa one of the leaders in the revival of Eu ropean classicism.

His fondness for precision and hi scientific curiosity made his buildings no only beautiful designs but also workabl schemes with numerous clever and in genious details.

It was largely through the persona influence of Jefferson while Presiden that the adoption of the present schem of a central dome and wings was use for our national capi tol. This later becam the accepted form fo state capitols and t a considerable exten for foreign capitol down to the present day. The rotunda o the national capitol like Jefferson's own capitol at Richmond Virginia, was originally intended for a conference room o the two legislativ houses, but unlike th hall at Richmond i had an external expression entirely ou of proportion to th use it finally received The intended use was lost sight of long before the rotunda was ever completed and the lack of practical function in th rotunda which gives such a monumenta expression through the dome has frequently brought comment and inquiry from foreign architects.

He was a strong advocate of th founding of the Academy of Fine Art in Philadelphia and introduced the sub ject of architecture in the University o Virginia; thus to the colleges of thi country he left an influence in architec ture as important as his services in poli tics or contributions to science. And al though his work in architecture is no as well known as are his triumphs i other fields, his contribution has been o the greatest significance.

Directly or indirectly classicism i America traces its ancestry to Jefferso who may truly be called the father o our national architecture.

He died at the age of eighty-three o the fiftieth anniversary of the signing o the Declaration of Independence an was buried in the wooded hills of hi Monticello estate in Albemarle.

The Architects' Page

By E. A. CONE, Arch '31

By Way of Introduction

OCCUPYING the upper floors of the Main Engineering Building, we architects feel a little aloof and above the rest of the college. We would like, however, to stoop down a little—perhaps even as far down as the basement room of the TECHNO-LOG—and become better acquainted. We have a suspicion that the other schools and departments think we are a bunch of "goofs," and we intend to prove to you as we become acquainted that—well, that possibly you were right. At any rate, we give Barron G. Collier credit for a little sense and we want you to become acquainted with us and our wares, so don't overlook this page as something not intended for you.

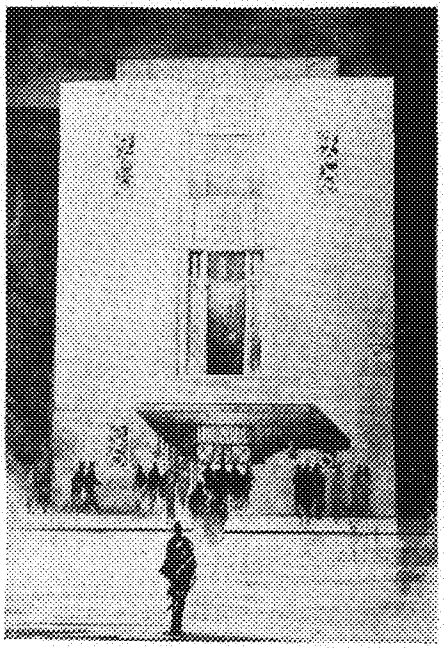
Two Mentions

THE cuts on this page are reproductions of two of the architect's problems which received the grade of "Mention" the past quarter. The first, "A Sketch Club" was a junior problem. The program, in part, read as follows: "In a city of moderate size, a club whose membership includes practicing architects and also younger draftsmen and students proposes to erect a building in which their activities may be carried on. This club will be used as a gathering place for those interested in the profession, as a place to hold exhibitions of interest to the public as well as to the members, and as an atelier in which the younger members may continue their study of architectural design and freehand drawing. The site selected is a short distance from the edge of the business district, in the midst of three and four story apartment buildings, etc." Since the plans of projects are not shown it will be of little good to give all the space requirements.

The second problem, "A Monastery in the Rocky Mountains," was a senior problem. The program was as follows: "A religious order of monks has determined to construct a monastic establishment dedicated to the founder of the order in an isolated region in the Rocky Mountains. They here propose to create a shrine, devote their lives in aesthetic reverence to its perpetuation, and further to lend a hand, as do the monks of St. Benedict, to the wayfarers who traverse this desolate country. The site is of a jagged rock outline adjoining a mountain pass on one side, and falling away precipitously on the other three sides. The contour of the site from the level of the pass is roughly that of a cone with a base of 500 feet. The shelf where the shrine is to be erected rises 100 feet above the pass. The monastery shall be composed of a chapel, an abbey, a cloister, a refectory, a library with adjoining rooms for study, a dormitory, a gate lodge, and beyond the walls, a hospice for guests."

Letters from Young Architects

IN this and a few of the succeeding issues of the TECHNO-LOG we plan to publish some letters written by young architects, by whom and to whom we care not, but of interesting subject matter. They are all written in a serious straight forward manner and give an insight into the thoughts and opinions of young men just entering the field of architecture. All of them were written to the same person and all written about architecture but they cover many different phases.



A sketch club

Dear Archie Tek,

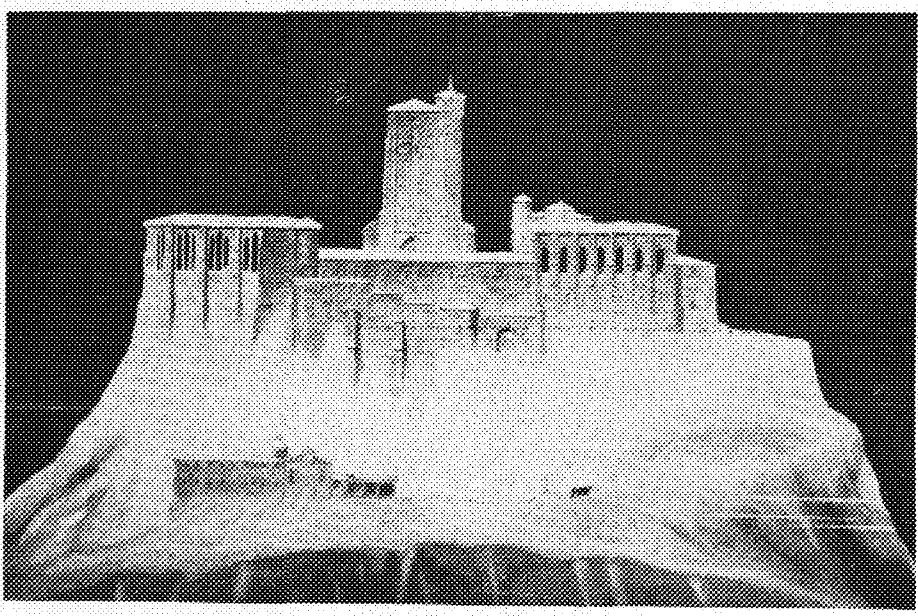
. . . Modern is the thing! Modern we try to be in our ideas, in our dress, in our thots, and in our architecture. In our architectural schools, from the first original problems of the freshman year to the last Esquisse-esquisse of the senior year, it is a design of concrete and steel, huge areas of glass, embellished only by a few overworked Oriental or Mexican motifs.

We have forgotten the writings of Vitruvius, Alberti, and Ruskin. They are pristine—archaic. We have forgotten the achievements of the Greeks and Romans, of Bramante, Michael Angelo, Brunelleschi, and even the later Wren. All the vast sums of learning from the days of the reindeer hunters to the Columbian Exposition in Chicago are tossed aside as old fashioned and useless.

To be a successful designer, it seems to me, one must know and understand the achievements of yesterday. The Greek architects as well as the Greek philosophers, poets and scholars can be a constant source of inspiration to us. Not that our problems can be compared to those of the Greeks, the so-called "Neo-Greek" being one of the worst periods of American architecture, but their knowledge of symmetry, optical refinements and scale are unsurpassed to the present day.

Vitruvius gives us an interesting study of Roman architecture. He had many ideas concerning planning that are useful to us today. From Henry Adams' "Mont St. Michele and Chartres" we

(*Continued on page 114*)



A monastery in the Rocky Mountains

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

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Another Fallacy

THE undergraduate who holds that participation in extra-curricular activities is the open door to success in future life, is about as wrong as he can be. For the one thing that appeals most strongly to the personnel man is recognized success on the part of the student in developing whatever ability of his was most worthwhile. It may have been book learning and it may not. Even in scholarship there are gradations, from the absorption of book learning by rote that is productive of little save marks, to the intelligent understanding of perhaps only one subject, which may produce no marks whatsoever, and yet lay the basis for a well guided life that may produce success in whatever a man undertakes.

Aftermath

AGAIN undergraduate engineers at the University have been subjected to a series of final examinations. Again the gamut of emotions has been portrayed in their several hearts as a result of the outcome of these examinations.

Let us observe: There is a man who has maintained his Tau Bet average—sometimes it seems doubtful if he can experience any genuine emotion. Then there is a man of more average attainments, whose success is well merited, who takes just pride in the satisfaction of having obtained well earned success. Next we see a man who has surmounted the scholastic hurdle by appealing to the gullibility of his instructors—no man can say that he lacks emotionality. He's a winner—he used his head—but something about his bearing is reminiscent of gangland's "muscler." And here comes a pitiable figure—the one who flunked—and his number is legion. Yet there is something strangely admirable in the man who takes his breaks with head held high, and commences again with renewed vigor and determination. But there is yet another type to whom the utmost sympathy should be given—for he "flunked" and the realization of his mental inaptitude has filled him with a fear of his own mental shortcomings. He needs all encouragement, and comradeship—that life may not "lick" him—and his future be definitely labelled with FAILURE.

The Architects' Page

THIS issue contains the first Architect's Page, which issues from a department that fairly froths with energy. Written by students in the College of Architecture, it nevertheless contains items of interest to every undergraduate engineer. A diligent perusal of the page should prove very profitable.

Research

A GENERATION ago there were probably only about 50 research laboratories in this country,—today we see a great reversal for there are some 1,000 laboratories devoting their time exclusively to research work. And yet, despite this increase the field remains practically virgin, for there are scores of thousands of industries in this country each one of which could reap the reward of increased profit by expending more money on research.

Possibly the situation has been caused by the lack of training in the field of research that has been given to scientifically trained men. There are countless testimonials of the results of research, but how few are the accounts describing the manner in which the work was conducted. How little actual instruction is given in research,—how few the opportunities for instruction. Of course there is a great wealth of laboratory courses offered in every engineering school,—but true research can hardly be compared to the blind attack demanded by the average laboratory course.

By increasing the training, and by increasing the interest which scientifically trained men have in research, possibly a remedy will be obtained. It is at least a step, that would undoubtedly be in the right direction.

Arabs Ho!

AND what of the Arabs? Formerly it was the custom of that organization of engineers to delight the campus with the presentation of an annual play. This year we see no preparations being made for the continuation of the fine work.

Many are the enjoyable memories of those former shows; many are the benefits derived by engineers who participated in the productions. To an engineer, whose life consists of an inordinate amount of drab mathematical solutions,—the Arabs offered a fine outlet for the expression and possible development of dramatic ability that might have been latent.

Let the few remaining members of the Arabs who are now in school, band together, that this tradition of Minnesota Engineers may not become mere history.

Tomorrow

I WOULD not dare to say what I think electricity may do in the future. We are always making the mistake of supposing we have exhausted our knowledge in any direction. Discoveries and inventions are not terminals. They are fresh starting points from which we can soar to new knowledge.

—Dr. W. R. Whitney.

AROUND THE WORLD WITH OUR ALUMNI

Architects

'18-'22—Moorman—Ralph and Albert Moorman, members of the firm of Moorman and company, have moved their offices from St. Paul to Minneapolis.

'23—Holien—Edward Holien, who was married recently, has gone to Europe for the third time.

'27—Anderson—Having been awarded a Paris prize for study in the Beaux Arts academy, Lawrence Anderson has left the University of Virginia, where he has been an instructor, for a two and one-half year sojourn in Paris.

'28—Huchthausen—Walter J. Huchthausen is in Paris for a year and a half studying on the Robinson Memorial and the Frederick Sheldon scholarships.

'29—Hakenjos—Fred Hakenjos, having received his master's degree at Columbia University in June, is now assistant manager of the R. Y. Ferner company, the United States and Canadian agents for the Société Genevoise d'Instruments de Physique, of Geneva, Switzerland. Mr. Hakenjos is living in Washington, D. C., with Erling Saxhaug, '29 EE.

Chemical Engineering

'24-'27—Whitney—Robert B. Whitney, "youngest person to receive a doctor's degree from the Minnesota School of Chemistry," is now a Fellow at Harvard University.

'25-'28—Sprung—Murray M. Sprung is now doing research work here under Dr. Hunter, head of the Organic division. Mr. Sprung came here from Harvard where he was working on a National Research Fellowship.

'26—Kobe—Having severed his connection with the DuPont De Nemours at Charleston, W. Va., Kenneth Kobe is now back at the School of Chemistry doing research work towards his master's degree.

'28—Hella—Roy Hella stopped in for a few days recently. He was on his way from Chicago to Cloquet, Minnesota, where he will continue his research for the Northwest Paper company.

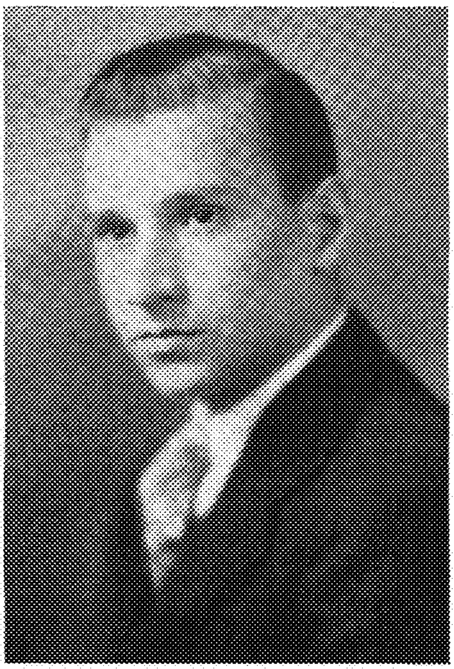
'28—Stromberg—Hans Stromberg, who is now working for his doctor's degree at the Mayo Foundation, interrupted his research a short time ago to be married to Miss Catherine Young.

'30—Rosenblum—Charles Rosenblum, here as a Dupont Fellow, recently attended a national Cosmopolitan Club meeting at Cleveland, Ohio. Mr. Rosenblum is president of the Minnesota chapter.

'30—Hammerquist—Employed by the Bell Telephone laboratories, 463 West street, New York, William L. Hammerquist is doing some research on corrosion.

'30—Higgins—Ray Higgins, manager of the Minnesota Union, recently returned from the Eleventh Annual Convention of University Unions at Providence, Rhode Island. According to Ray, Providence resembles Duluth in being damp and foggy and built on a hill. The meeting, which was attended by 27 managers, was held at Brown College.

While returning Mr. Higgins stopped at New York, Boston, and Cambridge, where he visited Gus Erickson, '29, and Cameron Kay, '30, who are working for advanced degrees.



WESLEY GRAY, EE. '29

He is at present in active service as a naval aviator, and was in Minneapolis during the holidays.

'30—Selund—Bob Selund, now conducting research on distillation problems for the Standard Oil company at Whiting, Michigan, returned home for the Christmas holidays.

'30—Kay—Cameron Kay recently visited Minneapolis. He is working for his master's degree at Massachusetts Institute of Technology.

'30—Joyce—Thomas Joyce has accepted a position with the Cudahy Packing company at Omaha, Nebraska.

'30—Levy—While working in the food department of the United States patent office, Maurice Levy is studying law at the Georgetown Law School. Examining applications for all kinds of food preparations and methods of food preservation, it is necessary for him to study records in many languages that are filed at the patent office. In his present position Mr. Levy associates with some of the foremost chemists of the country, and believes it to be one of the most interesting positions in the patent office.

According to Mr. Levy, an application for a patent has a long road to travel before the patent is granted by the government. He writes in part: "When an application comes into the office, it is assigned to one of the sixty-three divisions for examination. Each division handles certain classes of patents and has a library containing all the best books and magazines relating to the subject in the division. The division also has a complete file of United States, British, French, Swedish, and German patents. Each application has to be searched and checked in the books and patent records for former history. The examiners also have access to a complete scientific library in the patent office as well as books in the Congressional Library. It is really surprising how few new applications are made that we cannot find a reference for somewhere. If a reference is found, the applicant has a very difficult time obtaining a patent. About fifty per cent of the applicants never receive patents, and some are considered from two to five years before they are granted or refused."

Civil Engineering

'11—Mattison—George C. Mattison, also with the U. S. Coast and Geodetic Survey, is in command of the U. S. C. and G. S. S. Pathfinder.

'13—Wilks—Benjamin Wilks is still manager of the Standard Building Products company of Detroit, Michigan. Mr. Wilks and his family recently visited at Virginia, Minn., to attend the forty-fifth wedding anniversary of his parents. Mr. Wilks now has five children attending the University of Minnesota.

'17—Boyce—E. R. Boyce has changed from Minnesota to Louisiana where he is with the Highway Commission at Baton Rouge.

'23—Villaume—Walter F. Villaume was recently married. His wife was formerly Miss Margaret Osbourn, a Minnesota graduate of '26. Mr. Villaume is in St. Paul with the Minnesota Macaroni company.

'27—Lund—And another engineer is married. Stanley D. Lund was recently married to Miss Esther Burgeson of Minneapolis. Mr. Lund is working in Minneapolis with the Genfire Steel company.

'27—Murray—Successfully completing a million dollar dam across the Niangua river Harold E. Murray has finished his first large project. The most outstanding feature of the dam is an 850 foot diverting tunnel cut through the base of a mountain.

The project was first undertaken by the Missouri Water Power company, but after starting the dam and spending about two hundred thousand dollars, the work was abandoned. Then the Missouri Electric company, a subsidiary of the Utility Power and Light company, employed Mr. Murray to complete the work.

'27—Morris—Still with the U. S. Coast and Geodetic Survey out at Manila, P. I., George E. Morris writes, "Last winter an anopheles mosquito was mean to me, and in spite of five months in the hospital I still have malaria. As a result I'm ordered back to the States for further treatment. I sail next week and will visit in Oceania, India, Egypt, and Europe en route."

And all on account of one mosquito bite!

'28—Rydeen—James Rydeen has apparently moved to New Hampshire as he recently visited the campus with a car bearing a license of that state. He formerly was in Corry, Pennsylvania, with the U. S. Geological Survey.

(*Continued on page 112*)

NEWS FROM THE TECHNICAL CAMPUS

Eleven Degrees Awarded At Graduation Exercises

Showing an increase of one degree over those given the year previous, the College of Engineering and Architecture awarded eleven degrees at the Fall quarter graduation exercises held December 18 in the Northrup Memorial Auditorium. Of the engineers graduated, six received Bachelor's degrees, two received Master's of Science, one was given the degree of Civil Engineer, and two were awarded their Doctors of Philosophy.

The men graduated are: Karl O. Larson, aeronautical engineering; Harold W. Fridlund, architecture; Theodore G. Noble, architectural engineering; John H. Roe and Fred C. Wherland, electrical engineering; and Wilbur B. Ervin, mechanical engineering. Eugene A. Undine was awarded a Master of Science in Architecture and Carroll A. Clark a Master's degree in Chemical Engineering. Clarence J. Velz received the degree of Civil Engineer.

The two degrees of Doctor were awarded in the School of Chemistry. Gordon D. Byrkit, who received his Bachelor's and Master's degrees at the University of Kansas and the University of Washington respectively, was graduated with a Doctor's degree with a major in organic chemistry and a minor in physical and inorganic chemistry. Earl F. Ogg, who also received the Doctor's degree, majored in physical chemistry and minored in inorganic and analytical chemistry. Mr. Ogg was graduated from Carleton College with a Bachelor's degree and from the University of Wisconsin with a Master's.

C. K. Textor Speaks on Paper Making

The Minnesota section of the American Institute of Chemical Engineers held a meeting on the evening of Wednesday, December the tenth, in the School of Chemistry, at which Mr. C. K. Textor of the Northwest Paper company spoke on "Science and Paper Making."

Mr. Textor is chief chemist for the plant located at Cloquet, Minnesota, which is one of the largest plants in the State due to the fact that timber is today the basic raw material for paper and Cloquet is in the heart of the timber section. Mr. Textor mentioned the various kinds of wood and why they are generally suitable for only a limited number of papers. He also discussed the three kinds of conditions available in transforming pulp into paper—acid, basic, and neutral.

Dr. Straub Gives Two New Hydraulics Courses

Dr. Lorenz Straub, Associate Professor in Hydraulics at the University, is teaching two courses in hydraulics, both of which are being offered for the first time by the Engineering department.

The course in Advanced Hydraulics gives to students who are specializing in hydraulics many practical applications of the theory of varied and uniform flow in open channels. The computation for backwater curves, drawdown curves, hydraulic jump, measuring flumes, and other river design problems are stressed in this course, which meets three times a week in the Experimental Engineering Building.

The course in Advanced Hydraulic Problems, which is closely related to the above course, consists of special problems in the design of hydraulic structures.

Bookstore Offers New Library Plan

The Engineers Bookstore announces that as a result of interest evidenced during the past three months a new innovation is planned in the dollar library maintained by the Bookstore.

According to Mr. Harold D. Smith, Manager of the Bookstore, a member of the Bookstore who purchases a book from the dollar library may bring it back at any time within a year and exchange it for another volume upon payment of twenty-five cents, provided only that the book returned is in good condition. Mr. Smith believes that this will enable a member to read extensively and leisurely and to make only such additions to his own library as are expressive of his own taste and individuality.

Kibbey Teaches Legal Aspects of Engineering

Mr. E. W. Kibbey has returned to the campus after an absence of seven years, to teach a new course, "Contracts and Specifications," which is being offered by the College of Engineering this semester. This course, giving three credits, is open to all who desire a knowledge of the legal aspect of engineering.

Mr. Kibbey was an instructor in the Drawing department here from 1919 to 1924, after which he became associated with the Kibbey Engineering company. Mr. Kibbey comes to the campus three times a week, to meet his class, while continuing his associations with his company in Minneapolis.

Mechanical Building Undergoes Improvements

By Maurice Norton, E '32

Since the opening of school last fall there have been a number of improvements going on in the Mechanical Engineering Building. The first was that of moving the offices from the west wing directly opposite into the east wing next to Pillsbury Hall. The latest project to be completed was that of closing the unused corridors on the first floor east side and placing suitable hooks and coat hangers for students' clothes engaged in recitation on that floor.

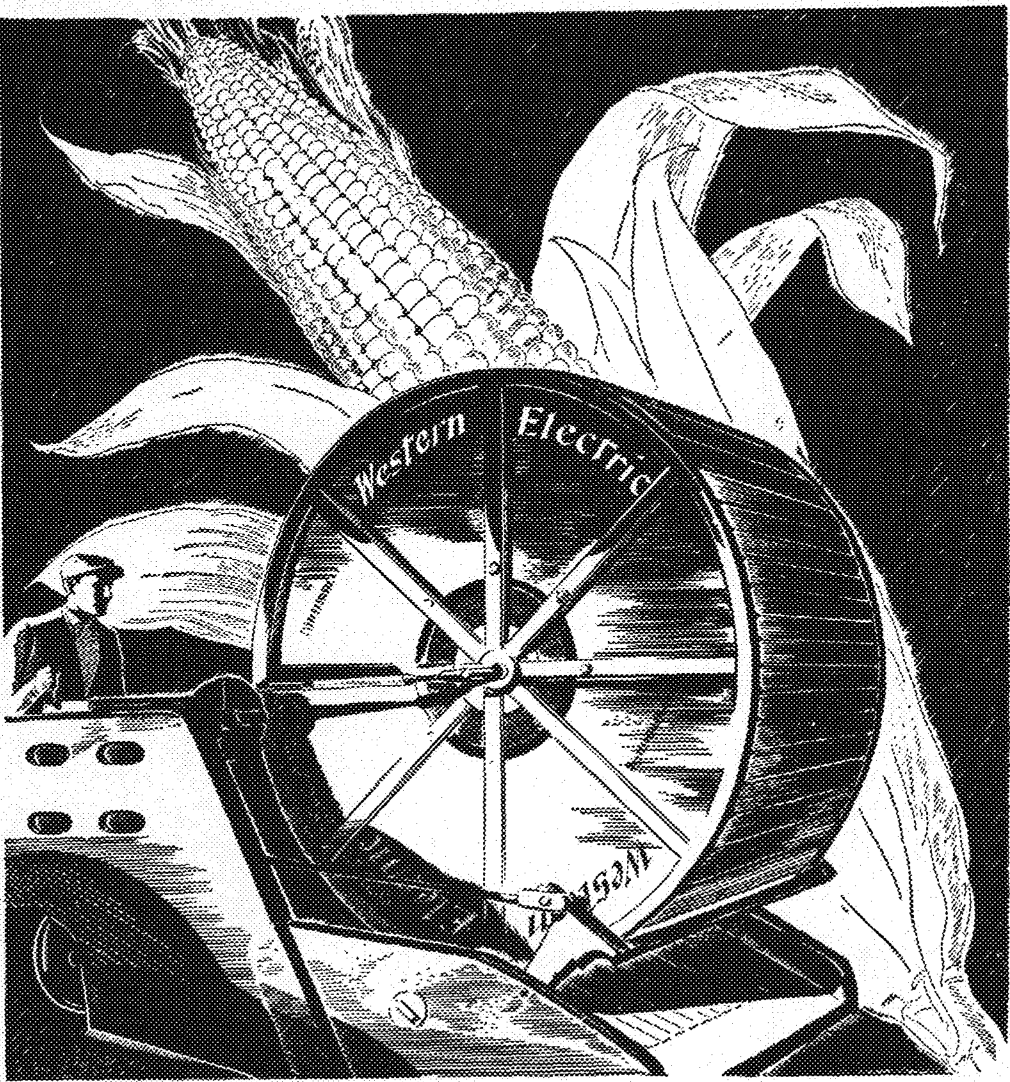
It might be well to pause here and in a retrospective manner gaze on this building called "M.E." The present structure was originally constructed as two separate buildings in a manner such as they have been referred to: East Wing and West Wing. The present Business Administration Building, as is more or less known, was the original Mechanic Arts Building. When the school of Engineering outgrew the structure the buildings above mentioned were built. The East Wing being the Electrical Engineering Building and the West Wing near the Administration Building was the Mechanical Building. At present it is hard to tell where one building left off and the other began. But on the inside one may see easily that such has been the case for there are innumerable "windows" opening from the machine shop out into the foundry and forge shops. In the beginning these shops just mentioned were located on the rear of the original Mechanical Building and extending over into the present site of the Northrop Auditorium. When the present New Campus "Mall" was started it was clear that the Mechanical Building would have to be cut off. The new location of the shop was happily solved by roofing over the area between the two buildings—Electrical and Mechanical—and putting in a concrete floor.

In the meantime the Electrical Engineering department was moved bodily into a new building built expressly for that purpose and the Mechanical department took over the complete lay-out. In the main floor of the building which had been the laboratory a number of partitions and suitable blackboards for class rooms and drawing laboratories were placed.

The new arrangement of the Mechanical department under one roof was all right with the possible exception that there were no suitable class and demonstration rooms for the shop courses—

(Continued on page 114)

STEPPING INTO A MODERN WORLD



6-ton reels of cable distributed with the *speed* of perishable food

A carload of telephone poles laid down a thousand miles away within 36 hours after getting the order! Rush calls of this sort must frequently be handled by Western Electric, distributors for the Bell System.

But even more remarkable is the regular day by day flow of telephone supplies. The Chicago warehouse—one of 32 in the national system—handles 1,400 orders a day. In 1929 more than $400,000,000 worth of equipment and materials was delivered to the telephone companies.

Distribution on so vast a scale presents many interesting problems to Bell System men. The solutions they work out mean much in keeping this industry in step with the times.

The opportunity is there!

BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

Humanizing the Engineer

(Continued from page 97)

nothing in making out the final grades. The result is that students get by the course who have never solved a problem through correctly. Their work is sloppy and careless—they are incapable of carrying through a sustained piece of reasoning. They get in the next course where a knowledge of what they have had before is presupposed and they flounder around helplessly. Their next instructor too, must make a showing and by similar artifices they pass again. Thus it goes.

The reader may well ask, why should the instructor go to all this trouble in fixing up grades? It would be far simpler just to write down an arbitrary set of marks, to fix up some fancy figures and percentages off hand and let it go at that. The answer, I suppose, is that the other way is more scientific, more in keeping with the spirit of educational technique and allows the instructor to delude himself into thinking he is teaching his students something. Besides, the students like it, they no doubt like anything or anybody that gets them through the course.

The latest scheme is to "humanize" the technical man. We proceed to define the term. In the parlance of the educationists, to humanize means to render less technical. The plan seems to be to alter the engineer's course of studies by replacing technical subjects with courses in the "humanities" in which only the five per cent ever fail. This should raise the odds of a man's graduating considerably. Besides it gives him an insight into an academic system of political economy or sociology that exists only in text books and manages to substitute some thoroughly unscientific courses for some thoroughly scientific ones. Even if the term to "humanize" meant to culture, the university curriculum would do nothing toward such an aim. We associate the word culture with music, art, literature, and consider a person cultured who takes an interest in some phase of the arts whether it be string quartettes or sketching for his own amusement. While it is possible for a college to help a person along in following an avocation, the result is rarely achieved. Should a technical student be interested in restoration drama, for example, and wish to take a course in this field, he is pretty apt to run afoul of some rule or regulation generally in the form of a prerequisite that prevents him from following his desire. Though he be merely interested in sitting around and enjoying the course, he must be treated as though he were working for a Ph. D. in English. The university that encourages chamber music in its music students let alone in students not majoring in music is a rarity. All this talk then about making a cultured person out of the technical student who has not already a leaning for culture is nonsense.

If our avowed purpose is to train prospective salesmen and draftsmen, well and good,—herd the students together in classes of a hundred or more, cut out half the technical courses, pass them all and turn out the product that is now a drug on the market. On the other hand if we wish to turn out engineers in the full sense of the word we must take cognizance of these facts. The four year engineering course as now given in the American schools is totally inadequate in view of the enormous strides engineering science has made along practical and theoretical lines. Our students when they graduate do not know enough mathematics and theoretical physics to have even a foundation on which to develop. They are incapable of following the literature except perhaps in a very vague way. The physician who is ten years behind in his subject is useless, nay dangerous. Yet we graduate engineers who have not the technical equipment to understand their subject of twenty-five years ago, and what is worse do not have the fundamentals which are necessary if they are ever to get up to date. Engineering is becoming more technical and theoretical every day and yet we hear about propositions to render engineering education less technical. Was there ever a more incongruous situation?

The point then is to devise some system of engineering education that will sort out the two main groups. On the one hand we have men who want the real technical engineering education, and on the other hand we have men destined to be shop hands, draftsmen, computers, and self-styled administrators. It is ridiculous to put them all through the same mill. Perhaps a device like that employed in other professional colleges might help, a three or four year pre-engineering course. It would make possible the admission of any high school graduate, allow students to get a thorough training in the fundamentals of mathematics, physics, and chemistry, give them an opportunity to develop the cultural side of their education, and, what is most important of all, allow a clear separation of these two main groups to be made. The ten or twenty per cent of outstanding students would then be allowed to advance and the balance could fill various places necessary in industry. They could be given nicely engraved certificates and set loose leaving the field free and unhampered for the material we could work with and to whom we could give a real engineering education.

« « MENTAL TILTS » »

COCOANUTS

GIVEN: Three men are stranded on a desert island and must live on the food the island will supply. The first day they collect a pile of cocoanuts. After collecting the nuts, it is quite late in the day and the men decide to go to bed and divide the nuts in the morning. After lying in bed a short time, one of the men decide to take his share of the nuts and hide them. So he gets up, counts the nuts and finds when he divides them into three piles that there is one nut left over. He gives this one nut to a monkey; hides his share, and returns to bed. In a short time, the second man does the same thing with the remaining nuts, dividing them into three piles, he finds one left over which he gives to the monkey. He hides his share, and returns to bed. The third man does the same thing, he divides the remaining nuts into three piles, gives the one that remains to the monkey and hides one-third of the remaining nuts.

In the morning when the men get up, they take what cocoanuts are left, divide them into three piles, find one extra which is given to the monkey and each man takes one of the three piles as his share.

REQUIRED: The number of cocoanuts originally collected.

Answers to last month's Tilts

1) It was necessary to hire 94 children, 5 men and 1 woman.
2) By assuming that the barber shaves himself, it is proved that he does not. By making the alternate assumption, the given statement proves that he does shave himself.

The New Telephone Building

(Continued from page 101)

vals of about 15 seconds, the same results were obtained without damage to the equipment in the adjacent building. If a satisfactory gas exhaust system can be devised, it is planned to use the delayed charge method in sinking caissons for five additional column footings under the occupied nine-story building.

Another interesting construction feature is presented by the refacing of three sides of the nine-story building. This will necessitate the tearing out and rebuilding of these walls without interfering with the equipment or operations within, and since the equipment permits a working leeway of only four inches inside the walls, all this work must be done from the outside.

Another feature of this project which is looked upon as of paramount importance both by the contractor and by the telephone company is the decision and the plan to make it a "no accident" job. A safety committee representing the telephone company, the contracting company and the architect is engaged constantly in doing everything possible to eliminate hazards. One of the most important features in this safety work, the committee believes, is the careful selection of men. The safety efforts have been rewarded so far by a record of no fatali ties and only a few minor mishaps.

The steel in the new structure wil consist of 3,000 tons of Carnegie sec tions and it is estimated that 20,000 bar rels of cement will be used in the con crete mixture. The concrete is mixed i a plant and hauled to the job in tank trucks. The additional material, both steel and concrete, required to give the building a strength of 150 pounds live load to the square foot as compared with the more usual capacity of 75 pounds places a load on the footings equivalent to that of an ordinary office building of about 35 stories.

The facing of the building will require 65,400 cubic feet of stone. The inner surfacing of the outer walls will be plaster on load bearing tile. Both tile and steel will be used for partitions. The concrete floors will be surfaced with linoleum except in the lobby which will have a marble or decorative tile floor. Aluminum spandrels will be used between the windows throughout the building.

The underfloor ducts for telephone distribution will represent a model system which permits placing a desk anywhere in the building and connecting a telephone on any desk without running wire across the floor.

During construction, a complete telephone system with its own private branch exchange will be installed on the job. This will make it possible to carry on conversations between various locations on the project and by the use of "tie lines" confer with the office of the general contractor and the telephone company. At the same time this system will be connected with one of the telephone central offices making it possible to talk with any telephone in Minneapolis as well as with all telephones reached over the lines of the Bell System.

Tappa Nu Keg: I'm going to study at Heidelberg next year.

Sappo: Why there?

T. N. K.: I've heard they had som Schnapp courses there.

With Our Alumni

(*Continued from page 105*)

Mechanical Engineering

'05—Sperry—Leonard B. Sperry, still in Chicago with the International Harvester company, has two sons in college, one playing on the football squad.

'20-'21—Tuve—"Mechanical Engineering Laboratory Practice" of which George Tuve is co-author, has recently gone to the press for its second impression.

'21—Tuve—The TECHNO-LOG wishes to correct a mistake appearing in the November, 1929, issue. George L. Tuve is now Associate Professor of Mechanical Engineering at the Case School of Applied Science, Cleveland, Ohio.

'25—Martino—Holding the position of secretary of G. M. Orr and company, A. D. Martino has moved to Minneapolis. The firm, headed by G. M. Orr, '15, is a consulting engineering company.

'27 — Hutchinson — Edwin Hutchinson has moved to Minneapolis. He is here with an office in the Northwestern Bank building. Mr. Hutchinson has been with the Aluminum corporation of America.

'28—Bowers—And now Raymond Bowers has a son. He has recently moved to Chicago, Ill.

Electrical Engineering

'99—MacKusick—A few words of encouragement from E. M. MacKusick of Ross, California, "John Tarish, '98-'01, engineer for the Natomas company at Sacramento, and myself, have sworn to meet next year and join the Minnesota rooters at Palo Alto. There, we hope, by repeating our enthusiastic vocal support, as we did in Minneapolis in the gay '90s, to cheer our 1931 team on to victory and bring back to ourselves the elation we experienced when we were undergraduates many long years ago."

'17-'21—Swenson—George W. Swenson, head of electrical engineering at the Michigan State College of Mines, recently journeyed to Chicago to attend a convention of the student chapters of the A. I. E. E.

'25—Keller—Raymond W. Keller has been transferred from the securities to the illuminating engineering department of the Ohio Edison company. He was placed in charge of the Springfield division of this department about September first. The work involves both sales and engineering.

'26—Nelson—Paul B. Nelson attended the annual convention of the Engineering College Magazines Association at the University of Colorado at Boulder, last fall. Mr. Nelson is Eastern vice-president of the association.

'27—McKesson—L. J. McKesson, transmission engineer for the Radio Corporation, is looking forward to returning to Minneapolis about a year from now.

'27—Moore—Gordon B. Moore is with G. M. Orr and company of Minneapolis as treasurer. He was recently married to Miss Harriet Bren.

'28—Burris—Arthur P. Burris has de-

(*Continued on page 116*)

The Architects' Page

(*Continued from page 103*)

can understand the spirit that made possible the grand cathedrals of the Gothic period; achievements consummated by the mass efforts of everyone in the community. The works of the Renaissance alone provide material for a lifetime of study. Vasari's "Lives of Painters" is a marvelous history of this period.

In the present day many of our designers fail completely to use this vast store of information. Ruskin's "Seven Lamps of Architecture" are condemned as impractical, the modernist failing to realize the great truths which he points out. The World's Fair in Chicago in 1893 was the greatest architectural inspiration in American history, yet it is often condemned as being merely a Roman mask on a modern framework. McKim, Meade, White, and Cass Gilbert are being flayed for the finest buildings in America.

We want to be modern, of course, but fine modern architecture will be built by architects who have a knowledge of what has been done and who will use this knowledge to develop finer buildings than have ever been built.

But you must be tiring of this raving, and I must press a pair of pants and go to bed.

Here's to the intelligent modern!

C. J.

Technical Campus News

(*Continued from page 106*)

Foundry Practice and Forge Practice. The Pattern shop had gained the use of a one time drawing room when the old Electrical Building had been taken over. A solution to the demonstration room was found in equipping one large class room with a complete "bleacher" section grouped around a demonstration "moulder's" work bench. In the remaining portion of the room is located a group of chairs facing a screen. There is available a projection lantern for giving illustrated lectures on all the topics pertaining to both shops.

For some time it has been known that it would be necessary to give the Machine shop more room. During the Summer it became imperative that there be more room because of the new equipment to be placed. At present the room made available by the removal of the offices is being used by unit machines, i.e., those machines that are not dependent on "line" shafts for driving power. A motor driven lathe, a centering machine and a manually operated press are located there. As time goes on, the new implements purchased will be equipped so that they will be suited for use in the "new room."

The Mechanical department offices are now closer together since the advent of the old Electrical Building into the group. This advantage is only one of the minor results of the progressive movement, but it is indicative that the whole will work far more smoothly.

Did some one say, "Why not a new Mechanical Building?"

Undoubtedly they did, but considering the equipment located in the old building and that the cost to move it is almost prohibitive, the old M. E. Building will be with us for some time to come.

Ray Englund: All my ancestors were blondes.

Weston: Then you come from preferred stock.

Recent Progress in the Soviet Union

(*Continued from page 99*)

plants and so on have arisen or are under construction in different parts of the Union.

It may be pointed out that the capital invested in new plants now under construction and to be completed within the next two years is larger than the total capital of all the existing industrial enterprises. The highest rate of development falls on agricultural machinery, the output of which has increased by nearly 50 per cent during the year 1929-1930. According to the revised figures for next year the output of this branch of industry will be five times larger than was originally planned, which is due to the unexpected progress of the collectivisation of agriculture (see below). The output of big scale industry for next year is expected to increase by 60 per cent over that of the second year, the corresponding figure for small scale industry being 30 per cent.

Dr. Frenkel's article on the Soviet will be concluded in the February issue of the Techno-Log. —Editor.

In these days of hard likker and strong women, two pints certainly make one cavort.

(*Continued from page 112*)

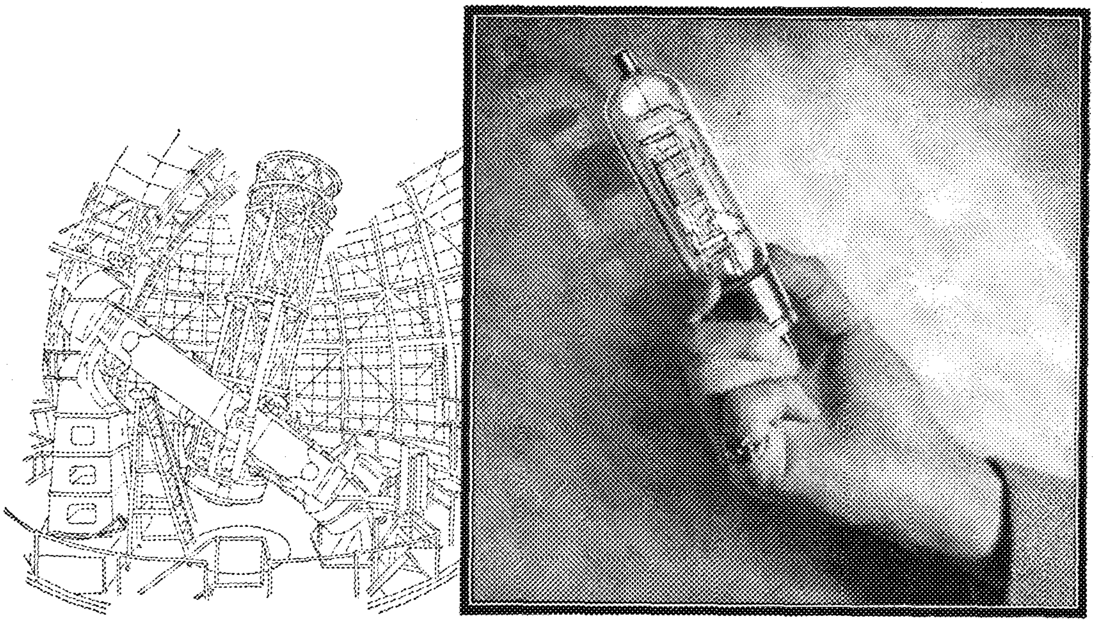
cided that there is just no place like Minneapolis, and, acting accordingly, has accepted a position with the Electric Machinery company, located here. Art took up his new duties here on the first of February, and will henceforth be connected with the sales department. He was formerly attached to the Chicago sales department of the Westinghouse manufacturing company.

'29—Perotti—John Perotti has just finished some very interesting work with the Minneapolis-Honeywell Heat Regulator company. The first year was spent in installing an incentive pay plan throughout the plant. The remaining time he spent as foreman of the punch press department.

'29—Larson—M. C. (Larry) Larson recently completed the student course offered by the Cutler-Hammer manufacturing company, and celebrated this event by making a week-end visit to Minneapolis to see everybody in general, but one friend in particular.

'29—Owens—R. R. Owens, who is a fractional horsepower motor salesman for the General Electric company, was recently transferred from the Fort Wayne office to the home office at 120 Broadway, New York City.

'29—Rollin—Verne G. Rollin, 218 Victoria avenue, Hampton, Virginia, is working on research of the "Effect of Supercharging" with the Government testing works. He plans to complete the test by the last of May. He will spend July to August at East Monroe, Virginia.



The new G-E low-grid-current Pliotron tube capable of measuring a current as small as 10^{-17} ampere

This Little Tube Measures Stars Centuries of Light Years Distant

BY MEANS of a new vacuum tube called a low-grid-current Pliotron tube, astronomers can gather the facts of stellar news with greater speed and accuracy. In conjunction with a photoelectric tube, it will help render information on the amount of light radiation and position of stars centuries of light years away. It is further applicable to such laboratory uses as demand the most delicate measurement of electric current.

So sensitive is this tube, that it can measure 0.000,000,000,000,000,01 of an ampere, or, one-hundredth of a millionth of a billionth of an ampere. This amount of current, compared with that of a 50-watt incandescent lamp, is as two drops of water compared with the entire volume of water spilled over Niagara Falls in a year.

General Electric leadership in the development of vacuum tubes has largely been maintained by college-trained men, just as college-trained men are largely responsible for the impressive progress made by General Electric in other fields of research and engineering.

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GENERAL ELECTRIC

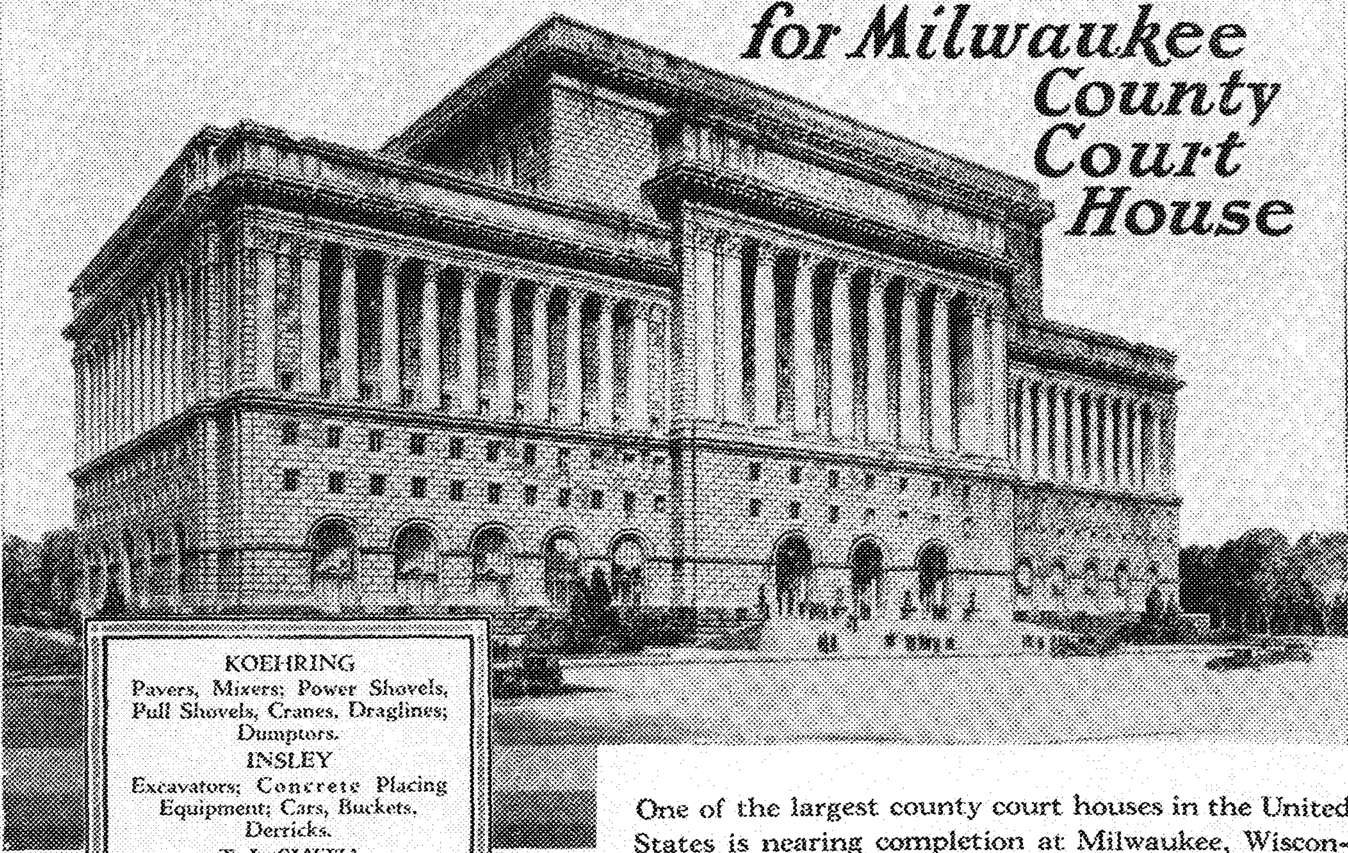
THE MINNESOTA TECHNO-LOG

Vol. XI FEBRUARY, 1931 No. 5

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Smith-mixed Concrete

for Milwaukee County Court House



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KWIK-MIX
Mixers — Concrete, Plaster and Mortar.

"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.

One of the largest county court houses in the United States is nearing completion at Milwaukee, Wisconsin. This new eight million dollar building of classical architecture takes an imposing position on its raised elevation.

General dimensions show a length of 450 feet, a width of 200 feet and a height of 200 feet. In the foundation, 6,700 piles were sunk in order to provide a secure base for the heavy structure. There were 12,000 tons of steel used in the building and the limestone order, which was third largest placed in the United States during 1929, amounted to 303,000 cubic feet. The six columns over the entrance are 7 ft. 6 in. in diameter and are 60 ft. high.

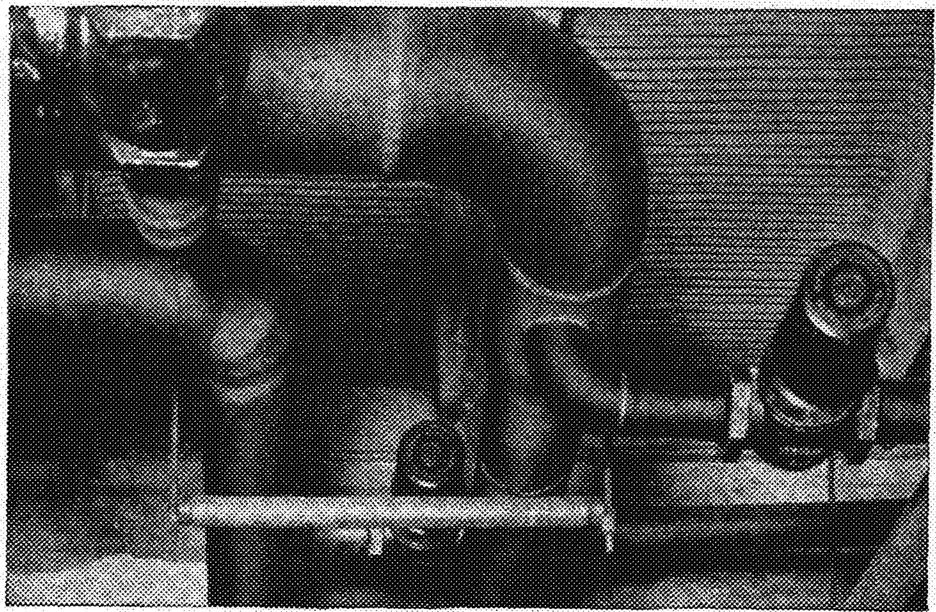
Among the N. E. C. machines used on the Milwaukee County Court House was a large Smith Tilting Mixer of 2 yard capacity. With the famous Smith end-to-center mixing action, the big tilter mixed 10,000 cubic yards of concrete—Smith-mixed concrete for permanence.

National Equipment Corporation

**30th St. & Concordia Ave.
Milwaukee, Wisconsin**

OXWELDING

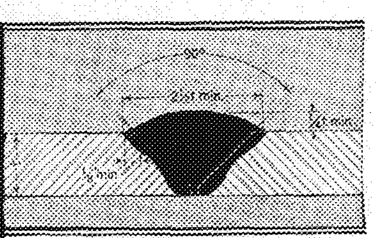
SIMPLIFIES PIPING DESIGN



THE laying out of a piping system is materially simplified by oxwelding. Where this method of jointing is used, plans are not governed by the availability of standard fittings and the avoidance of specials.

Oxwelding does not change the general design features. Size of pipe, method of suspension, provision for expansion and contraction and location of turns, branch connections, valves and other fittings are the same as for other types of construction. Welded joints and fittings are merely substituted to obtain increased compactness, economy and serviceability.

Under Procedure Control, welded piping construction may be undertaken with the same confidence in a satisfactory result as older methods.



DESIGN STANDARDS FOR OXWELDED PIPING

Any welded piping system, even in its most complicated form, is a combination of a few fundamental welding design details.

WELDED LINE JOINTS

Open Single Vee Butt Weld

Explanation of Design:

The Open Single Vee Butt Weld illustrated is the type of weld most extensively used for jointing steel pipe. When properly made, it develops the full strength of the pipe wall; it is easy to make and of low cost.

Uses:

The Open Single Vee Butt Weld is the standard line joint and is recommended for standard, extra heavy and double extra heavy piping, for all services carrying all pressures to which steel and wrought iron pipe are subjected.

Specification:

When the Open Single Vee Butt Weld is specified the following should be included in the specification:

1. The spacing between pipe ends, before tacking, shall be as given in Table 1, page 11, "Design Standards for Oxwelded Piping."

2. Welds shall be thoroughly fused to the joint edges and shall extend completely to the bottom of the vee.

3. Welds shall have a minimum width of 2½ times the pipe wall thickness and shall be symmetrical with respect to the center line of joint.

4. Welds shall be built up to present a gradual increase in thickness from edge to center.

5. Thickness at the center of the weld shall not be less than 1¼ times the pipe wall thickness.

6. The weld shall be of sound metal free from laps, gas pockets, slag inclusions or other defects.

The above is excerpted from a handbook on fundamental designs, titled, "Design Standards for Oxwelded Steel and Wrought Iron Piping," published by The Linde Air Products Company. A copy of this handbook should be in every architectural drafting room. It is yours for the asking. Just fill in and mail the coupon.

Technical Publicity Dept., 12th Floor
205 East 42nd St., New York, N. Y.

Please send me a copy of your new book, "Design Standards for Oxwelded Steel and Wrought Iron Piping," which also explains procedure control for pipe welding.

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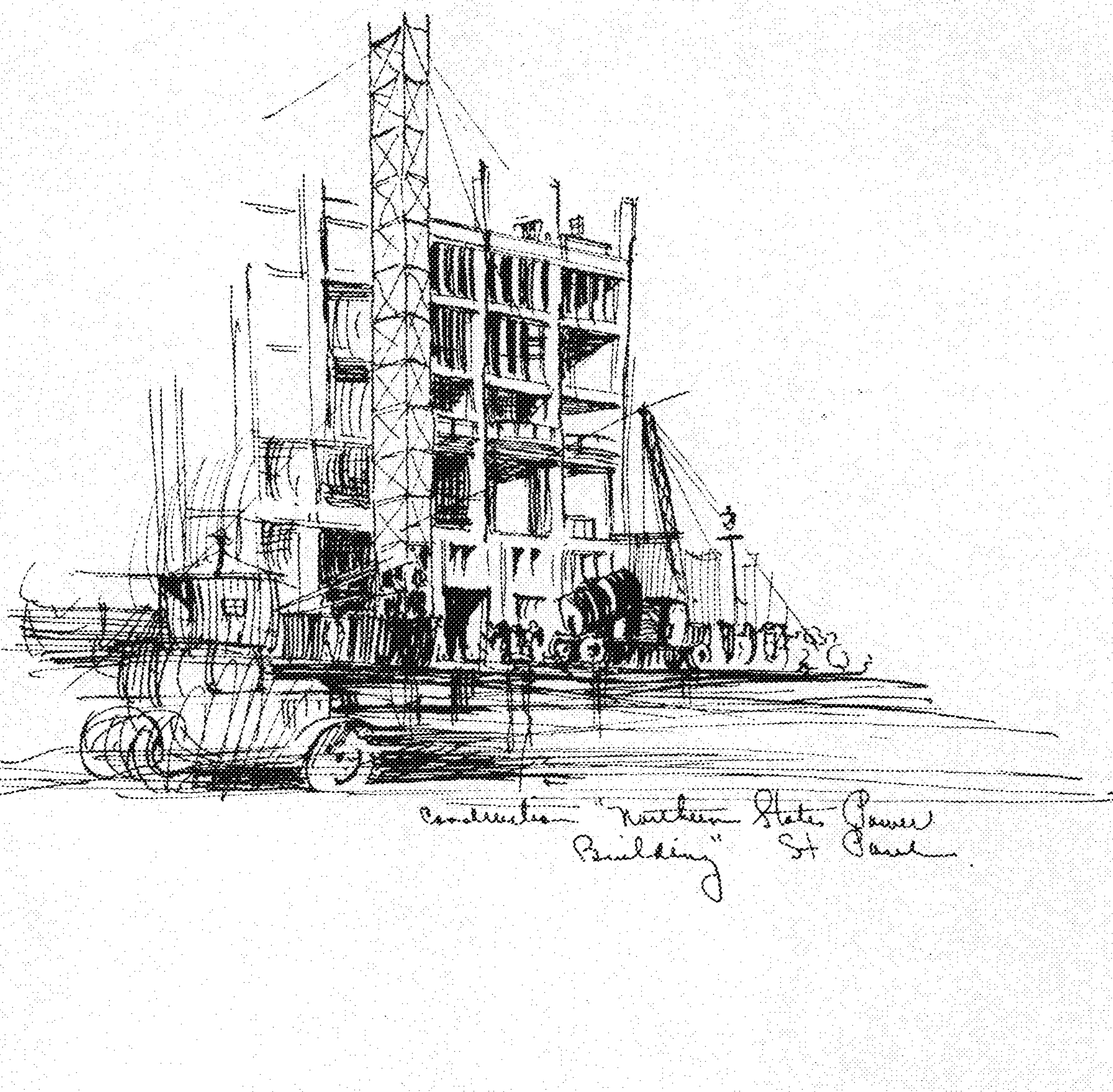


Construction "Northern States Power Building" St Paul

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Volume XI — FEBRUARY, 1931 — Number 5

Reminiscences of the Panama Canal

By JOHN HARRISON MOFFETT

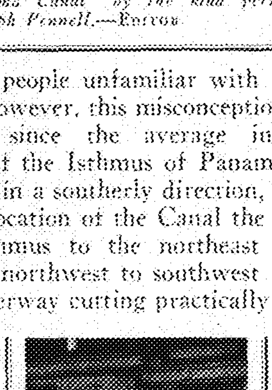
Instructor in Foundry Practice

*The illustrations of the Panama Canal have been reproduced from Joseph Pennell's "Pictures of the Panama Canal" by the kind permission of Mrs. Joseph Pennell.—*EDITOR

THE American people have taken a lively interest in their Panama Canal for the construction of that waterway, under the handicaps that obtained at the time, is a national achievement in which they justly may take pride. When one reflects that the earth removed from the "Big Ditch" if piled on a city block, would tower to the amazing height of seven miles, and the concrete poured into its structures would suffice for the erection of sixty-four stadia the size of the Memorial Stadium at the University of Minnesota, a fair conception of the stupendous undertaking may be evisaged. Despite the keen interest shown in the engineering triumph a great many Americans entertain misconceptions and misunderstanding about the canal across the Isthmus of Panama. With this in view, it will be the purpose of this article to clear up these erroneous conceptions, and also indicate features which are not commonly encompassed or emphasized in treatises on the subject.

The Panama Canal lies directly south of Pittsburg, and is 600 miles north of the equator. There is no railroad running to it, so the Canal must be reached by boat either from New York or New Orleans. From the former the distance is about 600 miles greater; making it necessary to sail about a day and a half longer, or six days, to reach the Atlantic terminus of the Panama canal. It is almost twice as far from San Francisco to the Canal as it is from New York City. A glance at the map of North America will make this evident, and show the reason for the difference. San Francisco can be reached quicker from the Canal by sailing to New Orleans, and thence going by rail, than by using the direct water route—a trip that requires ten or twelve days.

The Panama canal does not cross the narrowest portion of the Isthmus of Panama as that route happens to be about 100 miles to the south in the Province of San Blas. However, the Canal does follow the most favorable crossing, which, although longer, requires less excavation than the shortest passage where the land is at a much higher elevation. Nor does the Canal run from east to west—an idea common to people unfamiliar with the subject. However, this misconception is surprising since the average individual thinks of the Isthmus of Panama as extending in a southerly direction, whereas at the location of the Canal the twist of the Isthmus to the northeast gives a slightly northwest to southwest route to the waterway cutting practically straight

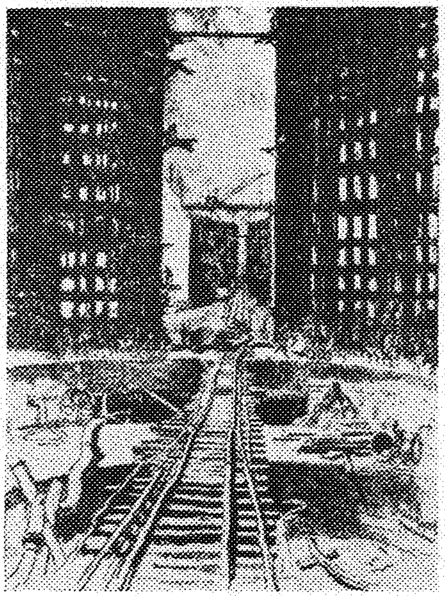


JOHN HARRISON MOFFETT

across from one ocean to the other. In this connection it should be pointed out that the peculiar lay of the land provides what seemingly is a paradoxical situation in that one standing at the Atlantic entrance of the Canal may see the sun set in the Atlantic Ocean when he looks across Colon Bay as the day ends, while at the Pacific terminus the sun rises out of the Pacific Ocean as the fiery orb is viewed across the Bay of Panama in the haze of a tropical morning. It is no wonder that a resident of the Canal Zone finds it difficult to obtain a correct sense of direction. About all that can be done about it is simply to forego any hope of obtaining one's bearings, and decide to live in a land that is topsy-turvy.

It frequent has been said that there are two seasons prevailing on the Isthmus of Panama—the rainy and the wet. Although Porto Bello, 26 miles north of the Atlantic entrance of the Canal is one of the six rainiest places in the world, there is not a continuous downpour of rain throughout the four seasons as we in the north know them. The average annual rainfall at the Atlantic side is about 120 inches, or approximately four times the precipitation of the state of Minnesota. On the Pacific side of the Canal Zone the rainfall is about one-half that at the Atlantic, or about 60 inches. Practically all of this rain falls during the rainy season which extends from March 15th to the middle of December. The autumn months are the rainiest, but even then clear weather frequently prevails, as the writer distinctly recalls that for several days around Armistice Day, 1918, the weather was what would be considered ideal anywhere. Ordinarily at this time of year the rainy season is at its peak. During the winter months a shift in the trade winds brings a dry season during which there is very little rainfall. In fact, there have been seasons in which no precipitation was recorded by the weather station at Balboa on the Pacific side. Throughout the dry season the nights are quite cool, and heavy dews are prevalent. Even then the grass is seared; the ground cracks open, and the leaves fall from some of the trees. These concurrent manifestations are about the only ones occuring in this tropical country that resemble any season in the States as the conditions are similar to those prevailing here in the fall season. There probably is good reason for the misconception about the rainfall in view of some exaggerated reports sent back by new employees who wish to give a vivid account of the tropical rains. The writer recalls that a fellow employee, who came to the Isthmus at the height of the rainy season, wrote home such glowing description of the torrential rains that he was the chagrined recipient of a Christmas gift in the form of a pair of rubber hip boots at a time when there could have been no need for them as the dry season had set in two weeks previously.

It seems as if almost everyone has a mistaken idea about the temperatures prevailing in tropical Panama. In the Canal Zone, at least, the maximum recorded temperature is 94. The minimum is 65 degrees Fahrenheit. Ordinarily the prevailing temperature is from 82 to 84, although it feels somewhat warmer because the humidity is excessive. The



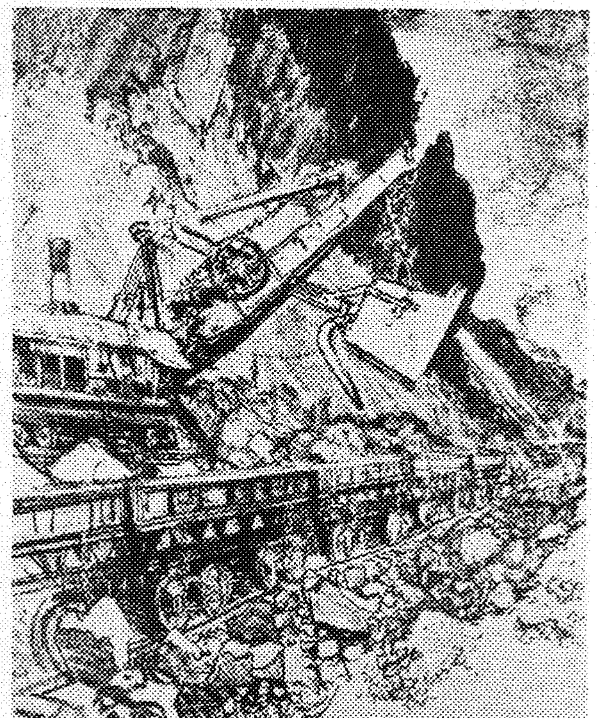
THE GATES OF PEDRO MIGUEL
The pictures shows the great length from gate to gate and also something of its building and construction.

coolest weather prevails during the dry season when at night the heat of the day quickly dissipates under clear skies and the drive of the vigorous trade winds. If one is able to keep in the shade where the breeze will strike him, the climate of the Isthmus is pleasant. But if the conditions are otherwise it is possible to perspire and freeze at the same time, for when one faces the sun and his back is to the tradewinds this sensation will be obtained.

There still is much doubt about the healthfulness of the Canal Zone. There are people who think that malaria and yellow fever still stalk the inhabitants to wield their deadly poniards. The Canal Zone, on the contrary, is one of the most sanitary places in the world. In fact, it must be kept so, as every port in the world would quarantine any ship that passed through the canal if an epidemic of yellow fever became prevalent there. Since no cargo carrying ships would pass through it, the result would be disastrous to the income of the canal. To keep the zone sanitary, an efficient and alert sanitary corps has for its duty the clearing away of all undergrowth and breeding places of vermin which includes the yellow fever carrying mosquito. All stagnant water is oiled to prevent the propagation of the stegomyia mosquito, the female of which species transmits the yellow fever germs. The writer has seen the mosquito squad even oil the little pools of rainwater held in the cavities of the scrap iron piled outside of the foundry of the Mechanical Division, and reflected at the time upon the assiduousness with which the fever bearing insect is hunted down. In fact, the sanitation of the Canal Zone was the first big problem confronting the builders of the Panama Canal, for if workers could not live on the Isthmus the construction of the waterway could hardly have been possible. During the French attempt at digging the canal there was a frightful loss of lives because the reason for the transmittal of yellow fever was not fully understood. In the hospitals of the French organization the feet of the beds were placed in cups of water to prevent ants from crawling up to the patients. These vessels became veritable breeding places for the mosquitoes that carried the fever from one patient to another.

The Panama Canal was built for military purposes, and not as a commercial proposition. When the battleship Oregon was forced to travel from the west coast of the United States around Cape Horn to join the fleet off Santiago during the Spanish American war, the military necessity of a canal across the Isthmus of Panama was deeply impressed upon the American people. Of course the canal is used by commercial cargo carrying ships to bring a return on the $400,000,000 investment of the government. Now the tonnage passing through the Panama canal is second only to that of the Soo canal which handles the largest tonnage of any canal in the world. It was one of the tenets of the military engineers who advocated the construction of the canal that it could be used during peace time to bring a return on the heavy expenditure. Since the Panama canal is a military works, it is provided with adequate coast defense fortifications, submarine base, coaling stations, aviation equipment and shops capable of handling marine repair work, including the forging and machining of the largest of propeller shafts.

From deep water at the Atlantic entrance to deep water at the Pacific end, about 30 miles the waterway is at an elevation of 85 feet. To get ships up over this hump, six sets of locks and a huge dam were constructed—the dam for impounding the water of the Chagres River to supply lockage for the ships. The locks, to the writer, were one of the most interesting features of the Panama canal, as the construction of them was an engineering task of first magnitude. The fact may be appreciated when it is known that the three sets at Gatun are practically one mile long; that the lock chambers are 110 feet wide, 1,000 feet long, and have one wall that is 60 feet feet thick at the base. But the intent in this connection it to emphasize that the Panama canal could hardly have been built as a sealevel canal. Even if that type had been constructed, locks would have been necessary to care for the difference between the tides on the Atlantic and the Pacific coasts. At the former the tide is about two feet; whereas at the Pacific entrance, it is sometimes as much as twenty feet. It now is evident that one set of locks would have been needed anyway to keep the Pacific Ocean from flowing into the Atlantic. The high tide at the Pacific end of the canal is due to the wedge shape of Panama Bay wherein the tide water piles up as it sweeps inward toward the apex. One can visualize the difficulty that would be met in attempting to navigate a 50,000 ton vessel through a 300 foot channel if a tide of 20 feet were coursing through it. When Congress was considering the feasibility of a sea level canal at Panama there arose a deadlock between the proponents of this type and those advocating the construction of a lock-type canal. The argument was advanced that a lock-type of canal would be vulnerable when attacked by an invading enemy army, because a canal of this type could not function if a set of locks were destroyed or seriously damaged. The opponents were set against the great cost, the time that would be required and the possibility of failure if an attempt were made to dig a sea level canal. Subsequent events have substantiated the sagacity of Theodore



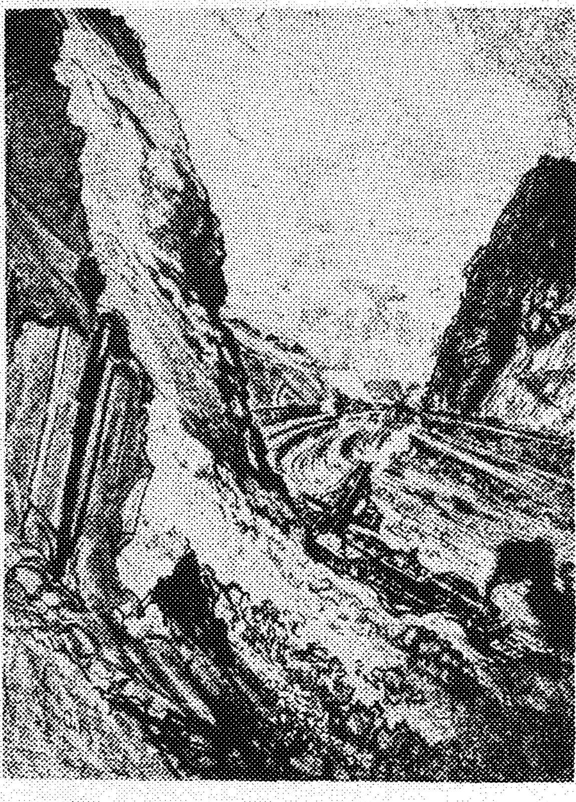
STEAM SHOVEL AT WORK IN CULEBRA CUT
This beast, as was said in Panama at that time "can pick up anything from an elephant to a red bug"—the smallest thing on the island.

Roosevelt who decided the issue by supporting the advocates of the lock type canal. That Roosevelt was right would have been evident to anyone who stood on the banks of the Canal in October 1915, and watched two 15-yard dipper dredges toiling 24 hours a day to remove 10,000,000 yards of earth as it slid into the Canal prism. Although each one of these dredge dippers brought up 96 barrels of mud each minute, the work required to remove a landslide from a canal 85 feet lower staggers the imagination.

While the great slide of 1915 is being considered, it might be informative to mention that this blocking of the channel for six months was an indirect cause that involved the United States in the World War. At this time a great amount of Chile saltpeter was being transported through the canal to the eastern seaboard of the United States. There the nitre was converted into munitions and shipped back, through the canal, across the Pacific to the eastern terminus of the Trans-Siberian Railroad. From this point it was hauled to the Russian army on the Eastern Front. The Russian opposition to the Central Powers was wavering at this time and consequently the cutting of the main artery of munitions supply induced the sudden collapse of the Russian military operations. The submarine warfare in the Atlantic made it impossible to despatch supplies by this route in sufficient quantity to the Russians so that their participation in the war might be sustained. The Russian debacle left the Central Powers in a position that they irrationally concluded would enable them to maintain a dictatorial attitude toward the United States. It now is history that this policy finally goaded the American government into entering the conflict.

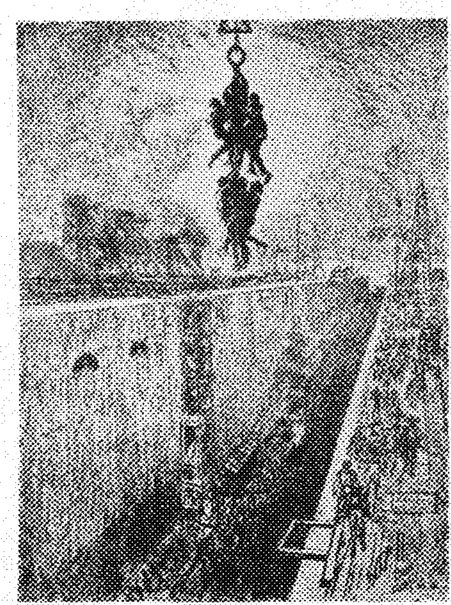
More than once the writer has been asked if the Panama canal is lined with concrete. Why anyone should formulate such a mental picture is hard to conceive. The Panama canal is merely a big ditch, 45 feet deep and 300 feet wide, dug through the cordillera of the North American continent. At Culebra cut it was necessary to dig down 400 feet to get through the ridge of the continental divide, and the bulk of the digging was done in a strip nine miles long, where 45 steam shovels served by 140 locomotives handled the spoil which was dumped into swamps to provide conveniently located townsites. It hardly would be feasible to line such a gorge with anything, at least if it is cheaper to dredge out occasionally the silt washed into the channel and thus maintain the minimum depth of 45 feet.

The Panama canal operates similarly to a double-track railroad since there are duplicate sets of locks. When going through the locks a boat is towed by electric locomotives, but in the canal proper, travel is at a low rate of speed under the boats' own power. However, in Gatun Lake, which incidentally is the largest artificial body of fresh water in the world, ships travel at full speed for a distance of 18 miles. Ordinarily a transit of the canal requires from 8 to 10 hours, but smaller, speedier craft like a destroyer, make the passage much quicker. Traffic through the Panama canal is rapidly approaching the maximum capacity, which is limited by the number of lockages that can be made in 24 hours. These in turn are dependent upon the supply of water in Gatun Lake during the dry season. The shortage of water as the traffic increases has brought forth the propoal to contruct another dam across the Chagres River at an estimated cost of $10,000,000. If this dam provided sufficient impoundage, another set of locks could be constructed for about $25,000,000, and then the Panama canal could be operated like a four-track railroad. The United States Government at this time has a party of 200 engineers making a preliminary survey of a route for a canal across Nicaragua via Lake Nicaragua. It is estimated that a waterway across this route can be constructed at a cost of $1,000,000,000. In view of the water supply problem at Panama, the cost of another dam and twelve more locks, and the much shorter distance for coast to coast shipping as well as for other trade lanes, it may be that the idea of increasing the capacity of the canal in Panama will have to yield in favor the Nicaraguan project.



THE CUT—LOOKING TOWARD CULEBRA

The most pictorial as well as the most profound part of the cut.



END OF THE DAY—GATUN LOCK

The Canal Zone is a strip of land 10 miles wide and 50 miles long. It has been leased from the Republic of Panama for 99 years at an annual rental of $250,000. At the expiration of this tenure the leasehold automatically becomes one in perpetuity. The zone is clipped off at the northeast and southeast corners within one to two miles of the canal so that the Panama cities of Colon and Panama City will be beyond the limits of the Canal Zone. However, if military exigency makes it necessary, these two cities by treaty will be considered as lying within the confines of the Canal Zone when the end borders are spread apart to the 10 mile limit.

Probably it would be of passing interest to say that one living on this Isthmian strip of land is able to see both the Atlantic and Pacific Oceans within a few hours as the Panama Railroad operates passenger trains crossing it in an hour and a half. A favorite novel accomplishment of a newcomer to the zone is to swim in both oceans during the same day. And if one has the stamina under tropic skies he will find it possible even to walk from one ocean to the other within the same day. Few automobiles have gone across the Isthmus under their own power within one day because there is no highway across the Canal Zone. It has been done, nevertheless, by driving a car for 25 miles over the crossties of the Panama Railroad after following

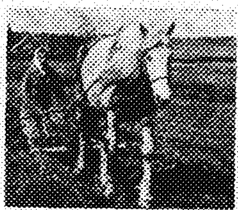
(Continued on page 138)

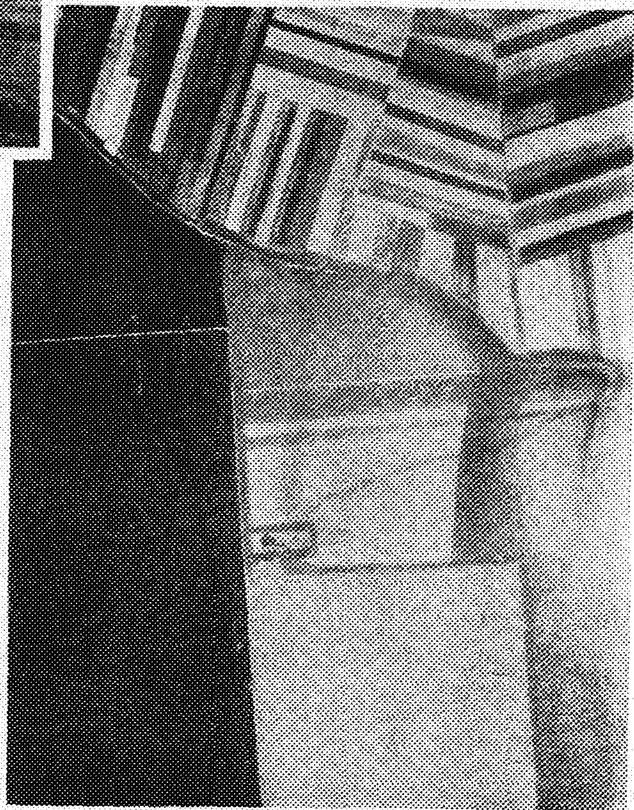
Recent Progress in the Soviet Union

By PROFESSOR J. FRENKEL

This issue concludes Professor Frenkel's series of two articles on the Soviet Union. In the January issue of the TECHNO-LOG, *Professor Frenkel outlined the history of Russia since the revolution of 1917, and briefly summarized the results achieved in industry during the first two years of the reconstruction period. In this issue Professor Frenkel recounts the progress made in agriculture and speaks of general conditions in the Soviet.*—EDITOR.

AGRICULTURE. The development of agriculture along the new socialistic line started last year only, and proved to be an altogether unexpected success, despite many mistakes made at the beginning. One of these was the forcing of the peasants by the local authorities to join the collectives; another to collectivise not only the agricultural tools and the horses, but also sometimes the cows, poultry and other things upon which the daily existence of an individual peasant family depended. And last but not least the peasants were told that they would have a share in the profits of the collective farm proportional to their toil, but independent of the capital invested. As a result the peasants, before entering the collective, tried to sell all the property that had to be collectivised; and to slaughter the cattle for meat—more than 30 per cent of the cattle were slaughtered within two or three months. All these mistakes were early recognized and corrected. Finally at the close of the first year of the new agricultural policy 25 per cent of all the individual peasant households willingly remained in the collective farms. The crops of the latter proved by fifty per cent larger than those of the individual peasants in the same district, this being due mainly to improved methods of cultivation, use of machinery, etc. In all this the collective farms had the fullest assistance of the government, which did its best to help the individual farmers too (granting them better seeds, advice, credit, etc.), but of course this assistance was much more effective in the former case than in the latter. The rate of collectivisation having greatly exceeded the plan's figures, the amount of imported machinery proved insufficient and in most of the collective farms tractors were kept at work day and night (the staff being changed every eight hours, the normal duration of a laborer's day).





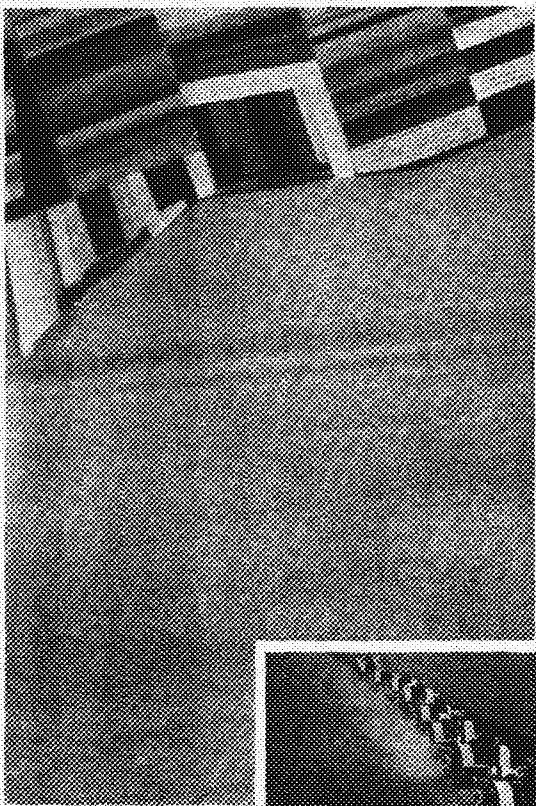
A bird's eye view of two epochs: "the furrowed strips of the one-man farm and the vast unbroken expanse of the collective farm." At the present date 40 to 50 per cent of all peasant holdings in the chief grain growing districts of the U.S.S.R. have been collectivized. In the unbroken stretch of the land held and cultivated by the collective farm there are other signs of gain besides those accruing from the ploughing down of the balks that used to divide one peasant's strip of land from the other. Now there is no barren land, lying fallow and useless. Now there are no tares or weeds grown from the wind borne seeds of a poor neighbor's sowing."

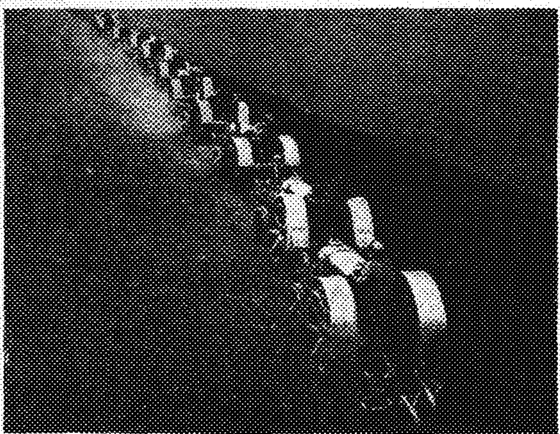
As a result of this big success there is a strong movement on the part of the rest of the peasants to join the collective farms. It is estimated that by the end of this year fifty per cent of all the rural population will be united into large scale collectives, and this figure which is probably an underestimate is much larger than that originally devised for the final year of the plan.

In the collective farms the peasants are living in their old homes and keeping a separate household outside of the common cultivation of the common land with common tools. In the state farms we have an organization entirely similar to that of big industrial plants. These state farms have also developed far more rapidly than has been anticipated. Some of them are so big that the managers have to use aeroplanes to be able to travel in a reasonable time from one end to the other. There has been however, not only a quantitative development of the big scale farming, but also a qualitative one, consisting in a gradual division of labor between different farming enterprises. Some of them are concerned exclusively with the raising of grain, being actually a kind of large scale grain factory, others with technical crops or with cattle, sheep, pigs and so on.

The tremendous success of the new agricultural policy is manifested by the fact that Russia has been able this year for the first time since the war to export some wheat—about one-third of the amount exported before the war. It is expected that next year's export figure will be as large as that of pre-war years at least.

Last year was a very hard one for the population of the Soviet Union. There has been a shortage of food stuffs, especially meat and fats (bread being abundant) and of all sorts of commodities—clothes, shoes, etc. The superficial observer, visiting Russia, might be inclined to believe that the country was drifting towards ruin. As a matter of fact it was emaciating because of excessive growth—as often occurs to children. One of the factors responsible for the shortage of consumers' goods in Russia last year was the economic depression in Europe and America. This depression has cut down the prices of raw materials exported by Russia (lumber, pulp wood, oil, manganese ore, etc.), and in order to keep the balance in the most vital part concerned with the purchase of equipment for big scale industry and agriculture, the government not only reduced the import of raw materials for small scale industry (cotton for instance) but was compelled to export food stuffs—canned goods, butter and so on, that were deficient in Russia itself. In the case of meat products and fats the crisis has been caused to a great extent by the above mentioned slaughter of cattle. As to the shortage of textiles and other commodities, it has been not absolute but relative; the output of these goods has been actually increased on the average by another 20 per cent during last year, but they were supplied to the villages in order to stimulate the collectivisation process, to the detriment of the cities, that heretofore had been the main consumers of the manufactured goods.





There is no fear of a repetition of the crisis this year. For the prospects are very bright indeed. Food stuffs will no longer be important part of the export, with the exception of grain that has been collected in an amount far in excess of the population's needs. A large amount of technical crops, cotton in particular, raised in the country (partially in entirely new districts in the south of Russia), will ensure a rapid development of the small scale industry (the plan's figure being 30 per cent). Leaving, however, the future aside, Russia can already boast of a very great achievement—the *complete elimination of unemployment*. The rapid rate of the country's industrialisation has not only absorbed all the labor reserves, but produced an acute shortage of labor, both skilled and unskilled, in all branches of industry.

The problem of supplying new engineers, agronomists, economists and skilled workers for the needs of the tremendously growing industry and big scale farming has now become the most difficult one in Russia. To cope with it the government nearly doubled in one year the number of schools, technical colleges, and higher institutions (corresponding to universities) as well as the number of students attending them. In Leningrad alone with its population of two millions, 22,000 of new students have been received this year in such institutions, the total number of students in the Union having exceeded 300,000. This figure does not include the still more numerous students of technical colleges and preparatory schools of various kinds, in particular of factory schools where youngsters and unskilled workers are prepared for skilled work. In spite of all these efforts the number of new engineers and milled workers is still insufficient to meet the tremendous demands of the rapidly increasing industry; and the Soviet government is planning to ship to Russia this year about thirteen thousand technicians, of higher and lower grade, from Europe and America, where many of them are suffering from unemployment. The education, primary, secondary and higher, is all free of charge. Moreover the large majority of college and university students are getting stipends from the government enabling them to concentrate all their forces on learning. Students from the very beginning get a practically equal amount of theoretical work and of practical work in factories or other enterprises, corresponding to their specialty. Most of them in the third or even the second year of their course are enrolled by these enterprises for future work, and are paid a pretty high salary (in the form of a stipend). The educational program of the Soviet government is not restricted to the preparation of the staff for their industrial, agricultural, commercial and other jobs in particular. A tremendous effort is being made to raise the general cultural level of the broad masses both in cities and in villages. The illiteracy even among the older generation is being quickly eliminated. The compulsory education of all children from 8 to 11 years in the villages and up to fifteen years in the cities was inaugurated last year. It has been impossible to actually carry it out everywhere, especially in the villages. But the progress of the collective farm movement insures its rapid and successful spread even among the rural population, which has been preserved by the old regime until the revolution in a state of primitive wilderness. It is estimated that at the present time forty millions out of the total one hundred million of the Russian population are attending schools of different kind.

The achievement of the tremendous economical and cultural revolution implied by the original five year plan in a period of four and even less years may look like a miracle. As a matter of fact we are not used to that character of scientifically organized activity of a nation by which this miracle is being achieved. Such nation-wide activity, well co-ordinated and directed to one definite purpose—has been witnessed until now only in time of war when it has been directed towards destructive and not constructive ends. Russia's fight for prosperity as a socialistic state implies a psychological tension and enthusiasm which is also very similar to that of war.

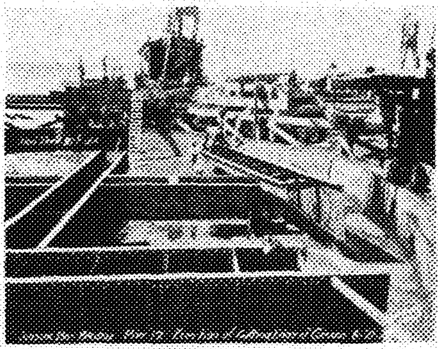
This bloodless war against the elements and the nation's own backwardness requires hard and efficient labor. And such a labor is just as worshipped now in Russia, as efficient murder has been worshipped during the war. Different methods, both moral and material, are used to stimulate it. There is a socialistic competition between different organizations—including universities and learned societies—to effect the best and quickest fulfilment of their share of the plan. There are "shock brigades" in factories and other enterprises that are willingly working better and harder than the rest, inducing the latter to follow their example. These efforts are rewarded by moral applause; by "labor decorations" similar to those that were granted for military exploits; by prizes to the whole working collective—in the shape of new houses for the workers, new schools, hospitals, or nurseries, and so on; by sending the best individual workers and whole shock brigades to the universities, or rewarding them an extra rest in the best summer resorts, and lastly by financial remuneration.

It must not be thought that all this

(*Continued on page 136*)

Building the Sub-structure

By John E. Davidson,



ERECTION OF CUTTING EDGE OF CAISSON AT PIER 12

ONCE more the ingenuity of the engineer has made an art of bridge building. The substructure for the Southern Pacific Railway's double track bridge over Suisun Bay in California marks an advance in bridge engineering thought.

Because of the depth of the water, fluctuation of the tides, swiftness of the current during winter floods, and softness of the underlying bay deposits, ordinary methods of sinking deep water caissons were considered impracticable. To meet this situation, what is known as the sand island method was developed. An artificial island of sand was built in a steel cylinder sunk to the rock bottom, and the pier was then sunk through the sand to the rock bottom. This method was used for the construction of all the deep water piers while open cofferdams were used on the shallow water piers.

The superstructure of the brige consists of ten steel trusses with approach viaducts, the substructure includes two piers (10 and 11) constructed in open cofferdams and 8 piers, 12 to 19, constructed by the new sand island method.

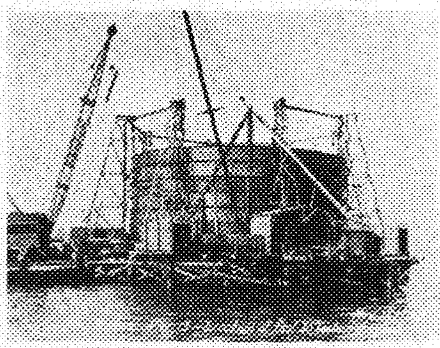
By the use of expert triangulation, the falsework piling was driven with absolute accuracy. On the piling was built an octagonal platform within which was sunk a steel cylinder 81 feet in diameter. By this behavior of the falsework piling while driving, the engineer was enabled to estimate very closely the depth to which the steel cylinder would sink into the mud.

On the platform were set up steel gallows, frames, and suspender beams previously assembled. By means of hand winches in the gallows frames, the steel shell was allowed to sink into the mud until it came to rest. This shell was made up of sections ten feet in height bolted together so that the portion of the shell above the mud line might be unbolted and used again on another pier.

The steel shell rose above high water and was then filled with sand which had been dredged from the bay about a mile above the bridge site. The sand filling rose to a point 3 or 4 feet above low water so that the island thus formed was dry. On the island was then laid the cutting edge which was made up of steel plates and angles shaped so as to offer the least resistance to the sand and mud while sinking the caisson. Included in the cutting edge was a bracing and reinforcing system adequate to secure rigidity as well as bond with the caisson. On the steel cutting edge, was then erected the caisson which was a block of concrete 40 feet x 60 feet in plan with 6 well openings 10 feet 6 inches x 11 feet 6 inches. The thickness of the outer walls of the caisson were 6½ feet while the walls separating the dredging wells were 6 feet thick.

Steel forms were then laid along the faces of the cutting edge and the first lift of concrete poured. The first lift was about 15 feet high with each consequent lift 10 feet high.

Twenty-five feet of caisson were completed before sinking was started. With

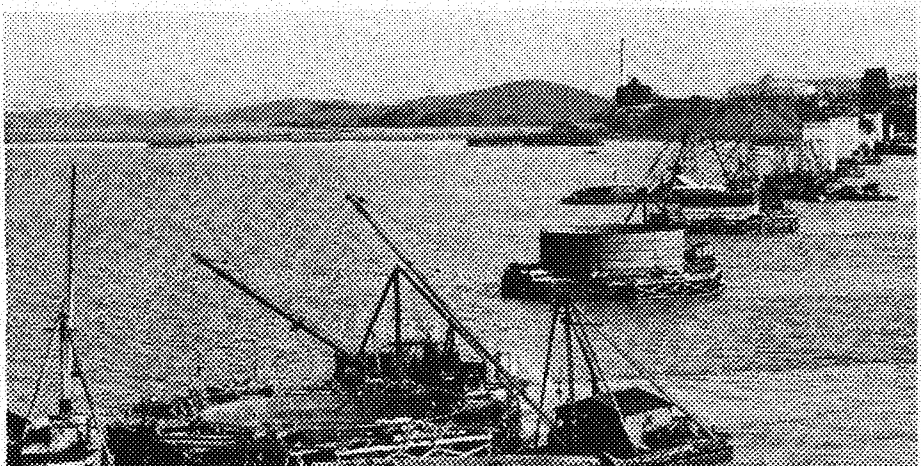


ERECTION OF FIRST 30 FOOT SECTION OF CYLINDER AT PIER 13

this amount of caisson on the sand, the maximum weight of the island was secured and from this point on, the weight of the sand removed and the water displaced by the concrete outbalanced the progressively increased weight of the concrete caisson.

Dredging through the 6 wells in the caisson was done by two derricks, one stationery on the platform and one on a barge, which moved from pier to pier. The excavation with clamshell buckets was rotated from well to well so that the caisson would sink evenly. When the caisson had been sunk 22 feet, the forms were then raised to their next position and another ten foot lift poured. In this system, a ten foot lift would be completed in three to four days. From time to time, sand would be removed from between the caisson and the steel shell to reduce the friction between the sand and the caisson and produce more rapid sinking.

From elevations —20 to —30, a recess was left in the top of the pier base for the distributing block. This block was 53 feet long, 33 feet wide and 10 feet deep with a wall 2½ feet thick all around the caisson. Anchor bolts were set in the top of the wall at about 6 feet



GENERAL VIEW OF SUISUN BAY BRIDGE SHOWING PIERS IN VARIOUS STAGES OF COMPLETION

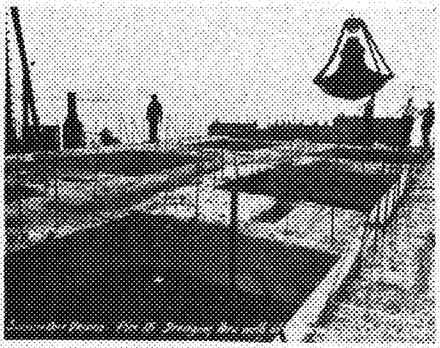
for the Suisun Bay Bridge

Arch. Eng. '28

center for the purpose of holding down the timber cofferdam in which the pier shaft was constructed.

The cofferdam walls which were 30 feet high were made up in sections of 12x12 inch timbers laid horizontally, calked and treated against toredo attack, and tied together with drift bolts. The sections varied in height from 5 to 10 feet and were very easily set up and dismantled so that the cofferdam could be reused several times.

The cofferdam was anchored to the caisson by means of 10 inch channels,



DREDGING SAND THROUGH THE WELLS OF THE CAISSON AT PIER 15

20 inches long, spaced at about 12 foot intervals with the flange upward on top of the cofferdam. The channels were connected by two ¾-inch cables to the anchor previously set in the concrete caisson. These cables hooked into U bolts that passed through holes in the webs of the channels and were held in position by nuts at the upper end. They extended down the sides of the caisson to the anchor bolts and when tightened, served not only to tighten the joints in the timber, but to prevent the crib from floating away.

The interior bracing in the cofferdam was placed above the cross walls of the caisson so as not to interfere with the dredging operations.

With the completion of the cofferdam, dredging was again resumed. At this stage of the sinking, the dredging would at times be from five to six feet below the cutting edge. It was not deemed advisable to go more than six feet below the cutting edge because of the danger of tipping.

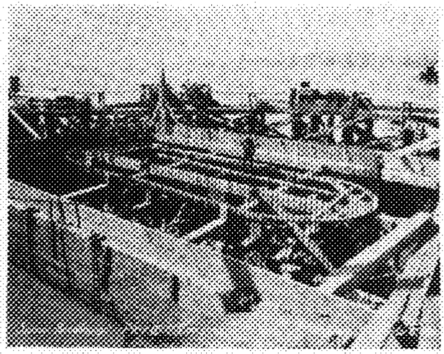
If the material holding up the caisson proved to be too hard to remove by jetting, a few charges of dynamite would usually loosen up the mud and dredging would again proceed until the caisson was landed on the rock. At this stage, a diver was sent down each well to report bottom conditions. Each well was carefully explored and the condition of the bottom reported by telephone as the diver proceeded around the sides of each well.

The diver depended entirely upon his sense of feeling as to how much sand or mud was under the cutting edge and cross walls and how far into the shale the cutting edge had penetrated.

As soon as each pocket was explored and the condition reported, a jet was lowered into the well and the material jetted from under the cross walls and cutting edge. Jetting would proceed for about six hours in each pocket and the jetted material removed by clamshell. Alternate jetting and clamming would continue in 12 hour shifts for about three shifts to each pocket, or until no further material could be removed.

The diver was then sent down to make a final inspection of the bottom. If he found the bottom satisfactory, the dredging wells were then sealed with concrete to a point a few feet below the distributing block.

The specifications for the deep water piers stated that the dredging wells were to be filled with concrete 35 feet above the cutting edge and the rest of the concrete to be poured in the dry. The only pier done in this manner was pier 12. After making several tests of the tremie concrete in pier 12, the engineers decided that the pouring of the concrete in salt water did not affect the strength and allowed the contractor to fill the wells



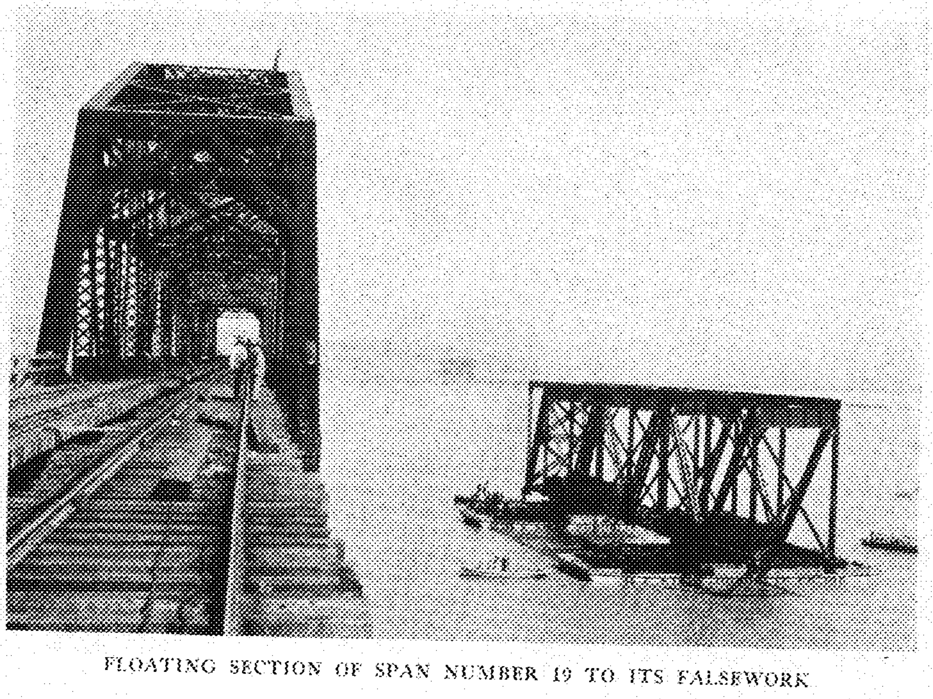
CONSTRUCTION OF SHAFT IN COFFERDAM AT PIER 13

in the rest of the piers up to the distributing block.

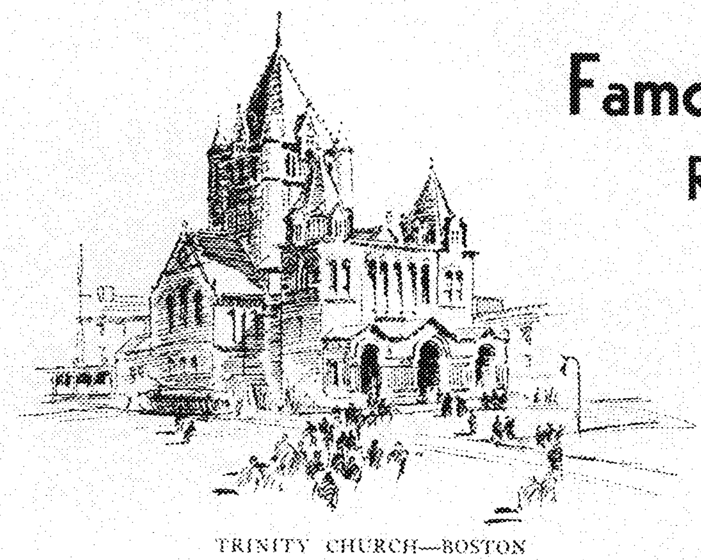
The pouring of the tremie concrete required about four days. On the fifth day, the unwatering of the cofferdam was started, which would take from four to six hours. On completion of the unwatering, the concrete is thoroughly cleaned off and a 2 inch layer of grout poured over the surface of the old concrete and the distributing block poured. Each block contained about 850 cubic yards of concrete, six tons of reinforcing steel and required about three days to place.

On the top of the distributing block the pier shaft was built. As the pier was built, the struts in the cofferdam were boxed out and the concrete poured around them leaving large keys at each set of struts. The cofferdam walls were braced against the finished concrete before the struts were removed and the next pour made. The pier shaft in the

(*Continued on page 144*)



FLOATING SECTION OF SPAN NUMBER 19 TO ITS FALSEWORK



TRINITY CHURCH—BOSTON

Famous American Architects

Richardson and Romanesque

By FRANCIS V. GORMAN, Arch '31

Illustrated by Milton V. Bergstedt, Arch '31

THE credo of American architecture recognizes a dyad of importance and consequence in a period of individuality and eclectism — Henry Hobson Richardson and the Romanesque Revival.

Eclectism, that indiscriminate use of many types of architectural precedent (and often on the same building) marked a period called the dark ages of American architecture which began about the middle of the last century. This new country, finding itself without architectural background, turned to every period in history in an attempt to find a sympathetic style from which to create a national architecture. Eclectism resulted, and architectural crimes were perpetrated without protest.

After the Civil War, Richardson was graduated from Harvard, and went at once to France to study architecture at L'Ecole des Beaux Arts. He was the third American ever to study architecture in Paris, and hence one of the first few who recognized that above all else, American architecture needed organization and leadership to change the prevailing bad to an idealistic good art.

No man ever displayed less, however, of the academic point of view of the Beaux Arts. Richardson found the methods L'Ecole slow and laborious. Seeking training that would satisfy his originality and genius, he chose André as his patron because of the "bigness and stuff" in his designs, and because he liked the great round arches and other picturesque features of André's work. Under such tutelage, Richardson made for himself a style, electric, personal, romantic, robust, virile, ingenious, and wholly barbaric; remarkable for its absence of proportion and yet creditable in appearance.

Subsequent travel in Southern France and Spain showed the Romanesque style to possess those elements Richardson was then trying to embody in his own work —rugged strength, comparative horizontality, and greater quiet. Richardson found his ideal Romanesque in Provence and Auvergne. One may characterize that Romanesque as the most classic of all Romanesque styles. It was inevitable in a district which still preserves the Pont-du-Gard, the Baths of Diana at Nimes, the amphitheatre at Arles, the triumphal arch at Orange, and countless other monuments of Roman antiquity. In general, Spanish Romanesque resembles that of Southern France. It was, therefore, a style akin to classic with all the dignity and proportion of classic but without its sameness. Richardson proved a diligent student of Romanesque as he saw it, and became thoroughly enthusiastic about its possibilities.

He returned to America and worked quietly in his favorite style. In 1872, Richardson obtained the commission for Trinity Church in Boston. The congregation was most elite,—one whose good will would be a tremendous asset. So, on his first "big" commission, Richardson gave Boston a Romanesque church, which had affinities to Spanish and Provencal Romanesque and yet without any portion of it being a slavish copy. This cleverness at adaptation without plagiarizing made Richardson Romanesque truly vital and unique. Trinity Church was a massive composition in sandstone,—powerful, and yet composed. It was the first monument of a period of vigorous Romanesque development.

By the time Trinity was completed in 1877, Richardson saw in Romanesque forms a far-reaching adaptability to American needs which would permit the development of a truly national style. The simplicity and ruggedness seemed suited alike to materials readily available, to the general limitation of funds, and to the relative lack of skilled stoneworkers. All his personality and power were concentrated in Romanesque. He secured innumerable commissions, all of which he executed in the same style.

At once, because Richardson was a leader and an innovator, he was imitated by hosts of lesser architects in whose hands the style became lawless, and the country was overrun with picturesque towers and broad low arches, all in browntone, and in all types of buildings. One found the same elements of Romanesque in court houses and country houses, in libraries and railroad stations, and in churches and warehouses; massive monstrosities rose on every hand to confound the originator.

Minnesota followed the pseudo-cosmopolitan East, and her architects designed Romanesque residences, stables, office buildings and colleges during the period. The University possesses Pillsbury Hall to show Romanesque handled by the most facile of native architects; and one may see the immense voissoired arches, short, squat columns, and the brownstone so characteristic of the whole style.

Meanwhile, Richardson, the originator, produced many designs for all classes of structures which were in themselves masterly. It is not the use of precedent in his work that is condemned, but rather the stupid work of his imitators. Richardson's use of precedent was that of an intelligent and discriminating artist who adapted and revitalized an historic style to conform to modern requirements. Such masterly adaptation of Romanesque gained recognition for Richardson both in America and abroad to such an extent that European writers of a half century ago assumed him to be the one outstanding original genius of American architecture.

As an architectural period, the Ro-

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HENRY HOBSON RICHARDSON

The Architect's Page

Edited by E. R. CONE, Arch '31

The Magney and Tusler Prize Competition

THE subject this year for the prize competition sponsored by the Magney and Tusler architectural firm of Minneapolis was "A Tea Garden in a Park." The program reads in part as follows: "In the park system of our city there is a chain of lakes much frequented by canoes, row boats, and motor boats. At one especially attractive point on the shore line of one of these lakes it is desired to establish a tea garden where boating parties may obtain rest and refreshments. There should be provided first of all a broad landing place where boats could be moored and from which broad flights of steps lead up to the terraced ground above, which form the tea garden proper.

"It is suggested that there might be a broad central space for dancing, fringed with tables for refreshments. These tables might be raised up on successive terraces, backed finally by pergolas, colonnades, trellis works, which shut in the gardens from the land side. All sorts of various garden features such as terraces, fountains, hedges, trees, and parterres may be utilized. Some provision must be made for such necessary services as toilets, serving rooms and kitchen."

The project which took the first prize is shown on this page. It is the work of a first quarter junior. Charcoal was used as a medium for rendering.

The Year Book

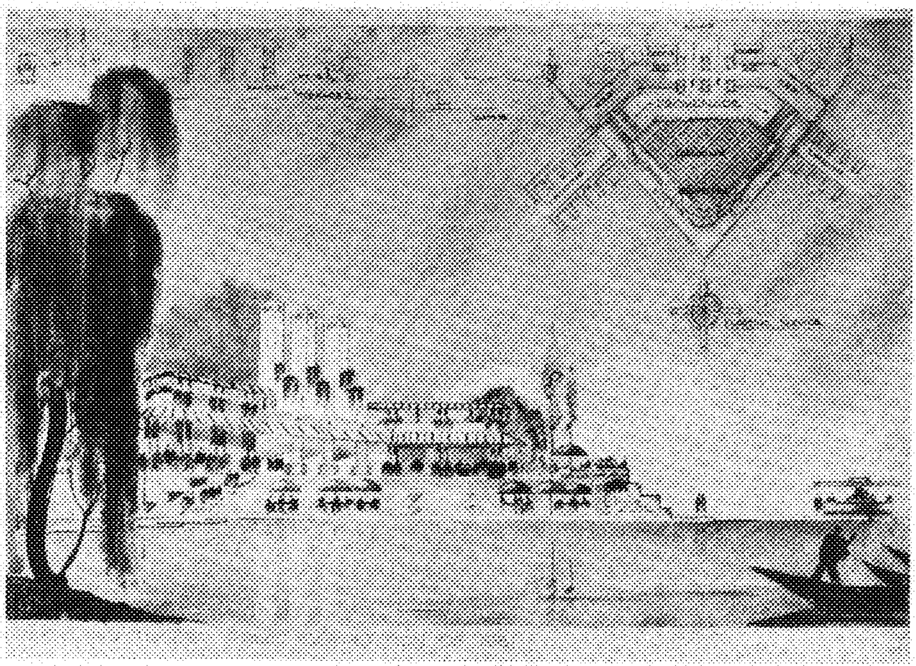
ARRANGEMENTS are under way in the School of Architecture to publish a Year Book reviewing the work done during the past year. The book will contain, for the most part, cuts illustrating the work done in Architectural Design, Freehand Drawing, and Building Construction. Other features will include pictures of the faculty and of the Architects' Jubilee, editorials, and reviews of important events taking place during the year. At present the Freshman class is engaged in a competition for the cover design and the sophomores are working on a similar competition for the frontispiece.

Year books of this sort have been published in the school in the past but the last one, which appeared in 1922, was not properly financed and proved a failure. It is expected, however, that with proper business administration the publication will become an annual affair.

As this article goes to press, the committee on subscription reports 175 subscribers with a probability of two hundred by the end of the campaign. This will include about seventy-five per cent of the students and all the faculty, the administration being very much in favor of the book. With this large number of subscribers, and with money coming in from other sources, it is expected that a very fine book will be put out, no doubt the best in the history of the school. An appeal is being made to the alumni to help support this publication and several subscriptions have already come in.

Milton V. Bergstedt is acting as editor with Rudolph Dahl as his assistant. James Dovolis is taking care of the business end of it and Francis Gorman will act as art editor.

The publication will appear sometime in May.



A TEA GARDEN IN A PARK—BY G. WHEELER McLAUGHLIN, ARCH. '32

The Annual Architectural Engineers' Banquet

THE Seventh Annual Architectural Engineer's Banquet will be held Saturday, February twenty-eighth, at Glenwood Chalet. The banquet, which is a stag affair, is sponsored by the senior class.

The program, which includes speeches by the faculty and a group of musical selections by Jack Tews, promises to be very entertaining. The high light of the evening will be a round table discussion with both faculty and students participating. The subject matter of this discussion is greatly varied but centers principally on undergraduate affairs.

The chairmen of the committees arranging for the event are as follows: James McHugh, general arrangements; W. B. Vercoe, banquet; F. C. Bolline, programs; G. R. Laub, entertainment; H. G. Harvey, publicity; H. L. Levine, tickets; D. L. Witcher, transportation; J. A. Morrison, alumni, and G. B. Townsend, decorations.

It is expected that there will be about one hundred men present and with the arrangements proceeding at a rapid pace, the banquet this year promises to be the most colorful one of recent years.

Re Brunelleschi—A Letter

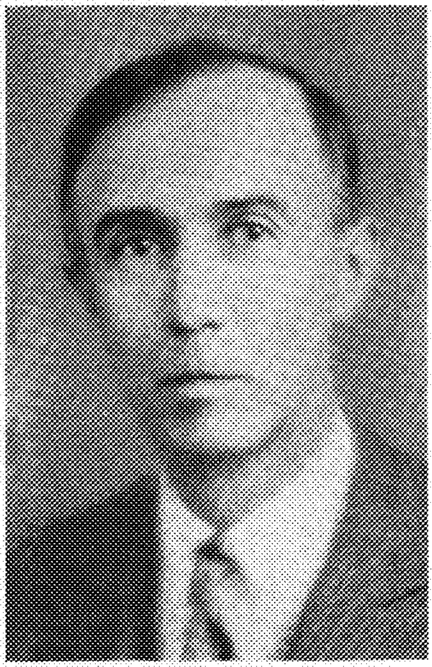
Dear Archie Tek,

HAVE you ever read Vasari's life of Brunelleschi? I have become very interested in him just lately and I'll tell you how it happened. The other day my boss and I had a long chat together. We often have little chats, but this one lasted all afternoon. I don't know how we got started but anyway we began talking about architects in general, and then the boss started talking about Brunelleschi. He got me so interested in this old character that I finally borrowed Vasari's Lives from him so that I could read more about the old boy.

I was surprised at the knowledge this one man absorbed—knowledge outside of his own profession. He seemed to just hunger after knowledge, not only in his own profession but in sciences as well. He was an architect, sculptor, mathematician, astrologist, philosopher, and above all he seemed to know an awful lot about human nature. Then too, he had a surprising amount of self reliance. When the competition was held for the design and construction of the dome of

(*Continued on page 148*)

NEWS FROM THE TECHNICAL CAMPUS



PROFESSOR FRANK B. ROWLEY

Rowley Honored for Work in Heating and Ventilating

At the last convention of the American Society of Heating and Ventilating Engineers, which was held at Pittsburgh, Professor F. B. Rowley of the Mechanical Engineering department, was elected first vice president of the society. This recognition came after almost ten years of research by Professor Rowley and his assistants at the experiment station.

Professor Rowley in addition to the new appointment will retain the chairmanship of the research committee. He has also been appointed by the United States department of Commerce as a member of the national committee on wood utilization.

According to Mr. Rowley, "Research work in heating and ventilation has been in progress at the Engineering Experiment station for several years. The main objects have been 1) the determination of the flow of heat through different types of insulating materials and built-up wall construction; 2) a study of dust in air and methods of measuring the amount present; 3) distribution of air and heat in large buildings such as theaters and auditoriums."

"The equipment that has been developed at the Experiment Station for heat transmission is recognized as the most compete in the country," Mr. Rowley said. "It consists of (a) an apparatus for testing built-up wall sections 5½ feet square, which are capable of measuring temperatures from 60 to 150 degrees on the hot side and from 60 to a

(*Continued on page 142*)

University Acquires Burton Etchings

In the group of the University's newly acquired art possessions are drawings of Geo. T. Plowman, Ivan Mestrobie and also 24 original etchings by S. Chatwood Burton, associated professor of Architecture at the University. The presentation was made late last fall.

This group of etching together with those of Plowman and the drawings of Mastrobie which were recently exhibited at a lecture given in the Engineering Auditorium by Mr. Plowman constitutes the nucleus of an art collection which University officials have started to build this year.

A wide variety of scenes is portrayed in Professor Burton's etchings ranging from a Castilian castle in Spain to the pines at Taylor's Falls. The unusual situation of the Spanish castle impressed Professor Burton as resembling a large man-of-war. This is the result of its being built on a high, rocky formation with the turrets of the castle resembling the masts of a great warship.

An etching of the Bridge of St. Martin in Spain has an unique background according to Professor Burton. The architect who designed the bridge the first time had made a mistake in the calculations. The bridge was about to be opened with great festivities, when on the night before the celebration, the architect told his wife that immediately after the scaffolding was removed the bridge would collapse. In the middle of the night his wife set fire to the bridge and it fell. As a result the people not suspecting the architect recommissioned him to design another bridge,—and his second attempt proved successful.

The majority of Professor Burton's etchings were done in Spain where he says that there is enough material in one small town alone so that all the art students in Minneapolis could go out every day of their lives and find a new subject to sketch or point.

Pi Tau Pi Sigma Holds Meeting

Pi Tau Pi Sigma, honorary Signal Corps fraternity, held a meeting in the Electrical Engineering building on January 29, 1931.

After a short business meeting a talk was delivered by Major J. H. Hester which was followed by a moving picture showing action at the front during the World War.

It was decided to hold the annual formal party of the fraternity on February 20th.

Annual Electrical Show Will Be Held in April

Plans are well under way for the Electrical party which will be held on April 17 and 18. This is a bi-annual affair and has become a tradition in the Electrical school.

At this time the Electrical students hold "open house" to the general public. For two days the school is open to inspection, and the students are given a chance to demonstrate their ingenuity and engineering ability. Electrical phenomena and freak stunts will be exhibited which are amusing and at the same time instructive.

The first day's exhibition will be followed by a dance.

The party is not only for the entertainment of the public but is also a chance for the student to exercise his initiative in the planning and execution of a social activity. Many large problems are encountered, and several months of planning and work are necessary if success is to be assured. Although a little objection has been raised by the faculty from time to time on account of the unavoidable detraction from class work, this difficulty has been overcome and the faculty backs the movement and co-operates to full extent.

The party is sponsored by the student branch of the A. I. E. E., and is financed solely through the sale of invitations and tickets to Electrical students. This requires a complete turnout of the entire Electrical school.

S. CHATWOOD BURTON

Phalanx Holds First Formal Initiation

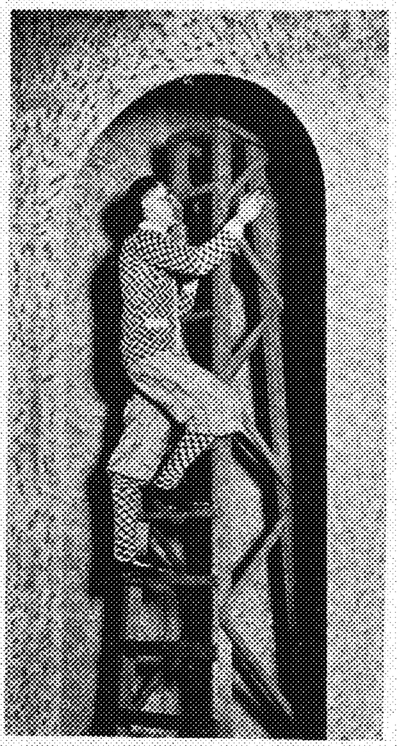
Phalanx, national honorary and professional military fraternity, which was installed on the Minnesota campus during the early part of fall quarter held their first formal initiation on February 7th at the Andrews Hotel in Minneapolis.

The first chapter of Phalanx was founded at Illinois in 1925, and expansion was deemed unwise according to Mr. Buchak until the past year when the Beta chapter was founded at Minnesota. Members are chosen from the various branches of the army at the University and limited to those taking advanced courses, who are of high standing in their military work.

The officers of the organization are: Robert Cunningham, commander; Kirk Buchak, vice-commander; Paul Markosan, secretary; and Irvin McNally, treasurer. Lieutenant R. W. Minckler of the Signal corps, has been chosen faculty advisor.

Among the more prominent honorary members are: Major John H. Hester, commandant of the military department at the University; Captain Porter P. Wiggins, adjutant; Lieutenant Harlan Hartness, and Lieutenant Hewitt Richmond.

Recent initiates among the undergraduates are: Leonard Erickson, Earl A. Hanson, Clifford J. Hauge, Harry C. Holmes, Robert Howe, Parker Lowell, B. A. McDermott, Torry C. Orest, H. C. L. Swanson, R. B. Thompson, and T. H. Tillisch.



JOHN ENGINEER THE MALE LEAD IN THE 1927 PRODUCTION OF THE ARABS

SKOAL TO THE ARABS

By CLIFFORD I. HAGA, Instructor in English

It is frequently claimed for the engineering students that as a group they live up to the campus superstition that membership in a particular college endows the student with a set of beliefs, virtues and symbols more noble, more pure and more delightful than any which it would be possible to ascribe to the members of another college. In short, the engineer resolutely clings to a vigorous faith in his own superiority. And it is well that he should, for in this subconscious way he transforms what might seem a frivolous loyalty into a real symbol of his faith in his profession. He is, he says, an engineer first, a college student next.

To make sure that others may realize that fact, he dramatizes such differences as tradition has been pleased to set up between engineers and arts students, or engineers and agricultural students, and lives according to the opportunities offered by his arbitrary differentiation. Anyone who has been an undergraduate on this campus remembers the peculiar impact of an engineer on a group of assorted students. As an undergraduate in the college of Science, Literature and the Arts here several years ago, I knew few engineers, but all those I knew were most remarkable men.

For a long time, I was not able to explain this, but now I think I know. That body of loyalties and traditions which all engineers recognize has established a fairly stable type, a remarkably close-knit social group. It is not too far-fetched to compare the state of mind of the engineer with the peculiar temperament of say, a Frenchman or an Englishman, and the marked difference between such a national and an American. Custom and tradition have fixed the manners and beliefs of the citizens of the old country; the result is that they possess in themselves a set of standards by which they can judge others. Doubt and confusion do not exist among them to the extent that those disturbing factors have all too often hindred us in our attempts to produce works in literature or art which may be described as purely American. Engineers may rebuke such an attempt to explain their peculiarities, but to one observer at least the comparison is legitimate and revealing.

I just spoke of literature and art. Let us see what happens when we carry out our comparison in this direction. Engineers produce no literature or art? We must not forget the pageantry of Engineers' Day. Vulgar and naive as it frequently is, it is still a definite expression of a particular point of view characteristic only of engineers. It entertains and instructs, it sometimes discovers a feeling for beauty—primitive though its form may be, it still has some relation to art.

A BRAWNY ENGINEER AS SEVEN CORNER SADIE IN "BROADCAST"

But more important than Engineers' Day is another event which actually dramatizes in proper form the faith of the engineer that he has a special role to play in college life. This is the annual production of the ARABS, the evening when John Engineer puts aside the role he himself has created and peopled with outlandish and grotesque puppets by whose words and actions he seeks to interpret the mysteries of the universe and the folly of mankind. He writes the songs and dialogue himself, composes his own music, sets his own stage,—it is his show and he runs it himself. When the curtain goes up we see and hear what the engineer thinks of others, always to his amusement and frequently to ours.

The ARABS return each spring to hold their Falstaffian mirror to the rest of us. As we hear sounds of their preparation for the annual effort, we look back on the past with a feeling of relief—they were not hopeless when they last appeared—and look forward to the future with a guarded anticipation —they may be better this time. But whatever happens, we know that John Engineer has a whale of a good time. It is our part to join with him in his humors and to cheer all those who worked to give us this pleasure,—burning the midnight oil in framing John's windy speech for the stage, sweating through the routines of the chorus, blistering fingers on the lighting switches, cursing mashed thumbs and refractory props. Skoal to the Arabs.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Go Gopher!

FOR the past few weeks, the 1931 Gopher has been carrying on a well planned and well executed subscription campaign. This annual publication of the University attempts to portray and record the pulse of student life throughout the year, in a manner that is at once interesting, artistic, complete and historical.

The Gopher is the one opportunity offered to a student by which he may obtain a tangible picture of the University and the inter-relationship of the Colleges and various departments. It serves as a medium for gaining an All-University outlook and stimulating the idea that we as engineers are just a part of a great institution that has given us much and to which we owe a great debt.

As we peruse our studies year after year it becomes increasingly more easy to lose sight of the fact that the University is something more than the College of Engineering and Architecture. It is even easy to lose sight of the fact that the University is something more than a means to an end as far as we are concerned. And once this attitude is obtained,—and it develops merely because the matter is given such scant attention,—then we are powerless to take advantage of any opportunity to broaden ourselves and gain a little of that precious something that can make us useful to our University,—that precious something called vision. Vision is worthwhile. Its cultivation will lead to a fruitful, constructive and useful life.

Engineers,—let the Gopher aid you in obtaining this outlook. Give your support to the Gopher,—the oldest Minnesota tradition, a pictorial history of your life as a student at Minnesota.

Power to the Arabs

THE spontaneous re-birth of the Arabs, engineering dramatic organization, is as gratifying as it is surprising. For the past year the organization has been practically inactive on the campus and it appeared that in the future Minnesota engineers would not be enabled to witness the annual production of the organization.

But suddenly a chance spark fell on smoldering enthusiasm, and violent activity was immediately manifest. Weekly meeting are being held, the membership roll has doubled or trebled, the plot for this year's play is rapidly nearing completion, musical scores are being written,—in short, the Arabs are "on the make."

Industrial Engineering

IN recent years there have been many investigations to ascertain the number of engineers who remain in the scientific field after graduation. According to a survey conducted by the Society for the Promotion of Engineering Education, out of every ten men who graduate as engineers, after a period of ten years, seven are engaged in administration rather than engineering.

At the present time there is no actual course in industrial engineering at the University of Minnesota. In accordance with the present arrangement a student may take two years of engineering, and then two years of business. The superhuman student may take in addition to his already heavy engineering curriculum a group of business electives. However, the latter is beyond the average student's capacity.

Industrial engineering should be introduced as a unit complete in itself. It should include courses in engineering, business, English, public speaking, mechanical technology. There should be numerous inspection trips not only to plants in the Twin Cities, but to other districts. Inspection trips to view the practical applications of theory studied in school should be the backbone of such a course as industrial engineering.

In consideration of the fact that only thirty per cent of the graduating engineers remain in the field of engineering it might be well to give thought to the installation of a course in industrial engineering.

Question

MEN that study the laws of nature and reduce them into complicated mathematical formulae tend to become self-sufficient. That science is a search for the truth is a well known fact. But do engineers believe that there is a spiritual power which controls all the forces of nature or do they believe that the day it not far distant when all of nature's laws will be discovered and the old belief of the spiritual force come tottering down with a crash?

With every discovery in engineering and scientific fields another step forward is taken and more of the old beliefs and superstitions move back to make room for the truth. Will it not then be possible that the slide rule symbolic of science will replace that age old instrument the Bible in the eyes of engineers?

Yet remembering that science is the search of the truth what can the words of St. Thomas mean when he said, "where science ends truth begins?"

Can You Qualify?

IN the springtime a young man's fancy lightly turns to . . . . etc.

In the springtime companies which employ many engineers turn to a study of the applicants for positions. The greater number of those applying for work is usually made up of graduating seniors. Today, the successful applicant is one that not only has a good scholastic record, but also those characteristics which go to make up a good personality.

A study made a few years ago of the records of 3,806 men employed by the Bell System to determine the relation of scholarship to progress in the company revealed the fact that those men who had received high marks in college advanced much more rapidly than those who had received only fair grades. The median salary of 498 men who stood in the first tenth of their class was over 10% more than the median salary of the entire group at ten years after graduation; 30% more at 20 years after graduation; and 55% more at thirty years after graduation.

In addition to a good scholastic record employers want men who are socially acceptable. By socially acceptable is meant the sum total of those qualities which gives one a favorable impression of the individual.

The following questionnaire is typical of those used by employers to assist them in their selection of applicants:

1. Scholarship record—excellent, good, fair, poor.
2. Appearance — pleasing, careless in his dress, unkempt.
3. Leadership—strong, average, weak.
4. Loyalty to superiors and the organization — satisfactory, questionable, disloyal.
5. General Accuracy — exceptional, satisfactory, fair, inaccurate.
6. Congeniality—congenial, unpleasant, contentious, quarrelsome.
7. Initiative—Is he a self-starter? Is he original? Can he do ordinary assignments of his own accord? Does he need occasional prodding? Much prodding?
8. Industry—exceptional, satisfactory, fair, lazy.
9. Mental alertness—above the average, satisfactory, slow thinker.
10. Adaptableness to work—especially versatile, satisfactory, limited.
11. Punctuality—satisfactory, unsatisfactory.
12. Reliability—trustworthy, not dependable.
13. Executive ability—exceptional, satisfactory, fair, poor.
14. Ability to meet public—exceptional, satisfactory, fair, poor.
15. Conscientiousness—very careful, fair, lax.
16. Is candidate always willing to do his best, or must he be humored? Yes————, No————.
17. Judgment — quick and sure, slow and sure, hasty, not reliable.
18. Persistence—determined, tenacious, too willing to give up.
19. Remarks ....
....

This list should be studied in its application to yourself. What rating would you receive from your classmates; from your instructors; from your employer? Make a self-analysis to learn your weak points, then endeavor to overcome your deficiencies. Studies of this kind should spur one on to make of himself a "desirable" engineer, not only one with a good scholastic record, but also one who is congenial, industrious, punctual, reliable, and courteous.

The development of these characteristics is most essential to future success. Many opportunities are afforded the student for the acquisition of habits of industry, of punctuality, of initiative, of gentlemanliness, etc. Careful budgeting of one's time will quite frequently give one an opportunity for adequate preparation of studies. The habit of being on time should be cultivated. Instructors resent very much the annoyance caused by the student who is always two or three minutes late for class. Employers do not tolerate the habitual latecomer.

Some students are under the impression that an engineer must be "hard-boiled." Yes, "hard-boiled" perhaps in the sense that he does not take things for granted. "Hard-boiled" in the sense that he seeks the truth, but certainly, not in the sense that he must be rough, vociferous in his exclamations, or a rowdy. There is a time to wear evening clothes and a time to wear flannel shirt and boots. Each is proper in the right place. The real engineer is both a scholar and a gentleman. He greets his fellowmen. He is considerate and willing to lend a helping hand.

Your instructors are willing to help you, if you will show them that you mean business and are willing to co-operate with them. Contacts with your instructors frequently lead to

(*Continued on page 140*)

MISS RUTH CARTER

FACULTY SKETCHES

MISS RUTH CARTER, instructor of Furniture, a course offered in the School of Architecture, was born in Windom, Minnesota. She attended the Windom High school, and upon graduation matriculated at the University of Minnesota, where she enrolled in the course of Interior Architecture.

While attending the University she was engaged in all of the activities current in the engineering college. She was a member of Alpha Alpha Gamma, honorary architectural sorority. She also found time to serve on the decoration committee of the Architects' Jubilee, and the annual masquerade of the Architectural Society, of which she was also secretary. She helped the engineers by serving on the committee for the Green Tea on St. Patrick's Day.

At the conclusion of her four-year course, Miss Carter received employment in the designing studio of Mandel Brothers, of Chicago. Here she drew brief perspective sketches of various interiors, which were taken by the decorators, to show the prospective customer. This involved a great deal of efficiency and art ability in order to successfully catch the eye of the customers. Besides the drawing of these sketches she drew the detail on some of these problems and the drawings of furniture to be made. While in Chicago she lived with a friend in a small studio, a few blocks from Michigan Boulevard, near the gangsters' section and over an antique shop—a quaint setting for a lady architect.

After a year in this employment Miss Carter returned to Minneapolis and became an instructor in the School of Architecture.

Idiosyncracies: Likes to walk down Michigan Boulevard, Chicago.

Pet aversion: Being called "Swede" by Chicago people.

Recreation: Sketching in unusual places such as the slums of Chicago or the sand dunes of Michigan.

Admitted vice: Staying up late at night.

AROUND THE WORLD WITH OUR ALUMNI

Architects

'23—Johnson—Elving Johnson was recently in the city. He is now with the firm of McKinn, Wead, and White of New York City. He was formerly with York and Sawyer company, architects.

'25—Molander—Ed Molander is now practicing out in North Dakota, with offices in Bismarck and Minot. He was at the University the other day and paid a visit to the architectural department.

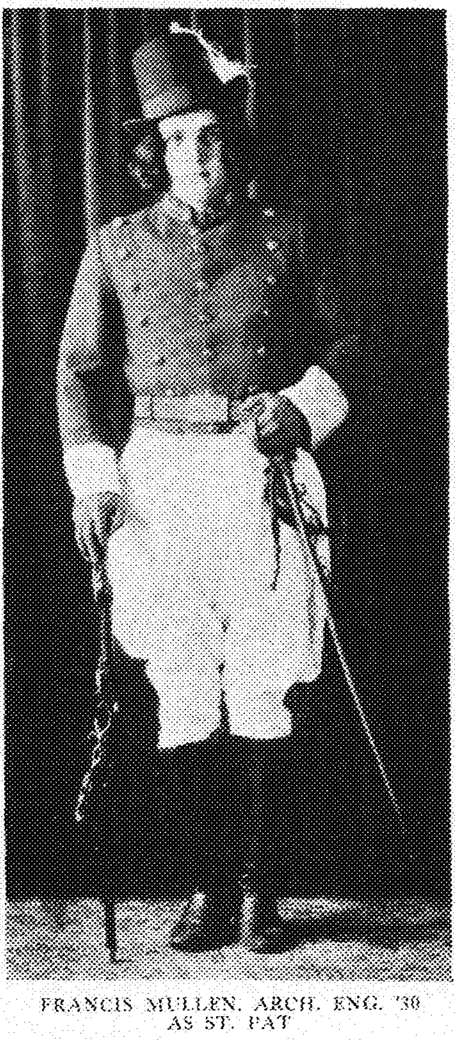
'27—Bull—Stan Bull has been going places and doing things. His former address was General Motors building, Detroit, Mich. Now he may be found at 10 Woodside, London, N. W. 11, England.

'27—Kilpatrick—Porter W. Kilpatrick, who is now residing at Grand Forks, North Dakota, paid a visit to his friends as he passed through the city the other day.

'29—Melzian—Milton Melzian is an instructor at the University of Idaho. He has married and seems to have settled down.

'29—Shifflet—Glyne Shifflet is now working in the office of Cass Gilbert of New York City.

'29—Berzelius—Carl Berzelius is still working for the Insulite company, but now he is in Columbus instead of Cleveland, Ohio. He hopes to see the Minnesota basketball team defeat Ohio State and believes that there will be many followers of the Maroon and Gold to cheer the team. His address is 2253 Indianola Avenue, Columbus, Ohio.



FRANCIS MULLEN, ARCH. ENG. '30 AS ST. PAT

'30—Fridlund—Harold Fridlund is drafting for the firm of McEvary and Larson, architects of Minneapolis.

'30—Wallace—Bruce Wallace is connected with the firm of Lang-Gaugland and Lewis and has been transferred to their newly established branch in Eau Claire, Wisconsin.

'30—Brunet—James Brunet is designing for the Fleur City Ornamental Iron company. He has worked there since his graduation.

'30—Knuth—Lloyd Knuth is working for the Minnesota State Highway department and at the present time is located at Elk River, Minnesota, with the paving inspection department.

'30—Mullen—Francis (Moon) Mullen, who is well remembered as our St. Pat of last year, is working in the bridge department of the Soo Line railroad and frequently comes around school to visit the boys.

Civil Engineering

'08—Dougan—Henry Dougan, executive assistant to the president of the Great Northern railway told of his recent trip to Russia at a meeting of the Women's Club on January 5th.

'23—Buhr—Lester M. Buhr is at present employed by the U. S. government as an assistant engineer with headquarters in St. Paul, Minnesota. After his graduation in 1923 "Pa" entered the employ of the Byllesby Engineering corporation working for them until 1929 when he became associated with the government. "Pa" is married and has two children. He reports that prospects for the future are bright.

'23—Schaller—George C. Schaller has moved to 1182 Stanford avenue, St. Paul. George is a papa now. Samuel Brown Schaller arrived at the house last July 20th.

'23—Hill—Hibbert Hill is now with the U. S. Engineer's office, St. Paul. He recently talked to the Minnesota branch of the A. S. C. E. on hydraulic model testing.

'25—Swanberg—John H. Swanberg of the road materials department in the American Tar Products company, was married in April 1928. Now he is a dad—the proud father of a daughter born in September 1929.

'26—Brownell—Ed Brownell has been working in the U. S. Engineer's office in St. Paul since leaving his position with the Northern States Power company.

'27—Kastner—Roy W. Kastner, formerly of the Illinois Highway department, now draws his check from the famous city of Peoria, Illinois. He is holding down a job as assistant city engineer.

'27—Engler—Myer Engler is now working for Cook County, Ilinois. He reports that he is not married yet, but is slipping fast.

'27—Bolnick—Harry W. Bolnick is still with the valuation department of the Santa Fe Railroad. His home is in Amarillo, Texas and he is not married, but according to Bolnick that won't make much difference.

'27—Paulson—Joe Paulson, who was working as a draftsman in the office of the assistant chief engineer of the Great Northern Railroad up to February 1, 1930, has begun to receive his rewards for honnest labor. He is assistant engineer to division headquarters on the Cascade division of the Great Northern railway. His office is in Seattle.

STANLEY BULL, ARCH. '27 AND PAUL B. NELSON, EE '26, LUNCHING IN PARIS IN 1929

'28—Ringwood—James B. Ringwood formerly with the Joliet and Eastern Railway company, has now changed his address to Mexican Hat, Utah. He is a Junior Hydraulic Engineer for the U. S. C. and G. S. and has been in charge of stream gaging and silt sampling work on the San Juan river in conjunction with the Colorado river investigation.

He is not married and his nearest post office is thirty miles away. His neighbors are coyotes and Navajo Indians.

'30—Crippen—Curtis Crippen is in Minneapolis in the Milwaukee Railroad office.

'30—Louk—Frank Louk is in Kansas City working in the U. S. Engineer's office making designs and cost estimates for hydro-electric and irrigation projects on the Missouri river and its tributaries. After being graduated Mr. Louk worked for the Illinois Highway department at Paris until his appointment at Kansas City.

Electrical Engineering

'22—Tuve—Dr. Merle Tuve working in conjunction with D. L. Hafstad, has been awarded a $1,000 prize by the American Society for the Advancement of Science in honor of his research in discovering the most intense radiation ever produced. These radiations are equal to those giver off by radium, which is worth many thousands of dollars per ounce, and will no doubt become an important part of the fight against cancer. Dr. Tuve is also director of the department of terrestrial magnetism at the Carnegie foundation in Washington, and has won recognition for other scientific research and invention. He is now attempting to invent a vacuum tube of 5,000,000 voltage, having already produced one with the capacity of 2,000,000 volts.

'27—Norberg—Hans Norberg has gone

WILLIAM B. STOUT, EX. '05

west. He used to draw his pay from the General Electric company of Schenectady, New York, but now he is located at Bartlesville, Oklahoma. The Phillipps Petroleum company receives the results of his work.

'30—Green—Arthur T. Green is now living at 212 Lexington Avenue, Buffalo, New York. He is working for the General Electric company in the meter and relay department and writes that his work is very interesting.

Mechanical Engineering

'05 Ex—Stout—William B. Stout, aeronautical engineer and head of the Stout Airways, Inc., along with his daughter, Wilma, suffered severe cuts about the face and head in a minor airplane accident recently. When he was landing at the Ford airport at Dearborn, after taking a short trip in his personal plane, the wheels struck a ground rut and the plane nosed over.

Mr. Stout gave the commencement address to members of the graduating class of the University at the end of the fall quarter of 1929.

'30—Odegaard—Harold T. Odegaard is still located at 908 South Main Street, Aberdeen, South Dakota, but there is a difference. Last fall a baby girl was born to Mr. and Mrs. Odegaard.

'29—Shannon—Harold R. Shannon has been elected president of the recently organized Minnesota Alumni unit at Fort Wayne, India. The association has already held two meetings and Harold states that it is a real success.

Notes on Plowman's Lecture on Engraving

By GLADYS WALLENE, ME '34

About three or four hundred years ago some goldsmiths were working in Italy. They were making designs on objects of different kinds, and they desired to preserve these objects when disposed of, so they filled them with lamp black and put a piece of damp paper on these and when this came off and they were able to store it away and use it over again. They were making the first engravings. . . .

A steel engraving is simply an engraving on steel. The engraver has to work for months to make these in order to come out right,—the lines must be cut at different depths. Then it was discovered that by putting a steel facing on a copper plate, copper could be made as hard as steel. After this discovery, no more steel engravings were made. However, all American paper money is made from steel engravings. Uncle Sam still has time and patience to make true steel engravings. . . .

After experimenting for sometime, it was found that by putting beeswax on the plate and then cutting the wax, and immersing it in a bath of HNO_3, the lines that were left open would be cut in the plate. This is a form of engraving called an etching. Although the picture is drawn on the plate, the final effect of the acid must be kept in mind all the time. . . . The fact that a man can do a beautiful drawing in pencil or ink does not mean that he can make a good etching. When the acid gets into the copper it goes sideways and down, so the depth of the lines must be governed by this fact.

Furthermore, the etcher must draw in the reverse. First a drawing is made on paper and the drawing placed in front of a mirror, then it is drawn on the copper plate as it appears in the mirror. The only other way would be reflect the desired scene upon a mirror, and make the etching from this image, but even this is not successful. . . . Mr. Plowman at one time made etchings by means of a mirror (his wife's hand mirror) from a window in Italy. But, it would not be convenient to do this on the street.

When the acid is attacking the copper and bubbles begin to appear the etcher takes a feather and brushes them away, and lets them again form. This repeated three times. If he decides some lines are not deep enough, the lines which are suitable are covered with wax and again the plate is put in the acid bath. So he progresses and by this means, he obtains his values. One method of determining the depths of the lines is to take the needle and go over the lines, or look at it toward the light. . . . The only other way is the saddest; — it is the trial proof. . . .

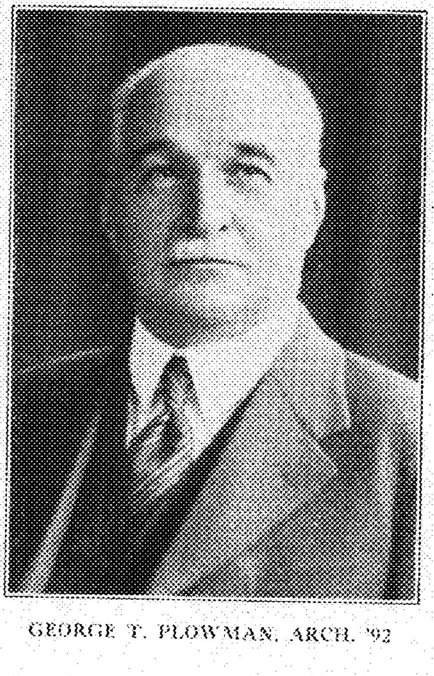
After the plate has been made, it is necessary to reproduce it in ink. The etcher first covers the plate with printing ink, pushing the ink into the plate, and being careful not to scratch the plate. The excess ink is then removed with a piece of muslin, but it is essential, of course, that some ink remain all over the etching. Just the right amount of ink must remain—not too much—not too little. Extreme delicacy must be used in this part of the process. Finally, after the ink has been safely placed, a proof is taken.

An etching press has two steel rollers with a steel bed passing between them. An etching paper is dampened, put over the plate and wrapped in blankets. It is then inserted in the press under great pressure, so that every part of the etching will be taken from the plate onto the paper. You can feel the ink standing above the paper on an etching. A good etching must take practically all the ink. . . .

A successful etching has three essentials: 1. Successful drawing, 2. Successful biting with the acid and 3. Successful printing.

The artist generally will be disappointed after the first proof. He finds that some lines are not deep enough and others are too deep. He has tools for making these lines deeper, shallower, or taking them out entirely. His by-word becomes, "While there's copper, there's hope." In a drawing you cannot make corrections, but in an etching sweeping changes may be made and the freshness and life retained. It is possible to make

(*Continued on page 140*)



GEORGE T. PLOWMAN, ARCH. '92

Recent Progress in the Soviet Union

(*Continued from page 125*)

implies an over work for the mass of the people. To the contrary, the working day has been reduced to eight and in one-half of all enterprises, even to seven hours, and the seven day week has been replaced by a five day week, four days of rest, all other festivals, except a few revolutionary anniversaries, being abolished. In addition there is an annual leave, ranging from two weeks to a month usually (two months for the teaching staffs of schools and universities), without cessation of payment. The latter is also preserved in case of illness, medical aid in the hospitals being granted to all working people and members of their families free of charge. The increase of the well being of the Russian population is beautifully demonstrated by the steady increase of their number—over 3½ millions a year, which is wholly due not to the increase of the birth rate, but to a great decrease of the death rate (over 30 per cent).

There is thus no over-work, at least as a rule and for the vast majority. Exceptions are made only in cases of emergency, if some part of the "front" is in danger of defeat. In this case the party and trade union organizations may go so far as to make mobilisations among their members to provide relief for the endangered part. At the beginning of the collectivisation campaign in the autumn of 1929, for example, an army of 25,000 working men of various factories were mobilized in this way, quickly trained and sent to the villages in order to help the local authorities and the peasants in the carrying out of the collectivisation.

What the Russians had to suffer last year was not over work but rather under payment. To be still more exact: they got good wages, better on the average than before; but shortage of commodities prevented them from actually using their money to the full extent. In this connection it may be remarked that the shortage or abundance of goods does not in the least influence their price so far as state trading and co-operative organizations are concerned—a situation entirely different from that met with in capitalistic countries.

As has been said above, however, this shortage has been a transient condition, a one year's sacrifice of the nation's well being for the solid prosperity of the immediate future. There will be no question of shortage towards the end of the present year.

Russia's struggle for socialism is not entirely peaceful, because it implies not only the resistance of natural elements but also that of human beings—in the first place of the capitalistic elements both of cities and villages. The former have been crushed in the course of the last three years by milder means—mainly by heavy taxation which made them abandon their jobs. Thanks to the elimination of unemployment these ex-capitalists can now make their living by working for wages in offices or factories. The "liquidation of the kulaki class" has been prepared by heavy taxation too, but actually carried out in a violent revolutionary manner,—by requisition of their land in favor of the collective farms. Thus the kulaki had to suffer the same lot as the rich landlords twelve years before. This requisition has been limited, however, to the regions where the collectivisation involved the majority of the rural population.

Ex-capitalists and kulaki are the outcasts of the Soviet State for the present moment; they (and the priests) are the only group of the population who are deprived of suffrage. The rest of the population is divided into three groups—the industrial workers, the officials, and the poor or middle peasants. These three groups are treated by the government in different manner, the first being the most favored. This is explained by the fact that the revolution was mainly carried out and supported by the working class. The distinction between these groups is, however, artificial, that is of a purely historical character, and quickly vanishes, as they are mixing and diffusing into each other. It may be safely believed that in a few years the "class struggle" in Russia, with its bitterness and unfairness, will be over; and all Soviet citizens will enjoy exactly the same rights and advantages as citizens of the socialistic state, working for their common welfare under the control of a government which will be considered not as their ruler but as their servant.

This equality should not be misunderstood. It does not imply equality with respect to the share each citizen will enjoy in the common benefit. Such equality does not exist now—the wages depending on skill, knowledge and ability, and ranging from about 50 to 700 roubles a month. It is not intended to establish it in the future—the share of each individual in the total benefit of the society will probably always remain dependent upon his share in the achievement of this benefit. But, such things as misery and superabundance—the contrasts of the capitalistic society—will no longer exist in the Union of Soviet Socialistic Republics.

Prizes to Be Given for Articles

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, 1931.*

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.*

Famous American Architects

(*Continued from page 128*)

manesque Revival can not be judged by present-day standards. It is to be visualized as the first step from chaos to order. By his adroit use of Romanesque, Richardson also accomplished a great purpose in calling public attention to architecture as one of the fine arts, and it was in his office that the men were trained who were to satisfy modern demands and at the same time bring into architecture the elements of beauty and real charm.

Romanesque (whether or not we think it good architecture) was the first movement for the recognition of appreciation, beauty, and culture; the first attempt to organize confusion; and the first step toward the clear thinking that produced today's architecture.

Reminiscences of the Panama Canal

(*Continued from page 123*)

the short length of paved roadway at either terminus.

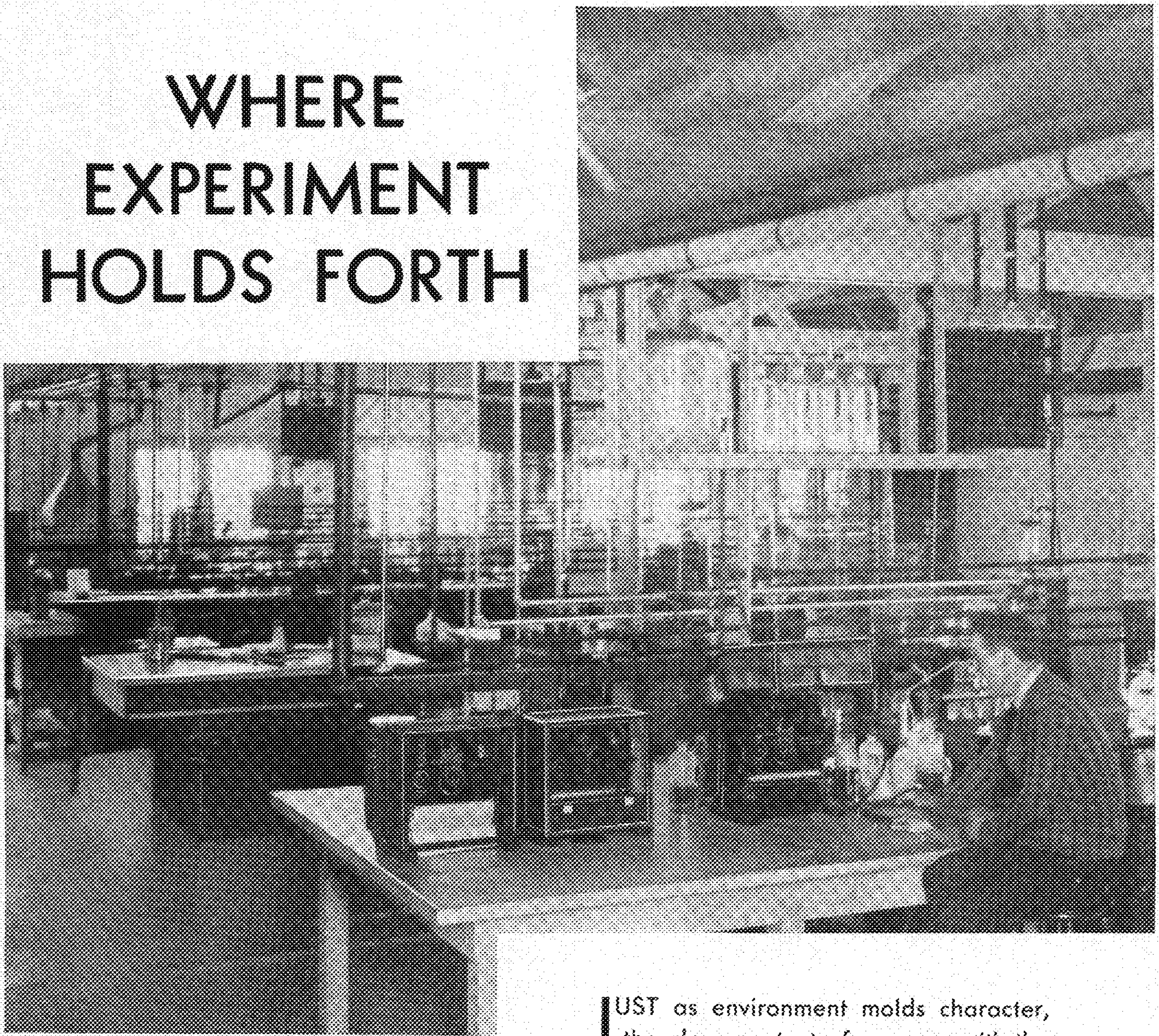
After a residence of five years in the Canal Zone the writer has concluded that the building and operation of the Panama canal by the war department involved the transplanting of a typical American community with its industrial organization to a tropical country, and making what changes were necessary to adjust it to the new environment. The adaption to the new conditions have produced many features with which the average American is unaccustomed. The Government provides everything for the canal worker except food and clothing. Medicine, hospital care, light, water, fuel, furniture and housing may be listed. All enterprises are operated by the Panama canal. Laundries, ice plants, cattle ranches, dairies, recreation houses, restaurants, hotels, commissaries are Government owned and operated, which, of course, eliminates privately run business from the Canal Zone.

As boats reach the canal every day from the United States the employees are able to purchase practically everything in season from the States, and in addition they have a wide variety of tropical fruits and vegetables at their disposal. Ordinarily the American finds most of the new foods palatable. The writer himself still hankers for the avocato or alligator pear, breadnut, mamey, chayote or chocho, plantain, mango, and the lucious papaya. The plantain is a large, coarse variety of banana that is delicious when either baked or fried. Why this tropical fruit has not been introduced into the United States is not clear, because it will withstand the effects of transportation better than the banana. The mango is not a stuffed bell pepper as we know it here, but instead a large plum for which usually a taste must be developed. To the uninitiated the turpentine taste of the skin of some varieties of the mango is decidedly repulsive. The papaya is a melon that grows on a tree, and its succulent, golden, papain flavored meat might well serve as the ambrosia of the gods.

The writer often has been asked if he ever cared to return to the Panama canal. The answer always has been in the negative unless the return was made for just a visit. The monotonous round of warm weather, the depressing climate, the lack of complete diversion which can be obtained in the United States, and the restricted opportunity argue too strongly against permanent residency in the tropics. It is granted that going in one's shirt sleeves and wearing a straw hat on Christmas Day is a novel experience for one from the far North, but it is not long before one yearns for our Indian summer weather, Big Ten football games, and the activity and bustle characteristic of the United States.

There is one feature of the life of the four thousand American employees of the Panama canal that stands in bold relief. It is the economic independence of the workers, and the consequent levelling of the social strata. On the Canal Zone there are no rich or poor. Everyone has work to do. He is doing it, too, otherwise he will have no residence in the Canal Zone, because if one loses his job he automatically forfeits his quarters. The only alternatives left are either to move over into the Republic of Panama, or return to the States.

WHERE EXPERIMENT HOLDS FORTH



A section of the Physical Laboratory

TRADE **Dow** MARK

JUST as environment molds character, the close contact of our men with the consistent development of new processes and new products, inspires the desire to follow thru individual ideas.

Our staff of over 190 graduate chemists, physicists and mechanical engineers is always alert to discover new and better methods and products as well as to test and check the old ones.

The facilities offered by our finely equipped chemical, physical and metallurgical laboratories, and a complete chemical library are available to our personnel.

Such co-operation results in better products for our customers and broader opportunities for our men.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

Can You Qualify?

(*Continued from page 133*)

a certain intimacy and better understanding of each other. Intimacy when flavored with courtesy and respect is delightful.

Due to the present business situation, a company which employs hundreds of engineers each year is compelled to limit its selection of graduates to those "from the upper half of the class both from the point of view of scholarship and from the point of view of leadership."

Can you afford to merely "get by?"

—A. S. LEVENS,
Asst. Professor of Drawing and Descriptive Geometry.

She was just a switchman's daughter, but she sure side tracked me.

Notes on Plowman's Lecture on Engravings

(*Continued from page 135*)

any change one may want to make. This work on the copper has been called tinting.

Dry-point is a process of engraving in which a sharp steel needle is employed to make furrows on a plate. No acid is used in this process, and as a result a deep velvety black results which is not seen in etchings. When the ink is put on the plate, the shell keeps the ink, and the ink spills over and makes this soft velvety black. Furthermore by drawing with a sharp needle, some of the freedom enjoyed in the making of an etching is lost. . . . Velvety black and lack of freedom in the lines tells you the difference between etching and dry-point.

If there are very delicate lines, these lines will gradually fade out after many printings. From fifty to seventy-five, even up to one hundred printings may be made from one plate. In the case of dry-point, it is not possible to obtain as many reproductions because the ridges become worn down. Thus, dry-points are more expensive due to the fact that you cannot get as many copies. . . .

There are two other mediums, aqua-tint and mezzo-tint. Aqua-tint is a medium where the spaces are bitten in with aqua fortis after the plate has been heated with resin. In the case of mezzo-tint, the copper is roughened by a scraper called a cradle. This roughness is gradually scraped away to give the light parts. Work is done from the dark to the light. . . .

Suppose that a drawing is made on a piece of wood and everything cut away except the lines, a relief will be obtained which constitutes a wood cutting, which is just the opposite of an engraving. . . . Wood cuttings can be printed on an ordinary press.

Lithography is surface printing. It is done on stone with a greased crayon and the printing is done on a lithographing press which is entirely different from the others. The discovery of the process of lithographing was quite accidental. A man was working in Munich making music scores in copper plates, and experimenting with greased crayons to see if he could get some results. On Monday morning a woman came for his washing, and he made a list quickly on the floor which happened to be made of stone. He thought afterwards that it would be wonderful to reproduce this. So he continued to experiment and his book written on this subject is still authoritative. . . .

« « MENTAL TILTS » »

AND HALF AN EGG

GIVEN: A woman came to town with a basket of eggs. To the first customer she sold half her eggs and half an egg. To the second customer she sold half of the remaining eggs and one-half an egg. To a third customer she sold half of the remaining eggs and one-half an egg. Then counting the eggs that remained in the basket, she found that there were exactly three dozen. An analysis will show that the problem is neither absurd nor impossible.

REQUIRED: How many eggs had she at the start?

BRICKS

GIVEN: A brick weighs a pound and half a brick.

REQUIRED: How much does the brick weigh?

Answers to Last Month's Tilts

The number of cocoanuts collected was 79 + n 81 where n is zero or a positive whole number.

NEWS FROM THE TECHNICAL CAMPUS

(Continued from page 130)

Architects Plan Annual Jubilee

Much has been said and much has been done in past years about the Architects' Jubilee which is always a gala event of the spring quarter. Like the Beaux Arts Ball which is one of the outstanding events of the New York social world, the Architects' Ball here is a great social function for the architects and interior decorators. In the past years the day of festivities was held during the spring quarter, but for various reasons it was proposed to hold it this year in the winter quarter.

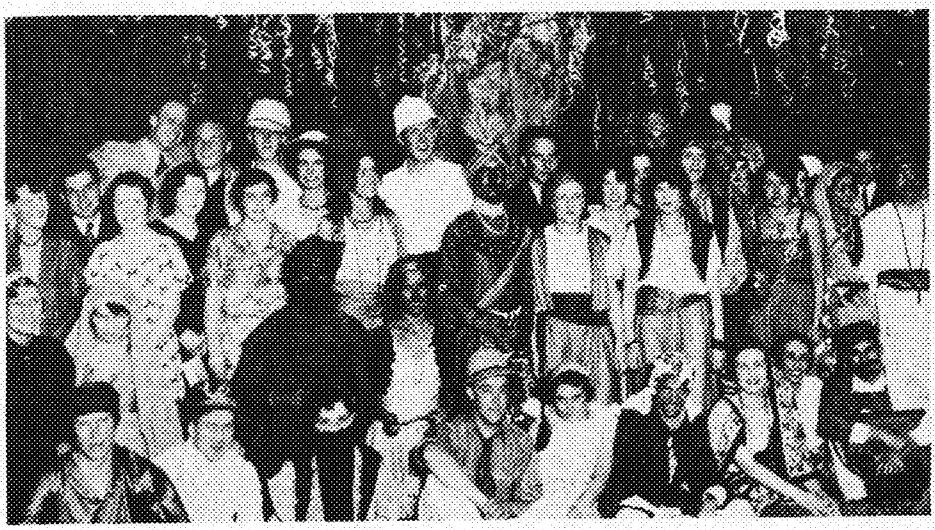
On this day of the Jubilee one may see in the halls on the third floor of the Main Engineering the best drawings in design and freehand made by students during the year. Later in the afternoon tea may be sipped in the architectural Library served by the interior decorators whose abilities as cooks will be demonstrated by Elvira Betlach, chairman of the tea.

There has always been much ado about the motif of the Ball because upon this the decorations and costumes depend. It is important that the types of the costumes match the decorations. A caveman's outfit would not fit the "Spirit of the North Pole" in either temperature or style. In the past years the motifs have been various, last year it was the Hindu or Indian, the year before the scene was in Davey Jones' Locker and various fish and pirates attended. This year, after due deliberation, the committee decided on the period of the Vagabond King. This period embodied the time of Louis XI and was given the title by the architects of "Medieval Madness." At that time vagabonds were the vogue with their doublets, pointed shoes, rags, and their vagabond songs which thrilled many a court lady on her rose covered balcony. At the Jubilee there will be many vagabonds, and the usual soldiers, monks, bar maids and executioners. (Oh, yes, they'll use their axes on those who try to break in minus their tickets.) And the gay townspeople will be represented by the butcher, the baker and the candlestick maker.

Earle Cone has the tremendous task of decorating the Engineering Auditorium in order to depict properly the chosen motif of "Medieval Madness." All those who have seen the past decorations will testify that the architects are certainly not lacking in this ability.

L. O. Anderson will assist Earl Cone with the decorations. Programs are to be designed by Gene Gray. The other committees are as follows: Walter Vercoe, publicity; Beatrice Johnson, tickets; Sherman McMahon, music; Frank Hubbard, patrons and patronesses.

As chairman of the Jubilee and president of the Architectural Society, Milton Hoglund will act as the Vagabond King of the Ball. All the architects will attend and it is hoped that the day will live up to the reputation of past Jubilees and continue a glorious tradition of the department of Architecture.



GAILY COSTUMED REVELERS AT JUBILEE OF 1930

Rowley Honored

(Continued from page 130)

—35 degrees on the cold side; (b) hot plates which have been designed for measuring the heat flow through homogeneous materials; (c) special apparatus that has been designed to measure heat flow from surfaces of materials and through air spaces under special conditions of temperature and air motion."

Mr. Rowley said that over fifty walls have been built up and tested. These inclue frame walls with different arrangements of insulating materials. Brick, hollow tile, concrete and masonry construction have been tested.

Determinations have been made of surface coefficients of heat transmission for the various materials used in building construction at different surface air movements and temperatures. The insulating value of air spaces has been measured for different temperatures and thicknesses of spaces. It has been found that distances up to ¾ of an inch are in advantage, but after that width has been passed little or no change is evidenced. Coefficients of heat transmission for air spaces, materials, and surfaces have been obtained which make it possible to calculate the heat flow with accuracy through a built-up wall where different combinations of materials and air spaces are used.

According to Professor Rowley, "The work during the last three years has been financed jointly by the Engineering Experiment station and the American Society of Heating and Ventilating Engineers. A study is now in progress to determine the thermal characteristics of the different species of wood. This work is being financed by the National Lumber Manufacturing association and will cover about 25 different species of wood tested at different temperatures and moisture content. When completed it will be the most comprehensive study of the thermal properties of wood ever made."

Several papers have been published covering the results of the research work during the past four or five years. A bulletin is now being prepared which will give a complete report on the work. The significance of heating and ventilation may be realized when the long severe winters in this section of the country are considered. The cost of heating in Minnesota each year is over $30,000,000.

"Prepare to meet your maker," the minister told his congregation.

The next day three old maids had their faces lifted.

Building of the Sub-structure for the Suisun Bay Bridge

(*Continued from page 127*)

cofferdam was poured in 5 foot lifts, with the exception of the last lift which was 10 feet. From this point on, the shaft was poured in 10 foot lifts up to the coping which was 5 feet in height and into which the truss anchor bolts were set.

The forms for the pier shaft were made in the yard in sections, set in place, and braced by a system of rods and bolts that held them rigid.

Pier 19 proved the most troublesome of all the piers. The Southern Pacific drawings showed that the bottom was blue mud with vegetation. The falsework piles used were from 120 to 126 feet long and extended practically to the rock. The bottom was so soft that the weight of the hammer (a 32000 lb. steam hammer) on the pile, drove it to the required depth for building the falsework platform.

The shell on this pier took three decided settlements. The first settlement occurred just as the sand fill was being completed. The shell dropped 7 feet on one side and moved 2 feet down-stream from the centerline of the bridge. The sand fill also dropped on the low side, pushing the falsework piling up. Several methods were tried to lower the shell before one finally succeeded. The first method tried was removing the sand from the low side, piling it on the high side, and jetting on the outside of the shell. This method was not very successful for after twenty-four hours of jetting, the shell had only moved 1½ inches. It was then decided to load the high side as heavily as possible and wait a few days to see if any settlement would take place, but none did. Finally, it was decided that the only method was to remove the mud from the outside of the shell. After clamming mud on the high side of the shell for about twenty-four hours, the shell settled back to within 2½ feet of original position. Ten feet more of shell then had to be added, and the shell refilled with sand, for most of it had pushed the mud out from under the filling.

A few days after completing the filling and redriving and building the falsework, the shell dropped 10 feet on the down-stream side and moved 4 feet off center, pushing up the falsework. Clamming was again started on the high side but after several days of clamming, the shell had dropped back only 2 feet and was still 3 feet off center, but it was decided that building of the caisson would be started.

The falsework piling was again redriven and new piling and bracing added, the steel shell was refilled with sand, the cutting edge laid and the caisson started.

When the caisson had reached the height of seventy-five feet, the shell dropped 2 feet on the low side and 6 feet on the high side and moved 1 foot down-stream. This settlement took place while jetting for the bottom. More piling and bracing were again added to the falsework and the building and sinking of the caisson continued. When the concrete had reached a height of 95 feet and the cutting edge was at —63 feet, the caisson dropped 4 feet out of level on a line with the diagonal of the caisson. By clamming and jetting on the high side, the caisson settled into position and was sunk to the bottom without any further mishap, and when landed, was about 8 inches off the center line.

The depth to the rock at pier 11 was not great enough to make economical the use of the sand island method. The depth from high water to rock at the

(*Continued on page 146*)

Suisun Bay Bridge

(*Continued from page 144*)

deepest point was 58 feet. Therefore, it was decided to use an open cofferdam and construct the pier inside of it.

The cofferdam was a single wall of steel sheet piling, rectangular in shape, 46 feet x 70 feet and 58 feet deep. Falsework piling outlining the cofferdam was driven to rock in the form of a rectangle around the pier site. The piling was driven in a single row around the pier site with the piling across the current 8½ feet on centers and 14½ feet on centers across the flow. Each vertical pile was braced with a batter pile with the exception of the corner piles, which had two batter piles each. The falsework was completed by bolting two sets of 12x12 timber wales to the inside of the piling forming the rectangle. The first set was placed near the tops of the piling and the second set as far down as low water permitted. This framework then served as a guide in which the steel sheeting was driven.

Deep-arch section steel sheet piling 65 feet long, was then driven around the inside of the waling. Before closure of the cofferdam rectangle could be made, it was found necessary to use a wedge-shaped pile, due to the fact that the first piles placed had canted somewhat at the top, and it was not possible to bring them to a vertical position. Two piles were cut and vertical webs riveted together to form a wedge pile wider at the bottom than at the top. The wedge pile was then placed in position and the remaining of the closure piles driven to rock. The steel sheet piling was then bolted back to the waling and the mud excavated from the cofferdam by a clamshell.

The interior bracing consisted of a timber cage made up of heavy struts, posts and waling pieces. The struts and waling pieces were so spaced as to utilize the full strength of the timber. The struts were placed horizontally so as to allow pockets through which a clamshell, and the necessary material needed, could be dropped. Vertically, the struts were spaced at intervals ranging from 5 feet at the bottom to 12 feet at the top of the cofferdam.

Struts were used in pairs, two pairs to each set of wales being placed parallel with the long axis of the cofferdam and four pairs per set of wales parallel to the short axis. All struts were continuous, with vertical posts placed at the intersection of the two systems of struts and acted as spacers between each pair.

The timber cage floated by its own buoyancy and was built so as to leave a slight clearance between the waling pieces and the sheet piling which facilitated greatly the sinking of the cage. When ready to sink, the cage was loaded with 268 tons of second-hand rails placed on the top set of struts and allowed to

(*Continued on page 148*)

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If It's Printing, "Leave It to Lund"

(*Continued from page 146*)

sink. The mud was jetted out from under the bottom wales and removed by a clamshell.

When all the material had been excavated and the cage was resting on rock, the sheet piling in the cofferdam was driven into the rock. Lugs were bolted to the top of some of the steel sheet piles and short posts were inserted between these lugs and the top wales to hold down the timber cage. One hundred tons of rails were then removed and unwatering of the cofferdams started.

It was found very difficult at first to lower the head on the cofferdam but as the head increased, greater progress was made. Because of leaks between the interlocks on the sheet piling, leached copper ore was deposited in the water outside of the cofferdam and was forced by the water pressure through the interlocks, and proved very effective in stopping the leaks.

Two days after pumping had been started and a head of 19 feet had been reached, water blew in under the sheet piling at the point of closure, filling the cofferdam in about eight minutes.

To correct this leak, the sheet piling was driven further into the rock and the cofferdam, at the point of the break, was backfilled with gravel in sacks, and mud. Pumping was then resumed and continued until the cofferdam was completely unwatered. At the completion of the unwatering, the mud remaining on the bottom was removed by dredging and sluicing into the pumps.

Before pouring the concrete, the remaining 168 tons of rails were removed from the top of the cage. The foundations were carefully cleaned off and the surface of the rock was covered with 2 inches of grout. The first 6 feet of the pier footing was poured against forms set against the waling, but above that height, the base was stepped back to the prescribed dimension, 38 x 60 feet.

The four lower sets of struts were left in the concrete as they were well below the mud line and would have been very difficult to remove. All timber above that was removed. Each set of struts was boxed out, forming large keys at each construction joint, and concrete poured around them. The wales were then braced against the concrete before the struts were removed. All concrete surfaces were cleaned and washed and construction joints covered with 2 inches of grout before pouring the next lift.

Upon completion of the pier, the gate pile was pulled and the cofferdam filled with water. The sheet piling was then pulled and the falsework dismantled, using as much of the material as possible on the other shallow piers.

The Architect's Page

(*Continued from page 129*)

the Cathedral of Florence, Brunelleschi was so positive that his scheme was the correct solution that he built a model—perfect in every detail—to show how each stone was to be laid in the dome construction. The dome, as you know, was built without any centering.

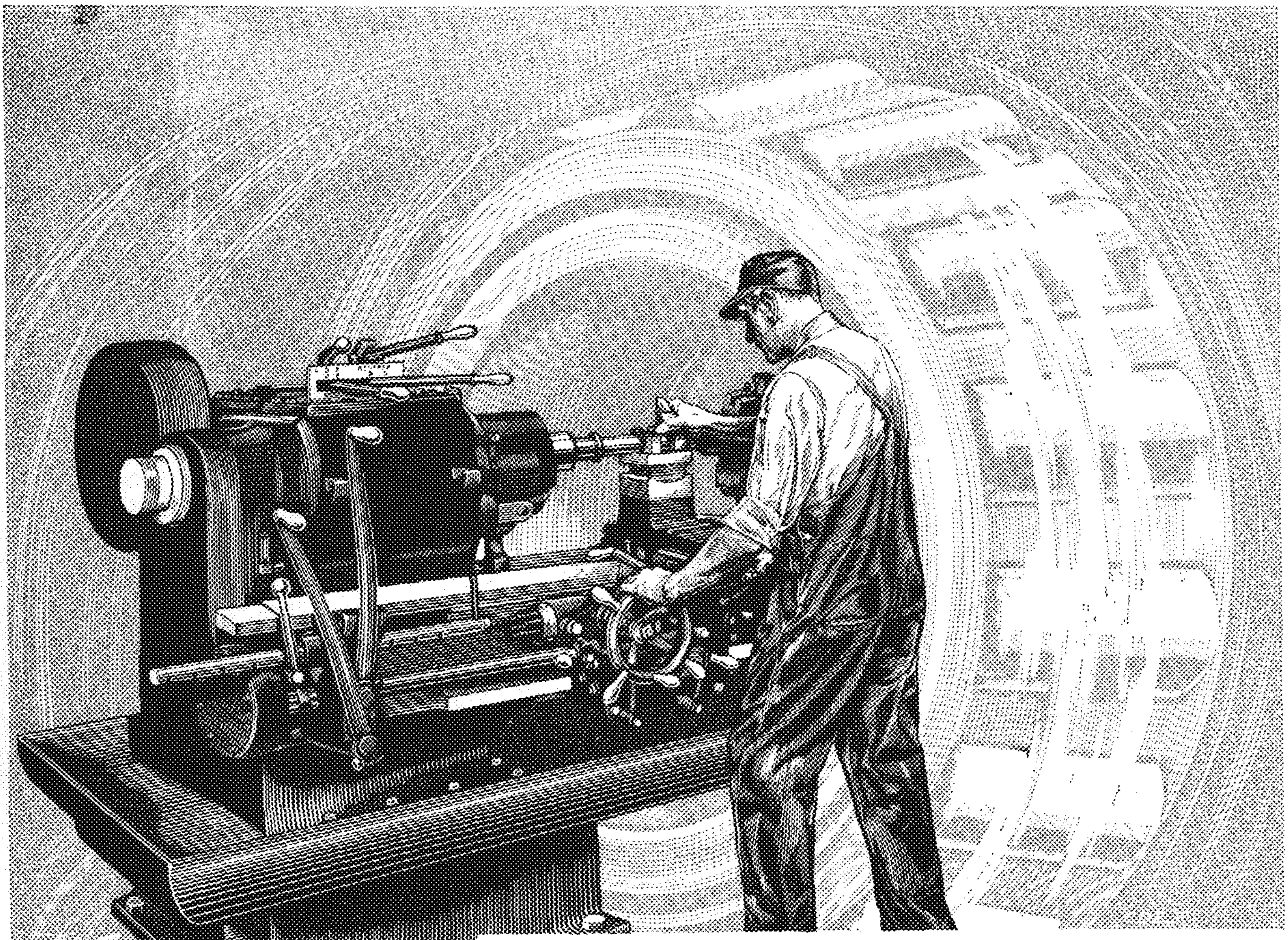
And just imagine,—at one time Brunelleschi was carried bodily out of a meeting of architects because they thought that his ideas were foolish dreams. Yet, so confident was he of himself and so great was his understanding of human nature that he finally persuaded the members of the board to give him the commission.

That is my idea of a real architect. A man who is cultured and educated—and when I say educated I mean educated in the broadest sense. It seems to me that an architect's client may and should demand that the architect have a liberal education equal to his own.

I like this new job of mine. The boss is just that type of man I've been writing about. He arouses my interest in so many things outside of architectural practice. I wish that you were working here, too.

Well, perhaps I'll get some more ideas.

Yours, F. S.



THE MINNESOTA TECHNO-LOG

Safety Engineering in Industry

Hardening Steel by Carburizing

Louis Sullivan—Famous Architect

The U.S.C. & G.S. in the Philippines

Vol. XI MARCH, 1931 No. 6

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

THE MINNESOTA

TECHNO-LOG

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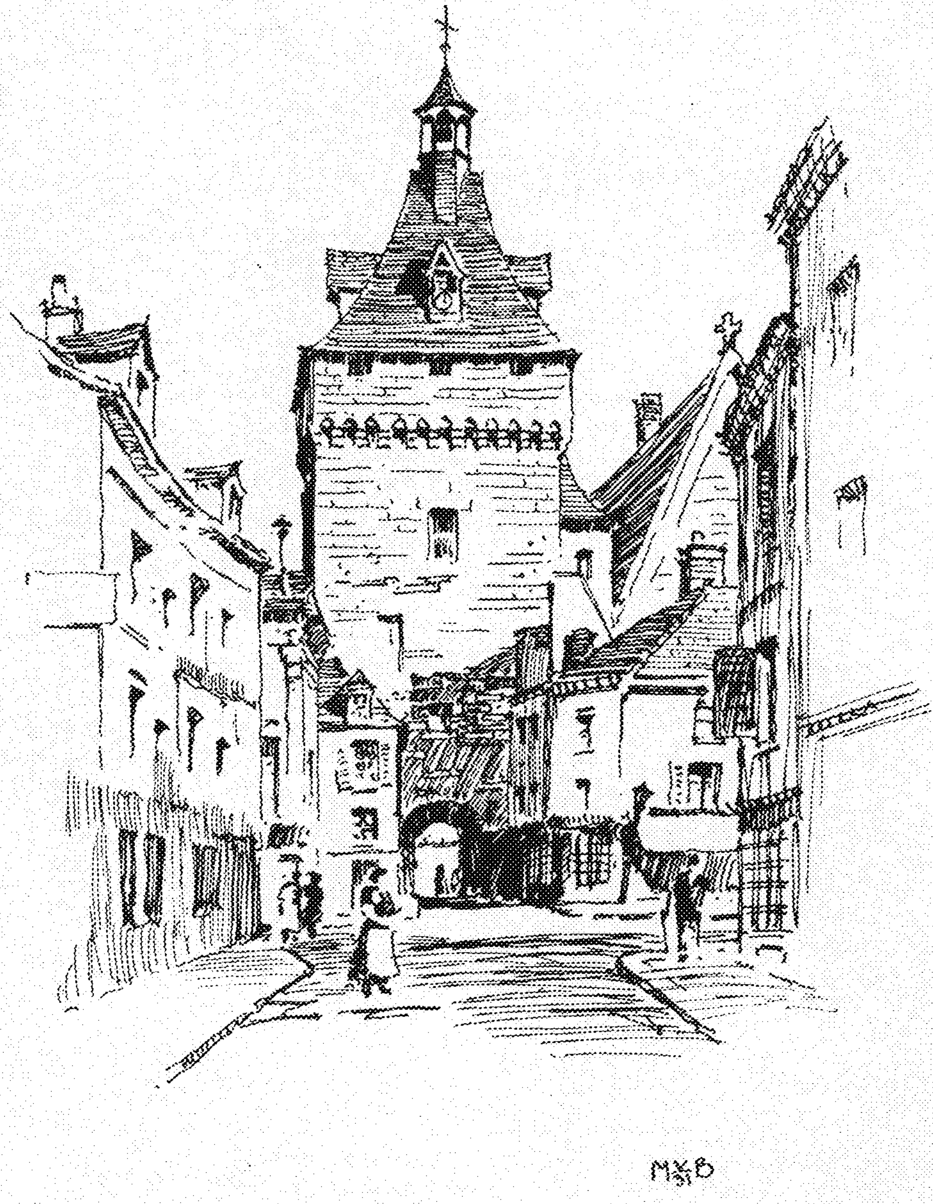


The Hotel de Ville — Loches, France

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Volume XI MARCH, 1931 Number 6

Safety Engineering

By ARTHUR A. HANSEN, CE '25

VERY little thought was given to accident prevention prior to ten or fifteen years ago. At that time most industries and the public in general considered an accident just part of a day's work. In other words, they were regarded as a necessary evil. Since that time, however, there has been considerably more stress placed on accident prevention measures and now most all progressive industries and men in general realize that accidents can be prevented, and are taking active steps in that direction. Accident prevention is now considered good business.

This article will deal chiefly with industrial accidents, although home, street and automobile accidents are probably entitled to as much consideration. Space does not allow discussing these as each is a subject within itself. However, the fundamentals of accident prevention are identical, regardless of the type, the only difference being in the application.

The outstanding reason for the increased efforts on the part of industries to cope with the accident situation was for business reasons. These industries realized that accident prevention was nothing more than business economy. There is no doubt that the humanitarian standpoint was also considered of great importance.

The economic cost of accidents is responsible for a considerable portion of operation expenses. This loss is brought about by inferior workmanship, decrease in production, increase in labor turnover, lowering of plant efficiency, insurance cost, etc. Every employee in the plant represents an investment and should this investment cease to function, the results are apparent. Every accident means loss of time and any loss of time means to some extent a disruption in plant operations. One accident oftentimes breaks down the morale of a department and sometimes the entire plant. Such accidents not only mean that the operations carried on by the injured party cease, but other employees will leave their work either to offer assistance or through curiosity. Even should they continue to work, their individual efficiency has been reduced for a period of time, depending on the seriousness of the accident and the individual. It has been estimated and there is every reason to believe that the estimation is practically correct, that the cost of accidents to industries is approximately four times the compensation benefits paid to the injured man including the cost of medical attention. The annual economic loss in the United States because of accidents is considerably more than two billion dollars. In addition to this, the loss of human lives and the resulting human suffering is so great that it alone is worthy of all the present efforts to reduce our high industrial accident frequency and severity. For example, the annual loss of human lives through accidents is greater than the number of American soldiers who lost their lives during the entire World War.

> *The study of accident prevention which was given but little thought before the last ten or fifteen years, has recently become a subject of vast importance. Thus another new field has been opened to the engineer.*
>
> *The tremendous yearly toll exacted from industry by accident brought the subject of accident prevention to the attention of production experts, and once that definite knowledge had been obtained on the economical cost as well as the humanitarian considerations envolved, constructive steps were immediately taken to counteract the condition.*
>
> *In the accompanying article, Mr. Hansen, who has done considerable work in this field since his graduation from the University, defines safety engineering and outlines the general procedure that is used in attacking a given problem.*—EDITOR.

The steel industry was probably one of the first to realize the importance and value of accident prevention work—at least they were one of the first to advertise this fact. Through the experience and assistance of these pioneers, other companies soon started to promote safety work and realized beneficial results from their efforts. At the present time every progressive industry is devoting considerable time and effort toward reducing the number of accidents to employees, realizing that it is a necessary step in reducing the cost of production which will aid them to place their products on the market at an equal or lower cost than their competitors.

Safety engineering is a study of accident causes and the formation and application of plans for their prevention. The study of accident causes includes not only the physical conditions but also psychological conditions prevalent in workmen's minds, considered both as a group and individually, under general operating conditions. This study is worthy of as much effort as any other step in the application of safety engineering. This might be called the foundation of safety engineering work, for it enlightens the subject to such an extent that the following steps can be carried out in a more definite manner. It is necessary to follow the cause to a completion so that a summary of the prevalent causes can be established.

With definite knowledge in regard to prevalent causes, the next step is to formulate a plan which will tend to reduce the accident frequency and severity. This plan should include physical protection to the employee, educational steps that will encourage safe practices, and last and most important, the placing of responsibility for the causes of accidents and the carrying on of safety work. The success of any plan depends largely upon how it fits in with the regular operating routine. It must work smoothly. The plan should be built around the idea of illuminating accident causes and should be flexible to such an extent that it will be suitable for varied conditions.

The third step, which is also important and oftentimes demands the most ability on the part of the individual who has been designated to promulgate safety work, is the selling of the plan to the management so that it may become a company policy, with the complete cooperation and backing of every one connected with the organization. Any safety work that does not have the active backing of the management is practically of no value. It is absolutely necessary that they give some time and con-

(Continued on page 168)

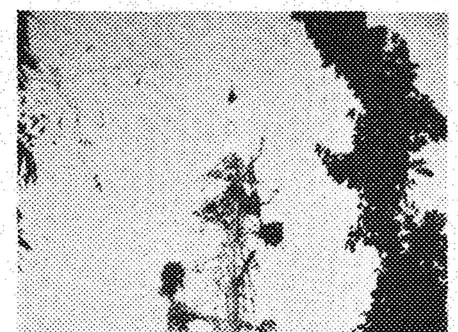
PLANE TABLE WORK ALONG A MANGROVE SHORELINE

Charting the Waters of

G. C. Mattison, CE '11

WHEN the United States took over the Philippine Islands at the turn of the century, one of the many tasks confronting the federal and insular governments was that of making adequate surveys of the Philippine waters. Accurate charts were essential for the proper development of the Islands, as practically all commerce, both foreign and inter-island is waterborne. Some idea of the magnitude of this project can be gathered when it is considered that the Archipelago covers an area extending one thousand miles in a north and south direction and six hundred miles east and west, the rough outline forming a somewhat irregular triangle. More than seven thousand islands comprise the group.

The U. S. Coast and Geodetic Survey is the federal agency engaged in surveying and charting American waters, and this bureau took up the Philippine surveys, starting work in 1901. At the present date, the major portion of the work is completed, the only remaining unsurveyed areas of any extent being the isolated coasts of northeast Luzon and western Palawan. These areas are being surveyed at the present time.



TRIANGULATION STATION USING A TREE TRUNK AS AN INSTRUMENT STAND

The production of an accurate maritime chart necessitates several types of survey work, each of considerable importance and value when considered alone, or as separate projects, but especially so when correlated as essential parts of a charting scheme. These may be listed as control surveys (triangulation), topographic surveys, hydrographic surveys, tidal surveys, current surveys and magnetic surveys.

When the field surveys are made, it is usual to complete all types of operations in that locality at the time with a large party engaged in combined operations, and it is only occasionally that a survey party is limited to one particular type of work.

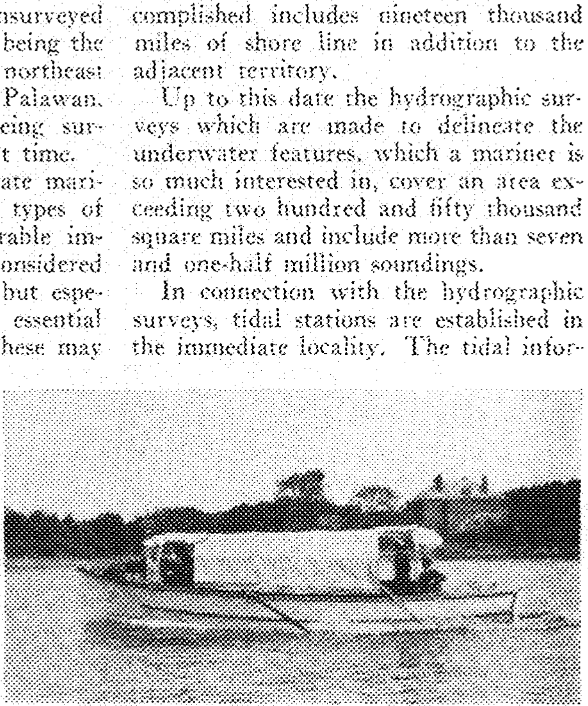
A short summary with some brief statistics will give a fairly comprehensive view of the amount of work accomplished under the various heads.

An accurate geodetic control in the form of a net of triangulation is the foundation on which is based the proper location on the earth's surface of the various features of a chart. The main triangulation of the Philippine Islands covers an area of one hundred and ninety thousand square miles and is now practically complete. The comparatively small amount of triangulation remaining to be done will control the present unsurveyed areas. This net of triangulation is not only used for control of Coast and Geodetic Survey projects, but also for other topographic surveys and cadastral surveys. The many triangulation stations comprising the net are permanently marked on the ground, so that they can be used at any future time by surveyors or other interested individuals. These stations are described, and other pertinent data regarding them are published in book form in two volumes entitled "Triangulation in the Philippine Islands."

All maritime charts show the topographic features adjacent to the coast line and as far inland as may be considered necessary to supply information for the mariner. The topography so far accomplished includes nineteen thousand miles of shore line in addition to the adjacent territory.

Up to this date the hydrographic surveys which are made to delineate the underwater features, which a mariner is so much interested in, cover an area exceeding two hundred and fifty thousand square miles and include more than seven and one-half million soundings.

In connection with the hydrographic surveys, tidal stations are established in the immediate locality. The tidal information obtained in connection with the surveys, is correlated and used in compiling annual tide tables which are published in advance, giving tidal data for about two hundred and forty stations in the Islands. These tables are used by the mariner who is interested in the stage of the tide as he cruises between the islands or enters or departs from a harbor.



30-FOOT HYDROGRAPHIC MOTOR BOAT USED BY U. S. C. AND G. S.

Magnetic observations are also made at frequent intervals along the coast and in the important channels. Results of these observations are shown on the chart in the form of a compass rose which indicates to the mariner the magnetic declination in that locality.

While engaged in the field surveys, local information is collected regarding harbors, ports, anchorage, courses, ranges, local products, shipping information, facilities for fuel and other ship supplies, and any other information in which the mariner may be interested.

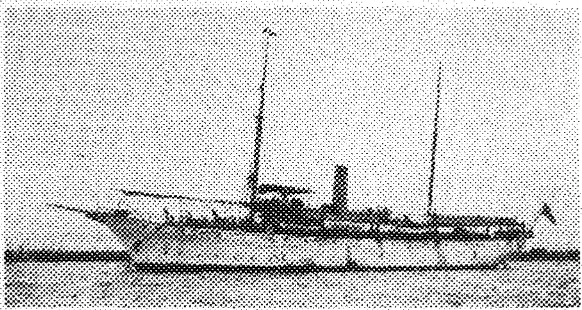
After the field work is accomplished the records and sheets are forwarded to the Manila office where they are carefully verified. The various surveys are compiled in the form of a chart drawing which is then photographed and transferred to an aluminum plate from which the chart is printed. Every step in th

the Philippine Islands

U. S. Coast and Geodetic Survey

compilation in the office as well as that in the field is carefully checked and verified, it being very important that the finished product be as accurate as possible. An office is maintained in Manila where all the work of compiling and printing charts is done. There are one hundred and fifty one different charts of the Islands published at the present time.

All information that has been gathered by the field parties and that cannot be properly included in a chart is edited, assembled and published in book form under the name of "Coast Pilot." At present, there are two volumes containing information regarding the Philippines.



U. S. S. PATHFINDER WHICH IS NOW IN SERVICE AT THE PHILIPPINE ISLANDS

The charts, coast pilots, and tide tables are all important equipment in the navigation department of an up-to-date vessel.

The Coast and Geodetic Survey is also the mapping agency for the Insular Government and publishes fourteen topographic maps of the Islands, a relief map and maps for aerial navigation.

Practically all of the field surveys are made by parties operating from survey vessels. At present, there are three steam vessels used for the work in the Philippines. The officers on these vessels are detailed from the United States for two-year periods. The crews are made up of Filipinos and Chinese mess men, many of whom have been in the service for ten or twenty years or more; the surveying assistants, doing the work of recorders, draftsmen, sextant observers and other clerical duty on board ship, are Filipinos who have attained proficiency along these lines.

The vessels are equipped to remain in isolated localities for various periods of time depending upon fuel capacity. The largest vessel can remain in the field for a period of three weeks or more depending upon the character of field work under which it operates. The refrigerator space on board is large enough to keep fresh meats, fruits and vegetables and other perishable products for this period. A doctor is usually included in the complement. In other words, an attempt is made to make the vessels entirely independent of outside sources for the period they are away from port.

The officers on board the vessels, with the exception of the chief engineer and medical officer, are all civil engineering graduates who have been especially trained for this work. The commanding officer and executive officer has had enough experience and training to obtain marine licenses as master of ocean going steamers, and to be entrusted with the responsibility and care of the lives and property on the vessel.

It would probably be of interest to the readers of the TECHNO-LOG to know something of the routine connected with this work. I will try to give a brief description of a typical cruise of the Steamer "Pathfinder," one of the vessels engaged in the work in the Islands.

At present, the Pathfinder is engaged in field work on the west coast of Palawan Island and is basing at Manila for coal and supplies. En route to Manila from the working grounds, plans are made for the next trip, and a list of supplies made up. Upon arrival at Manila, orders are placed for coal, fresh water, gasoline and kerosene for the launches, surveying supplies such as lumber, signal cloth, etc., and any other necessary equipment that may be needed. Staple food articles are ordered at this time, but perishable products are not taken aboard until the day before sailing. The necessary work in connection with the ordering and receipt of the various supplies is divided among the officers on board. There are seven American officers on board and a crew of about sixty Filipinos.

When the vessel is completely supplied and outfitted for the cruise, departure is made for the working grounds off westward Palawan. Upon arrival

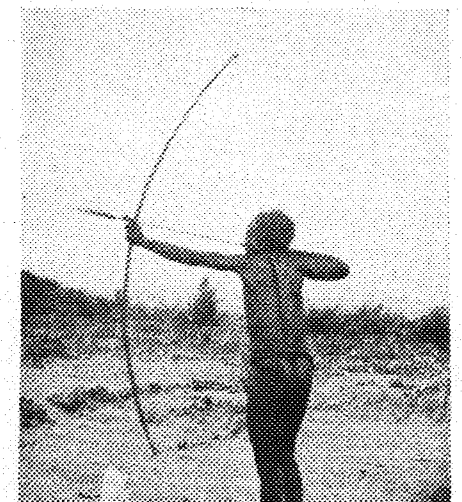
LANDING WITH SUPPLIES FOR THE TIDE OBSERVER'S CAMP

there, a camping party is put ashore to take up topographic work along the coast. This will consist of one officer, a launch crew of coxswain and engineer, and three or four seamen and the cook. A launch and pulling boat are also left with the camping party. All necessary supplies and equipment are furnished them such as tents, cooking utensils, gasoline for the launch, food supplies, etc.

A launch hydrographic party is also put in camp with the necessary outfit and supplies. One officer and the necessary Filipino members of the party, usually numbering about six, are included in this camp.

The vessel then visits the tide observer's camp, which is maintained continuously, two men having been left there while the vessel was away from the working grounds for supplies. Nec-

(Continued on page 170)



FOOD IS STILL OBTAINED WITH THE BOW AND ARROW IN SOME INTERIOR PORTIONS OF THE ISLANDS

The Case Hardening of Steel by Carburizing

By GEORGE TAFT, Ch E '32

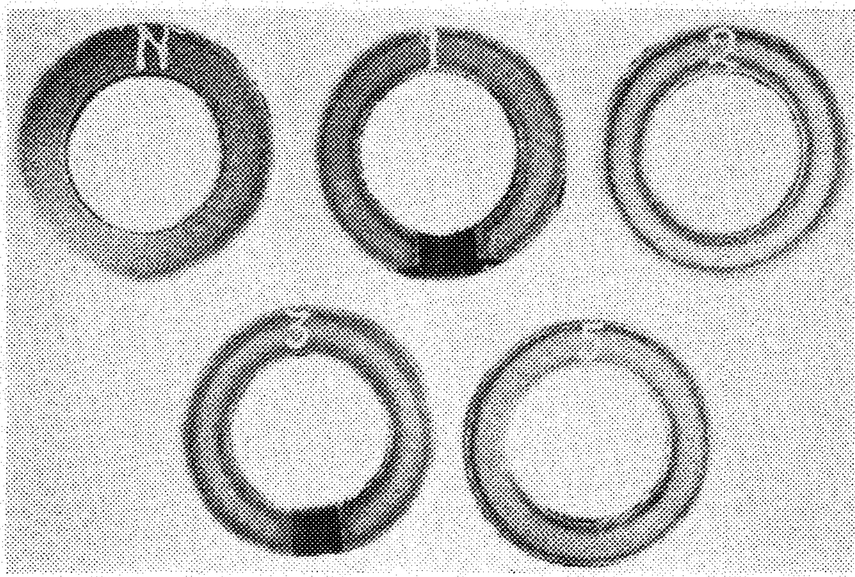
THE engineer's most useful construction materials are metals, particularly the so-called ferrous metals. Their great use may be attributed to their range of useful properties. The metallurgist may make soft or hard, a brittle or tough metal. And by proper working of the material he may combine two of these properties into one metal.

There are several ways of making a steel or iron both strong and hard. One way, a rather new field, is by the alloying of iron with various other metals. By variation of the alloying metals and their quantities the proper steel may be produced. The second process is by covering a tough steel with a hard surface either by plating or by formation of a hard case.

In the choice of steels for a construction material, the engineer must select his material with three things in mind. He must look at the material from its mechanical side. Is it strong enough? Must it be hard or soft, tough or brittle? Or must it be both? Then the chemical properties must be known. Will it be subjected to a strong corrosive action? Will it introduce impurities into a product if it is used for manufacturing? Then last, but probably most important, comes the economical side. Is the material expensive? Has it a long life?

In comparing case hardened metals with alloys the cost will probably be the most significant factor. Alloyed metals are expensive. Therefore, especially where massive pieces are needed, it will probably be found cheaper to use a case hardened metal.

Pure iron displays a series of interesting properties. Unlike our ordinary cast irons and steels, it is impervious to natural atmospheric corrosion, especially that near large bodies of salt water. It is exceedingly tough and may be easily welded. However, softness and cost prevent pure iron from becoming important in the engineering field. The cost arises from the difficulty of freeing the iron of impurities present in the ore and refining materials. These impurities are useful, however, in the fabrication of steels.



Microphotographs of carburized wrist pins. N—Pin before carburization. 1—Case separating from core at bottom of pin caused by poor case hardening. 2—A good case formation. 3—This case has a higher carbon content near the bottom of the hole through the pin caused by exposing a greater surface. 5—Carburized by slipping pin on rod to prevent waste of carbon on inner surface of pin.

The most important impurities in iron are silicon, phosphorus, sulfur, and carbon. The carbon, up to about two per cent, makes a hard steel. Above that amount the product begins to soften. The other three elements cause shrinkage and particularly brittleness,—some by their effect on the carbon compounds in the steel.

When carbon is added to molten iron, cementite (Fe_3C), an extremely hard compound, is formed. On cooling of the solution, crystals of this compound are closely interspersed among the iron. Pure iron is a very soft material, but, with these hard crystals between the iron crystals, a very hard surface is presented. Accordingly, the more cementite formed the harder the steel.

However, there is one bad point to this picture. The more carbon added, the harder the steel becomes until a state is reached where the liquid iron carbide will no longer solidify completely. From this point of approximately two per cent carbon the excess cementite present in the molten iron decomposes on cooling. Theoretically, the hardest steel should contain the maximum amount of iron carbide and no free carbon.

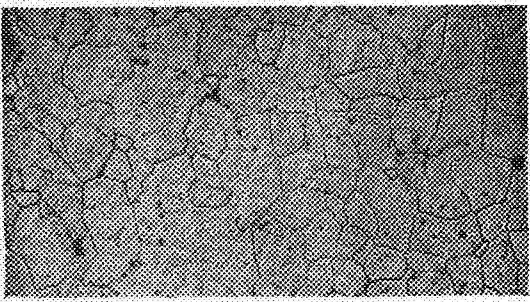
The carbon in the cooled steel or iron is finely divided and evenly distributed. When the iron is molten, the carbon is in solution combined in the iron carbides. On cooling, the excess iron carbide decomposes before crystallizing out, thereby leaving the carbon in the form of minute bits of graphite. The graphite has a very soft surface, even softer than that of the iron and, located as it is between the iron crystals, lowers the hardness of the surface. Also, these soft graphite particles may be compressed. Therefore, when the iron is subject to a bending, these particles are compressed and allow the metal to "give" slightly without the formation of a stress between the iron crystals. Consequently, the excess carbon should make a tougher steel. However, if too much carbon is present, the iron crystals lose intimate contact with one another, and the steel loses tensile strength.

There are several ways of making more than the normal amount of iron carbide stay in the steel. Some elements, such as silicon, seem to delay the decomposition of the cementite. However, as these elements also have outstanding bad effects, the only practical way is by the rapid cooling of the metal from a temperature above which the cementite is stable to that below which it decomposes. This is applied in the tempering of metals by quenching.

Many time a metal is needed which is both exceptionally hard and strong. Perhaps the best way to make such a material is by the coating of a strong substance with a harder material. This may be done by mechanical means, by plating, or by the formation of a case of high carbon or nitrogen content.

In the formation of a high carbon case the iron must be made to react with carbon to form cementite. The solid carbon in the original iron cannot be used as it will not react until it has entered into solution with the iron. This solution can only take place when the iron is molten. Therefore, some other means must be devised by which the carbon can be introduced when the iron is below its melting point but above that of the decomposition of iron carbide. This can be accomplished by bringing gases containing carbon into contact with the hot iron.

After the iron in the surface of the hot metal has reacted with the carbon



A microscopic study of Armco ingot iron, the purest commercial iron obtainable which contains but a small amount of carbon.

containing gas, the iron carbide must penetrate to the interior of the iron crystals. This can only be accomplished by the "migration" of the iron carbide through the iron. As this "migration" is relatively slow, it is apparent that the more surface the gas can cover and the deeper it can penetrate around the crystals, the deeper the case and the shorter the time required for its production. Therefore, the rates of diffusion of the various gases used governs, to a large extent, the carburizing process.

The gases used in the carburizing processes are usually carbon monoxide and methane, with hydrogen present as a by-product of the carburizing compounds. The carbon monoxide is made by the reaction of carbon dioxide with the carbon of the compound according to the following equation:

$$CO_2 + C > 2CO \quad \text{......(1)}$$

or from the direct burning of the free carbon. The carbon monoxide then reacts with the iron forming iron carbide:

$$3Fe + 2CO > Fe_3C + CO_2 \quad \text{......(2)}$$

The iron carbide must then diffuse through the iron crystals.

Water is very detrimental to carburization as it reacts with the hot carbon to form hydrogen and carbon monoxide.

$$H_2O + C > H_2 + CO \quad \text{......(3)}$$

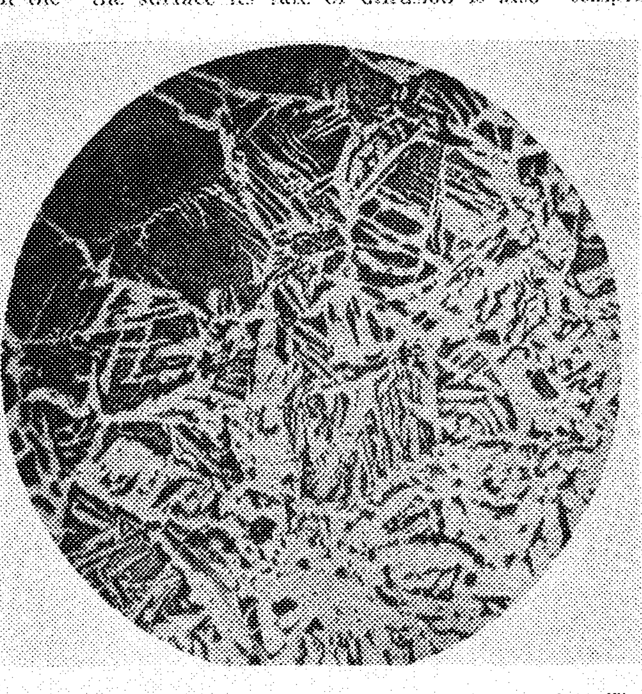
The hydrogen materially delays the diffusion of the carbon monoxide to and through the metal.

The rate of diffusion of the carbon monoxide is entirely dependent upon the densities of the materials it must penetrate. Graham found by experimentation that the rate of diffusion of a gas through another is inversely proportional to the square root of the density of the gas. Therefore, the lighter the gas the faster it diffuses. Now, 22.4 liters of carbon monoxide weighs 28 grams while the same volume of hydrogen weighs but two grams. Therefore, the carbon monoxide will diffuse very slowly through hydrogen or a mixture of carbon monoxide and hydrogen. This rate of diffusion may be represented by the formula:

$$S = K(c_2 - c_1)$$

where S is the rate of diffusion and equals a constant times the difference in concentration of the gas (c_1) and the gas (c_2) it is to penetrate. Now, if gas c_2 happens to be a mixture of hydrogen and carbon monoxide and gas c_1 carbon monoxide, then the amount of carbon monoxide penetrating the iron will be very small. By lowering the concentration of the hydrogen and increasing that of the carbon monoxide, the rate is increased.

As the iron carbide must diffuse through the metal after its formation at the surface its rate of diffusion is also very important. A series of experiments conducted by the A. S. S. T. on a metal which had been carburized and then quenched showed that the rate of diffusion increased as the temperature increased. The metal to be tested was heated in a vacuum to the desired temperature, cooled, and then examined. No diffusion was apparent when the temperature was held at 1350° for five hours; and, at 1550°, the diffusion was very slight, still being confined to the case. However, at 1650° the case had deepened .6 millimeters while at 1750° it deepened 1.2 millimeters. Naturally, with the increasing depth the per cent of carbon in the case was lowered. From this experiment can be drawn the conclusion that, if the compound is able to withstand high temperatures, the higher the temperature the faster the carburization.



A microphotograph illustrating how case and core blend together. The dark area is the high carbon case, the lighter area is the core.

It is apparent from this discussion that the carburizing compound used is of great importance. The compound must produce carbon monoxide and must contain carbon to change the carbon dioxide (equation 2) of the reaction of iron and carbon monoxide back to the monoxide. The carbon is introduced by any carbonaceous substance such as charcoal or leather. The carbon monoxide is usually produced by the reaction of equation (1). The carbon dioxide for this reaction results from the decomposition of a carbonate by heat and the reaction of iron and carbon monoxide.

The carburizing compound must also have the property of forming the necessary gases at a temperature slightly below that required for the iron carbide formation. It must also be stable at these temperatures except for the decomposition of the carbonate. That is, if the iron carbide reactions begin at 1350°F., the carbon monoxide should be formed at a lower temperature in order to have a maximum concentration in the carburizing box at the carburizing temperature.

The carbonates are usually spoken of as energizers. The three most important energizers are the barium, sodium, and calcium carbonates. Of these, barium is the most stable and does not break down to give up the carbon dioxide at as low a temperature as either of the other two. It is, therefore, the most satisfactory of the three for general purposes. The sodium energizer breaks down easily and, therefore, is of advantage where the quickest possible case is desired. It acts at the lowest temperature at which the steel will carburize, and thus we have a slight speeding up of the carburizing process. However, it is much less stable than the barium carbonate, and, if used at too high a temperature, it will break down completely and the carburizing will stop. Magnesium is also used considerably, largely because of its lasting qualities. After the process has stopped, the magnesium oxide formed by the driving off of carbon dioxide again reacts with the carbon dioxide to form the carbonate. Unlike the other carbonates it decomposes long before the carburizing temperatures and, when wet, has an oxidizing reaction which retards the carburizing process.

The energizer, about 15 to 20 per cent of the compound, usually consists of barium carbonate with a small percentage of sodium carbonate to start the carburizing action at the lower temperatures. A standard carburizing compound

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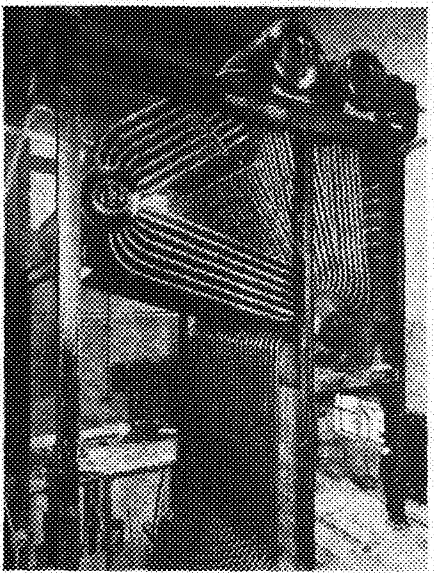
NEWS FROM THE TECHNICAL CAMPUS



THE UNIVERSITY'S NEW BENT TUBE BOILER RATED AT 750 H. P.

New Boiler Installed In University Plant

A bent tube, four drum, steam boiler embodied with a unit fuel pulverizer and an air cooled furnace has recently been installed in the University central heating plant, making it one of the most modern and completely equipped steam generating units in the northwest.

This installation leaves nothing to be desired—either from the standpoint of economical and efficient heating for the the University itself or from the standpoint of advantage to University students in the engineering courses. Completely equipped with every modern instrument in the field of analysis and combustion it will be possible to observe every phenomenon of heat transfer starting with the preparation of the fuel and ending with the observation of the gases emitted from the 225 foot chimney.

The new boiler stands about three stories high, as shown in the photograph which was taken at the time of construction and is incomplete as to details. The huge water wall at the rear leads down to a mud drum which is not shown. The water circulates by convection currents becoming warmed in the front bank of tubes and rising into the main boiler where it is generated into steam. The cold water goes down the rear bank into the mud drum where the mud is blown off in the sewer.

This boiler is one of the largest in the plant. It is rated at 752 H. P., there being two others of this size and two of 350 H. P., giving a total of 10,000 available H. P. for use in the University. Under actual test the newly constructed

(Continued on page 172)

Electrical Show Planned For April 17th and 18th

The Fifth Biennial Electrical Show which will be held on April 17th and 18th will present many new and interesting exhibits acording to Milton Agather, chairman of the general arrangements committee. Undergraduates, alumni, faculty and the general public as well are extended a cordial invitation by the Electrical department to attend the Show.

Among the exhibits of especial interest will be a talking arc, a magnetic cannon, a tin can motor, water that burns, a gravity defier and many other spectacular demonstrations. A television set will be demonstrated that has recently been constructed for exclusive presentation at the show. Many exhibits of an educational nature will be on display, including a mercury arc rectifier, a liquid air demonstration, a cathode ray oscillograph, a vacuum tube exhibition, etc.

The first Electrical Show was held in 1913 and was commenced at the suggestion of Professor F. W. Springer of the Electrical department. The Show this year will continue for two days and will conclude with a dance that is scheduled for Saturday evening in the Minnesota Union.

Mr. Agather announces the following committee heads: F. J. Blitz, student exhibits; E. Eggers, illumination; J. E. Sewall, programs; Richard Cady, finance; Max I. Risley, manufacturers exhibits; Fred Shidel, radio; L. G. Swendson, communications; R. P. Howe, education; W. F. Soules, Signal corps; P. A. Markson, reception; Roy Wiprud, publicity; Harland Harmer, dance; Irvin McNally, decorations, and Robert Lommen, Junior representative.

Jubilee Proclaimed Great Success

The Architects' Jubilee which took place in the Engineering Auditorium in February, was termed a great success by all those who attended. The theme of the ball, "Medieval Madness," made possible some very interesting scenic decorations and a variety of colorful costumes.

Professor Mann, in commenting on the affair, made the statement that he had never seen a Jubilee Ball in which the costuming was as much in character with the theme. Two prizes, an etching by Professor Burton and a water color by Mr. Young, were given for the best costumes, the etching going to Francis Gorman, a senior, and the water color to Grace Mitchell, a freshman.

Arabs Will Offer Production in May

The Arabs, Technical Schools dramatic organization, have chosen May 22 and 23 as the dates for their annual spring production. Rehearsals, which started February 17, are well under way.

Light-footed engineers, heavy-footed according to professors and instructors in the rooms beneath, would-be chorus "girls," have been tripping the light fantastic, twice a week in the Engineering Auditorium, under the direction of Miss Hazel Mack, who has been chosen by the Arabs to instruct the engineers in dance steps and chorus routine.

The 1931 production, which will be a departure from the usual musical comedy show which the Arabs have presented in years past, will mean more toward the revue type of show, styled after Earl Carroll's "Vanities" and other New York productions. The principals have also been rehearsing their parts, which have been tentatively assigned by the director. Sewell Gross, and Alden Stafford, have been working on the comic parts, Henry Cohn, and Sam Stein as character men, with Ben McDermott, Don Starr, treasurer, and George Holliday in straight parts, while D. Dickey and Kenneth Knox, vice-president, have been assuming feminine roles.

The play, which will burlesque and farce everything from college life and professors in the Engineering College to sports, everyday life, and moving pictures, and its continuity was written by Henry Frommelt, president of the organization. Collaborating on the music, which is destined to produce some of the season's greatest hits (written by engineers) are Don Starr and John Burch.

Although neither the production nor the business staff have been announced, premature rumors reveal that Steve Gadler will assume the responsibility for publicity, with Lester Carr on stage lighting and Gilbert Green working on the scenery.

Since there are still many parts open to men in the chorus, as principals, or on either the production or business staff, all engineers are urged to apply for membership, either by dropping a note into P. O. box 1289 or by applying at The Minnesota Techno-Log office.

Chemical Engineers Tour Industrial Plants

As a regular part of their curriculum, the Senior Chemical Engineers will begin their tour of industrial plans of the Northwest on March 18th, with Dr. Mann, Dr. Montonna, and Dr. Montillon accompanying the students. A chartered bus will take the group from plant to plant, and from city to city, so that no time is lost in waiting for railroad trains and streetcars.

Some of the plants which will be inspected are the paper mills of Aberdeen, Wisconsin, the sewage disposal plant at Milwaukee and a plate glass factory at Ottawa, Indiana. Four or five days will be spent at Chicago, from which trips will be made to a cement plant, a steel mill, a starch factory, Western Electric's plant at Hawthorne, and to several other plants.

Notes are taken during the trip of the equipment and methods of the different places visited, and a comprehensive report of the trip must be written.

The group will return on the 28th of March, in time for the beginning of the Spring quarter.

Haga Conducts Class in Fencing

Mr. C. Haga, English instructor in the College of Engineering, is conducting a class in fencing for the first time this quarter. This class, which meets twice a week, has at present nine active members.

In this class, the student is first taught a number of fundamental thrusts, and the parries, or defensive strokes, for these thrusts. Then comes long practice in the combining of these thrusts to form an attack or defense.

To those who remember the many famous duels with swords in the past, fencing might seem to be a rather dangerous occupation, but Mr. Haga affirms that it is quite painless. The foils, which are made of high grade spring steel, have no cutting edge, and the tips are protected with round balls. The object is to touch the opponent in what is considered fair territory. Some might be tempted to shorten the encounter by making one mighty lunge at their opponents' heads, but that, according to Mr. Haga, would be a horrible breach of fencing etiquette.

Fencing, like chess, is a game of wits rather than a display of brawn. A good fencer must be able to plan his strokes far ahead, and at the same time break up his opponent's offensive, for fencing requires a greater nimbleness of movement than any other sport.

Teeter Gives Talk on Engineering Over WLB

Mr. T. A. Teeter, assistant director of the Summer Session, recently gave an outline of the history of engineering in a talk over WLB.

Mr. Teeter introduced his talk with a number of interesting questions, oe of which was "Why is electricity transmitted over power lines at such dangerously high potential?" After these questions, which were intended to create interest in what was to follow, Mr. Teeter went on to tell of the rise of engineering to the great science which it is today.

According to Mr. Teeter, in the 18th century, all engineers were known as civil engineers, and the scope of their activities extended only to the building of bridges, dams, breakwaters, and other structures necessary for the limited transportation facilities of that time. In the early part of the 19th century, need arose for men able to design and construct the many machines which were being invented. The men who chose to answer this need were named mechanical engineers, and they formed the first branch of engineers. Today, because of the great advances made in engineering, many specialized divisions have become necessary. A few of the branches of engineering mentioned by Mr. Teeter are mining, marine, naval architecture, chemistry, electrical, and aeronautical.

In conclusion, Mr. Teeter stated that there were over 300 subjects being offered by the Extension division, there being a faculty membership of 175. He advised all who wish an engineering education to get a firm foundation of mathematics and engineering drawing first. The Extension division, in its evening classes, offers all courses in mathematics up to Differential Equations, and a great number of other engineering courses.

Mr. Teeter has given a number of talks over WLB during the last year. The purpose of these talks is to inform those who now hold lesser positions in the field of engineering of the courses given in the evening by the Extension Division.

Mr. Teeter, a civil engineering graduate of Purdue University, has led a roving life, having been associated with many of the great engineering achievements of the West, and having taught at six different universities. He came to Minnesota in 1922 as associate professor of engineering, in charge of the engineering courses of the General Extension division.

Mr. Teeter does not believe that the teaching of engineering over the radio will ever become a success until television is perfected, as, in his opinion, the development of many theories and problems on the blackboard is an essential part of any course in engineering.

PROFESSOR W. T. RYAN

Resume of Ryan's Sabbatical Year

On August 1, 1930, Professor and Mrs. W. T. Ryan left Minneapolis in their car enroute to New York City. On their trip East they stopped in Pittsburgh to visit the factory and research laboratories of the Westinghouse Electric and Manufacturing Company. After spending several days in Washington, D. C. they sailed for Europe leaving New York on August 23, 1930.

A month was spent in England and while there Professor Ryan made a particular effort to visit important electrical power plants and technical institutions. Three days of their visit to the British Isles were spent in Dublin, Ireland. From here they traveled to France and then on to Germany, spending a month in each country. While in Germany Professor Ryan visited the factories and research laboratories of the German General Electric company near Berlin. He was particularly impressed with the high standard of electrical development in and around Berlin,—also the high standard of the research laboratories in the large electrical establishments. The return trip to England took them through Switzerland.

They returned to New York City via the S. S. Aquitania. The voyage was an unusually rough one, the ship being more than twenty-four hours late, — they passed through the worst storm encountered in more than ten years.

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THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Re Examinations

EXAMINATIONS are given a student as a measure of what he has learned in a particular course and are used in most schools as a basis of grade to enable the instructors of large classes to obtain a rating of that student's work for a given amount of covered material. In large classes it is impossible to have oral tests hence written work must be resorted to. Much can be said for and against this type of examination from either the instructors' or students' viewpoint.

The greatest objection to written examinations is that they yield an inaccurate measure of achievement. The marking of examination papers is subjective and is left up to the opinion of the corrector. Also, the questions of examination are not equal in difficulty and will not represent a true survey of the course. The contents of examinations are not in agreement with educational objectives in that the questions asked do not cover the essentials of the course, but strike on smaller details, the theory of the instructor being that if the student really studied he should know the answer regardless of its importance in the subject. Furthermore the student has not adequate opportunity to demonstrate his ability in a single examination. The chance of misunderstanding a question and devoting much time to the wrong answer is highly possible in many cases when the question is not clear. It may also be argued that examinations tend to produce undesirable mental processes. The practice of cramming is always evident, the result usually being a muddled brain at the crucial moment. Physically, examinations have a harmful effect and are injurious to the health of students, especially those of nervous temperament. Possibly more depends on the length of the test as to its effect than anything else.

We have specified why we object to examinations; now let us see what can be done to eliminate these objections.

To begin with, some method of measuring the ability of students is necessary and since there seems to be no alternative, cannot examinations be made satisfactory to both the instructor and the student? Standardized educational tests made up regularly by a group of authorities to be given at regular intervals over a specified assignment of material would eliminate the objections of the single instructor system and would augment the necessity of preparing the student on the assigned material. This plan would necessarily place all classes studying the same subject on an equal basis. Another substitute would be a slight departure from the method of using the examination marks as they stand, basing the grades on the instructor's estimate of the student's previous work versus examination marks. The use of daily grades has always been a satisfactory way of rating students but why not increase their weight in grade enough to carry students through if they should slip in the final?

The results of examinations depend a great deal on their use. If used properly they may be beneficial since they force the student to review and organize the contents of the course assuming of course that the instructor has made careful selection and formulation of the questions. There is a temptation for the busy instructor to hurry through the task of preparing the examination. As might be expected such questions are seldom satisfactory to either the student or the instructor.

Food for thought at least.

Speech Again

LONG there has been hue and cry that engineering students are not able to obtain sufficient elective work during their four years at the University. Long has been the insistent demand that greater opportunity be given for engineers to study English and Speech in particular.

And yet the opening of the present quarter saw many students refused permission to register for courses in speech simply because one of the departments of the College has had that course made a required part of their curriculum.

Is it wise education to let the few prosper at the expense of the many?

What Price Highway Safety?

BRAKES have been improved, steering gears, axles, and tires made more reliable. Stop and go lights protect dangerous intersections, the number of traffic policemen has been greatly increased, roads have been widened, dangerous crossings and grades removed, and many miles of non-skid surface applied.

Nevertheless almost twice as many people were killed during the five-year period ending with 1930 as were killed in the corresponding period ending with 1925.

In the face of the improvements mentioned, why should the record become continually worse? The answer appears more simple than the cure,—it has been caused because drivers have over-rated the efficacy of the many improvements instituted and of their own ability to drive. In short, too much reliance has been placed upon driving ability and things mechanical, and all sense of responsibility to passengers, pedestrians and other users of the highways has been dissipated.

The cure lies in educating the public to the seriousness of the situation and in stimulating a proper appreciation of personal responsibility in both driver and pedestrian.

Famous American Architects

LOUIS SULLIVAN

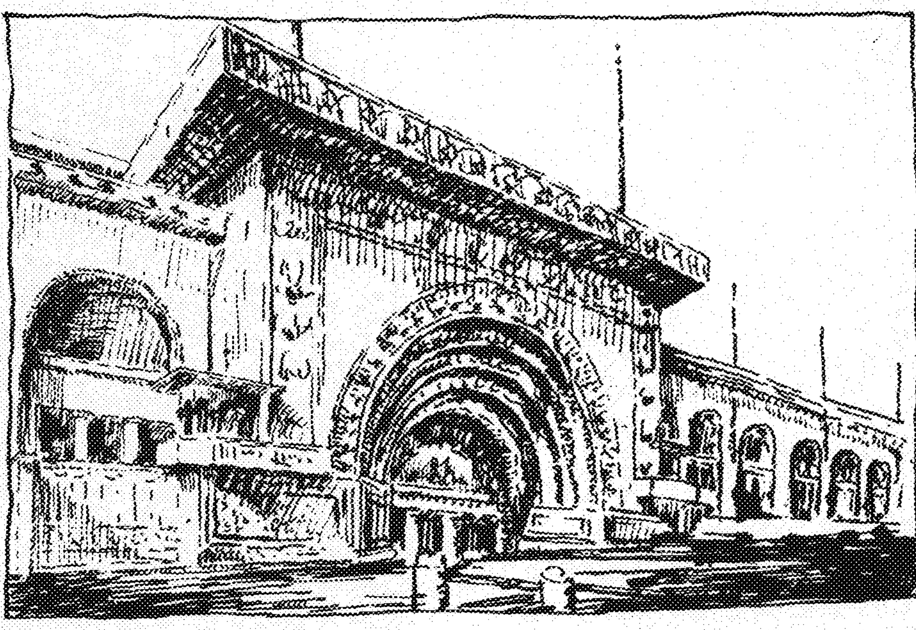
Prophet of the New World Architecture

By HOWARD WOO, Arch '31

Illustrated by the Author

WHEN Daniel H. Burnham and his associates adopted a classical mold for the Chicago World's Fair of 1893, he gave the already declining Romanesque style its coup de grâce. But what was of far greater importance was the assignation of the Transportation building of the Fair to Louis Sullivan to do what he liked with it, for the result marked a milestone in the development of American architectural design and philosophy. It was the beginnings of Modernism.

In the Transportation building and the Wainwright building in St. Louis, built in this early time, Sullivan elucidated his idea that form should express function. The purpose of the Transportation building was to house locomotives and Pullman cars, and its outward appearance should look exactly its function and not like an extravagant Roman bath. Moreover the building was constructed of plaster so it gloried in it. The details appear molded as plaster would be handled, the exterior was painted much as Richardson had done on the plaster ceiling of his Trinity Church in Boston.



TRANSPORTATION BUILDING AT CHICAGO WORLD'S FAIR, 1893

The third element in Sullivan's credo was complete originality—nothing in his designs depended on the past. He stimulated his imagination with nature—designs of leaf forms, snow crystals, and abstract geometrical figures. It was pointed out time and again that originality has nothing to do with the relation between form and function which is after all his really important contribution to architectural philosophy.

Louis Sullivan was born—as he expressed it in his "Autobiography of an Idea"—of a "mongrel breed," mostly Irish but with much German and French blood.

He went to Massachusetts Institute of Technology and laid the foundations of a splendid education, where he came under the influence of Eugène Letang and the first faint line of Paris and the Bohemian life.

After a year at M. I. T. he chafed under the routine and discipline—"He felt the need and the lack of a red blooded explanation, of a valiant idea that should bring life to arouse this cemetery of orders and of styles." He dreamed of the fountain head, the Ecole, and went to New York, where he met Richard M. Hunt, one of the first Beaux Arts men. Then he worked in Philadelphia until the panic of 1873 terminated his job.

He appeared in Chicago and found "a crude extravaganza in intoxicating rawness, a sense of big things to be done," and loved it. He entered the office of Major William LeBaron Jenney, but his spirit of restlessness and ambition drove him Paris bound in 1874.

He passed his examinations for the Ecole des Beaux Arts after only six weeks preparation and celebrated by going to Italy where he visited the Sistine Chapel. Here he felt and saw a great free spirit, the superhuman genius of Angelo, and his courage, power and loneliness.

On his return to Paris, Sullivan entered the Atelier Vandremer, but as Shelden Cheney says—he "again mastered the basic teaching of a school, but found it, in spite of brilliancy and cleverness, 'a method, a state of mind, that was local and specific, not universal'—and not the reality that he sought."

He returned to America and Chicago in the following year and while employed as a draftsman in the larger offices, he studied engineering and gradually evolved his own theory of building design. As he says he "found himself drifting towards the engineering point of view, or state of mind, as he began to discern that the engineers were the only men who could face a problem squarely; who knew a real problem when they saw it. Their minds were trained to deal with real things—while the architectural mind lacked this directness, this simplicity, this singleness of purpose.

In 1881 he entered partnership with Dankmar Adler and a firm famous in Mid-Western architecture was born. The firm of Adler and Sullivan even threatened the long established supremacy of Burnham and Root. But with the World's Fair of 1893, a tragedy came in the life of Sullivan, and a greater tragedy to American architecture. For thirty years afterwards American skyscrapers were to be squeezed into a classic mold as sanctioned by the World's Fair architects. He wrote of the Fair: "These crowds were astonished. They beheld what was for them an amazing revelation of the architectural art, of which previously they in comparison had known nothing. To them it was a veritable Apocalypse, a message inspired from on high. Upon it their imagination shaped new ideals. They went away spreading again over the land, returning to their homes, each one of them carrying in the soul the shadow of the white cloud, each of them

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AROUND THE WORLD WITH OUR ALUMNI

WILLIAM I. GRAY, '92 E. E.

William I. Gray '92 E. E., prominent in Minneapolis engineering circles, died Friday, February 6, at his home on Lake of the Isles boulevard. He had been ill for three months.

Mr. Gray was born in Lake City, Minnesota, in 1865 and attended district school at that city. He graduated from the University of Minnesota with a Bachelors degree in electrical engineering in '92, and was awarded a Masters degree in '98. As a charter member of the Minnesota chapter of the Theta Delta Chi fraternity and a member of Tau Beta Pi engineering society, he was active in affairs on the campus. He was elected to the Board of the *Ariel* and held offices in a number of student organizations. He was formerly president of the General Alumni association and was active in the initiation and support of legislation for the enlargement of the University campus. His work in helping to secure legislation for engineering buildings and projects was outstanding.

Mr. Gray built and operated a number of electrical power stations in the state, among which was the Wheaton Electric Light company of Wheaton, Minnesota. He later organized a contracting company in Canada. This organization contracted for electric, ventilating, plumbing, and heating equipment of all kinds. In 1894 he organized the firm of W. I. Gray and company, contracting engineers, and was president and treasurer at the time of his death. The company installed nearly all the heating and electrical equipment at the Minnesota State capitol. This included the power house building, tunnel, steam plant, and miscellaneous electrical equipment.

Mr. Gray served on the state board of electricity from 1899-1909 and became a noted authority on the work carried on by the board. He was president of the Minneapolis Builders exchange, and one of the founders of the Citizens' Alliance. He was a member of the Athletic club, the Rotary club, the Masons, the Scottish Rite, and the Mystic Shrine.

He made steady progress in his profession, making his way upward through his well developed powers and marked ability, his experience and continual study of electricity continually bringing him a wider knowledge and greater efficiency.

Surviving him are his wife, formerly Isabelle Welles; two sons, Franklin D. Gray, Minneapolis, and Wells A. Gray, Washington, a brother, James E. Gray, Gratton, North Dakota, and a sister, Mrs. A. M. Stewart, Loveland, Colorado.

Honorary pallbearers included Professor Franklin Springer, '93 E. E.; E. P. Burch, '98 E. E.; Dr. S. P. Rees; Judge A. W. Selover; R. T. Boardman; Richard Paul; Judge G. W. Buffington; and Dr. T. B. Hartzell, all of Minneapolis, and Dr. G. S. Todd, Lake City, Minnesota.

Chemical Engineering

'15—Olsen—Leslie R. Olsen was elected chairman of the Northwest section of the American Association of Cereal Chemists. Mr. Olsen is at present director of food products control for the International Milling company with headquarters at Minneapolis.

'20—Korthage—Roy Korthage is still living in Fulton, New York. He states he and Mrs. Korthage take great pleasure in announcing the birth of Robert Roy Korthage, on December 2, 1930. He probably will be another Roy.

'25, '26 — Sprung, Kobe — Murray Sprung, class of '25 and Kenneth Kobe, class of '26, have been awarded fellowships in chemistry. Murray is working with Dr. Hunter and Ken is with Dr. Ryerson.

'27—Tenney—Art Tenney dropped in to say hello a few weeks ago. He is with the Mahr Mfg. company of Troy, Ohio, likes his work immensely, and has decided to settle down. For that matter he probably will have to—if Mrs. Art Tenney has anything to say about it. After several weeks he still thinks marriage is about the best ever.

'28—Brewer—Mr. E. P. Harding, associate professor of chemistry here, is taking a leave of absence due to illness. Ralph E. Brewer is filling the vacancy for the remainder of the year.

Electrical Engineering

Professor W. T. Ryan '05, had luncheon Wednesday, February 11th, in Hollywood, California, with R. R. Sweet '21 EE., L. S. McKibben '21 EE., D. P. Loye '17 EE., E. C. Manderfield '21 EE., and Dr. Frayne, formerly instructor in Physics at the University of Minnesota. Mr. Sweet is commercial superintendent of the Electrical Research Products, Incorporated, which leases to the various moving picture concerns the sound producing and recording apparatus manufactured by the Western Electric company and the American Telephone and Telegraph company.

John Hilliard '28 EE., who is a transmission engineer for the sound department of the United Artists Studio corporation, was also present. After the luncheon some of the moving picture lots were visited and a number of Hollywood's famous movie stars were seen at work producing talking moving pictures. Mr. S. Howard '92 EE., is also employed by the Electrical Research Products, Incorporated.

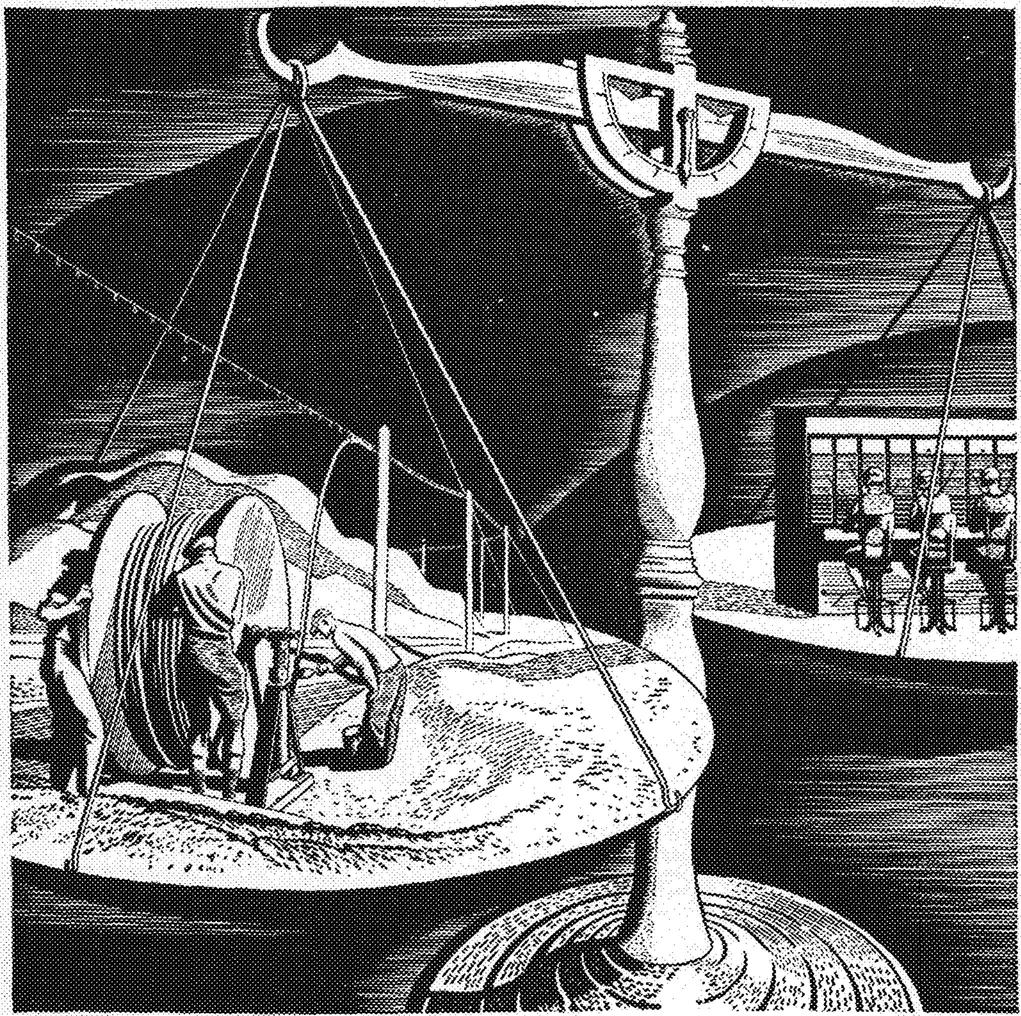
'16—Simons—W. W. Simons, who is now Division manager of the Electrical Research Products, Incorporated, visited the campus the other day. He said, "It certainly is a pleasure to see the old campus once more and particularly the new Electrical Engineering building which has been built since my graduation. I hope to be able to attend the fifteenth year Alumni reunion this June." His address is 910 S. Michigan Ave., Chicago, Ill.

'29—Saxhaug—Erling Saxhaug is working for the U. S. patent office in Washington, D. C., and studying law at Georgetown University. He writes, "I am in the Patent Office and trying to discourage a few of the country's embryo inventors. It is very interesting work. We examine the applications to determine their patentability and get some very interesting cases. The attorneys try to convince us that their cases are new and useful, and we have some very interesting arguments and interviews with them.

"There are quite a few Minnesota fellows here in the office. Richard Trexler and Paul Bliven, both M. E. '27, are staying together and I see them quite frequently. Leo Smilow, M. E. '29, is just across the hall from me. Edwin Dybvig, E. E.

(Continued on page 164)

DONALD STEVENS, '28 E. E., WHO WAS KILLED RECENTLY IN AN AIRPLANE ACCIDENT



(Continued from page 162)
'29, and I complete the '29 fellows in the office, but there are quite a few older men.

"There are three of us staying here together—Fred Hakenjos, Arch. '29, and Frank Freeman, M. E. '29. Hakenjos is assistant manager of the R. Y. Ferner company, importers of scientific and precision instruments and came down here after finishing his work for a Master's at Columbia. Freeman is with the Ingersoll-Rand company, and has just been transferred from their Philadelphia office.

"Gordon Reed and William Norley, also M. E. '29, are both here at the Navy Yard in the Bureau of Construction and Repair. Reed is now on his way to New Orleans with the fleet as a part of his Naval Reserve training. Russel Backstrom, M. E. '25, is here with the Wood Utilization section of the Department of Commerce. I see all these fellows quite frequently and there are quite a few others who I do not see so often. We had a fine gathering here a couple of months ago when the Dean was in Washington.

"In my spare time I am going to Georgetown Law School and finding out that maybe I should have stuck to engineering. This is my first year, but when I have completed my legal training and have been admitted to the Bar I expect to make a little money practicing before the office."

'30—French—Edwin E. French writes concerning the Christmas reception held by the electrical engineers of the Bell Laboratories. He states, "Walter Lehnert, William Field, George Stowe, Robert Friis, Charles Hendrickson, C. Jerome Hastad, and Herman Nygaard of the class of 1930 were all present at the theatre and dinner party."

'30—Heller—Robert Heller expects to attend the University of Pennsylvania after finishing his student course with RCA-Victor. So far, the only nice thing he has found about living in Camden, N. J., is its proximity to New York, Washington, Atlantic City, and other well known vantage points.

'30—Meffert—G. H. Meffert writes: "I have just completed a six months' training course with the Carrier Engineering corporation and am now at work in the branch office in Chicago. I enjoy my work very much and also like Chicago fine. I attended the weekly Minnesota luncheon at Mandel's Grill and met quite a bunch of former students." Address the letters to 1032 Burnham building, Chicago, Illinois.

'30—A few of the electrical engineers taking the student course of the Northern States Power company of Minneapolis are Harry Bruncke, Earl Ewald, Carl Lethert, Edison Knauss, John Meriman, John Berner, Joseph Sieberns, and John Stewart. They are each spending from two to four weeks in every department of the company.

'30—Comstock—Dropping the office a letter R. H. Comstock, former member of the TECHNO-LOG staff, said, "As you probably know, Karl Sommermeyer and myself are down here at Milwaukee at the expense of Cutler-Hammer and Company incorporated and so forth. I spent a little over two months on the various test floors and then, due to lack of work down there, they put me up in the experimental department. I have been there a month now and like it very well. I didn't do much work while on the test floor but am expected to do as much as anyone up in the experimental department. Karl has spent three months in experimental and is now down on the test floor.

"Karl and I have an apartment, together with two graduates of Michigan.

"I have come in touch with quite a few alumns since coming down here. Larry Larson and John Borden of the class of '29 have an apartment about two blocks from here. Borden is in the sales department. Larson works in the same part of the experimental department as I do. Glendon Brown, '28, is one of the 'big boys' in the physical research laboratory. He is noted for his good humor and a car that runs. They have some good games of Schafkopf (German for Sheepshead) in there at noon. I found out that it was a very good game for me to lose money on. Marvin Cook of '28 is working down at the Milwaukee sales office. I have not seen much of him but I understand that he puts in much of his time with his wife and John Marvin, Jr. John Newman of '23, or about that, is in the engineering department. Besides being a very good engineer he is about the best the company can boast as a golf player, is a good bridge player, and a great Minnesota football fan. He was up to the Vanderbilt game and plans to take in the Wisconsin game.

"I have a letter or so from Melvin Elmquist. He is with the Detroit Edison at Detroit and seems to like it very much. He writes that the company doesn't make them work very hard but wants them to learn a lot.

"And say, do you ever see John Healy, erstwhile able business manager of *Ski-U-Mah*, and now club man and advertising tycoon? If you do, ask why those good looking girls he knows down here never seem to come down. I haven't seen a good looking girl since I left Minneapolis."

Comstock also gave his name to the circulation manager.

Mechanical Engineering

'08—Norelius—E. F. Norelius spoke to the class in Highways the other day. He stated, "The engineers advancement and creative possibilities lies in constant improvement. Building more miles of road at less cost is a creative achievement." Mr. Norelius is now chief engineer of the tractor division of the Allis-Chalmers manufacturing corporation.

'28—Angell—Working for the Hart-Parr tractor manufacturers, Glenn H. Angell is now living at Charles City, Iowa.

'28—Lundquist—G. C. Lundquist has moved back to Minneapolis. He is here as project engineer for the Wright Airlance corporation of Paterson, New Jersey.

'28—Cook—Lyle M. Cook, now testing ship models for the U. S. Navy at Washington, visited the campus during the Christmas holidays.

'29—Tanner—Elo Tanner is now in the railway motor engineering department of the Westinghouse Electric Manufacturing company at East Pittsburgh, Pennsylvania. He has just completed a six months course given in the Westinghouse Mechanical Design School, which carries graduate credits toward an M. S. degree at the University of Pittsburgh.

'29—Freeman—Frank S. Freeman expected some '30 graduates call on him at Philadelphia where he is working for the Ingersoll-Rand company. The graduates are John Skidmore, Richard Guppy, Ralph Baskerville, and Coroe Hawkinson.

'29—Edey—F. E. Edey, now with the Wagner Electric corporation at 1225 La Salle avenue, Minneapolis, is living in St. Louis Park.

'30—Jacobs—In Minneapolis for the Indiana game William A. Jacobs left a note for the TECHNO-LOG.

"Worked for the D. M. and N. Ry. for the summer months before going to work for General Electric on November 3. Came down to Minneapolis over the week-end to see the game and to look around the department before going East. Am going to room with Ed Bottemiller, '27."

'30—Johnson—While trying to give the Minneapolis architects better ideas for illumination on new building projects, L. E. Johnson is drawing a pay check from the Northern States Power company.

« « MENTAL TILTS » »

HOW OLD?

GIVEN: A boy is twice as old now as a girl was when the boy was the same age as the girl is now. When the girl is as old as the boy is now, the sum of their ages will be 63.

REQUIRED: The ages of the boy and girl.

THE FARMER

GIVEN: A farmer hauling a load of stock to the market. In his truck were pigs, cows and horses. Now all the animals were pigs but four, all were cows but six and all were horses but eight.

REQUIRED: The number of horses, cows and pigs in the truck.

ANSWERS TO LAST MONTH'S TILTS

And Half an Egg—The woman had 295 eggs in the basket.

Bricks—The brick weighs two pounds.

Louis Sullivan

(Continued from page 161)

permeated by the most subtle and slow acting of poisons; an imperceptible miasma within the white shadow of a higher culture. A vast multitude, exposed unprepared, they had not had time nor occasion to become immune to forms of sophistication not their own, to a higher and more dexterously insidious plausibility. Thus they departed joyously, carriers of contagion, unaware that what they had beheld and believed to be truth was to prove, in historic fact, an appalling calamity. For what they saw was not what they believed they saw, but an imposition of the spurious upon their eyesight, a naked exhibition of charlatanry in the higher feudal and domineering culture, enjoined with expert salesmanship of the materials of decay. Adventitiously, to make the stage setting complete, it happened by way of apparent but unreal contrast that the structure representing the United States government was of an incredible vulgarity—Thus architecture died in the "land of the free and the home of the brave"—and the time of eclecticism in architecture was at hand.

After this time, the commissions were fewer, but Sullivan maintained his philosophy and probably did more to lead the architect through this fog of eclecticism to the present straightforward expressions of modernism by his pen than through his many buildings.

In the study of his many buildings, the honesty, simplicity, the integral purposefulness of them at a time when every other architect was masking the true structure within, offers an insight into the direct, straight thinking of the engineer coupled with the imagination of the architect. The architectural elements in their baldest type, the desire of the heart in its most primitive, animal forms are the foundations of architecture.

Sullivan then, has left a bod of architectural philosophy which has flowered in Saarinen's design for the Chicago Tribune Tower in 1922 and predicts a future development of a great architecture that will be true to its functions and materials, both logically and honestly. The last word may well be Sullivan's own: "A logical mind will beget a logical building."

Carburizing Steel

(Continued from page 157)

will contain 10 to 15 per cent of barium carbonate and 3 to 5 per cent of sodium carbonate. These proportions are varied considerably in different standard compounds, but the sodium carbonate is generally kept low because of the tendency which its product of decomposition, sodium oxide, has to attack the edges and cover of the carburizing containers.

The carbonaceous material is also quite important. It must oxidize quite readily to form carbon monoxide and still not burn immediately to the dioxide.

Water should be eliminated as far as possible from the compound. The water will, by a reaction with the hot carbon, form hydrogen and slow up the process. The moisture is usually introduced through a damp compound. In some cases this is water of crystallization and cannot be eliminated by drying as the compound, on exposure to the air, immediately takes up more moisture.

Frank Lloyd Wright Talks on Architecture

On February eleventh the undergraduate architects, as well as a great many other people interested in architecture, listened to the originator of some of the most radical ideas of modern architecture, when Frank Lloyd Wright, world renowned architect and theorist, criticised in a most derogatory manner our present styles and methods of building.

In introducing Mr. Wright, Professor Mann, head of the School of Architecture, made the statement that "Architecture is the most familiar and at the same time the least understood of all the arts," and followed this with a short explanation of the radical changes taking place in that field. Mr. Wright took up this thought but carried the revolution clear back to the early renaissance when "Michael Angelo superimposed the Pantheon on the Parthenon, naming it St. Peter's, and called in the blacksmith and ironmonger to aid him by putting a monstrous iron chain around the dome."

"In these days," Mr. Wright continued, "architecture is a confused thing. Everything has gone over to the blacksmith. Architecture has gone out, except as it may remain as surface decoration. We are suffering from the divorce of structure from architecture, yet we still pay tribute to the masonry mass." Mr. Wright then explained this statement by saying that masonry is used falsely, that masses of masonry are built up to appear as though they were supporting the building while actually the steel columns behind them were the supporting members.

As a remedy to the situation, Mr. Wright said that architecture must become a living thing, reflecting the times and that there should be a premium in academic work on things being natural, taking full advantage of every material used. He cited glass as one of the materials we do not take full advantage of, and asked what the ancient peoples might have done had they had the unlimited use of glass at their disposal that we do now. The Greeks, he said, knew only the post and lintel construction and they carried it almost to perfection. The present age lacks honesty, courage and freedom. We have ben set back centuries because we have been taught that architecture and life were different and that culture must be respectful of tradition. "We can learn more about architecture from a tree than from a book. The tree has its structural members, the trunk and branches; and then the foliage which screen it in and beautify it. Yet it has strength, openness, and dignity—not a masonry mass a box with holes in it. We should incorporate masonry, steel, glass, metal and textiles into one idea that is truth Stone masses supported on steel lie."

Safety Engineering

(*Continued from page 153*)

sideration to this work in the same way that it is necessary for them to do in regard to plant production, quality, etc. It is easy to understand why the remainder of the organization will carry on any work in a much more effective manner when such work is part of a company policy and is demanded by the company officials. Although progressive industries as a whole realize that organized accident prevention should be necessary, the officers are often prone to leave the work entirely in the hands of the individual so designated, not realizing the value of their own influence. Thus it becomes necessary for the individuals who work for organizations, such as insurance companies, to sell the officers of less progressive plants on the value of accident prevention and also sell them on the necessity of their complete cooperation. The individual in this step of accident prevention work must not only be an efficient safety engineer, but also a capable salesman.

The application of any accident prevention plan calls for a complete organization, including definite supervision. Such a plan should, and usually does provide for physical protection, and although the physical conditions probably cause no more than ten per cent of the accidents, they do enter into every accident indirectly and the psychological effect of a completely guarded plant is such that the employees are encouraged to cooperate to a greater extent. The educational features of the plan include the placing of responsibility for training new and old employees along safe working lines, the advertising of the value of safety first practices by means of bulletins, group meetings, etc., and the creating of an enthusiasm among the employees as a whole through competition, prizes, etc. Of all these the placing of responsibility is the most important and the plan should work definitely in this respect. This responsibility should start with the workmen and continue through the foremen, superintendents, and even up to the highest official.

The application of such a plan must be continuous and for that reason the safety engineering has not been completed with the mere organization of safety work. The investigation of accident causes must be continued as a part of the plan. Changes in equipment, operation standards, employees, etc., makes it necessary to not only devise new methods of physical protection but also in educational methods, to cope with the changed situations. A continual study of every operation and condition is necessary in order to determine any hazard, that fortunately has not resulted in an accident previously. The results of safety work are measured to a great extent by the ability of individuals and organizations to visualize hazards and eliminate them before accidents occur. It is necessary to keep new material in the hands of the organization at all times so that the safety work will never grow stale but will always be of a progressive nature.

That accidents can be prevented has been proven by many companies. Factories now operate for months and even years without accidents that necessitate lost time, but before safety work was given the impetus that it now has, some of these same concerns were accustomed to having accidents daily. These companies have not only reduced their accident cost to a minimum but have also bettered the morale of their employees. Effective safety work always brings about a higher spirit of good will among the employees, in fact safety work and good will are dependent to some extent upon each other.

Any individual who plans to follow safety engineering as a profession should train himself to some extent in the following lines: General engineering, salesmanship, psychology, public speaking, and a general knowledge of accident causes and their prevention. Like any other profession, it means continual study so that the individual may keep a trend of the times. He must have a creative mind in order to analyze a situation and formulate his plans accordingly.

The field of safety engineering is large and although the foregoing has stated that all progressive industries are carrying on safety work, nothing has been said about the industries that are less progressive. It might be said at this time that probably a larger majority of industries are not carrying on any safety work at all, or are doing so in a very unsuccessful manner. It is also true that

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Charting the Waters of the Philippine Islands

(Continued from page 155)

essary food supplies are left at this camp, and the tide gauge inspected.

The ship is then free to proceed with off shore hydrographic work and this work is taken up, usually pursued without interruption, and continues until the supply of coal becomes low enough to return to Manila. The camp hydrographic and topographic parties are then picked up, a visit made to the tidal camp party and necessary supplies left, and the vessel returns to Manila to replenish supplies. This is a typical monthly cycle of the movements of the Pathfinder.

This sounds as if it may be a very monotonous routine but there are many compensating factors, with some opportunity for recreation. The camping parties quite often come in contact with the natives ashore, and in some of the isolated localities these natives are as wild and uncivilized as you may find any place in the world, using bows and arrows and spears for weapons and in other ways living very primitive lives. The interested collector finds a wonderful opportunity to obtain primitive weapons and utensils, and takes an interest in observing the manner and customs of the various tribes. Along the shore can be picked up many interesting shells and specimens of coral. If one is interested in hunting, he may find in some localities, small deer, wild hogs and a few of the larger and more dangerous animals. There is also bird shooting for those interested, the rice birds being especially numerous.

Life on board ship does not have the opportunity for variety that is found in camp. When sounding off-shore, the vessel usually anchors for the night on some shoal or submerged bank, many miles from shore, where those so inclined are limited in their sporting tendencies to fishing. However, the living conditions on board are a little more comfortable than those in camp, especially so in the tropics. The quiet life on board after the day's work, finds favor among those studiously inclined.

Recognizing the fact that a healthy, contented personnel is necessary for efficient work, an attempt is made to make life on board the vessels and in camp, as comfortable as possible. Good cooks and a varied diet are essential. Radio equipment and operators keep the party in touch with the outside world. A laundry is maintained.

The surveying equipment is kept up-to-date, and progress is continually being made in methods and outfit. The up-and-coming officer is always on the lookout for short cuts in methods, and improvements in instruments or equipment.

Skilled mechanics are included in the ship's complement, and they are kept continually busy constructing new equipment, or repairing old.

Since the war, considerable advance has been made in sounding methods, with the development of echo sounding. Each survey vessel in the Philippines is equipped with a Fathometer, an instrument which measures the time required for a sound to travel from the vessel to the ocean bottom, and the echo to return, and automatically converts this time interval into units of depth, as shown by a dial on the machine. Echo soundings occur at intervals of one-quarter of a second and the resulting return flashes on the dial show at the rate of four a second. With this instrument in operation, the vessel can proceed at full speed and obtain an accurate profile of the bottom along its course. The position of the vessel is determined at frequent intervals by the three point location method using two sextants, observing simultaneous angles on three triangulation stations or signals on the land. Any area to be surveyed is thus covered by a grid system of sounding lines or profiles, the interval between lines being determined by the general depth in the vicinity. All pertinent data such as depths, sextant angles, courses, speed, etc., are permanently recorded in a special sounding volume and at the same time the officer in charge plots the courses, positions and soundings on a boat sheet.

The sounding launch uses hand lead in depths less than fifteen fathoms (ninety feet) and uses a sounding machine with sounding wire in greater depths. The same method of locating the sounding lines by means of sextants is used as on board ship. Sounding with hand lead, or wire was the method previously used on board ship, but very slow progress was made. The perfection of the Fathometer has speeded up the work to a great extent.

All topographic work done is by the plane table method, supplemented by other methods in those localities where the plane table cannot be used. Much of the topographic work is very difficult of accomplishment owing to the characteristics of the vegetation and physical character of the coast. Many miles of shore line are covered with mangroves and it is necessary to set up the plane table in the water sometimes waist high. Quite often it is necessary to use floating stations consisting of boats or specially constructed rafts. Again on the outer exposed coasts, which are usually rocky and steep, progress is very slow as the principal means of transportation is by boat, and landing on the rocky coast must be done under favorable weather conditions.

Probably the most interesting work in the islands, especially to those wishing to observe primitive living conditions, is that in connection with triangulation. Quite often the scheme includes stations five miles or more back from the coast on mountain peaks. Here can be observed the hill people, who are often isolated and untouched by any civilizing influences. Each locality seems to have its distinct tribe with different customs, language and dress. The civil engineer sees many novel construction methods.

Altogether, a two-year tour of duty in the Philippines is not as bad as usually pictured. Practically all vessels going to and from the islands touch at Chinese and Japanese ports, and an opportunity is here afforded to view several oriental cities. Social and family life in Manila is very much like that in the States. Any delicacies not obtainable locally, are shipped from California or Seattle. American automobiles are as numerous as in cities of the same size on the mainland. The "talkies" are firmly established. American schools have made the English language the common language of the various islands. Altogether, when in Manila, one hardly realizes that he is on the opposite side of the globe from the U. S. A. The real Filipino life is found only in the out of the way places.

Safety Engineering

(*Continued from page 168*)

where industries are carrying on safety work in a socalled successful manner, the results can still be greatly improved. Safety engineering is still in its infancy and it is only at the present time that it is gaining the impetus necessary to bring about standard practices in regard to this work. It can be said that the surface has hardly been scratched.

At the present time, the following groups of organizations are attempting to carry on safety work and stimulate an interest in the minds of the public in general: Various industries, local civic organizations, the National Safety Council, insurance companies, public schools, and federal, state and local governments.

The National Safety Council is an organization made up of industrial leaders all of whom are interested to such an extent in creating safety movements throughout the entire country that they are giving a portion of their time and efforts to further this movement. This is a non-profit sharing organization, receiving its working funds from advertising, membership fees and the sale of various forms of safety literature. This organization in itself is doing a very wonderful work in the field of accident prevention and it alone has been successful in creating more interest in this work throughout the country. Local civic organizations that are carrying on safety work as a general rule are members of the National Safety Council. Their safety work usually consists of promoting contests, securing the cooperation of law enforcement officers, and educational movements through radio talks, posters and other literature.

The casualty insurance companies are not carrying on safety work from a selfish standpoint alone, but rather from a service point of view, realizing that an accident prevented will mean a great deal more to the employer than to themselves, and in view of that the engineering departments of various insurance companies are now largely becoming service departments.

The fact that public schools are carrying on safety work is very gratifying to those who realize that accident prevention is entirely educational and that such education will have considerable more bearing on the younger generation than on those who have already reached maturity and who oftentimes hesitate to change their mode of living in order to conform with certain rules of safe practices. Another gratifying aspect of safety education in the schools is the fact that it has a wonderful effect on the parents and other associates of the children who are being educated.

The federal, state and local governments are continually carrying on accident prevention work through their law enforcement officers.

Safety Engineering is a very gratifying work inasmuch as it not only is productive of a large economic saving but also produces increased happiness and reduced physical and mental suffering. To what extent this work has been successful is and always will be indefinite, but the fact that the number of accidents have been greatly reduced where safety engineering has been applied is sufficient proof of its worthiness.

WIN

The Techno-Log Article Contest

WHILE YOU PLAY DURING VACATION

(Continued from page 159)

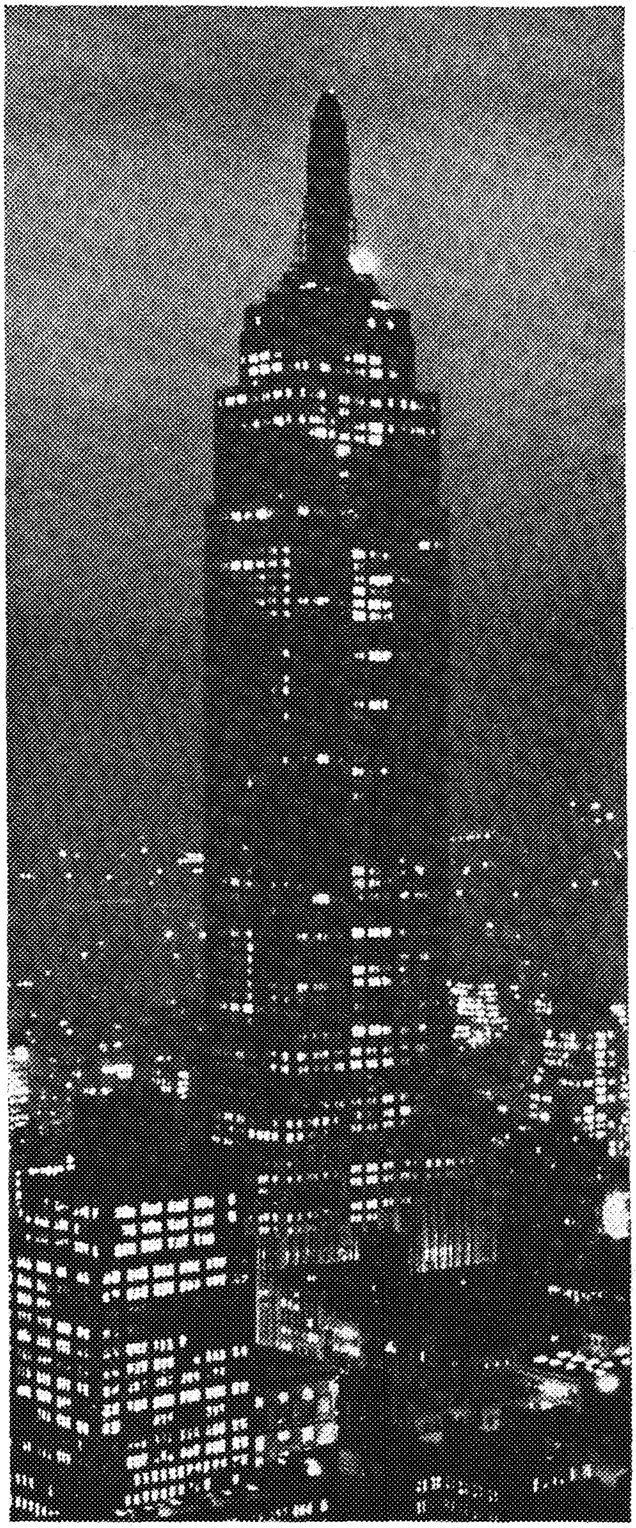
While in New York Professor Ryan visited the engineering departments at Yale University in New Haven. They then motored from Washington to Tampa, Florida, where they spent several weeks. Professor Ryan enjoyed being able to play golf in shirt-sleeves in the middle of December. From Tampa, Florida, they motored to Pasadena, California, via New Orleans, where they stopped during the holidays.

The remainder of the year Professor Ryan expects to devote to study at the California Institute of Technology, but will also deliver some lectures. Professor Ryan is particularly interested in power generation and transmission and hopes to be able to visit some of the large high voltage developments. These include the Big Creek project of the Commonwealth Edison company and the plants of the Pacific Gas and Electric company. He also expects to visit the University of California and Stanford University.

(Continued from page 158)

unit gave an efficiency of 83.5%, while previously the best percentage obtainable was 66 to 67% operating with chain grate stokers. The use of the pulverizer most likely accounts for the increase in efficiency.

Being the first of its type to be used in the plant, more attention is given to the pulverizer than previously. It is a 6000 pound unit driven by a 150 H. P. motor situated at its base. Coal is dropped in through a chute which leads to a series of revolving flanges actuated by centrifugal force. The flanges grind the coal into pulverized state, the dust being blown into the fire box as it is produced. There is very little vibration or noise to this type of pulverizer. The air used to carry the dust into the furnace is preheated and special construction of the furnace walls was made necessary by this air warming feature. The walls are constructed in two sections leaving an air space on each side and in front of the furnace chamber. These spaces are connected and are open to the atmosphere at several points. Air is drawn through these spaces from around the chamber into a single tube leading to the pulverizer where it picks up the fuel and carries it into the furnace. Being preheated, it makes combustion more complete.



THE MINNESOTA TECHNO-LOG

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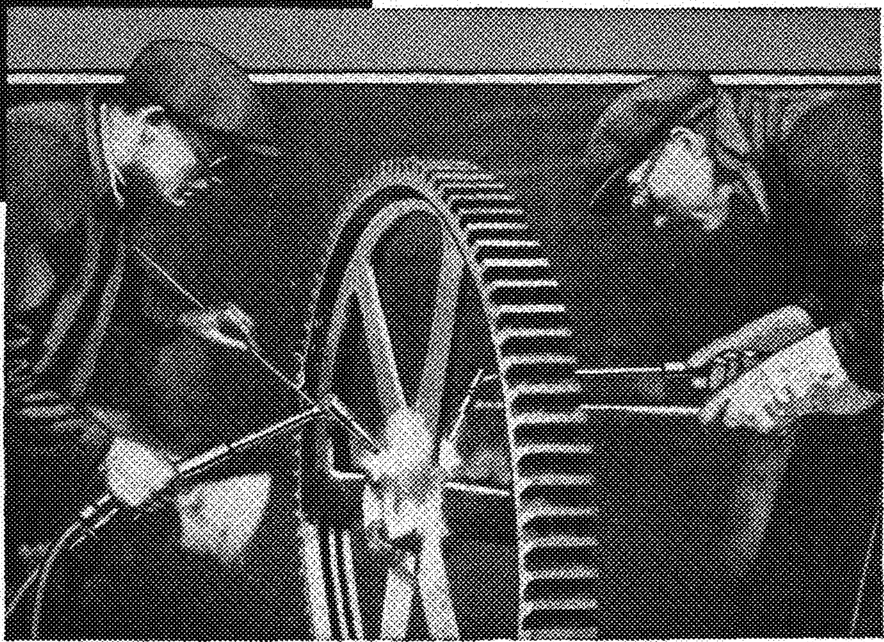
MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

THE FOE OF INDUSTRIAL WASTE ▲▲▲▲▲



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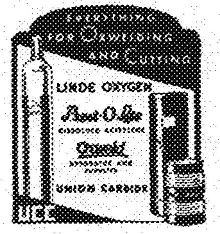

THE MINNESOTA

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An Italian Farmhouse

THE MINNESOTA TECHNO-LOG
UNIVERSITY OF MINNESOTA

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Breaking the Trail*

Between the lines of a surveyor's note-book

By LEON ARCHIBALD
Assistant Professor of Drawing and Descriptive Geometry

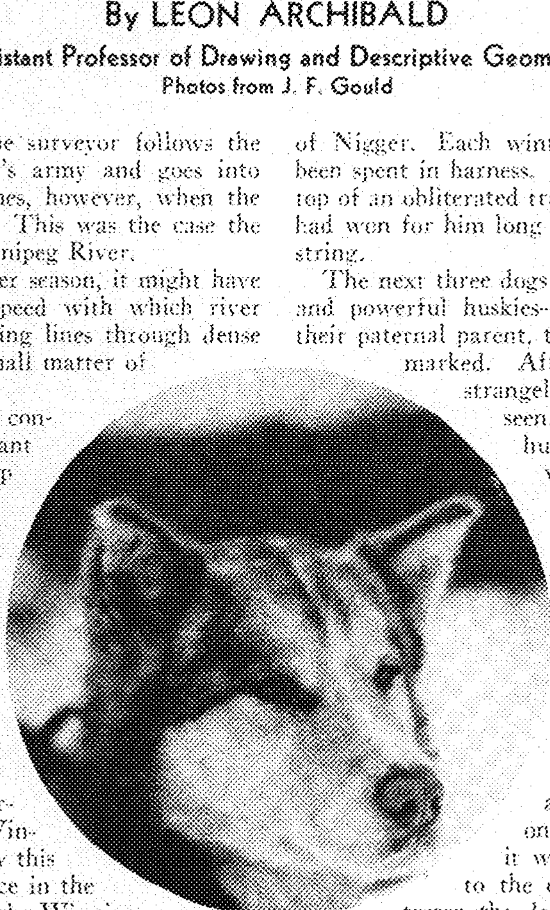
Photos from J. F. Gould

AS a rule, when winter comes, the surveyor follows the sensible example set by Caesar's army and goes into winter quarters. There are times, however, when the nature of his work dictates otherwise. This was the case the winter we made the survey of the Winnipeg River.

Had the work been done in any other season, it might have involved fewer hardships. But the speed with which river work proceeds on ice, as against running lines through dense timber, more than offsets the rather small matter of physical discomfort.

Our party for this winter's work consisted of ten men, the most important member of which was a first-class camp cook. With the exception of myself and the topographer, who had newly arrived from France, the other members were recruited on the ground. They were young half-breeds who had been born and raised here, and richly endowed by Nature for such an undertaking. As you are familiar with your daily haunts, so were they perfectly at ease in this wilderness of beautiful forest and water.

Kenora, Ontario, was our point of organization and taking-off place. The Winnipeg flows northerly from here. Today this beautiful body of water, from its source in the Lake of the Woods to its outlet into Lake Winnipeg, is the paradise of the summer-resorters and the mecca of sportsmen. But at the time of which I write, any knowledge of its northerly stretches was meager and was possessed by the comparatively few men whose business of trapping and fur-trading took them to those parts.



A TYPICAL HUSKY

We were conventional and used the dog team for transportation purposes. Harnessed to a sledge or toboggan laden to the extent of one hundred pounds per dog, a team was often called upon to make from forty to fifty miles per day over an unbroken trail. Pound for pound, they would put the horse entirely out of the running under any conditions.

Our driver came from similar service with the Hudson's Bay Company. With instructions to provide us with a good team from the wealth of material at hand, he demonstrated very clearly that he not only knew dogs, but also understood thoroughly the first duty of a public servant. Working on the theory of immemorial usage that a Government's exchequer is unexhaustible, he indulged himself freely.

The leader, which cost us seventy-five dollars, was a handsome, big, black, curly-haired fellow running strongly to the Chesapeake and Newfoundland, and answering to the name of Nigger. Each winter of this veteran's twelve years had been spent in harness. His ability as a fighter and to keep on top of an obliterated trail through hours of a blinding blizzard had won for him long before this his position of honor in the string.

The next three dogs in line behind Nigger were large, lean and powerful huskies—dogs in which the characteristics of their paternal parent, the big gray timber-wolf, were strongly marked. After these came the handsomest and, strangely enough, the meanest dog I have ever seen. In working condition he weighed one hundred and twenty pounds, all of which was bone and muscle. His hair was pure white, long and of the texture of fine silk, and as he trotted along it undulated in rippling waves along his back in harmony with his long, easy and powerful gait. He was a handsome brute.

Possessing an elegant head which marked him at once as of the collie genus, he was in appearance the peer of all dogdom—until one looked squarely into his eyes. Hatred of such an intensity smoldered there as to cause one to shiver. The driver's verdict, and it was well supported on the rideout, was to the effect that the animal was a cross between the devil and a wildcat. Either of these ancestors would easily account for his disposition, but they did not explain that wealth of outward beauty.

I am strongly inclined to the belief that Wobsemunk, for that was his alias, had at one time graced the pages of dogdom's blue book under a different name. Obviously the dog had an interesting past. It is well known that all good sleigh dogs are not born in the snow country, and undoubtedly it was the shanghaing process that was to blame for Wobsemunk's profound loathing of all things living, man in particular. And what a fighter!

The day we left town, our team, harnessed and ready for the trail, was lying in the street in front of a hotel. The proprietor of the hostelry owned a large, vicious and aggressive bulldog—the terror of every dog in town. Returning from his morning patrol, the bulldog took in the spectacle before him in one swift glance and then advanced belligerently upon the invaders of his sacred premises. Straightway he issued a challenge to the team individually or collectively—he said it made no difference.

Good sleigh dogs in harness will not fight, but Wobsemunk, of course, was an exception. In some way he contrived to back out of his collar, and then proceeded most effectively to make

* Reprinted by special permission of *Field and Stream*.

sausage meat out of the bulldog. Before the affair was ended, half the town was present, together with all of the police force. Every one did his best to stop the massacre, but before the white dog's lust was satisfied he had taken the bulldog completely apart, studded collar and all. That, I believe, was the day an emergency ordinance was hurried through the council, prohibiting dog teams entering the town.

Bringing up the rear, or in the wheel position, was a big, happy-go-lucky Saint Bernard pup, Prince by name and prince by nature. He was larger by twenty or more pounds than any of his mates, and this was his second year in harness. The chief requirements of a wheel dog are a placid disposition and plenty of strength. Immediately behind him is a heavily laden and lurching toboggan which, on down grades, must be kept under some semblance of control and at the same time off the wheeler's heels.

His most difficult work, however, is on the sharp turns. A cut corner means an upset toboggan, and no driver likes an overturned load, as any wheel dog will tell you. On the turns the wheel dog's strength is pitted against that of his mates, who are already straightened out on a new tangent, leaving him to get the toboggan around and at the same time keep his feet. On these occasions the best of wheelers often go down. When this happened to Prince, he always came up smiling to resume his game of trying to catch Wobsemunk's brush. Prince qualified with a lot to spare.

Our equipment, which included instruments, totaled considerably less than a thousand pounds. This may indicate the comparatively small amount of goods and chattels necessary for an expedition of this kind, even in the dead of a Northern winter. We were living under canvas—two sleeping tents and one for the cook.

Our mattresses consisted of carefully selected, graded, well-laid and woven-together balsam branches. For softness and resilience these were the equal of the finest bed upon which one has ever slept. They possessed another quality of great merit and found nowhere else. This was their seductive aroma. To roll up in warm blankets atop such a royal litter is to know the delights of unqualified repose.

Each tent was heated by a small sheet-iron stove of the so-called airtight variety—a utensil designed to convert fuel into heat in the least possible time. When we retired, it was allowed to go out even in the severest weather, but such was the quality of our blankets that we experienced not the least discomfort with the thermometer often 50 below zero and lower. To start a fire in the morning, one had merely to roll toward the stove and throw in a handful of dry pine whittlings, touch a match to them and roll back again. Then in two minutes' time he could get up and dress in comfort.

The average daily temperatures lay somewhere between 25 and 35 below zero. The constancy of the cold in these parts during the winter is such that the first mantle of whiteness to enshroud the landscape in November is the last to temper the winds of late March. A Sunday night of the last week in January saw the mercury standing at 58 degrees below zero. With each succeeding day of that week there was a drop of from one to two degrees until the following Sunday night, when the top of the silvery column just reached to the 68-below mark.

PRINCE IN THE LEAD, WITH WOBSEMUNK NEXT BEHIND

The air is unusually dry, and if there is little wind these temperatures are not so formidable as they appear on paper. During the whole of that winter we lost but one-half day on account of the weather.

Progress of the work made necessary a shift of camp about every ten days. It was on these occasions that we experienced our greatest discomfort—or so it was held by several members of the party. Each new camp-site meant a bath—one of the Turkish kind, and a thoroughly good one.

A red-hot stove and frozen ground under tight canvas make a very good "hot room." The steaming process lasted from one to two hours, during which time about all one could do was to remove his clothing and, as the head picketman so aptly put it, "set and sweat." A plunge into a snow bank, followed by a brisk rub, completed the ordeal. If there is any process more conducive to a genuine feeling of physical well-being than the foregoing, it is not commonly known.

The dogs, of course, stayed outside, each one being chained to a tree that would provide the most shelter from falling snow. They were furnished with beds of balsam brush, and seemed quite contented with this arrangement. It was hard to believe that they were not cold and most uncomfortable, but I failed to notice at any time any signs of distress among them.

A sleigh dog in winter has a strong aversion to being wet or even damp. When out in a snow-storm, he is continually shaking himself to get rid of the falling flakes so that they will not wet his pelt. He seems to sense quite well that water is a good frost conductor.

Corn-meal mush formed the bulk of the dogs' diet, and on this food they kept in first-class condition and gave a satisfactory account of themselves on the trail. This reference to the dogs' food brings up a matter which may tend to confound those "ologists" who deny an animal the ability to reason. The mush was fed to the dogs in deep pans and came to them right off the fire, scalding hot. Since they always seemed to be ravenously hungry, there was great impatience displayed while the food was cooling to the comfort of sensitive tongues.

Nigger, however, proved an interesting exception. As his dish was placed before him the grand old leader would nose it carefully to the bank of snow fringing his bed and methodically paw snow into it. He then ate the cooled top stratum and again made use of the snow. Billy, the driver, explained the matter in this manner, and perhaps he was not far wrong:

"Prince, he's too young; he learn bimeby. Dem tree huskie dey all same wolf; no brains. Dey only got sense for to pull toboggan. An' dat white devil over dere," pointing to Wobsemunk, "he got plenty brains, but he jus' don' gif a tam for notting, an' before he use de snow he burn heemself jus' for to show he's hard."

About once a week the driver made

the trip to town to replenish our larder and bring in any mail. As the distance between us and town began appreciably to lengthen, these trips were less frequent. Our last camp was ninety miles by trail from Kenora, and this round trip was made by driver and dogs in three days. Inasmuch as three-fourths of the trail was unbroken, this properly should appear as a very creditable performance.

In the matter of feeding, Napoleon's theory and that of the dog driver are almost directly opposed. An army may march on its stomach, but a dog team most certainly does not. Having observed the soundness of these policies in their respective applications, I cannot easily account for the inconsistency. An hour or so before starting a journey, the dogs received their customary breakfasts. If the trip were of all-day duration, a half hour's rest was taken at midday. During this halt their food allowance was almost negligible.

A dog's interest in his work ceases with a contented stomach. While this deprivation may seem like a gross injustice to a very faithful friend, it has its compensating features. The dogs are spared the sting of the whip on account of slack traces, and the unconsumed noonday ration is added to the evening meal; thus is the matter balanced.

Out of harness, some sleigh dogs, even those belonging to the same team, have a strong tendency to fight. Care must be taken to tie them securely and well out of each other's reach. Nigger, with the dignity befitting a leader, paid little heed to his mates, either while in harness or out of it. This display of canine "high-hatting" was at times so marked as to be amusing. Because of this, the leader might just as well have gone unfettered. But there was just a chance that in some unguarded moment he might resent one of Wobsemunk's insults and accept his perpetual challenge to do battle.

There had been a time when this valiant old fellow had taken on all comers and roundly whipped them, for he possessed not only fine physical strength but brains coupled with an indomitable courage. It was by virtue of these sterling qualities that he had risen to the rank of leader. But now the fine old dog's eyes were dimming, and the teeth that had once been a terror were dulled with age and many of them were missing.

Wobsemunk, in spite of his contemptible temper, was no coward. He wished for nothing more than a chance to fight, and I believe the shedding of his last drop of blood in mortal combat would be his one big moment. Furthermore, the dog that could stand up against his superb young strength and cruel, long white fangs, which were always bared through perpetually snarling lips, did not then, in those parts, exist.

Prince, due to an entire absence of malice in the whole of his puppy make-up and the belief that his desire to make himself agreeable would keep him out of trouble, was given the freedom of camp. He enjoyed this privilege until one unhappy day when he and the cook had a little misunderstanding which led to serious complications. During the unrestricted period, Prince made his headquarters in the cook's tent and managed most successfully to save that gentleman any anxiety that the disposition of scraps might have occasioned. He made a most efficient scavenger, for I overheard the cook remark once that Prince licked a dish so clean it was rarely necessary to wash it afterward.

THERE IS A THRILL ON THE TRAIL WITH A GOOD DOG TEAM

One day, with his domestic affairs out of the way, Prince selected a nice large stick of dry pine firewood from behind the cook-stove and proceeded, unnoticed, to chew and worry it into splinters on top of the cook's bed. The chef found most of the splinters upon retiring that evening and seemed somewhat annoyed. The next day the pup was caught in the midst of similar operations on another stick in the same place, whereupon he was summarily expelled from culinary headquarters in disgrace, followed by a well-aimed piece of stove-wood.

The liberty that the wheeler had enjoyed vexed his team-mates not a little; they were jealous of his privileges. To see him fall so precipitously from favor was most agreeable, and they took no pains to hide it, the most of them bursting into yelps of derisive mirth. This was the last straw, and in a sudden show of wrathful indignation the pup declared war.

Of his offensive brethren, Nigger was nearest, and with a fine display of injured dignity Prince advanced upon the leader. Feeling that his interest in the affair had gone quite far enough, Nigger yawned, then lay down and closed his eyes, to all outward appearances oblivious to the furry fury that raged and stormed just beyond the length of his chain.

With this added humiliation, the pup lost his head entirely. Ignoring the huskies as unworthy of his mettle, he made for Wobsemunk, whose lips were still parted in a snarling smirk. Craftily drawing back from the extent of his

(Continued on page 190)

Deleterious Substances in Concrete Aggregates

By F. C. LANG, Professor Highway Engineering, University of Minnesota
Engineer of Tests and Inspection, Minnesota Highway Department

IN this paper I am going to limit myself to deleterious substances in gravel pebbles to be used as coarse aggregate in concrete. I am not going to attempt to show how various deleterious substances have affected the quality of the concrete —there are numerous illustrations of this throughout the United States. I am going to confine my discussion to past and present specifications, and also to what I think should be the basis for the specification of the future.

Deleterious Substances

The word deleterious has always been very popular with writers of specifications when defining quality of gravel pebbles for concrete aggregate. I would say it is the usual practice to be as specific as possible and then to take care of unforeseen contingencies by stating that the gravel must be free from all deleterious matter. The following quoted from the standard specifications for concrete roads and streets as adopted by the National Association of Cement Users in 1910 is a typical good specification of the period. "Coarse aggregates shall consist of inert materials, graded in size, such as crushed stone or gravel, which is retained on a screen having ¼ inch diameter holes, shall be clean, hard, durable, and free from all deleterious matter. Aggregate containing soft flat elongated particles shall be excluded." How would the local engineer interpret this specification? He is not furnished any information as to what this deleterious matter is that must be avoided or for that matter as to what is a soft flat or elongated particle. You know that in gravels there are various stages of softness and flatness and that the terms are relative according to the character of local deposits. When construction time came the local engineer had to use his best judgment in enforcing such a general specification. When fundamental facts are not established through research in field or laboratory, we must depend on engineering judgment which varies according to the ability and experience of the individual. The specification quoted was written 21 years ago and some progress has been made since then. As an example of a specification representing the best engineering knowledge of the present I quote the American Society for Testing Materials (Serial Designation C33-28T) specification on deleterious substances.

"5. Coarse aggregate shall consist of crushed stone, gravel, blast-furnace slag, or other approved inert materials or similar characteristics, or combinations thereof, having hard, strong, durable pieces, free from adherent coatings and conforming to the requirements of those specifications.

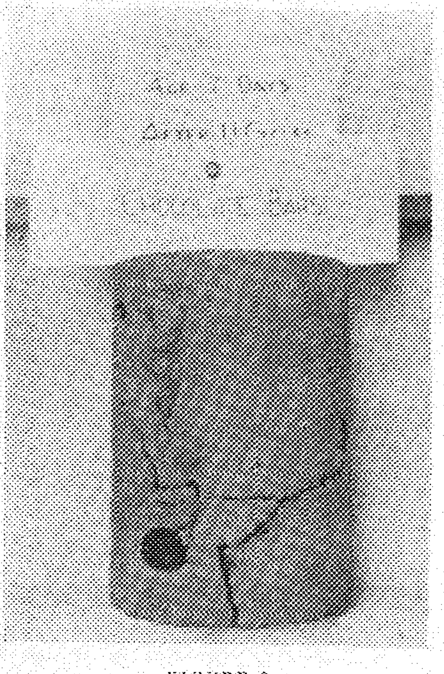


FIGURE 3

"6. (a) The maximum percentages of deleterious substances shall not exceed the following values:

	% by weight
Removed by decantation	1
Shale	1
Coal	1
Clay lumps	½
Soft fragments	5
Other local deleterious substances (such as alkali, friable, thin, elongated, or laminated pieces)	..

"Note: It is recognized that under certain conditions maximum percentages of deleterious substances less than those shown in the table should be specified.

"(b) The sum of the percentages of shale, coal, clay lumps and soft fragments shall not exceed 5 per cent of weight."

With the possible exception of shale, coal, and clay lumps, the engineer must decide what are the deleterious substances just as he did in the specification I quoted which was written in 1910. He is furnished with no unit of measure by which he can judge whether a substance may be considered as deleterious in the concrete which he is placing. For instance, on what basis is he to determine whether a particle should be classed as a soft fragment or not? Various impact or squeezing devices have been suggested for measuring softness, but they have not been able to exclude the shape of the

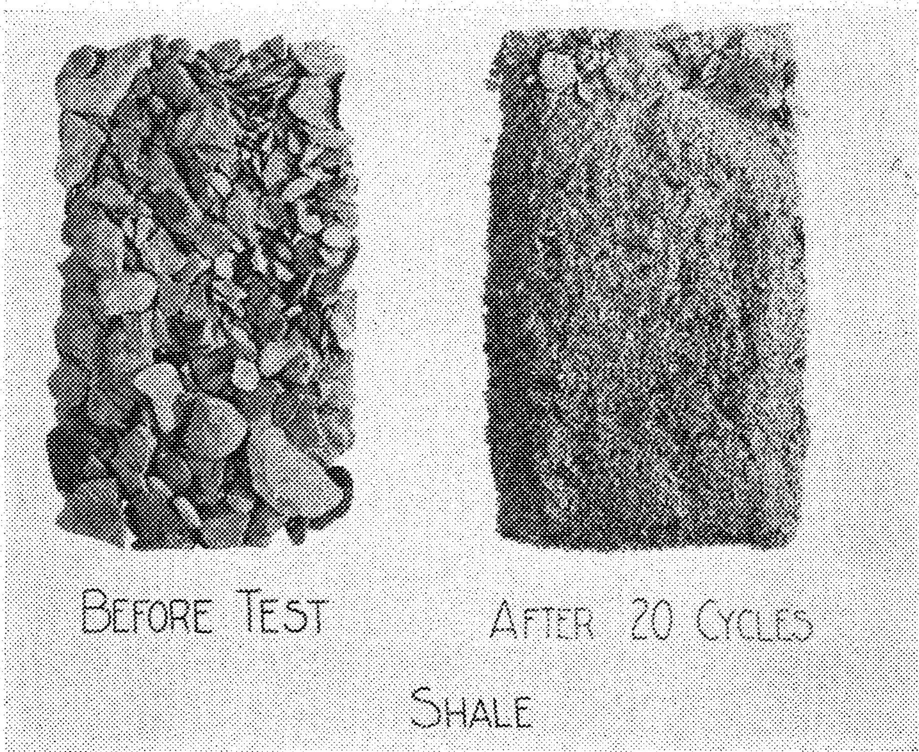


FIGURE 2

particle. The specification states that the pebbles must be free from adherent coating. This would apparently exclude coating of any character even though it were as well bonded to the pebbles as the mortar would ever be. This specification, therefore, depends on the individual's opinion and uniform results are not to be expected.

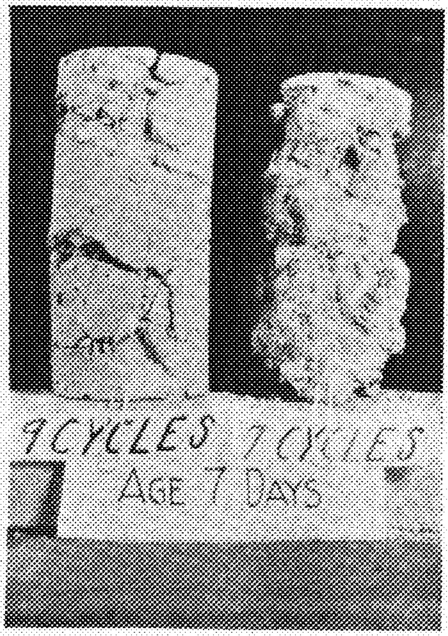


FIGURE 4

It has been recognized for a long time that it is the best practice to specify the quality of material according to some definite test. This removes the personal factor. Engineers have tried to do this with gravel pebbles. Up to the present time, however, the quality tests on gravel pebbles for concrete aggregates are largely copied after some tests which were developed for stone to be used for other purposes. Certain modifications have been made to make the tests more applicable to gravel pebbles. At the time the specifications were written there were no research data on which to base test limits and as a consequence test limits were set according to the quality of available commercial supplies.

Committee C-5 of the American Concrete Institute states in the 1927 Proceedings of that Society that "most of our present day specifications for concrete aggregates are rule of thumb documents based on engineering judgment of local conditions."

As an illustration we have the abrasion test. Bulletin No. 3 of your Association, published in August 1930, gives a summary of State Highway specifications for gravel pebbles to be used as aggregate for concrete pavements. The percentage of wear as given in this Bulletin varies from 5 to 20. This indicates that the test limits are set to conform to local conditions. As a matter of fact research data has not as yet shown any particular relationship between the strength of concrete and the abrasion loss within this range.

For those not familiar with the test, I would say briefly that it consists in taking definite sizes and weights of gravel pebbles and placing them together with six 1⅞ inch cast iron balls in a metal cylinder which is about 8 inches in diameter and 13 inches long, mounted on a 30° axis. This is revolved for 10,000 revolutions at 30 r.p.m. At the end of the test the part passing a No. 12 sieve is computed as per cent loss.

The objections to the test are that the per cent loss may be the same on a sample containing a very hard gravel with a few soft pieces as one of uniform quality but not so hard as most of the stone in the first set. Generally speaking, the uniform quality stone would be preferable. Then, too, the shape of the particle has so much effect on the per cent loss. There is a provision in the test for crushed pieces. However, gravel deposits may contain a percentage of pebbles which are angular in shape even though they have not been through a crushing plant.

Another test on stone which is also sometimes applied to gravel pebbles is the sodium suphate soundness test. In this test the stones are soaked in a solution, then dried in an oven. In the oven the salt crystals in the pores of the stone expand with an explosive force. This is in the nature of an accelerated freezing and thawing test. In applying such a test to gravel pebbles, one must remember that gravel pebbles are composed of a miscellaneous variety of stones whereas in crushed rock the stone from one ledge is always uniform. But as yet we do not have any data on which to establish test limits for a sodium sulphate test on gravel pebbles.

Basis of Future Specifications

It seems to me that the deleterious substances in gravel pebbles could all be divided into two groups: (1) those having volume change; and (2) those structurally weak. In the first class would be included such materials as shale, what we call "chocolate bars," some cherts, etc., which expand with such force after being placed in concrete that they may blow out the concrete which lies over them, or if present in sufficient quantity may cause complete disintegration of the entire structure. In the second class would be included all particles which decrease the strength of the concrete for the particular place intended, such as soft pieces, some adherent coatings, etc.

This involves the development of tests for this purpose and then setting test limits for the various uses for which concrete is designed on the basis of strength and exposure. This is no small job, but it seems to me the principle is so fundamentally sound that both producers and consumers should earnestly work toward that end. When facts are once established there is very little opportunity for misunderstanding.

I have a few illustrations taken from the results of some experimental work which is being carried on under the direction of Professor C. A. Hughes of the University of Minnesota and myself. This research work is being carried on cooperatively by the University of Minnesota and the State Department of Highways.

(*Continued on page 193*)

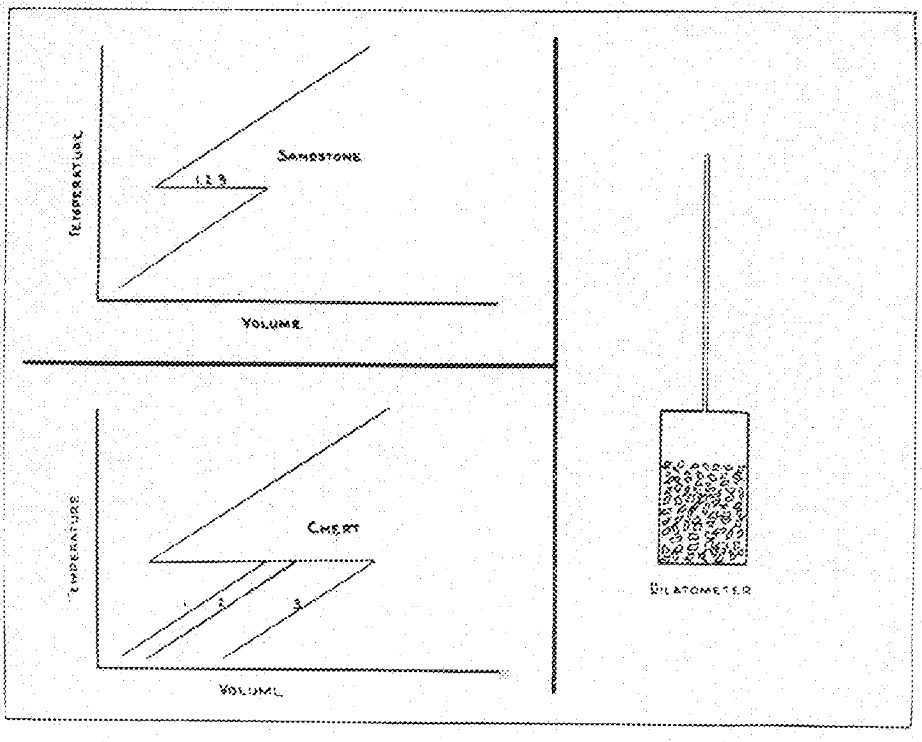


FIGURE 1

The Development of Aerial Surveying

By M. E. PARKS
Fairchild Aerial Surveys Incorporated

ALTHOUGH aerial surveying is really an outgrowth of the aerial photographic work that was carried on during the World War when the Air Corps made the first mosaic map, it was almost forgotten for a period of a few years right after the war. About 1920 aerial photography started to gain favor among engineers and from that time until today the improvement and development in both equipment and finished product of aerial maps has been startling. The early cameras and maps were, indeed, crude, but they furnished the engineer with information that he could not obtain in any other way. Many municipalities and companies realized the importance of aerial surveying and created departments or divisions to make a thorough study of this new science, so that they might take full advantage of it and save both time and money by applying it to their own problems.

Perhaps the best way to explain the details of aerial surveying is to discuss some of the problems which can be solved by its application:

Locating High-Tension Power Transmission Lines

Today we find one large generating station serving a large community, where before we found many smaller stations. Where water power is available we find hydro-electric plants far away from the market of the power and in some cases we find steam plants where cheap coal is available, which are also far away from the market of the power. The locating of the hydro-electric or steam generating plants at a distance from the locality where the power is used has been made possible by the development of the present methods for transmitting the electric power.

Not so very long ago, one hundred miles was considered the maximum length for a transmission line because of the great power losses occurring beyond that length. Today, however, we find a connection of high-tension power transmission lines extending for a thousand miles or more. The growth of the public utilities furnishing electricity to various communities has been so rapid that it was necessary for the engineers to find a rapid method to survey for the right-of-way of high-tension power transmission lines.

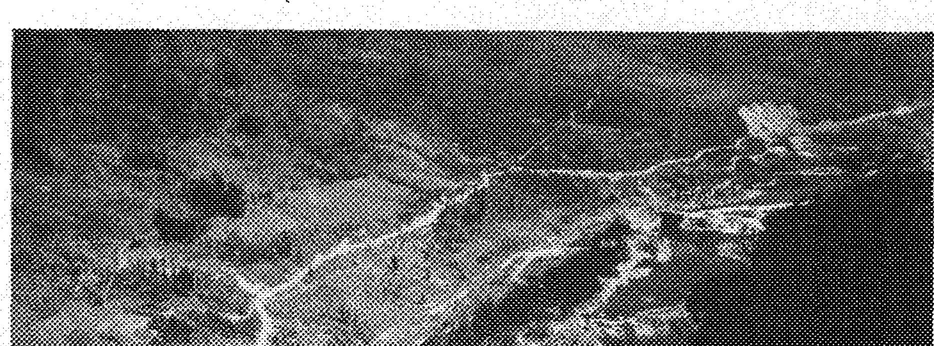
The advantages of aerial photographic surveys for this work are as follows:

A. Ability to map extensive areas without arousing suspicion of land owners to the effect that a right-of-way is being sought by a corporation. This implies material reduction in right-of-way costs.

B. More information is made available for money expended than is procurable by any ground survey method.

C. Better alignment of the power transmission line is made possible, because of ability to view all obstacles to line construction, resulting in fewer angles and less interference with private interests.

D. A material saving in time may be effected in locating the line and also in constructing it, because the map shows all transportation routes down to the smaller foot-paths, thus facilitating the delivery of materials along the entire route.



ASSEMBLY OPERATION FOR CITY PLANNING AND ZONING SHOWING THE WORK IN VARIOUS STAGES OF CONSTRUCTION

Tax Equalization or Tax Reassessment

Tax equalization is of vital importance to every individual for he should carry only his proper portion of the tax burden. It is claimed that 99 per cent of all cities and towns are unequally assessed and although this seems like a terribly high figure, if you could see some of the maps and records that have been used for tax purposes in this country, you would wonder how these cities were able to collect any taxes at all. One city in particular in this country claimed to have a wonderful system of tax assessment, yet when an aerial survey was made, it was found that 11 per cent of its buildings were not on the tax records. The cost of these aerial maps for tax equalization work is small. For instance, with the old method of ground survey, the tax maps of one city, the area of which is 16 square miles, cost $3,000.00 per square mile and consumed four years in the making. By the aerial photographic method, an aerial survey company furnished another city, which has an area of 43 square miles, with tax maps at a cost to the city of $162.00 a square mile. These maps, moreover, were delivered within 60 days after flying.

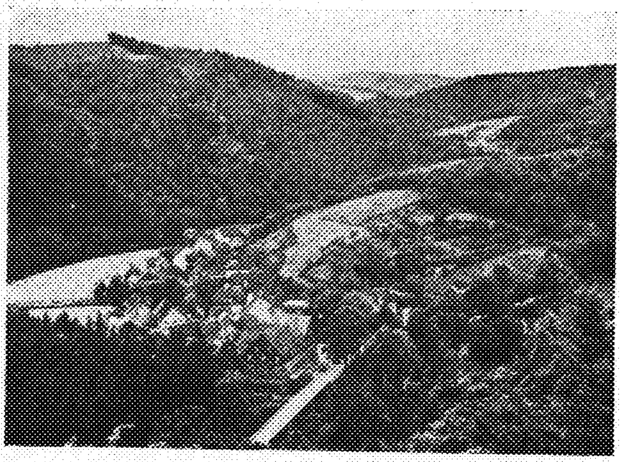
An aerial survey gives:

A. A fair and just unit measurement of value in both land and buildings.

B. Units of values which are necessarily applied uniformly and hence preclude any possibility of favoritism, prejudice or political juggling.

C. A non-political, 100 per cent inventory of all the municipality's tangible assets.

D. There is no "missing or overlooking property," because every industrial business block, house, barn, garage, shed and land plot can be checked from an aerial map.



CLOSE-UP OF HEAVILY WOODED AREA

E. It shows every building, wood lot, meadow and cultivated area, with photographic detail, "as is" and to scale.

F. Tax data, available to and easily interpreted by each taxpayer, enabling him to check his tax with his neighbor's and to understand why and how his tax figure was determined, thus stopping complaints automatically.

G. A tax equalization, which permits of a flat increase or reduction in the tax rate, at any future time, to suit changing condition, without injustice to any individual.

H. Increased grand list and borrowing capacity, reduced tax rate, comfortable budget, soundly financed community and contented taxpayers.

City Planning and Zoning

Engineers also find that the aerial map is of most practical use in city planning and zoning. We have just completed a number of surveys of cities, where the entire cost of the work was paid for by the city or town planning board. The cost of this type of a survey ranges from $75.00 to $150.00 per square mile, depending upon the size of the area mapped and the type of delivery desired. Even the cost of $150.00 is very low per square mile, compared to the old method of ground surveys. The aerial map is not only cheaper but it gives much more information than any other type of survey, for on it is shown every office building, store, factory, apartment, garage, house, etc. With the aid of the stereoscope, the relative height of all these buildings and objects can also be determined.

The city planning engineer can view his aerial photographic map and locate and study:

A. The industrial areas, business districts and different classes of residential areas.

B. The trend of the city's growth from the areas already built up.

C. The available land for parks, homes, business and industry.

By using an aerial photographic map, the engineer can greatly reduce zoning costs and many of the "battles" which are the inevitable aftermath of city planning and zoning are eliminated because both the parties or group in favor or opposed to the zoning or planning restriction can be taken into the engineer's office, where they can view the entire problem and discuss it more comprehensively.

Traffic studies can also be carried on because this type of survey shows with much greater speed and accuracy all automobile, truck, street car, and railroad traffic that occurs at the time the survey is made. Engineers are often astonished when they find some of the smaller side streets virtually clogged with traffic, while the wide through streets or boulevards have only a few automobiles on them.

Harbor Surveys

Where large bodies of water are involved, land surveying presents many difficulties, and aerial photographic surveying is unquestionably the quickest and most accurate method. In this type of survey all harbor, river, and dock lines are accurately shown, as well as all the bridges, or the possible location of new bridges, which might greatly improve traffic conditions in the river as well as on land. Then too, all movable objects such as boats and barges that frequent the harbor can be noticed, and the necessary improvements can be made to allow sufficient width of channels or length of docks to take care of existing water traffic. Sometimes the engineers desire the work done when water traffic is greatest, so they can study the congested conditions and develop methods for relieving it.

Highway Location

This work is very similar to high-tension power transmission lines, because we usually deliver a strip map ranging in width from 800 feet to 4,000 feet. Even a width of 800 feet is considerably greater than that obtained by the ground method of reconnaissance survey when you consider that every object on the ground is clearly shown on the map. With the aid of the aerial photographic survey, the engineer can:

A. Plan the main arteries for travel by studying the cities and towns to be served by the proposed highway.

B. View all obstacles to be encountered such as houses, barns, hills, valleys, streams and forests.

C. Study special problems such as grade separation.

D. No other method of surveying could possibly give as much detail, or be completed in the same time at an equal cost.

Timber Surveys

During the past few years, hundreds of thousands of acres of timber lands on this continent have been mapped or cruised by the aerial photographic method. The cost for this work in large areas is about three cents per acre and the finished map is of great aid to the forester in checking the value of standing timber. With the aid of the stereoscope, anyone with two eyes can see each tree in its true topographic position and every variation in tree height, crown spread, and density of stand. Furthermore, with an aerial survey:

A. All timber is covered.

B. Burnt-over areas, rock outcroppings, blow downs, swamps, and stranded logs above river flood lines are shown.

C. Distinctly separated are scrub brush, second growth and primitive timber.

D. A sharp line of demarcation separates the coniferous and the deciduous trees.

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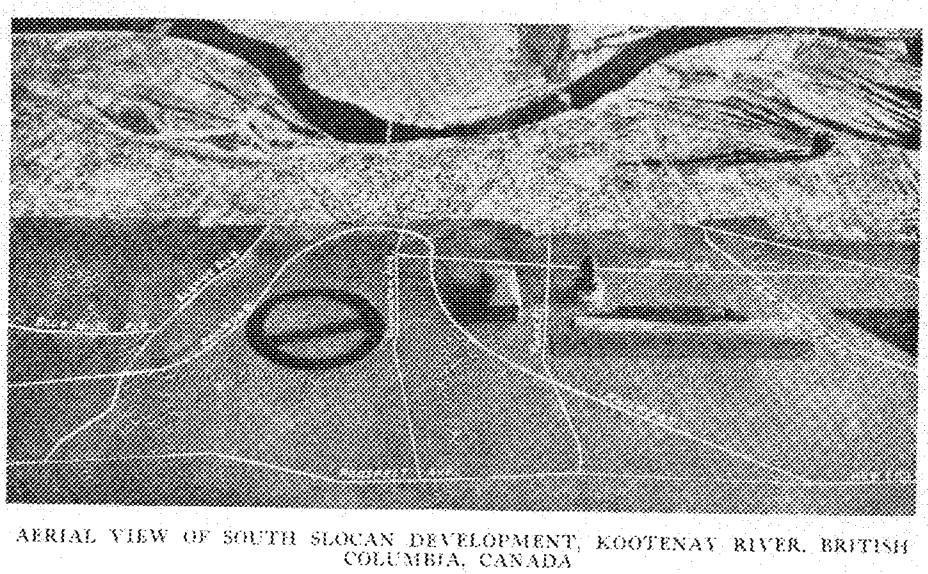


AERIAL VIEW OF SOUTH SLOCAN DEVELOPMENT, KOOTENAY RIVER, BRITISH COLUMBIA, CANADA

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Alma Mater

Roydon V. Wright in a recent address given before the local section of the A. S. M. E., stated that students have no assurance that in five years after graduation they will be in the same line in which they started out. Mr. Wright, who was a member of the class of '98, and who is now president of the American Society of Mechanical Engineers, explained that the industries of today may wane tomorrow, and no one can expect to remain long in one line.

Progress is change. If we wish to progress, we must anticipate the needs of tomorrow. Even the most alert, however, cannot always foresee what tomorrow will bring. The men who will keep abreast of the times will be those who are ready and able to change with changing conditions. Engineers are setting the pace for the rest of the world and for themselves. Many industries and many men will be left to stagnate in the backwaters of the swift stream of progress.

An active group of Minnesota Alumni, working together for the common interests of all, can accomplish much to benefit the schools and their graduates and in view of this fact, the class of 1930 founded the Alumni Service Fund.

One of the primary functions of the Fund is to maintain a system of professional records of alumni employment for use in recommending men for special positions.

These records will consist of the following:

(a) A list of employers of Minnesota men, with the names of alumni employed by each.
(b) A classification of employers—information about the employers from the employee's standpoint.
(c) A classification of alumni by nature of preparation and experience.

At present many good jobs that come into the office must "go begging" because of the lack of adequate information as to the location and experience of graduates. For example, there was a recent call for an engineer having certain qualifications and experience in refrigeration. No doubt there are a number of Minnesota graduates who could meet the requirements, yet the employer had to go elsewhere.

The founders of the Alumni Service Fund keenly appreciated the fact that it is easier to get positions at the time of graduation than it is later. By creating this centralized bureau for making contacts between employers and Minnesota engineers, architects and chemists they rendered a service to their schools, to themselves and to us who follow.

This year the seniors in some of the departments have already subscribed nearly 100% to the Fund, while those in other departments are slow in getting started. The Techno-Log, as a contributing member, urges all the seniors to assist their classmates to build up the Alumni Service Fund.

St. Pat's Ingenuity

Again old engineer St. Pat is coming to the foreground. Again engineers will band together to produce in some cases surprisingly original ideas. Yet the plans will always include some time worn aspects,—some occasioned by tradition, but others caused merely by a lack of inspiration.

While in the laboratory, the reputation of the engineer for ingenuity and skill heads the list, yet every spring sees these same engineers celebrate St. Pat's Day in the same traditional manner. There will be the same parade of engineering floats, the same sortie of the Miners with their pockets filled with aged eggs, the same dubbing of the seniors as Knights of St. Pat, the same afternoon of dancing in the Engineering Auditorium,—and the Brawl will probably occur as usual in the Minnesota Union.

But possibly this much heralded ingenuity of the engineer will assert itself this year, and there are certain evidences that such will be the case. Then we may expect innovations in the parade, possibly a better location for the knighting ceremonies on the knoll may be found, and possibly as some have suggested the Brawl will be held off the campus.

And why not? The Minnesota Union has proved that it lacks sufficient accommodations. Without a doubt, some place off the campus could be found which would supply the needs. But, as is customary, finances creep into the argument. Would the profits from a Brawl held off the campus be sufficient to pay the expenses of Engineers' Day? Undoubtedly yes, if we engineers would make use of this aforementioned ingenuity.

Study Mankind

Engineering is a specialized business and until the course is increased to five or six years, the curriculum must of necessity be specialized. Let us not forget, however, that there are many good reasons for the argument in favor of a broad curriculum for engineers.

You engineers entering your profession without the advantages of a working knowledge of law or business or the seven arts,—while your primary object should be to learn more than anybody else knows about some special phase of engineering, do not overlook a chance to find out all you can about the other man's work. The habit should be formed of getting acquainted with every interest that influences the social and industrial life of your community.

It is good business. It enables you to meet men on their own ground. Since it is impossible to know everything about everything, this habit will teach a great lesson,—the necessity of ascertaining the fundamentals of each new problem and applying basic principles to its solution.

Bigger and Better Examinations

Recently one of the leading eastern colleges adopted the system of annual comprehensive examinations. In putting this plan into effect it was necessary to make several other changes. All part-year courses were abandoned, and full year courses substituted in their stead. Included in this system there are three reading periods each year; two of two weeks each and one of one week directly preceding the examinations.

This new curriculum marks the beginning of a new and experimental era. It is based upon the need of greater initiative in the education process. It aims to secure a more comprehensive mastery of the field of study, with less of the superficial and smattering knowledge that is obtained today by men seeking their required credit hours. It offers greater individual freedom in return for the greater responsibility assumed. It seeks to have man produce *constructive* rather than *defensive* evidence of scholarship.

The omission of part-year courses is possibly the greatest step made against fragmentary education. It tends to make a college course a more connected unit instead of the piece by piece jumble of incoherency that one finds in the schools, especially the professional schools, of the country at the present time. There is hardly a course in any of the mid-western engineering schools which starts at the beginning of the year and runs uninterruptedly throughout the entire year. The student is taught some fifteen different courses throughout the school year, each of which he forgets to the best of his ability as soon as he has spent three months in its mysteries. At the end of the year he remembers very little about his first quarter subjects.

The TECH Banquet

With the announcement of the first annual Technical Student-Faculty Banquet to be held on May 28th, the *Minnesota Techno-Log* and Alpha Tau Sigma honorary engineering journalistic fraternity have taken a step that bids fair to become one of the most highly prized traditions of Minnesota engineers.

Juniors and Seniors in the College of Engineering and Architecture and the School of Chemistry together with all faculty members of the Technical Schools will meet at this first annual *Tech Banquet* to discuss topics of interest to engineering students.

It is the belief of the sponsors of the *Tech Banquet* that such an affair will foster a closer relationship between faculty members and students, not because of the contacts that might be personally made at such a dinner, but rather because of the interchange of thought that such an occasion permits. Under this fundamental objective may be grouped all the others that such a dinner strives after. For with an interchange of thought upon subjects that are pertinent to engineering education and practice, it is to be expected that faculty and students will be mutually benefitted by obtaining a better insight into the various problems which confront each group.

According to the proposed plans for the *Tech Banquet* there will be a number of speakers chosen from the members of the faculty and an equal number from among the student body. The discussion will be limited to subjects directly connected with the study or the field of engineering.

Student representatives have been chosen from the several departments of the Technical Schools. They are: E. A. Cone, architecture; Paul Salo, chemistry; Cedric Cowan, civil; Rodney Wood, mechanical; and Robert Lommen and Roy Wiprud, electrical.

The committees appointed to complete the various plans for the *Banquet* are: Milton Bergstedt, invitations; Howard Lowe and Winfield Foster, entertainment and favors; J. P. Shirley, speakers; Steve Gadler, program; and George Taft, publicity.

A Treasure Room

The University Library for many years has held concealed behind locked doors a treasury of books,—forbidden to the use of undergraduates in general.

Are not books the very heart and soul of a University? They are certainly the very life blood of a scholarly existence. We may do without athletics, we may do without buildings, we may do without journalism, but we may not progress without books.

Apparently then there is no possibility of following a certain study to its ultimate conclusion, when the necessary texts are guarded by the forbidding walls of the "Z" room—the prison cell of intellectual advancement.

Drive the Arabs

Starting with a blaze of glory that gave promise of eclipsing all previous endeavors, the Arabs recently undertook plans for their 1931 production.

The success of this year's show, however, rests upon the outcome of the next few weeks' practice. At present conditions are in a critical stage. Sufficient talent seems to be lacking in every department. More chorus men are needed, more leads are needed, more publicity is needed, more DRIVE is needed.

And that DRIVE in the final analysis will give success or failure to this year's production according as it is present or lacking. Let's get behind the Arabs,—give them some more chorus men, some more leads, some more publicity,—some DRIVE,—and make the Arabs Revue the biggest success of all similar productions.

Brick and Books

Buildings, equipment and a Board of Regents cannot make a school. The undergraduate needs more than books, instruments and executive machinery; he needs the inspiration of contact with living, thinking men.

There are many instructors in the Technical Schools whose relations with students, whose success in getting the enthusiastic efforts of their classes, and whose helpful influence over the students is sufficient answer to the accusation of soullessness of the big University.

These men never forget that their students are human beings with average sincerity of spirit and seriousness of purpose. They are not tempted by their autocratic power to become tyrants. They understand the difficulties of a class and have the patience to encourage questions and to answer them as long as uncertainties remain. Their offices are meccas for worried, troubled students.

As the undergraduate is indebted to them, so is the University, for they are the men that convert a place *for* learning into a place *of* learning.

Erratum

In the February issue of the Techno-Log which contained the second of the series of articles by Professor J. Frenkel on the Soviet Union the following errors should be corrected: the population of Russia is 160 million, not 100 million; the seven day week has been replaced by a five day week, four days of work being followed by one day of rest.

RAILWAY ELECTRIFICATION - -

TO ADVANCE the technology developed by electrical pioneers who designed and applied electric railway equipment to conquer mountains and to speed terminal traffic — there's a task to try your temper!

During the business life of young men who now are students, thousands of miles of railroad will be electrified — the undeniable economies of electrical operation make this advisable. To carry out such a program will call for the services of many of the best-trained men — in the industries allied with electrical manufacturing as well as in the electrical industry itself.

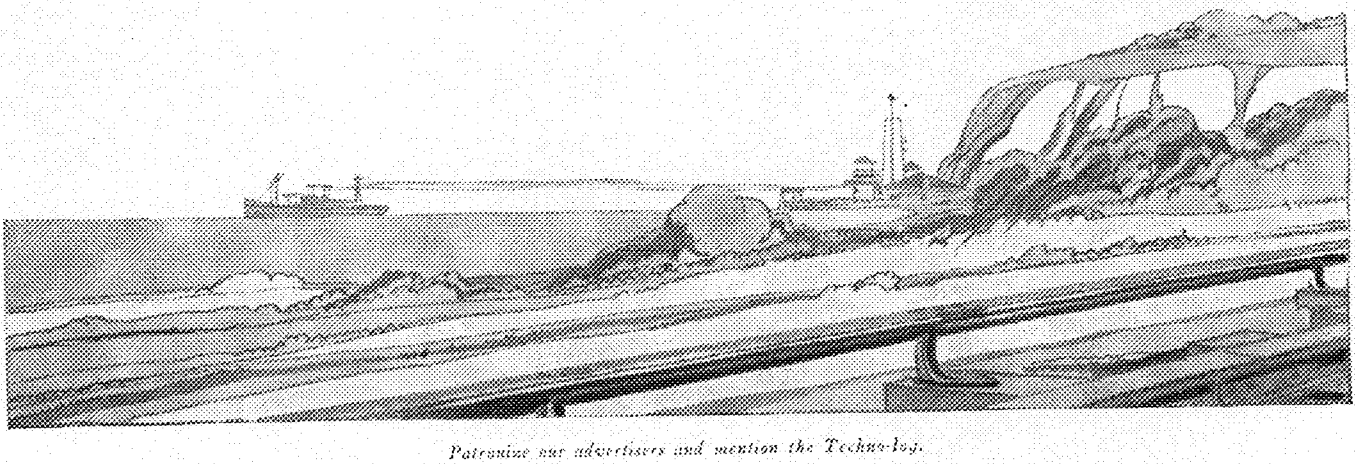
Out of college, established in your profession, it may be *your* job to direct a part of this onward march of electrification.

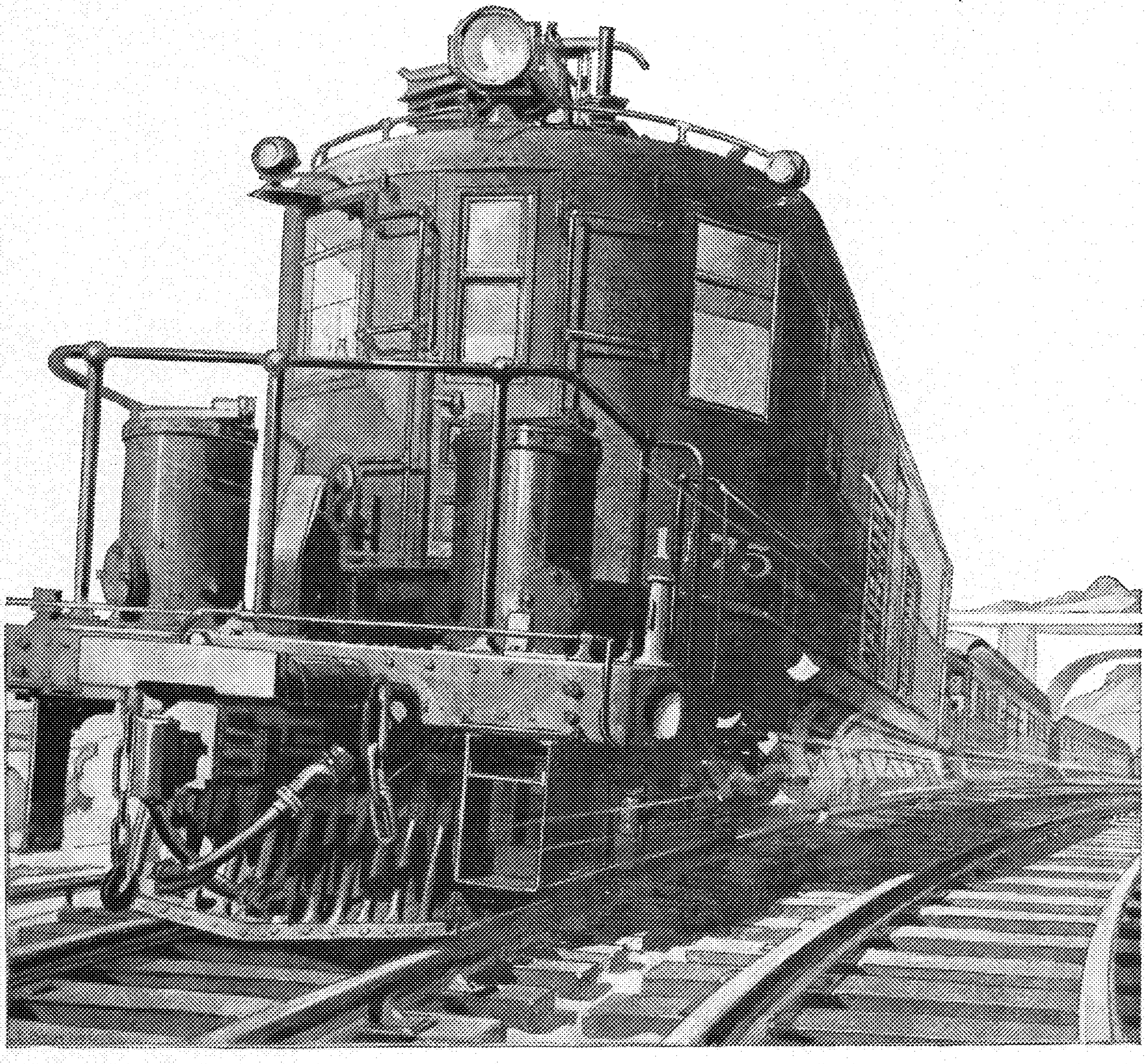
General Electric has equipped more railroad right-of-way and electrified more lines than any other company. For the future, General Electric anticipates a continuation of the vision, skill, and progress which have thus far marked its contribution to industry and transportation.

Booklet GEK-55 tells about some of the railway electrification projects with which G-E engineers have been identified. Address your request to Publicity Department, General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

95-771DH





The Electrical Show of 1931

By JOHN WILSON, EE. '32

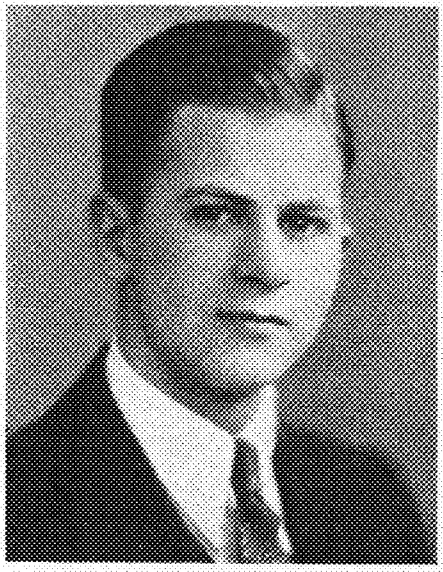
BACKED by the traditions established by nine successful predecessors, committees for the 1931 Electrical Engineering party have swung ito the final rush of preparation for the event which will be held April 17 and 18. The traditional opening night dance which in other years has had a capacity attendance will be held in the Armory from 9:30 until 12 o'clock on April 17. All students on the campus are invited to this function.

Since the beginning of the year, ideas have been generating and every indication points to the most spectacular and successful party that has yet been staged by the future developers of nature's mighty electrical power. Under the direction of Martin Agather, E. E. '31, a large body of students have been working strenuously to gather together a collection of exhibits to impress on the spectators the kind and quality of work that is being done by the students in the Electrical Engineering department.

This year's party will contain, besides the student exhibits, many interesting developments in the electrical profession. These exhibits by have been loaned to help make the party a success by such companies as the Northern States Power company, Westinghouse Electric and Manufacturing company, and Northwestern Bell Telephone company. The apparatus contributed will show the underlying principles and operation of modern electrical equipment. However, the greater part of the show will be given over to student exhibits in spite of the many recent developments in the professional line.

At the opening night, as has always been the custom, admittance will be limited to those receiving invitations from the faculty or students of the Electrical Engineering department. Saturday the party will be thrown open to the general public. As in years before a record crowd is expected to attend.

When entering the Electrical building a visitor will be greeted by strange and weird effects which will tend to make him doubt his sanity. An automatic counter records each visitor as he passes through the door. On entering a certain room a suspended light will be seen that goes out and as a person reaches for it, disappears. This "vanishing lamp" will puzzle all of the master minds. On opening another door your hair will stand on end for in the corner a human skull is glistening in the dark. You will say it is a fake but walk up to the skull



MARTIN AGATHER, E.E. '31

and ask it a question. Your astonishment will be greater when the skull answers all of your questions and tells the dark secrets of your past.

Rivaling the "mechanical man" that caused such interest two years ago at the party will be the beam of light that carries sound waves. A phonograph and a microphone are placed at one end of the beam. A person at the other end can hear the music or conversation. This machine is almost super-human since its main use at the present time is to test the different grades of whiskey smuggled into the country by former prohibition agents. If a bottle of good old Paul Jones whiskey or Hennessy cognac is put in the beam of light a shrill sound is heard at the receiving end meaning that the stuff is fit to drink. If, however, a bottle of modern "Moon" is put in the beam a low moaning sound will be heard. Everyone is invited to bring his girl as this machine can tell you the same things about your girl as it can about the soft drinks. If your girl had to leave town the week of the party bring over her picture and learn all of the inside dope.

While in the main laboratory please be careful of your language and the easy words that you are giving your girl because at any moment you might hear your own voice above the noise of the crowd. Microphones have been placed at different points and all sound near these microphones is highly amplified and broadcast over a large speaker. It is likely that you will not be talking in a loud bragging tone after you have seen the strongest little man in the world. This man, the smallest of his kind, defies anyone to duplicate his feat of turning a large wheel with ease using only his little finger, but a spectator will be stupefied when he tries to do the same feat.

A cannon that will shorten all wars has been set up in the laboratory. This cannon can shoot many miles merely by the application of an electrical current. Patents have not yet been taken out by the inventor so the visitors all have an even chance to manufacture these guns and end wars.

The marvels of the cannon are placed in the background however when the visitor turns around and sees a piece of iron floated in the air defying the laws of gravity with all the ease of Buck Rogers.

Many other interesting exhibits have been arranged by the students such as the tin can motor, perpetual motion machines, and the talking arc. All visitors should keep their hands in their pockets so as not to be tempted to lift anything that is loose, for the minute something is touched a burglar alarm rings and the culprit is discovered. A question box that answers all queries about the future or the past will be displayed, much similar to the one used by such noted astrologers as "Arzuna."

Breaking the Trail

(*Continued from page 179*)

bonds, the white dog sought thus to induce the pup within reach. Then, to make doubly sure of his victim, he sat himself down and let loose upon the head of the tormented one a flood of insults.

Hopelessly outclassed in these vocal fireworks and goaded to distraction by their venom, the big wheeler set himself and then launched, in a mighty spring, his one hundred and forty pounds of madness at the throat of his tormentor. Skilfully sidestepping the avalanche, the white dog was atop the invader almost before he had landed, his jaws clicking wickedly as they sought a hold on the heavily furred throat. In weight the pup was far the heavier, but here his advantages came to an abrupt end.

Two of the party speeded to the rescue, and as vivid reminders of the incident they will carry scars for many years as eloquent evidence of the keenness of Wobsemunk's teeth. Only the timely appearance of the driver, the only person of whom he stood in awe, saved all concerned from serious injury. To prevent further trouble which might end in the loss of a prize wheel dog, Prince was thereafter assigned a limited berth. This he philosophically accepted as evidence of his having attained maturity.

Throughout the winter we were paid frequent visits by the roving members of an Indian reservation near the White Dog Rapids. In exchange for tea, tobacco, flour and sugar they brought us venison, moccasins, beaded work and other wares of their handicraft.

As we returned to camp one day across the lengthening shadows of the stately pines we came upon a squaw on her way south to barter a quarter of deer meat. By means of a strap across her forehead, known as a tump-line, she was pulling a small toboggan upon which was a blanket or two and the meat. Of her journey there still remained a matter of twenty or so miles, and she was about to go ashore to prepare a night's bivouac. The only unusual feature of this incident was that upon meeting the little caravan the next morning we stopped to admire a wee bit of dark-skinned humanity, some four or five hours old, snuggled up in a bundle of warm furs and strapped to the back of a proud and broadly smiling mother.

Living in a country teeming with wild animal life, we frequently saw grim evidences of disaster which is often visited upon them. One day we came upon the body of a large bull moose frozen in the ice of the river. Above the surface were the massive head, crowned by an impressive spread of antlers, and one foreleg.

Having broken through the early and insecure ice, the big fellow had striven heroically to break and swim his way to shore. A long trail of jagged ice behind the animal portrayed most faithfully a valiantly fought battle by this monarch of beasts, only to be defeated at last by the stupendous odds. His superb strength gone, he had held himself suspended, only to be seized in the death grip of rapidly congealing water, while but a scant fifty yards before him beckoned the vast and inviting acres of his realm.

Spring in the North comes quickly. By the first of April the ice had become so weak as to make further use of it dangerous. A few days later we struck camp to make our way back to town and the confinements of civilization.

« « MENTAL TILTS » »

SQUARES

GIVE four examples where the sum of the squares of two consecutive integers is a perfect square?

AND SQUARES

USING the numbers 1 to 5 inclusive construct a square with 25 cells so that the sum of the numbers in each row, column and diagonal is equal to 15. It is necessary that each column and row contain the numbers 1 to 5 inclusive.

ANSWERS

Answers to Last Month's Tilts

How Old?—The boy is 28 and the girl is 21.

The Farmer—In the truck were five pigs, three cows and one horse.

AROUND THE WORLD WITH OUR ALUMNI

Civil Engineering

'09—Mark—Walter J. Mark is now associate construction engineer, U. S. Treasury department, Office of Supervising Architect. He also subscribed for the TECHNO-LOG for the coming year and asked that it be mailed to 76 Wilkin St., St. Paul, Minnesota.

'16—Lux—Arthur E. Lux has deserted the engineering field. He is now owner of the John W. Lux company, wholesale grocers, located at 154 West University Ave., St. Paul, Minn. Art's home is at Lakeview, White Bear Lake, Minn.

'18—Hagerman—Oliver S. Hagerman wrote the other day to subscribe to the TECHNO-LOG for the coming year. He states that he is still associated with the American Light and Traction company at Chicago, Illinois. His home address is 1436 Edgewood Lane, Hubbard Woods, Illinois, while his office is at 105 West Adams Street, Chicago, Illinois.

'20—Johnson—Byron F. Johnson's family narrowly escaped injury in the recent earthquake that devastated Managua, Nicaragua. They went by plane to Corinto 100 miles away and as a result missed the quake. Captain Johnson is with the Marine Aviation corporation.

'22—Cribbs—Harry E. Cribbs writes that he has been in charge of construction of paving on the Jefferson highway. Harry is resident engineer for the Iowa State Highway commission with offices in the First National Bank building, Eldora, Iowa.

'22—Palda—Charles H. Palda is now superintendent of Hanlon and Okes company. His office is at 1501 Merchants' National Bank, St. Paul.

'23—Cray—S. R. Cray, city engineer of Chippewa Falls, Wisconsin, has been working unusually hard this winter. He has been trying to keep 800 unemployed men from starving by extensive municipal and county projects. Seymour R. Jr. is five years old and Carol is one year old.

'29—Schaller—Louis M. Schaller is back in Minneapolis as a special agent for the Union Central Life Insurance company with offices at 850 Baker Building. He visited the TECHNO-LOG office the other day and seemed very interested in his new work.

Electrical Engineering

'03—Schumacher—J. H. Schumacher is president of Schumacher, Mackenzie, Limited, contracting electrical engineers. His office is at 334 Main St., Winnipeg, Manitoba, Canada.

'06—Albrecht—George M. Albrecht has opened offices at 807 Mariner Tower, Milwaukee, Wisconsin, in association with Hadley F. Freeman of Cleveland, Ohio, for the practice of the law of patents, trade marks, and copyrights, under the firm name of Freeman and Albrecht. Mr. Albrecht was formerly an examiner in the U. S. Patent Office and for the past thirteen years patent attorney for Allis-Chalmers Manufacturing Company, Milwaukee.

'22—Merritt—Alva W. Merritt is now with the Public Service Company of Northern Illinois as assistant power engineer of district J. Alva is now the proud father of a baby girl, Georgia Diana, born May 18, 1930. Mr. Merritt's home address is 202 Garnsey Ave. He asks for some news of former classmates.

'28—Stevens—Donald T. Stevens met his death February 15, as the result of an airplane crash when the seaplane he was testing went into a slow spin and plunged into the Potomac river from an altitude of 200 feet. Burial took place at Monticello February 19th.

Stevens was born in Warren, Minnesota, July 28, 1905. He attended grade school at Excelsior, and graduated from the Monticello High School. After graduation he entered the University of Minnesota, where he received his degree in Electrical Engineering in June, 1928.

While at the University, he enlisted in the Naval Reserve. The summer following his junior year he attended the Great Lakes Training school. His progress in flight training there earned him the opportunity to receive advanced training at the Hampton Roads Navel Base. At Hampton Roads he won the honor of first ranking student flyer. He held the commission of Ensign, and spent some time each year in active duty with the Reserves.

After graduation, he accepted a position with the Department of Commerce in Washington, D. C. In this position he traveled extensively and his visits on the campus were always enjoyed by his former classmates.

On December 22, 1930 he was married to Miss Ruth Jymon Brownfield of Nebraska. It was hardly two months later that Don was hurled to his death in the Potomac river.

Don will long be remembered by all who knew him,—by all who admired and respected him as a man and a friend.

Deleterious Substances in Concrete Aggregates

(Continued from page 181)

Figure No. 1. This is an attempt to show progressive volume change. On the right is a cross section of the dilatometer. This is merely a metal container with a tight fitting top in which is fitted the glass tube. The metal container is about one quart in capacity and the tube has an inside diameter of ⅜ of an inch. The container is first partially filled with a liquid which has a considerably lower freezing point than water. The material to be tested should be in a saturated surface dry condition and then placed in the liquid. The top of the container is then fastened on and more liquid added until the tube is nearly full. The temperature is then slowly lowered. By means of a thermocouple we are able to tell when the temperature in the center of the container is the same as the surrounding air or bath. Everything contracts until the temperature reaches a point where the absorbed water freezes. This causes an expansion and the liquid in the tube continues to rise until all the water is frozen. Then as the temperature is still further lowered the entire mass again contracts and the liquid descends. This horizontal line represents the expansion during the freezing period. You will note on the chart that No. 2 is a little longer than No. 1 while No. 3 is much larger than No. 1. On the second cycle the sample was left in the container while before cycle No. 3 the sample was removed from the container and soaked in water. The horizontal line on the sandstone is the same length regardless of whether the sample is resoaked or not. This particular chert showed progressive expansion, while the sandstone did not, illustrating why the chert might cause disintegration of the concrete.

(Continued on page 194)

DELETERIOUS SUBSTANCES IN CONCRETE AGGREGATES

(Continued from page 193)

In the hope that we could substitute an accelerated freezing and thawing test for the unsatisfactory abrasion test, we made quite a large number of tests on aggregate and some on concrete. A sample of aggregate consisting of 1500 grams (1½-1 inch screen), 1500 grams (1-½ inch screen) and 1500 grams (½-¼ inch screen) is placed for five minutes in ice water then immersed 30 minutes in a solution of calcium chloride at 0°F.; then placed 5 minutes in boiling water; then in ice water for 5 minutes, and so on for each cycle. We find that such freezing and thawing is very destructive, but it is of course another matter to set suitable test limits.

Figure No. 2. This shows what 20 cycles did to some shale.

Figure No. 3. This shows the expansion of a deleterious substance which we call "chocolate bars" when used as coarse aggregate. On account of the difficulty of obtaining small sizes of the chocolate bars only ⅓ of the aggregate, from 1" to 1½" size was composed of the chocolate bars, the other ⅔ of the coarse aggregate being a sound gravel.

Figure No. 4. This shows what a few cycles did to concrete cylinders in which the coarse aggregate was chocolate bars, and shale. Again in the chocolate bar cylinder only ⅓ of the coarse aggregate was that material, ⅔ being sound gravel while all of the coarse aggregate in shale cylinder was composed of shale. The concrete proportions were approximately 1:2:3, and 5 gallons of water per sack of cement was used.

*Paper delivered at National Sand and Gravel Association Convention, at St. Louis, Missouri, January 28, 1931.

Prof. Hartig: Tell me how to preserve fish?
Harmar: Put it on ice, sir.
Hartig: Well, what is that called?
Harmar: Isolation.

Aerial Surveying

(Continued from page 183)

Scale of Map

The selection of the proper scale is of paramount importance, first in order that the map may serve the purposes for which it is intended, and second, because the scale, more than any other element, affects the cost of making the map. If the map is to delivered at a scale of 1 inch = 400 feet, it will probably be flown at 1 inch = 1,000 feet and enlarged 2½ diameters. At 1 in = 1,000 feet each contact print covers an area of 7,000 feet by 9,000 or 63,000,000 square feet, but by flying at 1 inch = 500 feet each contact print covers 3,500 feet by 4,500 feet or 15,750,000 square feet, or just one-quarter the area of the above. In other words, to double the scale requires four times the negatives and four times the flying. When we speak of large scale, we mean large images and by small scale, small images. In making strip maps for locating high-tension power transmission lines or highways, the work is flown at 1 inch = 1,000 feet and the map delivered at 1 inch = 500 feet to 1 inch = 400 feet. This scale, of course, varies with each particular problem. In tax equalization maps, the work is flown at about 1 in = 600 feet and the map delivered at 1 inch = 300 feet, while atlas sheets are delivered at 1 inch = 100 feet. In city planning and harbor surveys the delivery is much the same. In timber surveys, the work is flown at 1 inch = 1,200 feet, and the map delivered at that same scale or 1 inch = 1,000 feet. In this type of work the area is usually so large that a larger scale than 1 inch = 1,000 feet, would mean not only a cumbersome map to handle but also a costly one.

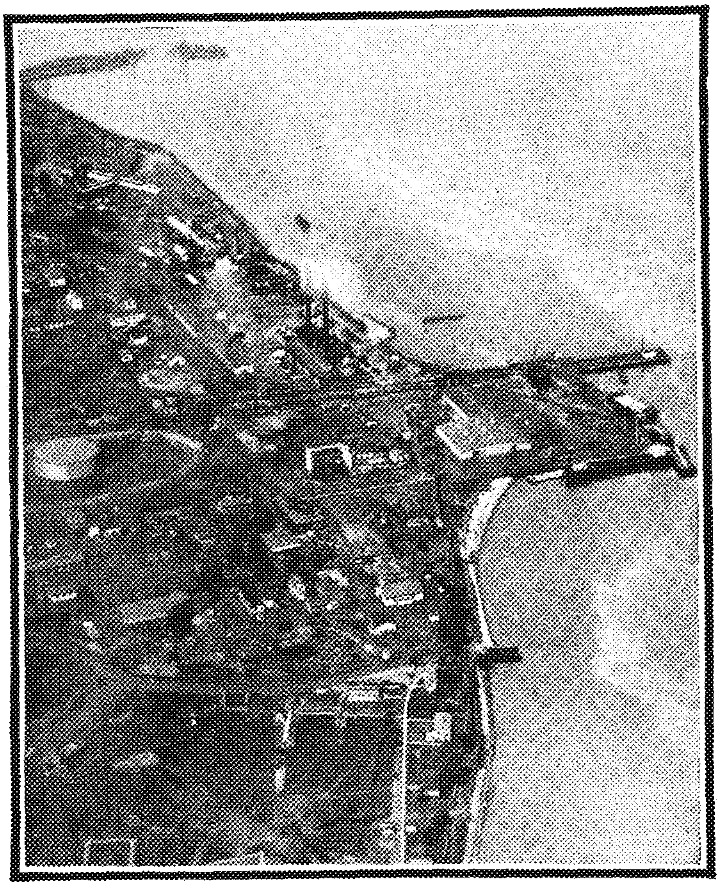
Ground Control

The character of the ground control that is required for aerial surveys should be gauged according to the importance to be attached to accuracy. As a rule no elaborate system of ground control is required and natural objects such as lone trees, fence corners, road intersections and the like are often sufficient.

Time Required

Aerial photography can be carried out only on perfectly clear days, and those usually occur during the entrance of an atmospheric "high pressure area." In various parts of the United States, the occurrence of days suitable for aerial photography vary from one in three, to one in ten. Under favorable conditions, 80 to 120 square miles can be photographed at a scale of 1 inch = 800 feet in one day. The laboratory work requires more time, however, for it takes about thirty days to assemble a mosaic of this same area.

Dynamite clears the way for modern engineering wonders!



The river front area of the Repauno dynamite plant near Gibbstown, New Jersey, where the du Pont Company first began manufacturing high explosives

...Can 129 years' experience help YOU?

In 1802, E. I. du Pont de Nemours, a young French chemist in America, built and began to operate a small powder mill on the banks of the Brandywine River.

Today—after 129 years—the trade-mark of the du Pont Company is well known throughout the industrial world. Du Pont Explosives have played a major part in building the nation's railroads, highways, aqueducts, reservoirs and subways; in clearing millions of acres of land, in mining enormous quantities of coal and other minerals, and in making possible many great engineering enterprises.

Du Pont has never been content merely to *manufacture* explosives. Its highly trained technicians have spent years in chemical research . . . matching ingredient against ingredient . . . to develop new improvements or to make new explosives that will do a given job better. It is significant that a vast majority of all valuable New explosives come from the du Pont plants.

The information that du Pont has gathered in more than a century and a quarter is available to you. As an engineer of today—and tomorrow—you can't afford not to know all there is to know about Dynamite.

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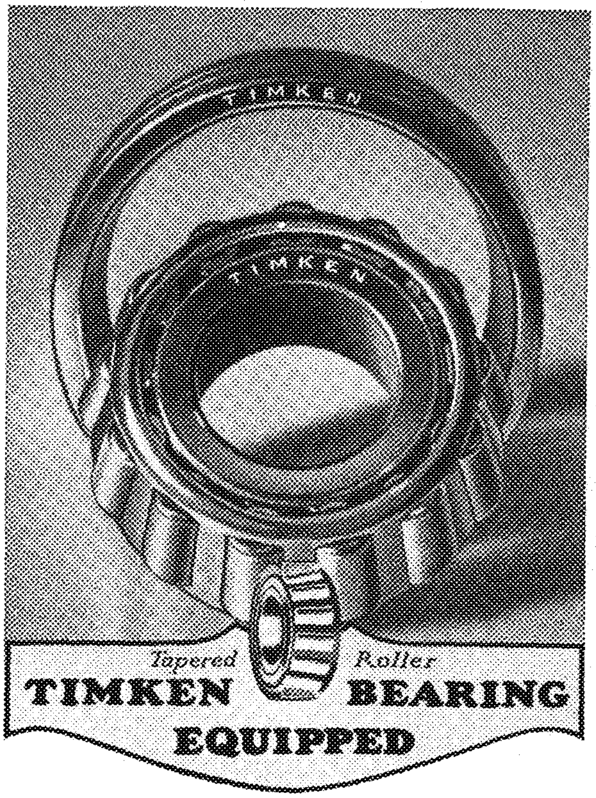

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Then you will find a thorough knowledge of the construction and application of Timken Tapered Roller Bearings one of your most valuable assets.

In order to appreciate how widespread and how profound the influence of Timken Bearings is throughout all industry, it is only necessary to consider that there is hardly any type of modern machinery in which Timkens are not used. The reason is found in the ability of Timken Bearings not only to reduce friction to the vanishing point, but to carry radial loads, thrust loads or both together in any combination at the same time.

Timken Bearings also hold shafts in alignment, and keep gears meshing smoothly and quietly.

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The Timken Roller Bearing Co., Canton, O.

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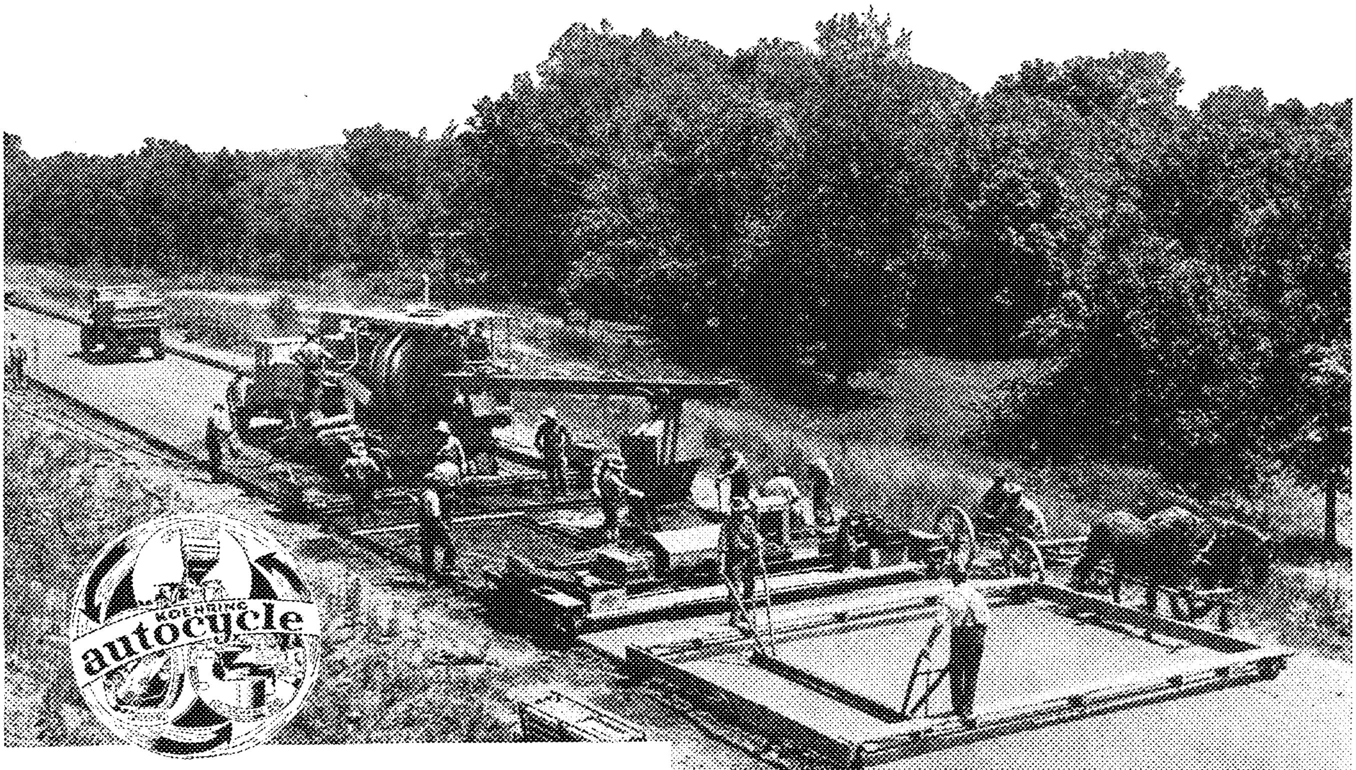
THE MINNESOTA TECHNO-LOG

Engineers' Day Number

Vol. XI MAY, 1931 No. 8

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

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 remixing principle—Koehring developed the autocycle, 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.

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THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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Chapel at the University of Chicago

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Volume XI | MAY, 1931 | Number 8

Conservation of Our Oil Resources

By SAMUEL S. WYER

Consulting Engineer

Public's Interest in Oil Conservation

CRUDE oil underground is usually heavily charged with natural gas at high pressure. Natural gas inherited the emotional and speculative aspects of the oil industry. The interrelation of natural gas and oil makes the more than 25 million automobile, motor truck and tractor owners in the United States vitally interested in sound conservation and a stable and continuing oil supply. Of the 2063 billion cubic feet of gas sold for public utility service in 1928, 1568 billion, or 76%, was natural gas.

The public's interest is obvious. As President Coolidge has aptly stated: "The oil industry's welfare is so intimately linked with industrial prosperity and safety of the whole people that government and business can well join forces to work out this problem of practical conservation."

Magnitude of Waste

For every 5 barrels of oil underground, we waste four in getting one. Our needless gas waste, in terms of what it will cost to replace it, has a value of more than 4 million dollars every 24 hours. The entirely unnecessary natural gas waste in Southern California alone in 1929 had a money value that would have paid for the entire Boulder Dam project in eight months.

Fooling the Public Regarding Substitutes

To divert attention from conservation, emotionally minded enthusiasts refer to how the public can get substitutes for oil and natural gas. A fact-facing attitude of mind necessitates the appreciation that while manufactured gas can be used to replace natural gas, manufactured gas will be worth less and cost the consumer much more. While coal and shale can be made to produce oil and gasoline, the cost will be greater and the quantity available much less.

Emotional Background of Wrong Legal Start

Old contemporary printed records accurately reflect the emotional thinking that dominated early gas and oil field developments and influenced the wrong start of the legal thinking. "The very word 'oil' has wrought like magic."

Conservation's Wrong Legal Start

On November 28, 1875 (Brown vs. Vandergrift, 80 Pa. p. 142) and November 11, 1889 (Westmoreland vs. DeWitt, 130 Pa., p. 235) before any doctrine of property right in natural gas had been established, the Pennsylvania Supreme Court in adjudicating two particular but insignificant lease controversies that reflected the usual emotional aspect of oil boom thinking, blazed the first legal trail in natural gas property rights by stating: "Water and oil and still more strongly gas may be classed by themselves, if the analogy be not too fanciful, as minerals ferae naturae. In common with animals and unlike other minerals, they have the power and tendency to escape without the volition of the owner."

> *The conservation of oil becomes a problem of paramount importance to every thinking man in this country, when the facts concerning the magnitude of present waste are brought under scrutiny.*
>
> *Dr. Wyer in the accompanying article states that for every five barrels of oil underground, we waste four in getting one, that our needless gas waste in terms of what it will cost to replace it, has a value of more than four million dollars every twenty-four hours.*
>
> *It is evident that such a condition demands the attention of the country as a whole, demands that immediate steps be taken to rectify such waste,—especially at a time when industry is supposedly controlled by scientific economy.*—EDITOR.

Exaggerating Migration

The preceding wild animal analogy has conveyed the idea that oil and gas are hopping around like wild game in a forest. "The courts habitually exaggerate the tendency of petroleum to wander from one tract of land to another." (James A. Veasey, American Bar Association, Vol. 52, p. 582.)

Failure of Law

Since 1875 we have made marked progress in dealing with wild animals. In fact the "1875 ideas" of wild animals would not be tolerated in any community today. We have, however, made no improvement in our natural gas property concepts since 1875. Had we shown as much intelligence in dealing with natural gas—nature's premier domestic fuel—as we have in dealing, for instance, with muskrats or migratory birds, we would be much farther along in getting justice for individuals and protecting the public interest today than we are.

The wild animal analogy with the denial of underground property right in natural gas resulted in:

1—The courts of other states, including the Federal courts following this until—regardless of rhetoric or opinions—in effect it is the universal legal basis.

2—Intensifying a wild orgy of competition and establishing a system of competitive robbery where the aim of each producer is to drain the largest possible underground area in the shortest length of time.

3—Periodic over production leading to "wastefulness and disregard of essential values."

4—Stimulating unnecessary waste and forever ruining valuable reserves of oil and gas.

5—Substituting harsh law for justice in that the rights of adjacent land owners, whose property may be drained, are completely ignored.

6—Completely ignoring the public's interest in a continuing and stable petroleum supply.

7—Exaggerating the tendency of oil and gas to migrate and substituting a legal fiction for a geological fact.

8—Making this an outstanding example of the failure of law to conform with the facts, secure justice for individuals, protect the public interest, or square with the facts of an intensive social problem of today.

(*Continued on page 224*)

The Aircraft Diesel Engine

By PROFESSOR B. J. ROBERTSON

ALTHOUGH Dr. Rudolph Diesel proposed his first compression ignition engine some forty years ago, the name Diesel has been known to people at large only in a vague way until very recently. An indication of the increasing popularity of this type of internal combustion engine may be found in the number of Diesel inventors and experimenters popping up like mushrooms in the most unexpected and isolated spots. The majority of these people have a very limited idea of the real problems involved in developing an engine of this type and rarely contribute anything of value to the art. It has become common practice to call any engine, depending upon compression temperature for ignition, a Diesel engine, and the term Diesel will therefore be used in this sense, although the engine may not operate on a true Diesel cycle.

Present Use of Diesel Engines

Up to the present time, the Diesel has demonstrated its supremacy most effectively in the marine field. Lloyd's report for 1930 shows 121 ships from 6,000 to 15,000 tons under construction which will use Diesel engines against 28 ships in the same class which will use steam. Enormous power-generating stations have been built, generally, for use as standby units; notably, the one at Hamburg, Germany, which develops 15,000 horse power and the one on the Panama Canal developing 7,500 horse power. A new Diesel engine is now being designed for the city of Copenhagen, which will develop 22,500 horse power.

The total horse power of engines built in small sizes for isolated cities and villages and for the operation of manufacturing plants using enough power to justify individual generating units is greater, however, than the total horse power built for any other one purpose. The Diesel locomotive is abating the smoke nuisance in city switch yards and is finding a place for itself on long runs and heavy pulling. Steam dredges are often no longer steam, and some trucks and tractors are giving excellent service sans carburetor and ignition system. Very recently, the seemingly impossible has been realized in the development of Diesel engines for airplanes, and surprisingly successful trials have been made with Diesel powered automobiles.

The Gasoline Engine Fire Hazard

With the extremely satisfactory operation of present day gasoline motors, the necessity for the Diesel may well be questioned. The refining processes have been developed until 60 per cent of the crude oil may be returned as gasoline where only 20 per cent was formerly realized. In fact, by the hydrogenation process, all of the crude oil may be processed to produce gasoline. Gasoline, however, is a volatile liquid. When exposed to the air, it may form mixture of vapor and air in proportions which are highly explosive. Any mixture between 1 to 20 and 1 to 50 parts by volume of vapor and air is explosive. Liquid gasoline striking a hot exhaust pipe is vaporized immediately and is very likely to ignite, resulting in a fire which generally cannot be subdued. In the case of aircraft, the ship itself often burns readily. The fuel used in the Diesel, however, has a high boiling point and will not form explosive mixtures with air at ordinary temperatures. It is not even likely to burn when thrown on a hot exhaust pipe,—fire hazards are therefore reduced to a minimum. This item alone justifies the development of the Diesel engine for aircraft.

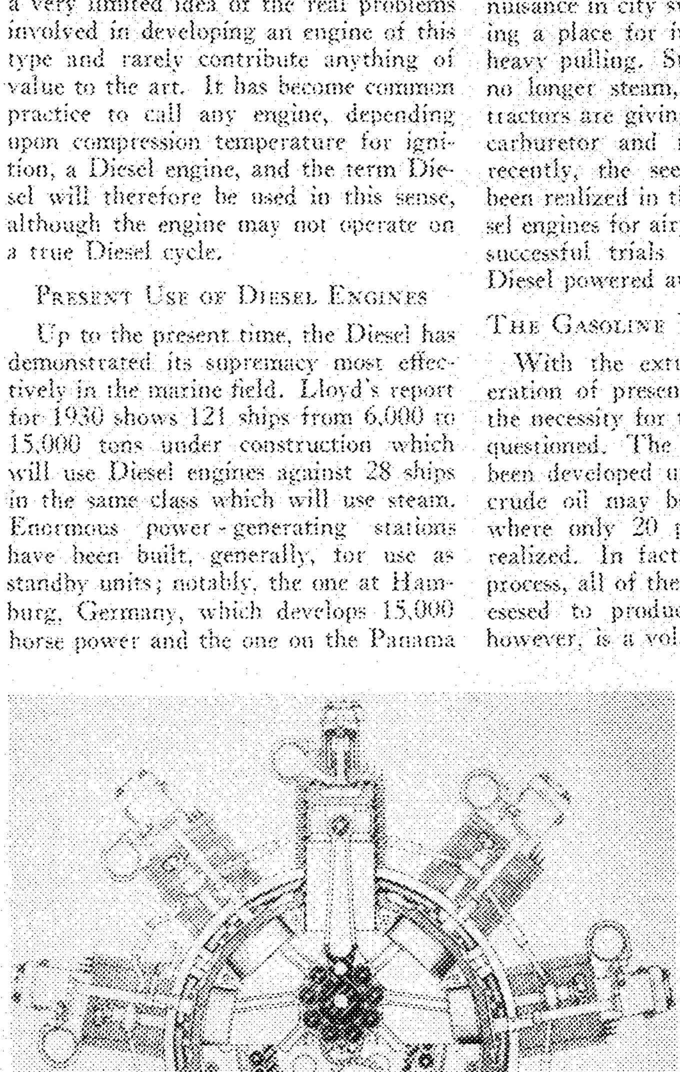

FIGURE THREE

Reliability

While ignition troubles are becoming less common than ever before, there is still an occasional ignition failure, and hence this equipment is always furnished in duplicate on aircraft engines. The Diesel engine is a compression ignition engine, eliminating the wiring and spark plugs, breaker points, and magnetos. It is interesting to note that one of the oldest and most reliable ignition equipment manufacturers has developed a fuel injection system for sale to Diesel engine manufacturers. Fuel injection systems seem likely to become specialties as have ignition systems.

It may be said that the fuel pump, like the ignition system, is liable to failure, and, of course, this is true. Individual fuel pumps are provided on most aircraft engines and the failure of one pump affects but one cylinder. The carburetor and manifold system, as well as ignition apparatus, has been replaced by the fuel pumps, so that the engine may be said to be simplified by the change. Too rich or too lean a mixture will not ignite in a low compression carburetor type of engine, but when the fuel is ignited by the temperature of high compression, burning will start the instant the injected fuel comes in contact with the hot air, regardless of the mixture ratio. Carburetor engines are very sensitive to hot spots due to uneven cooling, since they cause premature ignition of the fuel. It is obvious that ignition cannot take place before the fuel enters the cylinder, so that the Diesel is free from this difficulty.

Economy

Makers of gasoline engines of all types are continually endeavoring to increase the compression ratio. This is accomplished by decreasing the clearance volume. It is well known that the efficiency of the internal combustion engine increases with the compression ratio, but carburetor type engines compressing the fuel and air mixed together are limited to a maximum ratio of about 6 to 1, while 4 to 1 or 5 to 1 is more common. Higher compression ratios cause the combustion to take place in a phenomenal manner with extremely high and apparently localized pressures. These pressures are often destructive and are

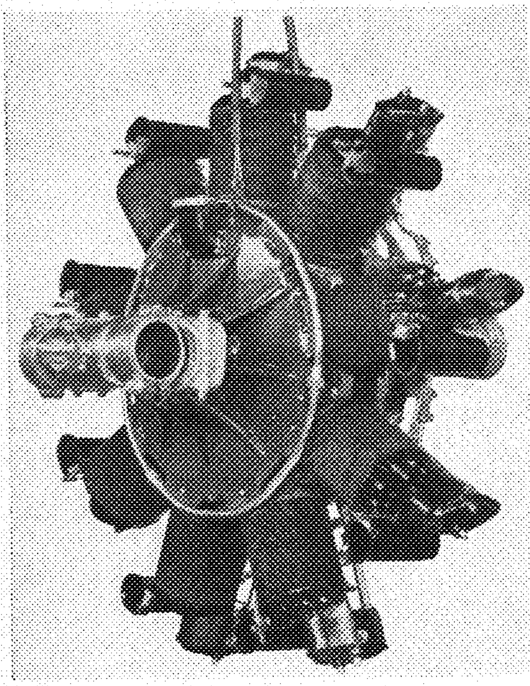

FIGURE TWO

accompanied by loss of power and engine overheating. The phenomenon is called detonation and anti-knock fuel, fuel dopes, special shaped combustion chambers, etc., have been developed to enable the use of higher compression ratios. The high compression ratios also produce quicker pick-up, acceleration, etc. The compression ignition engine may readily use compression ratios of from 12 to 1 or up to 16 to 1. This results in fuel consumption below that of the best carburetor engine. At the present time, the cost of a Diesel fuel suitable for aircraft engines is probably one-third the cost of motor gasoline or one-fourth the cost of aviation gasoline. Although the general use of Diesels will increase the demand and, consequently, may increase the selling price, the refining process will always be more simple than that employed in the production of gasoline, and the fuel should therefore be cheaper. At prevailing prices, the cost of Diesel power is about 20 to 30 per cent of the cost of power generated by aviation gasoline. This figure takes into consideration the decreased fuel consumption caused by the higher compression ratio.

Radio Interference

Electric ignition systems must be thoroughly shielded if a radio is to be used in the ship. No interference is encountered with the compression ignition engines.

Mechanical Details

The building of a satisfactory high speed Diesel engine is not a simple matter. The present products are the results of many years of experimental work and development. There are at least three engines whose successful operation in airplanes must be acknowledged. The Clerget is made in France. It is a nine cylinder radial, 4 stroke cycle, 5.12 in. bore, by 6.70 in. stroke, 208 h. p. at 1700 r. p. m., weight, 3.3 lb. per h. p. It is air-cooled. The Junkers is made in Germany, the latest model being a six cylinder in line 4.72 in. bore, with two pistons in each cylinder, the upper piston forming what might be termed a moving cylinder head. These two pistons are operated from two crank shafts, one above and one below the cylinders. See Fig. 1. The crank shafts are connected by gears so that they rotate in synchronism. The clearance space at compression is formed between the two pistons as they approach each other in the center of the cylinder. The stroke of each piston is a little greater than the bore of the engine. The effective stroke is therefore more than twice the bore. The engine is two-stroke cycle, the inlet ports being uncovered by one piston and the exhaust ports uncovered by the other pistons when they are at the extreme positions. The general scheme is identical with that used by Junkers in marine motors except that two crank shafts are used instead of one. In marine motors, the upper pistons are operated by long connecting rods fastened to extra throws on the lower crank shaft and placed outside the cylinders. The inertia forces are practically in balance. This engine develops 650 h. p. and weighs 2.85 lbs. per h. p.

The Packard is a nine cylinder radial, 4 13/16 in. bore, 6 in. stroke, develops 225 h. p., and weighs 2.27 lbs. per h. p. It was developed by the Packard Motor Car company under the direct supervision of the late Lt. L. M. Woolson, who was assisted by Dr. Dorner, a German engineer. Americans should be gratified that this engine, developed in our own country, weighs less per h. p. than any other similar engine of proved merit and that the engine has been brought through the development stage and is now in production.

Lightness has been achieved in this engine through clever design and the use of modern alloys. Maximum cylinder pressures reach 1,200 lbs. per sq. in. This means that a force of a little over 10 tons is attempting to tear each engine cylinder from the crank case at each explosion. The light aluminum alloy out of which the crank case is made would have to be made comparatively thick to prevent the cylinders from being torn off if they were bolted on in the ordinary manner. The photograph (Fig. 2) shows a hoop or band running completely around the crank case, which is used to bind all of the cylinders to it. This hoop is made of a special alloy steel and, together with a duplicate hoop on the opposite side of the engine, relieves the crank case of all tensile stresses. This construction allows a thin, light, crank case wall ribbed to withstand the compression pressure produced by tightening up the alloy ring.

The explosion pressure is about 2½ times that obtained in a gasoline engine, and yet the crank shaft in this engine is scarcely heavier than a conventional gasoline radial engine of similar displacement. The counter-weights are not rigidly mounted on the crank shaft, but are held in place by bolts drawn up against stiff springs. Rubber blocks will be found cushioning the connection between the crank shaft and the propeller. It is claimed that these springs and cushions absorb the impact forces so that the crank shaft is not stressed in excess of safe loading by the high pressures in the engine cylinders. The weight of the crank shaft is therefore kept at a minimum. It will be noticed that the engine uses but one valve per cylinder, thus eliminating the weight of one of the customary valves, rocker arms, push rods, and cam followers.

The engine operates on a four stroke cycle as does the Clerget. Clerget, how-

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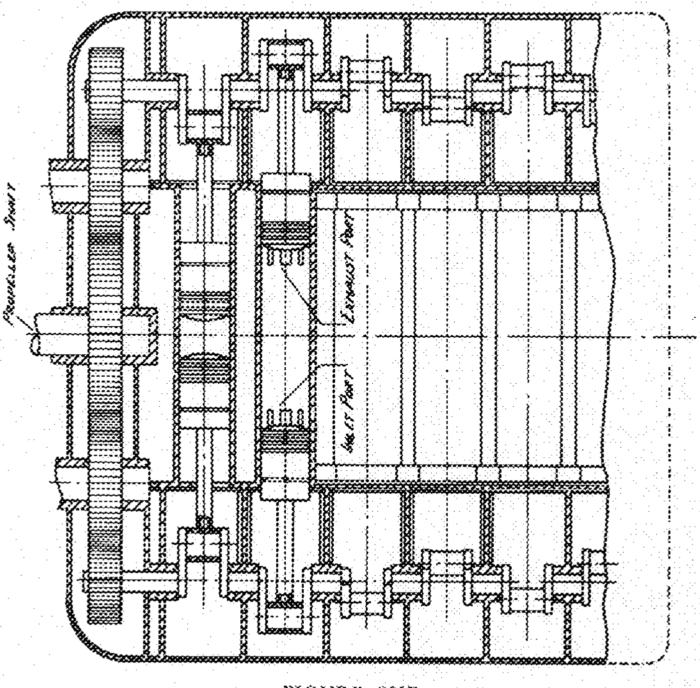
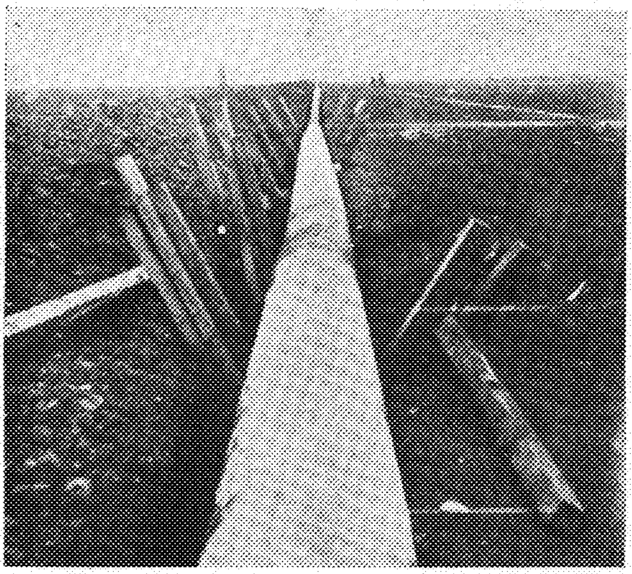


FIGURE ONE



—American Welding Society.
A LONG LINE OF WELDED PIPE READY TO BE LOWERED INTO THE TRENCH

Welding Instruction for

By ELMER H. SMITH,* President

SINCE the introduction of fusion welding in the United States about twenty-five years ago this process of joining metal parts has been utilized by essentially all of the metal working trades. The process has not only affected the metal trades but it has been used in all industries. Probably no other mechanical process has revolutionized the methods of fabricating metals to as great an extent as fusion welding. It has also been employed to a great degree upon the repair of machinery and equipment and by its use the final scrap pile has been made much smaller.

One of the newer applications of the process is the overlaying of steel parts which are subjected to hard wear and abuse with a protecting armor or hard surface of tough, abrasion resisting metal. Such overlays consist of alloys of tungsten, chromium and cobalt and steel alloys which contain considerable amounts of chromium and manganese. One of the latest developments in overlays is the application of pieces of tungsten carbide imbedded in a matrix of steel, forming the surface of cutting tools and other edges which must stand up under very severe service. These hard, tough overlays have revolutionized well drilling practice in the oil fields and are now entering the road machinery and farm implement fields. They are also being used to an enormous extent upon contractor's machinery, dredging machinery and similar equipment.

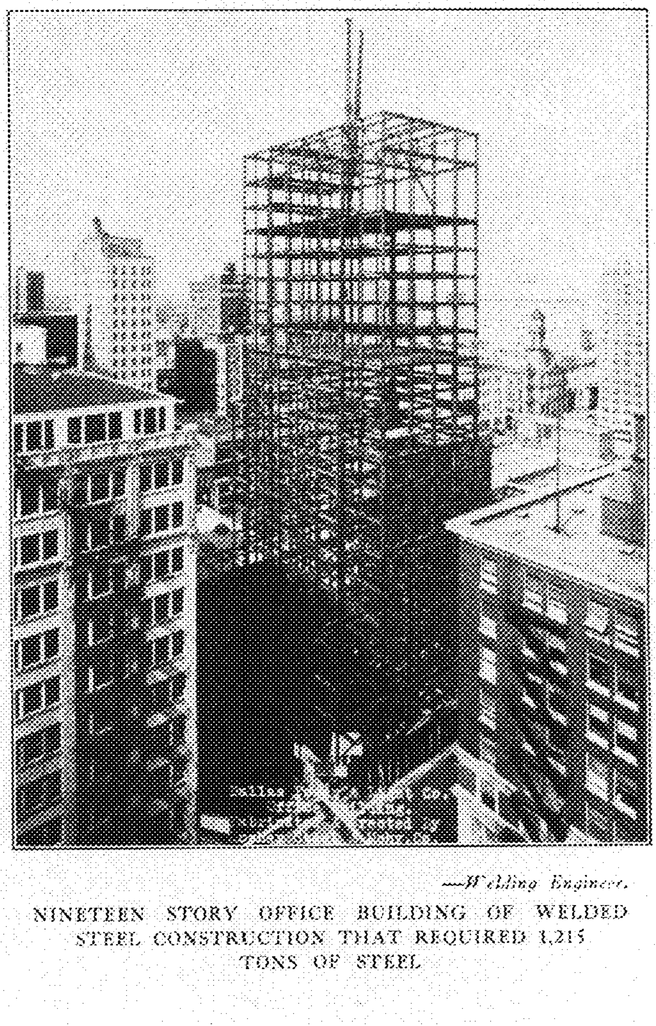
The engineering student has had little opportunity to gain a knowledge of fusion welding while in college, and it was not until he entered the practical field of engineering that he came in contact with it. He was then often handicapped by a lack of theoreican and pratical knowledge of the process, and while he undoubtedly knew that metals were joined by fusion welding, the correct design of a structure for the adoption of fusion welding, or the strength of welds in a bridge or building were unknown to him.

The industry itself has progressed in twenty-five years from practically the zero mark to enormous proportions. There are, without doubt, over 200 oxygen producing plants in the United States, Canada and Mexico, supplying probably 3,000,000,000 cubic feet of oxygen yearly, practically all of which is used for welding and cutting. Furthermore, there are at least 100 concerns in the United States manufacturing electric welding equipment. The total investment of capital in the welding industry amounts to a very large figure, probably several hundred million dollars.

This development has been largely within the industry itself. Engineers trained in the universities of the country have received further training from the industrial companies engaged in the manufacture of welding and cutting equipment, welding machines, the production of oxygen and acetylene, and the large electrical equipment corporations.

The schools and colleges with the exception of a few have, to a large extent, permitted this enormous development of a commonly used process to go unnoticed insofar as their general program of engineering education was concerned. It is true that some of the universities have established welding clinics or conferences which occur each year, and other schools have taught welding as a part of some other course of instruction. But these efforts to instruct engineering students in welding from an engineering standpoint have been, in most instances, too limited. There seems to be a lack of appreciation on the part of those responsible for the curricula in most engineering schools that during these twenty-five years a new engineering profession has grown up in industry which has not been accorded its rightful place upon the programs of engineering training in the universities throughout the country.

This profession covers a field which is believed to be sufficiently large to warrant a comprehensive course in all of the larger universities and graduation from such a course of training should carry with it a degree of welding engineer. It is true that the number of men who would desire to take a full course in

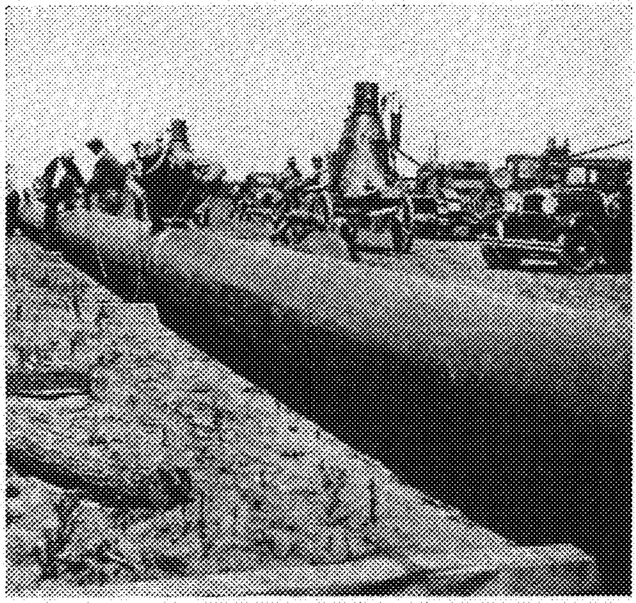


—Welding Engineer.
NINETEEN STORY OFFICE BUILDING OF WELDED STEEL CONSTRUCTION THAT REQUIRED 1,215 TONS OF STEEL

*President, Smith Welding Equipment Corporation and Commercial Gas Company, Minneapolis, Minn.

Undergraduate Engineers

Smith Welding Equipment Corporation



—American Welding Society.

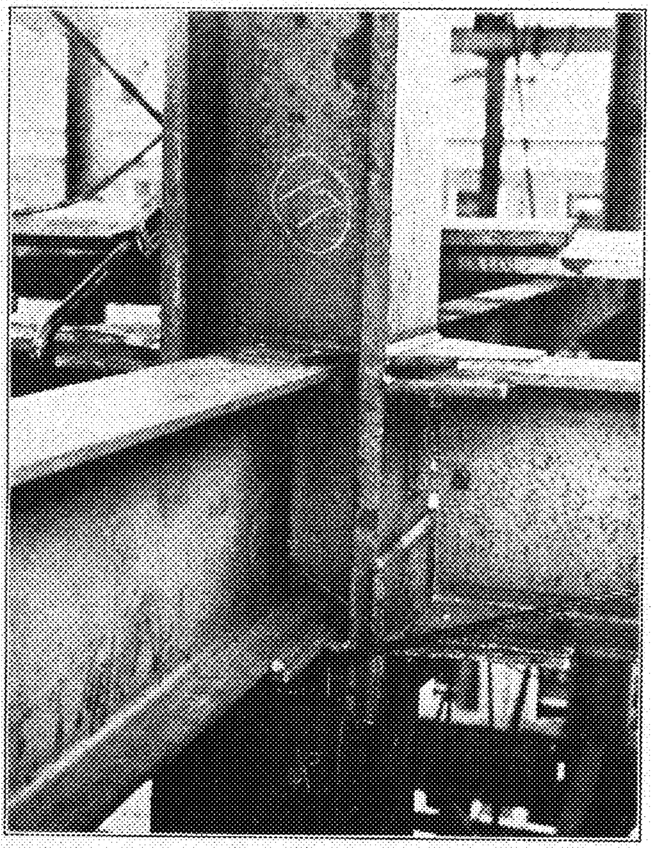
WELDING A LARGE DIAMETER TRANSMISSION PIPE LINE

welding engineering might be limited, but such a course could be so arranged that the essential features of it would be included in courses in mechanical engineering, in electrical engineering, civil engineering, bridge engineering, structural engineering and metallurgical engineering. All of these branches of engineering must ultimately contact in the field with welding as it is now a well developed, and in many instances, a standardized process in industry. The under-graduate student is certainly right when he says that he cannot obtain adequate instruction in this important process.

There are plenty of good books which have been written upon the subject of both oxy-acetylene and electric welding, and these are available in the libraries of most universities at the present time. There is one course of instruction in particular, entitled "Oxy-Acetylene Welding and Cutting," which has been published in book form and very thoroughly covers this subject, both from the viewpoint of the welder and of the engineer, while a number of good books have been published upon the subject of electric welding.

There is no lack of technical talent to make such instruction a reality. The apparent difficulty seems to have been that the process has developed with such rapidity that educators have failed to realize its true import and the close relation it bears to all engineering practice.

The structural engineer, who is graduated this year without knowledge of welding, will find himself almost immediately handicapped because riveting is not the only means today of joining structural steel members. It is believed by many forward looking engineers that the riveter will soon cease to be heard during the erection of the steel building of the future and that the silent means of erection, namely, welding, will be universally used. This may be an extreme view and, in all probability, a combination of both riveting and welding will be the eventual development.



—Welding Engineer.

TYPICAL BEAM CONNECTION TO FLANGE OF INTERIOR COLUMN OF WELDED BUILDING ON THE LEFT

The latest accomplishment of this kind is the nineteen story building of the Dallas Light & Power company at Dallas, Texas, which is now being erected. Fourteen stories have been constructed and the framework is continuing upwards at a rapid rate. The design of a great structural building of this kind, for welding, has become an exact science which should be taught in every university where a structural engineering course is given.

To teach undergraduates in bridge or structural engineering courses the intricacies of the design of a riveted structure and to fail to give them full information and instruction in the design of similar welded structures is to send the graduate engineer into the practical field of engineering utterly without the knowledge of a modern method which is becoming more important each day.

In Toronto, Ontario, a steel highway bridge was built in 1923, consisting of three spans, 672 feet over all in length and carrying heavy traffic into the city of Toronto. The steel work of this bridge carried the entire load and the design was unique. It was severely criticized by bridge engineers, who were not familiar with welded construction, but nevertheless was designed and built economically and has been successful in every respect. The steel work was covered with concrete, but the function of the concrete was for the protection of the steel rather than for carrying the load.

Every trade publication in the welding field is specializing today upon the theory and design of structures for welding. The journal of the American Welding Society, published each month from the Engineering Societies building in New York City, contains engineering knowledge of tremendous importance to every engineering student. How many undergraduate engineers know it exists?

Hundreds of miles of welded steel oil and gas pipe lines have been constructed from the oil fields to all parts of the country, in fact, welding has become standard practice in such construction. Welded piping in industrial plants for steam, oil, gas and air are now com-

(Continued on page 224)

The Alaska

By W. L. KINSELL, E. E. '00

THERE has been a great deal of comment lately on the fact that it has cost our government over a million dollars a year to own The Alaska Railroad but one must consider several causes of this condition, one being that the railroad was authorized to be built by Congress to develop the country and the resources thereof for the people of the United States without regard to what it could be operated for, and as a consequence more money has naturally been spent than it would have cost simply to operate the railroad as cheaply as possible.

One must realize that in order for the railroad to make money, it must carry freight and passengers to produce the necessary revenue and the only way this can be accomplished is by spending money to develop and populate the country through which this railroad runs so that in time enough revenue will be derived to make the railroad self sustaining.

Upon arriving at Seward, the southern terminus of The Alaska Railroad, on the eighteenth of last July the writer was naturally surprised to see a station which looked not unlike many one sees in the States, and standing in front of it was a thoroughly modern steam heated train of steel cars consisting of baggage and smoking cars, coaches and a compartment observation car. This train is known as the "Mount McKinley" while the one running in the opposite direction is called the "Midnight Sun."

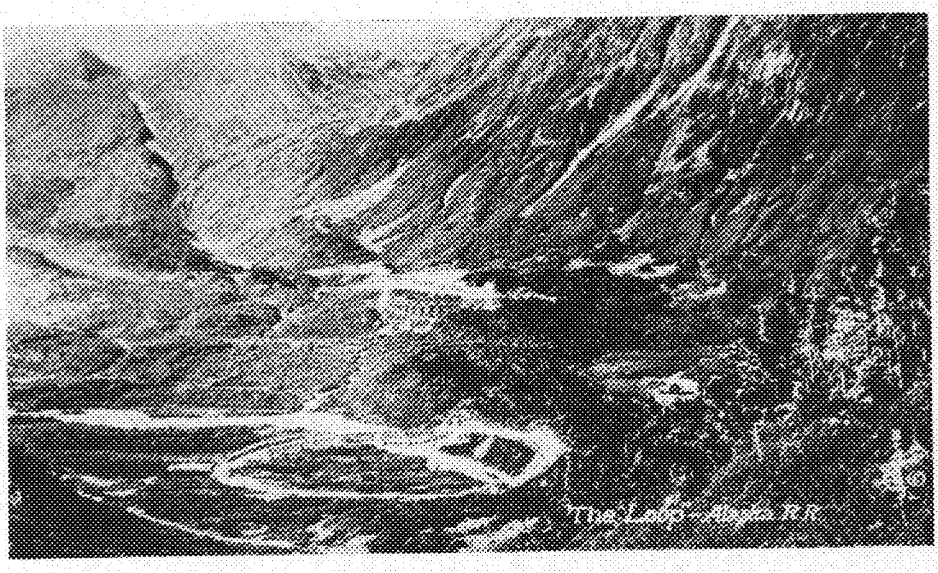
One hundred and fifteen miles north of Seward and located at the head of Cook Inlet is Anchorage, the headquarters of The Alaska Railroad. At this point the tide has a maximum rise of over forty feet, second highest in the world and while large boats could reach Anchorage at high tide, it may not be called a port of entry. Here the general offices as well as the principal shops of The Alaska Railroad were erected. Here also is located the Stores department where over half a million dollars worth of material is kept on hand at all times.

All of the buildings, except the power house, are of wood construction, the main shop building being five hundred and fifty feet long with two longitudinal tracks running its full length. Here all work in connection with heavy repairs to locomotives, steel freight and all passenger cars is taken care of. This building also houses the machine and boiler shops as well as the blacksmith shop, wood mill and gas car repair shop.

Considerable advancement in the manufacture of birch furniture has been made in these shops and a mill has been in operation for several years where the native birch logs are sawed into sizes best suited for making chairs, tables and other useful articles of furniture. There is a large amount of native birch which grows in close proximity to Anchorage and the railroad has been trying to develop the use of this wood and create a market for it.

Our iron and brass foundry has furnished castings for repairs to cars and locomotives as well as to various mining and other companies in the last six or seven years since this is the only foundry in Alaska. Coke, used in the manufacture of castings, is made in our own beehive oven. A fine grade of blacksmith coal, mined in the Matanuska coal fields about fifty miles from Anchorage on one of the branch lines, is used in the blacksmith shop and in the manufacture of this coke. We also make our own charcoal in this same beehive oven, a large amount of which is used in charcoal heaters carried in fruit cars which handle the perishables from the boats to various points along the railroad line.

In a twelve stall roundhouse the ordinary repairs are made on locomotives which run in and out of Anchorage.



THE PICTURESQUE LOOP DISTRICT WITH ITS CURVES AND STEEP GRADES.

Electric power and light was formerly furnished the city of Anchorage from the one thousand kilowatt power plant located at the shops but a water power plant has been built with private capital to furnish this power and light to the city so that at present part of the steam power plant is a reserve in case the water power plant fails.

At the present writing, all machinery possible which has been operated in the past with steam is being converted to be run by electricity. A sixteen hundred cubic foot steam driven compressor is being replaced by an electric synchronous motor driven compressor; a steam driven centrifugal fire pump or high pressure boiler washout pump has just been replaced by a motor driven pump capable of maintaining a pressure of two hundred and fifty pounds, while a steam driven vacuum pump is being replaced by a motor driven geared pump. Three high pressure boilers of four hundred horse power each will be held in reserve to operate the one thousand kilowatt electric steam operated emergency plant, in case the water power plant located up in the mountains becomes inoperative, while two one hundred fifty horse power boilers, which are being equipped with stokers, will furnish the necessary steam for heating the roundhouse, shops and other buildings.

It is estimated that there will be an annual saving of between $25,000.00 and $30,000.00 by this change which is being made at present and will be completed in the near future. This is accomplished by installing more efficient motor driven equipment for that which was formerly driven by steam; by obtaining a reduction in cost of current due to the increased consumption of electricity used by these additional motors and by equipping the two heating boilers with stokers and forced draft. The cost of making this change will be less than $20,000.00 and the saving which will be effected in eight months will pay for making the change.

A similar change has been made in a smaller power plant located at Fairbanks where electric current for power and lights is now being purchased to operate motor driven machinery while formerly electric current was generated in our own plant. A stoker and forced

Railroad

Superintendent of Motive Power and Equipment

draft are now used and one fireman does the work which required three in the past. The effect of making this change will result in a saving of over $8,000.00 a year.

Since the railroad carries no insurance on any of its buildings or equipment, it must make provision for protecting its properties as far as possible against loss by fire. At Anchorage, where the general offices and main shops are located, a well organized and paid fire department is ready at all times to answer alarms. A chief or assistant chief are on duty at all times while paid auxiliary and volunteer firemen make available sufficient help to meet any emergency. The city of Anchorage has a similar fire department which answers all railroad and city alarms while the railroad fire departments assists with the city calls.

The locomotives used in passenger service were formerly run on the Panama Railroad and were built at the Brooks and Cooke Works of the American Locomotive company in 1906. They have 20x26 inch cylinders, sixty-three inch drivers and are of the Mogul or 2-6-0 type in freight service having hundred and twenty-five thousand pounds on the three pair of drivers. The Mikado or 2-8-2 type is the standard freight locomotive having 22 x 28 inch cylinders and fifty-four inch drivers which carry a weight of one hundred and eighty-five thousand pounds on them. These engines are equipped with superheaters and boosters giving them a maximum tractive effort of fifty-four thousand four hundred pounds and in cold weather are often used to good advantage on passenger trains and to haul coal from the mines on the branch line, one of which has a five per cent grade.

In addition to the Mikado locomotives there are a number of the Mogul or 2-6-0 type in freight service having cylinders 19 x 24 and one hundred and eight thousand pounds on fifty-four inch drivers. These engines were also built at the Brooks and Cooke Works of the American Locomotive company and were used in the construction of the Panama Canal before being brought to Alaska. As five feet was the gauge used on the Panama Railroad, it was necessary to change these locomotives to our standard gauge before they could be used on The Alaska Railroad.

In addition to the above equipment, the railroad operates a Brill and several Ford gas cars as well as a Brill gas-electric steel train which consists of a combination baggage and smoker and a passenger coach trailer. Several gas cars with a seating capacity of ten to twenty persons are available for special service such as required by hunting and special parties, prospectors, etc., and for carrying sick people in an emergency. These smaller gas cars are manned by an engineer who handles the car, the same as a bus driver would handle a bus, that is, he goes according to orders, collects the tickets and carries the passengers to their destination.

At the present time, one of these Fords as well as a large Brill gas car are used to carry students and other passengers between Fairbanks and "The Farthest North College in the World" or the Alaska Agricultural College and School of Mines, located four miles west of Fairbanks.

The freight equipment is ample for the present business of the road. Fifty-five ton hopper bottom steel cars handle a large percentage of the coal mined along the Alaska Railroad. The ordinary automobile, box, flat and stock cars, refrigerator and fruit cars, as well as gondolas, tank cars, etc., are the principal kinds of cars which go to make up the balance of the freight equipment necessary to handle the business which this railroad is able to secure.

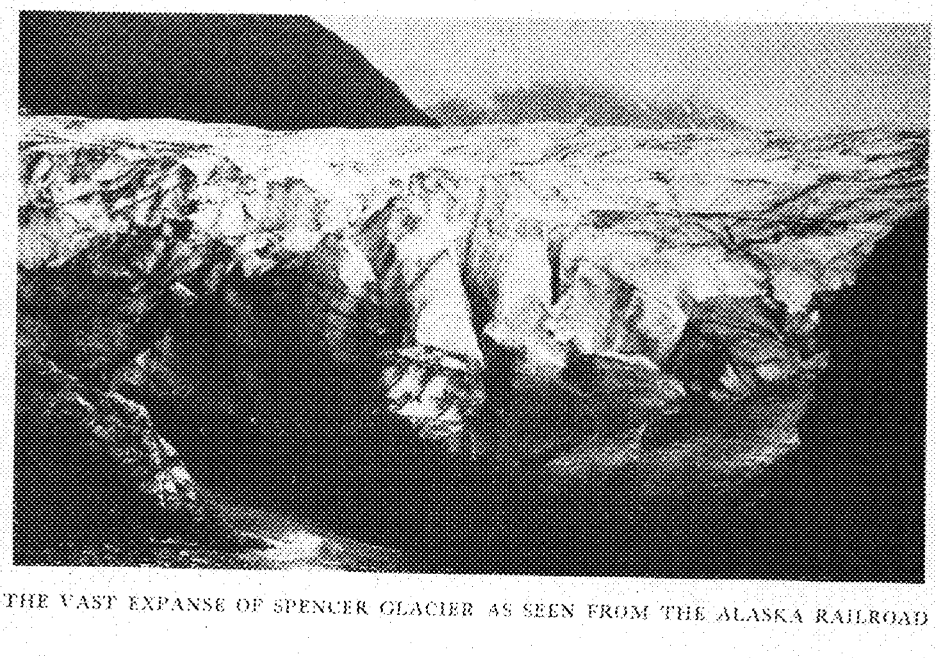
The road is well supplied with equipment to handle the large amount of snow which falls in certain districts. Three rotaries and two Russells, or wedge type plows, keep the road open to traffic at all times. Three ditchers keep the track clear in the summer time, rock and mud slides often covering the track for several hundred feet.

Several trains are kept busy all summer changing the location of tracks, putting in new ties and ballast, filling in old trestles and putting in new bridges, etc., as the road was never finished as it should have been but was connected up and trains run through so now the management has encountered the task of finishing the building of the road instead of simply maintaining it. This, naturally, is a drain on the earning which would not be the case if the railroad had been properly finished in the first place.

Many have said that the scenery along the Alaska Railroad is the finest in the world. From the time one leaves Seward until Anchorage is reached the visitor is thrilled by the beautiful and wonderful sights which are so impressive that they will never be forgotten. The natural beauty one sees on this trip, as well as the marvelous engineering feat and the most interesting sights through the "Loop" district, keeps one busy for hours wondering what will be the next surprise.

Twelve miles from Seward the summit of the crossing of the Kenai Mountains is reached. Here the river begins which flows north into beautiful Kenai Lake, known by anglers as the most wonderful fishing spot in the world.

At Moose Pass, twenty-nine miles from Seward, a road leads to several gold mining districts where work is carried on the year around. Upper Trail Lake is followed for several miles and finally Grandview, the summit of the second crossing of the Kenai Mountains, is reached and it is no uncommon sight to see several moose off in the distance when going through this district. Three miles north of here the "Loop" is reached, a section made famous by the inspiring sight one sees when making this fascinating trip. For four miles the track twists and turns on the mountain sides, over

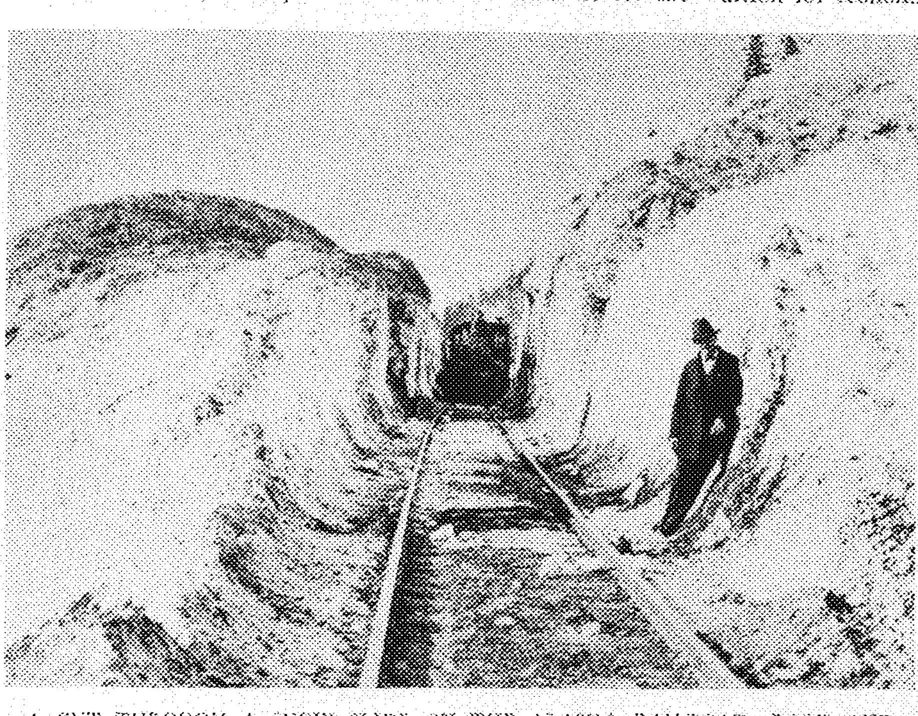


THE VAST EXPANSE OF SPENCER GLACIER AS SEEN FROM THE ALASKA RAILROAD high bridges, trestle spirals and through snowsheds and tunnels until it forms a complete loop over Placer River. The winding track is visible at one point in four places. There are two complete circles. In making this loop, Bartlett Glacier which lies nestled in high mountains is passed and a closeup view is obtained.

Spencer Glacier, fifty-three miles from Seward, is within one hundred yards of the track and an excellent view may be had of the formation. From here to Anchorage, the railroad passes through picturesque scenery following along tide water for fifty miles until the head of Cook Inlet is reached and here is laid out the most modern town in Alaska, Anchorage. Curry is reached in the evening where passengers spend the night at the Curry Hotel, "a palace in the wilderness." In this way, the passengers are given the benefit of daylight travel so that all points of interest may be seen. Continuing north, the summit of the Alaska Range of the Rocky Mountains is reached at Broad Pass and we soon enter the beautiful scenic Nenana River Canyon. For miles we wind around cliffs, enter tunnels, cross glacial streams and are soon at McKinley Park Station, the entrance to our new National Park where tourists usually stay for a visit in the Park before proceeding onward. Nenana, situated at the junction of the Nenana and Tanana Rivers, is the next principal point of interest and from here the railroad operates steamers to points on the Tanana and Yukon Rivers. After crossing the river on an immense steel bridge, which consists of the longest railroad bridge span west of the Mississippi, the train goes on to Fairbanks, the "Heart of Alaska," and the northern terminus of the railroad.

Other terminals where locomotives and cars are handled, besides Seward and Anchorage, are Curry and Healy, while at Nenana, situated on the Tanana River, is located the terminus for steamers plying the Yukon which is the longest navigable river in North America. Here are located the marine ways where the boats are taken out of the water after they have made their last trip of the season. Before being launched again in the spring, they are given a thorough overhauling starting at the hull and ending with the roof of the pilot house. Shops of sufficient size are equipped with the necessary machinery and tools to take care of overhauling these river boats which handle both freight and passengers during the summer months.

Wood is the cheaper fuel to use on the boats as it can be obtained along the river at several points, contracts being let to furnish this wood in four foot lengths. It is piled on the banks at certain points so as to be available when needed. The use of this wood saves the expense of hauling coal to Nenana and transferring it to the barges to be taken down the river and unloaded at different points so it will be available for the boats as they make the two thousand mile journey down and up the Tanana and Yukon Rivers.



A CUT THROUGH A SNOW SLIDE ON THE ALASKA RAILROAD—ROCK AND DEBRIS MAKE REMOVAL DIFFICULT

Nenana is the eastern terminus for boats running west on the Yukon to St. Michael, Holy Cross, etc., while it is the western terminus for boats which run east to Fort Yukon (on the Arctic Circle), Eagle, Dawson and Whitehorse connecting with trains on the White Pass and Yukon Railroad for Skagway.

In the winter, the frozen rivers form parts of the trails used by dog teams to handle the freight and mail but since the advent of the railroad and airplane the number of dog teams has greatly diminished.

When gold was first discovered in the Fairbanks district, the only means of getting supplies into that country was by the water way to St. Michael and up the Yukon to the Tanana, thence up the Tanana River to Fairbanks, but since the upper part of this river was too shallow for navigation during the period of low water, a narrow gauge railroad was built from Fairbanks to Nenana to handle the traffic between these points. When the railroad was built north from Seward, this narrow gauge railroad was converted to standard gauge and formed part of what is now known as The Alaska Railroad.

It was at Nenana that President Harding on July 15th, 1923, drove the gold spike signifying that the laying of the rails had been completed over the entire distance of four hundred and seventy miles from Seward, on the south, to Fairbanks, on the north. But even today much additional work remains to place the roadbed and structures in condition for economical operation.

Many natural difficulties are encountered at different seasons in different sections of the country through which the railroad operates. During the winter and spring months, the snowfall between Seward and Anchorage is so great that a rotary snow plow is kept busy most of the time opening up the road after a snow slide has brought down ice, snow, trees and rocks. Many times dynamite is used to break up a slide after it has started to freeze and a wire rope is used quite often to hook onto trees which have come down with the snow. In this way a slide is removed so that traffic can be resumed. Much damage results from plowing into great boulders which have become dislodged and come down with the snow and as yet no rotary has been built that can withstand the shock received when these boulders and trees are encountered.

During the rainy season, considerable trouble is encountered in the Nenana Canyon in the vicinity of Mount McKinley. The railroad skirts the west side of the river passing through several tunnels and over glaciers and chasms on its journey north and south. The rock formation in this district is peculiar in that it readily disintegrates when covered with water and become very slippery causing the roadbed to slip quite easily. At one place in this vicinity the railroad bed crosses a glacier over which there is about twenty feet of dirt and rock and from this point, twenty feet under the track to a point on the level

(*Continued on page 224*)

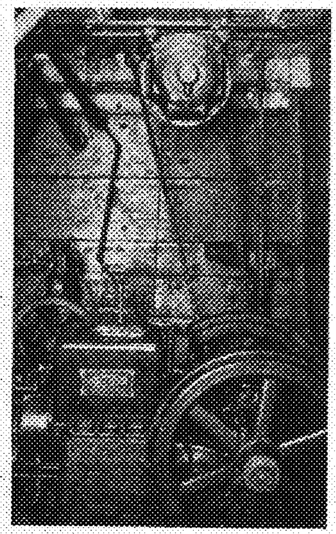
Power for the Smaller Fishing Vessel

By W. J. CALEY, Minn. '27

Westinghouse Electric and Manufacturing Company

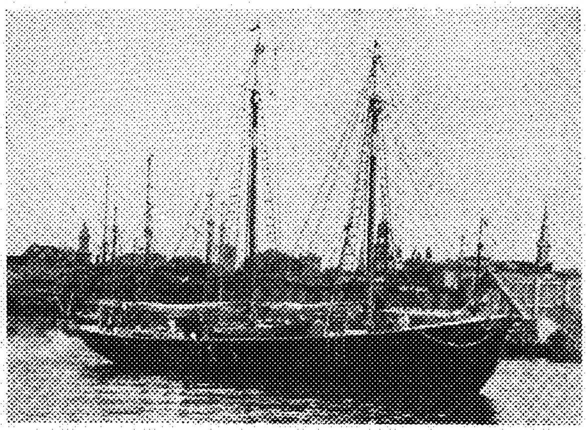
AMERICA'S so-called "First Industry"—that of fishing—has taken great strides toward modernization during the last few years. As in other industries, electricity has played a most important part in these advances. The use of floodlighting has been regarded as a luxury for the smaller fishing vessels, but when available it has made fishing possible twenty-four hours of the day. A source of electric power makes the installation of radio apparatus an easy matter—providing safety and entertainment for the crew, and—where market prices are broadcast—a complete up-to-the-minute report on the value of the catch of fish. Many times this knowledge has enabled the captain to go in with only a partial catch and obtain more for it than would have been possible had he waited for a full catch at lower market prices. Water in the bilges—long a cause of annoyance and danger—can be removed with a small bilge pump if some additional source of power is available to drive it.

All of these conveniences—regarded by many fishermen as necessities—are available without a separate power plant through the use of a portable marine generator-and-control panel unit. This generator, by keeping a storage battery floating on the line continuously, assures the availability of a reasonable amount of electric power at all times. This equipment is suitable for driving from the flywheel of the main engine by a belt; or by a silent chain from a sprocket on the main engine shaft.



MARINE GENERATOR USED WITH AUXILARY MOTOR

The application of this unit is not restricted to main-engine drive alone, however. In cases where it is difficult, due to space limitations, to install the generator within a reasonable distance of the main engine, it can be connected to the more slowly rotating tailshaft—the desired generator speed being attained through a step-up gear connection. If a small portable Diesel or gasoline engine is available, it can, of course, be used to drive the generator directly. The mechanics of attaching the unit to these respective driving sources are simple—and are left to the ingenuity of the owner of the craft.



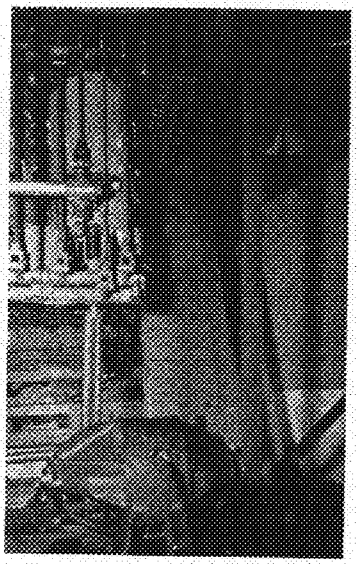
TYPICAL SMALL SIZE FISHING VESSEL

The complete unit consists of a generator, a control panel and a suitably-sized storage battery. The control panel is separate and can be located in any convenient place accessible to and in full view of the engineer. It contains a voltmeter, ammeter, field switch, field rheostat, armature protective fuse and reverse-current relay. This panel connects the generator to the battery circuit only when sufficient voltage is being developed for charging purposes. As the engine speed is increased, the charging current builds up and is controllable over a range of from 0 to 60 amperes by the field rheostat located in the center of the panel. If the generator pulley is of the correct size, the batteries will be charging at all cruising speeds. A reverse current relay prevents the battery from feeding current into the generator; when the reverse current exceeds about 1.5 amperes, the armature is automatically disconnected from the battery circuit, leaving the battery still supplying power to its load.

Many fishing vessels find it necessary to travel at times at what is termed "trawling speed"—something less than half the normal rate of travel. This power unit is so designed that at such speeds there will still be sufficient voltage available to charge the battery—although at a slower rate—assuring the maintenance of power at all times.

This marine power unit is especially designed to withstand the rigors of sea life. The generator windings are impregnated with a moisture-resisting compound rendering them impervious to the harmful effects of salt moisture. The contactor springs and contacts are treated to prevent corrosion. The brushholders are of a special metal designed to resist the electrolytic action often present when covered with salt spray. In short, every effort has been made to afford uninterrupted service with the minimum maintenance.

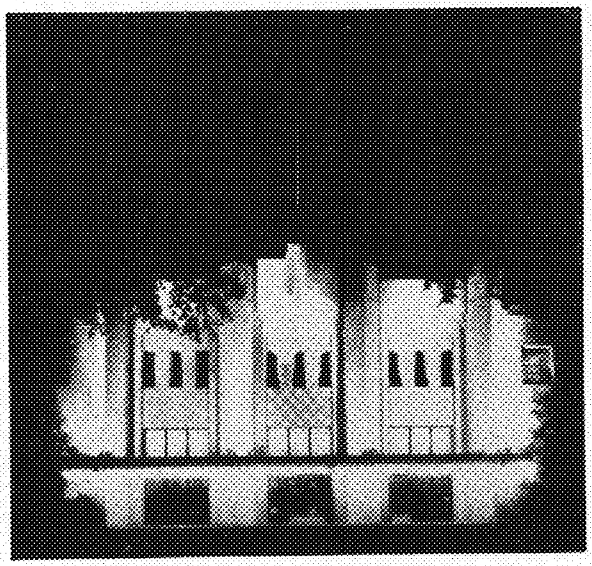
To summarize the situation it appears that the many practical uses to which the generator may be adapted place it among the necessities of the modern fishing vessel's equipment. Its wide spread use is moreover increased greatly because of the relatively simple operation of installing such a unit.



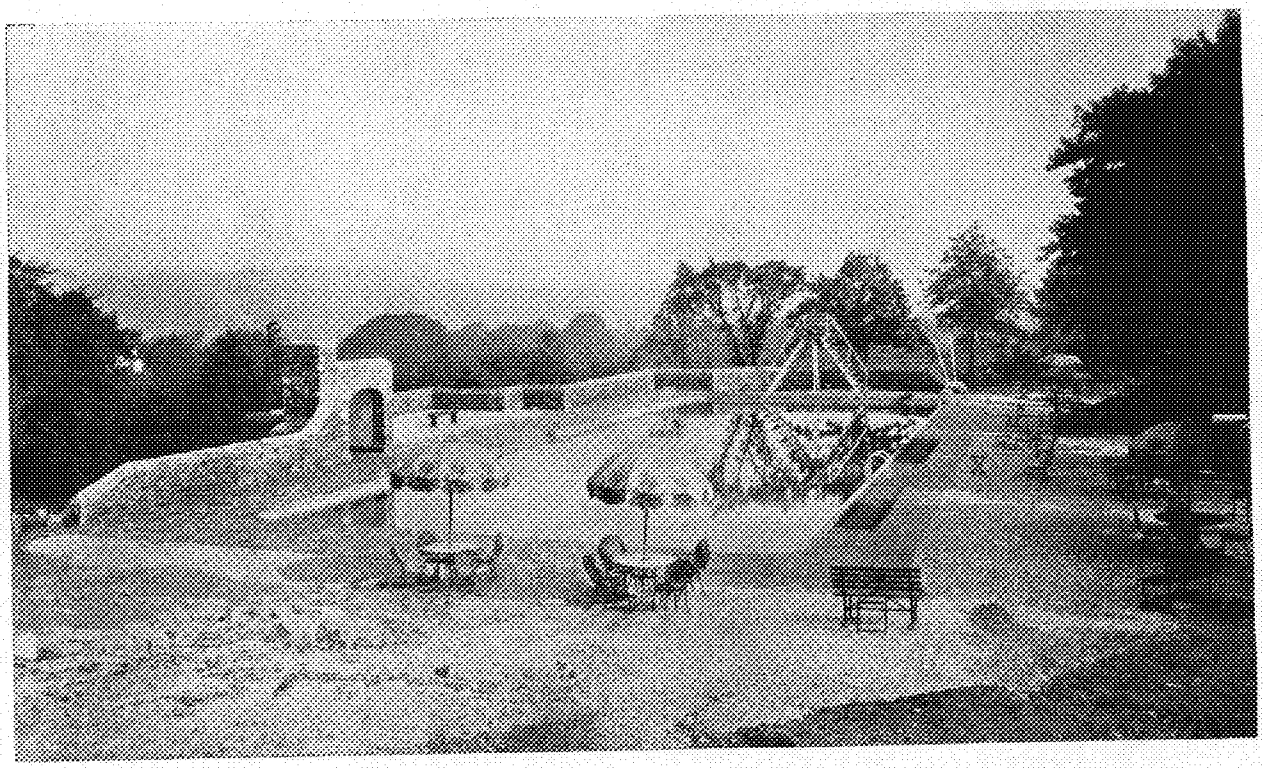
GENERATOR ATTACHED TO MAIN ENGINE OF SHIP

LEFT — *This fountain at Playland Park, Rye, New York, flooded with mobile colors by twenty-four projectors installed under water, offers a striking contrast to the baroque style utilized in amusement parks a few years ago.*

RIGHT—*Modern floodlighting adds simplicity to the beauty of today's architecture. The illumination is secured by using only eight 400 watt lamps placed in suitable projectors.*

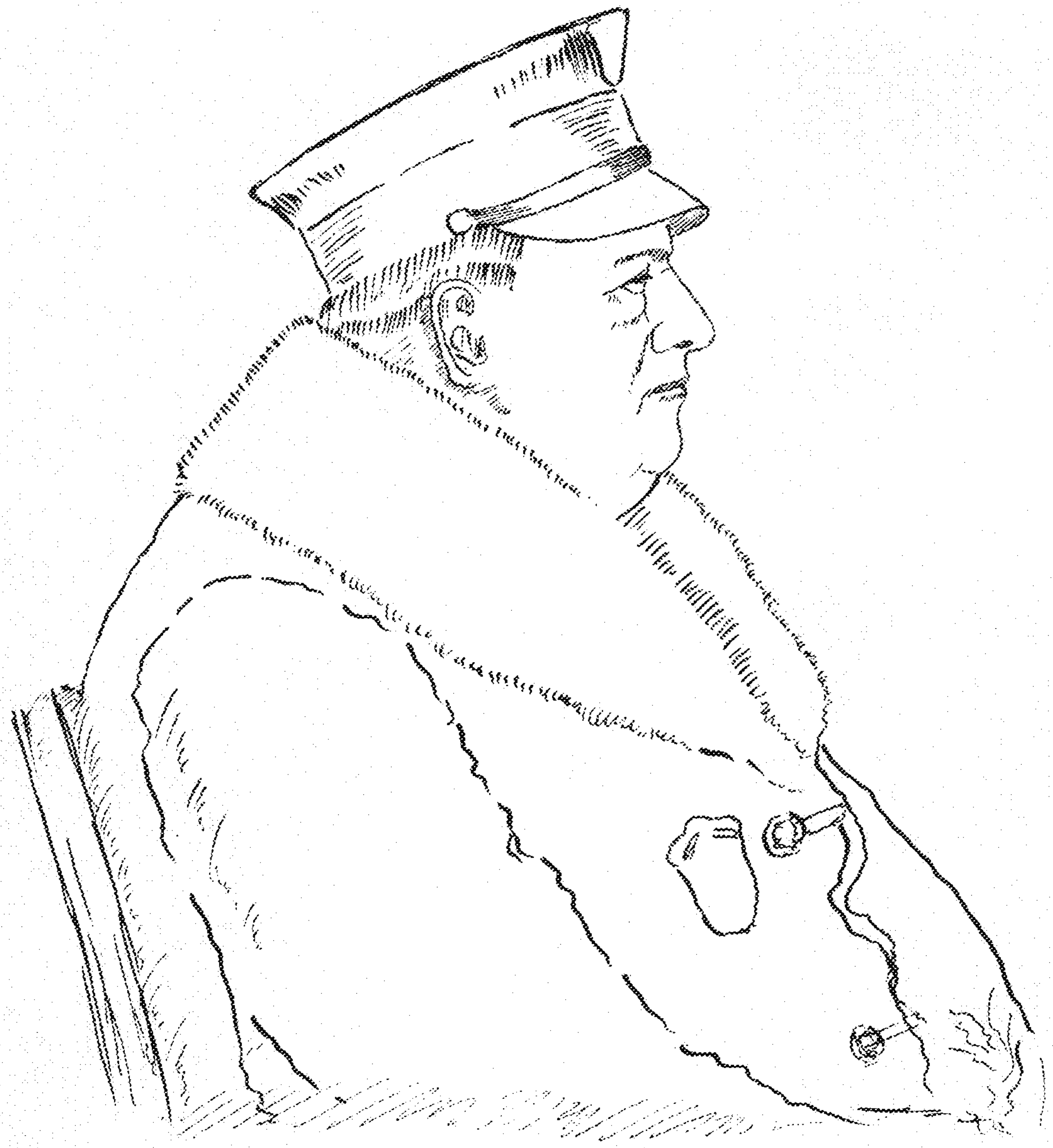


BELOW—*The placid waters of this swimming pool give no indication of the fact that inset in the walls, not far from the surface are twenty-five underwater floodlights. They are equipped with rectilinear-spread lenses and 250-wat lamps, so that by night the whole pool grows luminous in the darkness of its surroundings.*



ILLUSTRATIONS BY COURTESY OF WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY

The Campus Cop



HERMAN GLANDER

From a pen and ink sketch by Associate Professor Hugh B. Wilcox

STOUT of heart and body, Herman Glander, far-famed campus cop, will make it his special charge on Engineers' Day to protect parading devotees of St. Pat from any and all attempts of Miners, Foresters, et al, to disrupt the order of the gala affair.

Long exposed to the vagaries of Minnesota tradition, Special Officer Glander has been enabled to study the undergraduate and couple his supervisory duties with a warmth of personality and friendliness that have endeared him to the hearts of all Minnesotans.

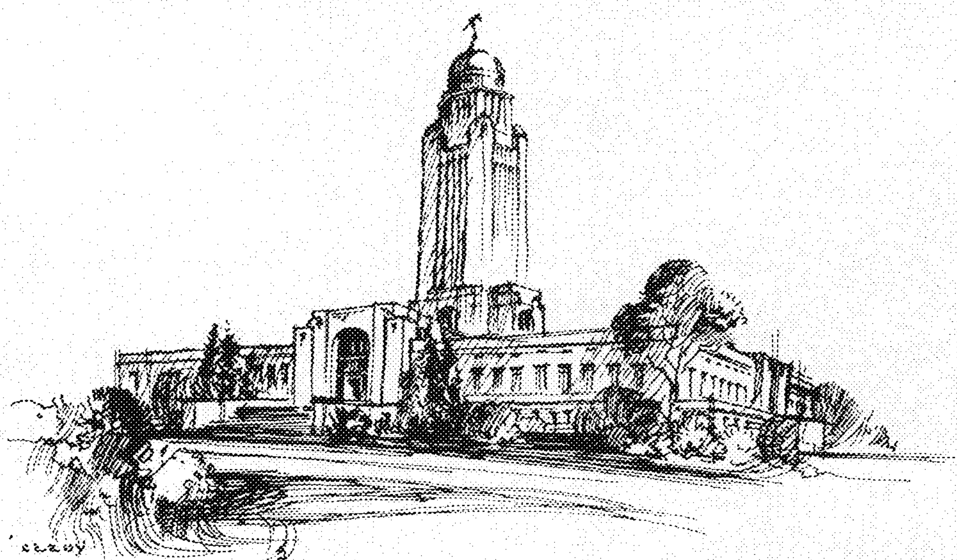
LONG MAY HE REIGN!

Famous American Architects

BERTRAM GROSVENOR GOODHUE

By ROBERT CERNY, Arch '32

Illustrated by the Author



THE NEBRASKA STATE CAPITOL . . . PLAIN . . . RUGGED . . . FREE FROM TRADITION . . . EXPRESSING THE SPIRIT OF THE PLAINSMEN

THE gift of genius is given to few, for most of mankind attain skill by gradual cumulative effort and seldom reach the perfection which raises them above their fellow men.

Genius came to Goodhue as an inheritance. He was rich in interest and understanding of the arts, and gifted with an insatiable desire to develop this understanding. His ability in architecture became evident at an early age, and was recognized by his parents, who encouraged him.

Goodhue started his career in architecture as an office boy when he was but fifteen years of age. He received no technical training, and his class room training consisted of but a few years in a grammar school in New Haven. He gathered his training by experience and study, developing rapidly and forming very definite opinions about the various architectural styles of the past and the variations in vogue at the time. His personality developed with his study which influenced it at times, but he always remained individual.

The Classic style held little of interest for him, as he believed it had no place in the architecture of the modern world. But Gothic fascinated Goodhue. The freedom and intimacy of the style played upon his fancy, giving him a chance to mold it as he wished. He saw in Gothic a relation between the organic piers and buttresses, and the steel forms with which he worked. He narrowed the piers and simplified them until they expressed the steel which they covered. The buttresses were made just large enough to take the thrust put upon them by the steel work. Arches and vaults frankly admitted the steel which supported them. Mouldings were cut down and detail treated as a decorative adjunct to the structural members. The chapel at the University of Chicago exemplifies his expression of Gothic at its best.

Goodhue had been regarded as a Gothicist although his interpretation of this style was regarded by many contemporary architects as a crude misunderstanding of the principles of the style. He did not misunderstand the Gothic style, but rather understood the motive and feeling of the Medieval builder which he transplanted to a modern age with any revision he felt necessary. As Goodhue approached the other styles he did not use the usual route of classic architecture but rather studied the works of classic derivation, particularly as exemplified in Spain. This branch of classic development was not hampered by rules or cramped by precedent. It offered a wealth of inspiration in its variety of color, forms, and detail. This Spanish influence coupled with the traditions of Southern California and Mexico formed the basis for Goodhue's masterpiece at San Diego.

Mr. C. G. Walker in his article on the work of Goodhue states that it is no idle compliment to say that the exposition building at San Diego is a masterpiece that is finer than anything in Spain. Here Goodhue's imaginative conception and mastery of mass and detail are most apparent. The building is harmonious throughout with its contrast of mass and detail, no portion is neglected or monotonous. Because of this marked contrast between mass and detail Goodhue conceived a new style of noble masses and large forms. He became rebellious against detail and worked towards its elimination.

At this time Goodhue was invited to enter the competition for the Nebraska State Capitol. He entered the competition with little hope of winning but a determination to plan a capitol for the people of Nebraska and apply his new theories of architecture to it.

People of the North were different from those of the South or West; their architecture must be different. With this conviction, he swept aside "State Capitol Architecture" as it may well be called, with its accompanying dome and columns.

Nebraska suggested agriculture and the simplicity of life typical of the plainsmen. The delicacy and sophistication of an Ionic column could have no place here. Understanding and imagination fused and from the flat plains of Nebraska rose a building simple of mass and commanding in its majesty. The plainsmen understood. This building, like themselves, was a pioneer, plain, eager, free from tradition.

Goodhue had developed a new style—true it did recall the serenity of the classic, and leaned towards the Asiatic, but the spirit of the building was new. Goodhue stated that he felt architectural expression reached its height in finely proportioned solids and surfaces devoid of all detail except that of sculpture.

His untimely death brought a fruitful career to a sudden end. That he would have gone farther there is no doubt, but the work he has left us will rank him with those creators who have shaped the architecture of the world.

HARLOW C. RICHARDSON WILL ACT AS TOASTMASTER FOR FIRST ANNUAL TECH BANQUET

INTRODUCING the student and faculty speakers, Harlow C. Richardson, head of the Engineering English department, will act as toastmaster for the first TECH Banquet to be held May 28 in the Minnesota Union.

The TECHNO-LOG staff and Alpha Tau Sigma, honorary engineering journalistic fraternity, are sponsors of the Technical Student-Faculty banquet.

O. M. Leland, Dean of the College of Engineering and Architecture, will start the program of constructive criticism of engineering problems pertaining both to practice and education. An equal number of faculty and student representatives will continue the discussion with short talks.

The TECH banquet will be a meeting open only to the Juniors, Seniors and faculty members of the College of Engineering and Architecture and the School of Chemistry. Invitations, which will be returned to the TECHNO-LOG office, 37 Electrical Engineering building, will be mailed to all Juniors and Seniors, and the faculty. Return of the invitation will signify acceptance.

It is believed by the sponsors that the TECH Banquet will become an annual affair. The Banquet is given with the fundamental objective of promoting a closer relationship between the faculty and student body by a mutual discussion of engineering problems. Such a program, with criticism from both the faculty and student body should result in a better insight into the problems discussed. The general tenor of the evening will be serious and constructive, and all of the problems that come under discussion will be pertinent either to the study or the practice of engineering. The formality of the class room in a large institution of learning has brought much criticism upon the larger type of university, and it is believed that an informal meeting of the proposed type will foster a better understanding between the faculty and the student body, and that both groups will be benefitted by obtaining a better insight into the problems which confront each other.

Professor Harlow C. Richardson
Toastmaster for the Tech Banquet

As yet no definite subjects have been selected, but many have been proposed both by the student body and by the faculty. Among those which are of especial interest are: whether the engineer should be required to take more English and public speaking; whether the standards of the College should be made more high; whether a pre-engineering course of one or two years is advisable; the fate of this year's graduate; athletics for all; etc. On the foregoing and other topics, the discussion will be based, each speaker being given a definite amount of time to talk on a given subject.

Student representatives have been chosen from the various departments of the engineering school. They are: E. A. Cone, architecture; Paul Salo, chemistry; Cedric Cowan, civil; Rodney Wood and Maurice Norton, mechanical, and Robert Lommen and Roy Wiprud, electrical.

The committees arranging for the banquet are Milton Bergstedt, invitations; Howard Lowe and Winfield Foster, entertainment and favors; J. P. Shirley, speakers; Steve Gadler, program, and George Taft, publicity.

EARL FELT, ***His Majesty St. Pat***

Here's Ho

By EARL J.

TO set aside all conflicting rumors and reports as to how I happened to be called the first engineer, I have this day set about to write the story, so that it may go down in the annals of history as the true record. In the good old days when the Irish were as great sailors as fighters, they made frequent trips to Scotland not only to subdue that race but to check up on the morals of the far famed Scotch lassies. Under the tutelage of the wiley Scots the Irish were soon initiated into the pleasures of the game of golf and were soon able to defeat the Scots in short order at their own game. Not to be outdone, the Scots inquired into the drinking habits of the Irish and were informed that their liquid diet consisted principally of water with milk running a close second. Upon hearing this, the crafty Scots evolved a plan to rid the land of the Irish without bloodshed.

Angus Ben Adam, the chief of the Scotch clans, immediately put the plan into action by inviting the invaders to a feast at his castle. The Irish attended in a body, and during the course of the meal consumed vast quantities of food, washing it down with fiery liquid which the Scots called "whisky." The brains of the temperate Irish were soon inflamed and they fell to singing bawdy songs of which they knew many.

The climax was reached when the last son of Erin dropped under the table and turned up his toes. Immediately the Scots loaded the men in ships and returned them to the shores of Ireland,

where they left them in ...
cases of the amber "whisk...
When they awoke, they ...
thirst and rather than dr...
the cases of "whisky" ...
Their sorrows were drow...
drunkenness. Thus they ...
the virtues of the new fo...
The king hearing of thi...
that he might discover ...
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eration producing thous...
A wave of drunkenness ...
children killed in the cur...
Not long after this, the...
the scene. At that time I ...
carrying a hod in the ...
work there, I had been ...

BEATRICE JOHNSON, ***His Queen***

...AND Howl

...St. Pat for 1931

...ken stupor along with a few

...fering from an overwhelming
...nched sea water, broke upon
...were immediate and dynamic.
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...ction.
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...Blarney Castle. During my
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Blarney, who was gifted with such a tongue that it was necessary to use these tanks to prevent his flow of words and sweet phrases from flooding the countryside. After this very excellent piece of work, I was assured of my capabilities and decided to take care of this little matter of snakes immediately.

To make me more confident of success, I was visited one night by a strange dream in which the walls of my humble cottage became illuminated with the following fiery words: "o ro-net oofa oofah . . . clicky." After considerable investigation, I determined the meaning of these words to be "Drive the plague from Ireland."

With the vision still fresh in my mind, I awoke the next morning, and kissing the keystone of the arch above Blarney castle I immediately set out for the center of the plague. Now it was a long established belief that anyone who kissed the keystone of that famous arch was gifted with a hypnotic tongue and given the power to charm not only the birds and beasts but also the Irish. Arriving in Dublin, the first sight that greeted my astonished eyes was a drunken rum staggering down the street shouting at the top of his lungs, "Keep them off. Keep them off." With a great shout of "Hah!" I rushed to his assistance, crying "Keep what off? Keep what off?" To my utter dismay, he replied, "Keep them off, keep them off . . . THE SNAKES." Upon looking about

(Continued on page 232)

The Arabs Revue

By LADDY MARKUS, E. '34

MAY 22nd and 23rd are the two dates which must be reserved by all loyal Engineers and their lady friends, for it is on these two nights that the "Arabs," famous engineering dramatic society, will present their annual show. This year's production is called "The Arab Revue," and will be presented on the stage of the Northrop Auditorium. The curtain's rising at eight p. m. will disclose many well-known Engineers in costumes so unusual and amusing, that everyone is going to be guaranteed a good time.

This year's show has been patterned after the regular Broadway revues, such as Earl Carroll's "Vanities." The feature of the show will be the chorus, in which Engineers will dance and kick to the latest and greatest tunes of the engineering season. Locks of curly hair peeping out from silk and tinsel headdresses, and colorful dancing costumes, complete even to the size six dancing slippers, will transform these husky engineers into lively, frivolous chorus girls who can kick the ceiling at the same time, and in tune.

Of course, no Arab production would be complete if the Engineers did not get a chance to give their ideas on life in general and S. L. A. students in particular, so this year's show will include several skits. All who may have, at some time, incurred the wrath or displeasure of the Engineers may expect to find themselves "honored and praised" in this play, which will burlesque everything from collegiate life to talking movies. Professors will find themselves in the limelight many times during the play, for in some manner the Arabs have found out where these dignified personages spend their spare time. Several baseball players, patterned after our famous Minnesota ball beavers, will discuss weighty topics of baseball with that wisdom which can only be obtained by knocking a home run for dear old Minnesota.

The many productions put on by the Arabs in the past have all met with great success, but this year's production, from early indications, will be the greatest of them all. A large cast of Engineers has been rehearsing twice a week for the past four months, under the able direction of Miss Hazel Mack. From 5:30 in the afternoon until far into the evening, the chorus has kicked away in the Engineering Auditorium, and those who have parts in the play have learned the art of saying funny things with a serious face from Mr. "Snooze" Kinnard, jokester at the Gayety Theatre.

The first dress rehearsal was a high spot in the long training period. It was a great surprise to all present to see what pretty girls those Engineers make, when urged on by a little powder and rouge, and a few gayly colored silk shawls. Since only six costumes were available at the first rehearsal, and there were many more engineers claiming them, coins were flipping merrily in the air for a time. 'Twas a struggle where only the strongest survived.

Under the guiding hand of Ben McDermott, the Arabs will carry out a huge publicity program, which will include a radio broadcast of parts of the play, and an armed and mounted escort of native Arabs to guard St. Pat on Engineers Day. Vincent Malloy has been quite busy organizing his ticket staff, and promises real results in the line of ticket sales.

LADIES OF THE CHORUS—"SO BUXOM, BLITHE AND DEBONAIR"

All scenery and stage props necessary for the production will be made in the workshop of Northrop Auditorium by the Architects of the organization. Some very fantastic scenic and lighting effects are promised by Earle Cone and his fellow workers. Although the stage of Northrop is one of the largest in the Northwest, the Arabs are going to do their best to fill it with a good evening's entertainment.

It was way back in 1922 that a group of Engineers decided that they were possessed of no mean amount of dramatic ability. In direct consequence they organized a club, christening it the ARABS, and producing the first show "The Caliph of Kolynos" on the Armory stage.

The public was rather skeptical over the probable outcome of this first show, but when the final curtain fell, all agreed that it was one of the most successful presentations of the year. Furthermore another engineering tradition had been established at Minnesota,—a dramatic organization had been founded that was to become known wherever Minnesota engineers might meet the whole world over.

Since that first production, seven plays, all carrying out the ideals and traditions of the Arabs, have been presented with increasing success. "Blue God" was the hit of 1923, "Riquiqui" astounded theatre goers of 1924, "Mona Lizzie" greeted the public in 1925, "Broadcast" was a sensation in 1927, "High Pressure" produced millions of laughs in 1928, "Enginferno" brought down the house in 1929, and "The Arabs Revue," according to predictions, will eclipse all.

Many times the Arabs have experienced the thrill of playing to full houses. "Broadcast" in 1927 which was probably the most elaborate of the Arabs' shows, was a spectacle that left the campus talking throughout the remainder of the year. The spicey dialogue between St. Peter and Seven Corner Sadie as she passed him on the way to Hell and the chorus that disappeared into the air before the very eyes of the audience are features which will long be remembered.

A night of genuine entertainment which even the most strict of Deans may possibly sanction is promised to all who attend "The Arabs Revue." To watch the Engineer at work is always interesting, but to actually see him at play,—well, there are many surprises and laughs in store for that first audience which will pack the seats of Northrop Auditorium when the eight o'clock whistle blows on the night of May 22, 1931.

The Installation of an Incentive Wage Plan to Increase Production

By JOHN PEROTTI, EE. '29

THE incentive wage plan in operation at the factory of the Minneapolis-Honeywell Heat Regulator company is a modified form of the Halsey Plan and provides that one half of the time saved by the employee through his extra effort, be paid to him at his regular wage rate.

All rates are arrived at only after numerous time studies have been taken on all the operations performed by a workman. A decimal stop-watch is used in taking all time studies and the time required to complete an operation cycle is found by its use. To the operation cycle time a delay allowance time must be added to absorb lost and waste time, and to include an allowance for legitimate tool changes and fatigue. The sum of the operation cycle time and the delay allowance time is called the standard time and is used to determine the "rate" or the pieces per hour that will pay the worker a bonus.

The most difficult part of setting a good rate is the calculation of the correct allowance time to fit the job in question. Dwight V. Merrick has plotted regular allowance curves based on a great many studies in the machine industry but these curves, after a trial period, were found to be unsatisfactory as they were much too liberal in the allowance time given to the workman. The method now used divides the total delay allowance into four distinct factors with the percentage of the operation cycle allowed as follows:

	Allowance
Fatigue	0 to 5 per cent
Flexibility	0 to 5 per cent
Personal	Male 3%—Female 5%
Incentive	0 to 10 per cent

The fatigue factor is flexible and is determined by the observer while taking the time study. The flexibility factor is used only in cases where out of the ordinary circumstances arise—such as special quality due to engineering requirements, special tool care due to condition of the material used and so forth. The personal allowance factor is constant at all times and allows 16.2 minutes for personal needs in the case of a male employee and 27 minutes for female employees if the nine hour day is used. The incentive factor is used to make the earning of bonus by the operator possible. This factor compensates for the movements necessary in production which cannot be accurately measured. These movements occur throughout the production cycle and consist of normal tool grinding, and the handling of tools and materials near the bench or machine, with the inevitable false motions made by the operator because she or he is not an automaton.

Two-thirds of the standard rate or $66\frac{2}{3}$ per cent is taken as the average speed of the employee working on a day wage basis and is therefore used as the bonus starting point. Then an employee who is making the rate is working at 100 per cent and is producing one and one-half times the work of the day wage man. The employee who makes the rate saves the company one-half of the time saved, which is a 25% bonus. For each per cent that an employee works above the bonus starting point he earns three-fourths of one per cent as a bonus—cents an hour and who is working at 95% of the standard rate would earn $.50\ (95\text{-}66\frac{2}{3})\ \frac{3}{4} + .50 = .106 + .50 = .606$ cents per hour for all the hours worked at the speed.

Individual bonus is not practical if applied to a group of employees who are all working towards the completion of a finished device. This is especially true in the case of an assembly line that contains many sub-assemblies which differ in their assembly time. To take care of these situations a group bonus rate is set by taking time studies of all the sub-assemblies and a standard time for the complete device being found. Then if the group turns out a complete device in the time required by the standard time, all the members of the group will earn 25% bonus. The number of complete units turned into stock at the end of the day is checked against the number of hours required by the group to complete those units and the group earnings are figured daily. The benefits of a group bonus plan are many, especially those which result from better co-operation within the group, and the elimination of surplus personnel in the assembly line because any employee in the line who cannot be kept busy all the time towards the completion of a unit is lowering the earnings of the entire group.

A vital part in the introduction of any incentive pay plan is played by the time study man. It is essential that he inspire confidence in and win the co-operation of both management and employees, and should bear in mind that his work has far reaching effect, as it raises or lowers plant morale and effects costs. It is his aim to establish a rate of output which can be maintained over a period of years, an industrial life time, with fairness to the worker. Antagonism has been aroused against stop-watch study procedure because of incompetent observers and attempted secrecy of operation. The tactful time study man can do much to correct this attitude with fairness and frankness to the workers together with a full explanation of methods and of completed studies.

The introduction of incentive pay plans in factories and shops throughout the country has shown that the same work is now complete in 50 to 60 per cent of the time required before the adoption of the plan. The time studies and rates now used in our factory show that the time required to do the same work now is only 58% of the time previously used under the day wage plan. This should be a convincing argument to many production managers of shops and factories who have seasonal rush periods with subsequent periods of normal production.

THE MINNESOTA TECHNO-LOG
UNIVERSITY OF MINNESOTA

Adequate Curriculum?

AND again the time worn question comes to the fore. Is the present curriculum of the College of Engineering satisfactory for the production of graduates of the highest quality?

Let us analyze the requirements of an engineer. First, he must know the technical side of the field which he enters. Second, he should be well equipped to keep in contact with the industries closely related to his own. And third, he should possess the ability to earn advancement in his chosen field.

Although we realize that the first point depends a great deal upon the type of program which the student follows while in the university, we must admit that he leaves, upon being graduated, with a fairly good technical training. Now the question of whether or not he will be successful in his profession depends largely on his ability to keep in contact with men in his own and other fields.

And here, apparently, is a great defect in the present system. In order to be able to make and keep in contact with men who are not trained for the engineering profession the engineer must possess sufficient imagination to see their different points of view. The mathematics classes and laboratories are not exceedingly conducive to the development of imagination. True, a man can develop imagination in those classes, but, he may be graduated without even having come to the realization that it will be an important factor in his following life.

And how could imagination be developed in the engineer? Perhaps the easiest way would be the introduction of a pre-engineering course of one or two years. At present the medical, dental, law, and business schools require a general cultural course before entering that school. And why not in the engineering school? The present freshman is usually an exceedingly young man (or should we say, boy) just out of high school and possessed, invariably, with an exceedingly strong enthusiasm for the technical side of his chosen field. Imagine his surprise and feeling of hopelessness when he finds that engineering consists of a little technical knowledge along with the ability to meet people, make a fairly good speech, and put his thought clearly into writing. And, at present, the engineering curriculum gives no strong encouragement to the development of these requirements which could be completely acquired in a year's introductory course to the present curriculum.

In any case, the professions are requiring a greater cultural background and if engineering is to remain on a par with the other professions, it must develop methods of giving this background to every student.

However, as the average engineering student of today is not financially able to spend five or six years in college, the College of Engineering could not put such a plan into immediate effect. But it could put a great deal more emphasis on the development of those supplementary requirements either by the allowing of electives of that type in the freshman or sophomore years or by allowing the substitution of some of the minor technical courses with those of a strictly cultural nature.

Progress

WITH the recent passage of the Wagner bill, formerly known as the Prosperity Reserve bill, a movement long supported by engineers throughout the country has become a reality. And although a compromise of the original plan, it is nevertheless a constructive step in the right direction.

The new law creates a board to advise the President from time to time of the trend of employment and business activity and of the existence or approach of periods of business depression and unemployment in the United States.

With the information provided by the board, the President is requested to transmit to Congress such estimates as he believes advisable for emergency appropriations, to be expended during such a period upon authorized construction in order to prevent unemployment and its accompanying ills.

Here is indeed a step that contains all of the benefits to be derived from a "spend more" policy and none of its evils.

Think Once

IT is dangerous to read about a subject before we have thought about it ourselves. . . . When we read, another person thinks for us; we merely repeat his mental processes. . . . So it comes about that if anyone spends almost the whole day in reading . . . he gradually loses the capacity for thinking. . . . Experience of the world may be looked upon as a kind of text, to which reflection and knowledge form the commentary. Where there is a great deal of reflection and intellectual knowledge, and very little experience, the result is like those books which have on each page two lines of text and forty lines of commentary.—Arthur Schopenhauer.

In Memoriam

THE Techno-Log as well as many students and faculty members wish to extend their most sincere sympathy to Professor R. W. Siler in the recent loss of his mother.

NEWS FROM THE TECHNICAL CAMPUS

Hughes Investigates Welded Connections

Professor C. A. Hughes, of the Civil Engineering department, has recently completed a series of investigations of the strength of welded connections for structural steel members. These tests were made for the Structural Steel Welding committee of the American Bureau of Welding, as a part of a comprehensive research program undertaken in cooperation with the National Research council.

The use of welded joints in structural steel work as an alternative to riveted joints is a very recent development, but one that has progressed at a remarkable rate, and which appears certain to exercise a tremendous influence on future steel design and construction. Whether or not welding will ever completely replace riveting for all types of connections, its use in certain types of structures and structural members has proved to be of very marked economic advantage, and the relative noiselessness of the process renders it especially desirable for building construction in many locations where the noise of riveting hammers constitutes a serious nuisance.

The novelty of the welding process as applied to structural steel has made necessary a large program of experimental investigation. The pioneer work in this field was carried out by Professor Hughes, while a member of the staff of the University of Toronto, the tests being made in the School of Engineering Research of that institution under the direction of the late Professor Peter Gillespie. These tests have been used as guide tests in the recent very extensive series of investigations of the American Bureau of Welding. This latter program involved the breaking of approximately 5000 individual specimens, and some 60 technical laboratories located in all parts of the country, cooperated in the work.

The University of Minnesota laboratory was especially honored in that the Welding Committee stated in their letter, acknowledging the receipt of the report on the welding tests, that it was the finest individual report received from any of the cooperating laboratories.

All data are now in the hands of the Committee on Structural Steel Welding of the Bureau, and when analyzed and correlated, they will form the basis for a new and more authoritative set of Structural Steel Welding Specifications.

An accompanying article in this issue of the TECNO-LOG by Elmer Smith treats of the widespread use of welding in industry and gives a comprehensive survey of its use and growing importance.

ABLE CHAIRMAN SANDERSON, E E '32
DIRECTS . . . HIS KEYNOTE COOPERATION

ENGINEERS' DAY COMMITTEES

GENERAL ARRANGEMENTS COMMITTEE

Harold A. Sanderson, Chairman, Gordon E. Bodien, Secretary; William M. Watson, Treasurer; Louis J. LaBonte, Cecil C. March, David Mercil, John Mokres.

PARADE COMMITTEE

Leonard M. Katz, chairman; Adolph E. Erickson, Paul Erickson, Forton A. Christoffer, M. E. Norton.

KNIGHTING COMMITTEE

Wilfred D Darling, chairman; Robert F. Kreis, Randall Thompson, Edgar Lauring, Henry A. Stadthert.

BRAWL COMMITTEE

Clifford H. Koplen, chairman; Orion A. Davids, George R. Anderson, John J. Huey, William C. Hill.

OPEN HOUSE COMMITTEE

Nelson E. Anderson, chairman; Alton Pierce, Rodney R. Wood, Roger Hooper, George A. Anderson, Dean G. Ball, Paul W. Solo.

ALUMNI RECEPTION

John M. Waliger, chairman; Clare Stout, Gale C. Patterson, Rudy Dahl, Gerald F. Timmins.

DANSANT COMMITTEE

James L. O'Marr, chairman; Andrew N. Justus, Frank J. Pesek, Ralph E. Peck, Joseph A. Gates.

GREEN TEA COMMITTEE

May E. Ohrbeck, chairman; C. Cheffe Marx, Helen McElroom, Bernice E. Engstrom, Theresa M. Wells.

TICKET SALES COMMITTEE

Ray A. Nelson, chairman; Olaf Lein, Jr., John Tofte, Kenneth F. Haagenson, Dean E. Anderson.

BUTTON SALES COMMITTEE

Thurston M. Williamson, chairman; J. C. Walta, Milton Schmidt, David B. Anderson, Marshall F. Ruley.

PUBLICITY COMMITTEE

Hugh F. Meindl, chairman; Fred H. Brockman, Cyril F. Prideaux, Walter W. Santelman, Marshall Ervin.

BROADCASTING COMMITTEE

Parker Lowell, chairman; Clelo Brunetti, Donald W. Schrepel, Walter A. Specht, Arthur Meiloh.

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Many Changes Made in Chemistry Curriculum

After a year of study and following suggestions made by a Committee of the American Institute of Chemical Engineers as well as findings published by the Society for the Promotion of Engineering Education, a revised curriculum of Chemical Engineering has been introduced during the current year.

The first two years of this curriculum are practically the same as was the old curriculum except that a new course of one credit on Chemical Engineering Materials is to be given to the sophomores in the third quarter. This course is intended to bring to the students' attention the importance of chemistry to the engineering materials of construction. Instead of the two-year course in German of which four quarters were devoted to General German and two to Chemical German, the whole work is now given as a one-year course during the sophomore year. In this course the students immediately learn a chemical vocabulary with the grammar that is necessary to teach them how to read scientific German.

Several courses have been rearranged as to the quarters in which they are given. Unit Process Problems, which was a two-credit course for three-quarters has been changed to a three-credit course for three-quarters.

The continued demand for some work in economics is responsible for the addition of a course in Chemical Engineering Economics in the second quarter of the senior year. Another addition to the curriculum is a course in Chemical Engineering Design which is given the third quarter of the senior year.

While the chemical engineering training at Minnesota has had an enviable reputation throughout the country for many years, these recent additions to the curriculum are introducing features in advance of those at other institutions in this field.

The faculty of the Chemistry division has made a systematic study of the four-year professional course in chemistry, resulting in a number of changes which will go into effect next year, 1931-32. The purpose was to provide for certain advanced courses in the upper two years which would better prepare students for graduate work in chemistry and also to meet the changing needs of industry. Flexibility is retained by means of a considerable amount of elective time. Also, a new arrangement has been made by which chemistry students may prepare for specialization or graduate work in certain related fields of science.

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AROUND THE WORLD WITH OUR ALUMNI

Chemical Engineering

'10—Gutsche—Frank C. Gutsche is now chief of the analytical laboratories, Western Electric company, Chicago, Ill. He reports that he likes his position very well. His place of hibernation is 611 N. Waiola Ave., La Grange, Illinois.

'17—Luft—Oscar Wilhelm v. d. who was formerly with the technical department of the National Aniline and Chemical company, is now with the Selden company as chemist-in-charge. He makes his home at 418 Serpentine Drive, Mt. Lebanon, Pittsburgh, Pennsylvania.

'20—Anderson—M. M. Anderson is associated with the Personnel department of the Aluminum company of America. He states that he sees A. C. Willard, John Morrison, and D. J. Bleifuss quite often. His address is 285 Lebanon Ave., Mt. Lebanon, Pittsburgh, Pennsylvania.

'21—Swart—Richard H. Swart is married and the family circle now numbers three. He is at present director of Physical Laboratory Research department, Kelvinator corporation, Detroit, Michigan. His home is at 17574 Patton, Detroit, Mich.

'23—Hatch—Lloyd A. Hatch is now living at 1352 Raymond Ave., Minneapolis. He is manager of the mineral division of the Minnesota Mining and Manufacturing company.

'26—Jordan—Wallace E. Jordan is now engaged in developing paint, varnish, and lacquer products for the George D. Wetherell company, incorporated. He formerly lived in Duluth where he was employed by the Western Paint and Varnish company. His new address is 1421 Arch street, Philadelphia, Pennsylvania.

'29—Linden—Carlyle M. Linden is now Laboratory Assist., Hercules Powder company, Kenvil, N. J. His address is the Hercules Technical Club, Kenvil, N. J.

Civil Engineering

'02—Lambert—Fred T. Lambert, 57 years old, bridge inspector in the state highway department, died recently at a hospital in Rochester from injuries suffered in a fall from a bridge under construction at Preston, Minnesota. He was buried in Young America, Minnesota, his former home.

Mr. Lambert, a civil engineer, became associated with the State Highway department six years ago, after serving in the land valuation department of the Northern Pacific Railroad. During the war he served overseas as captain in the coast artillery.

On his graduation from the University, he superintended bridge construction for the Northern Pacific and Spokane and Seattle railways in the Cascade and Rocky mountains. Two years previous to the World War he retired to operate a ranch near St. Mary, Idaho. He was also a veteran of the Spanish American War.

'22—Erickson—Edwin C. Erickson writes that he has taken a temporary position with the Wisconsin State Highway, Bridge Department, Madison, Wisconsin. He is living at 1225 East Mifflin Street. "Ed" formerly worked for the Kimberly-Clark corporation.

'24—McCrady—Archie R. McCrady, our St. Pat of '24 has been advanced to the position of acting patent attorney for the Hawthorne plant of the Western Electric company. Archie received his new job through his extensive experience as a patent attorney. He worked in the government patent office as an examiner, and is author of *Patent Office Practice*, a treatise on the procedural law relating to patent applications before the U. S. Patent Office. He started at Hawthorne early in 1928 as a patent attorney, and has continued this work up to the time of his recent promotion. Archie is a member of the bar both in the District of Columbia and the State of Illinois.

All alumni, faculty and seniors in the College of Engineering and Architecture and the School of Chemistry are invited to attend the Alumni-Faculty dinner to be held May 15 at 6:15 P. M., in the Minnesota Union. Professor A. S. Cutler, '05 is chairman of the committee in charge of arrangements.

The principal speaker will be J. C. Lawrence, University Dean, who has recently returned from Washington, D. C., where he has been working on the employment situation as a member of the special committee appointed by President Hoover. He will discuss various phases of the question and its relation to engineering operations. Other speakers will be Dean O. M. Leland and R. J. S. Carter, president of the Technical Alumni Association.

Reservations may be made by calling Dean Leland's Office.

'25—Bartholomew—Neal Bartholomew now lives at 2868 North 57th street, Milwaukee, Wis. He writes: "After several years of renting furnished apartments and houses we have just bought our own furniture and have rented a lower flat which is relatively 'out in the country.' At least we are only two blocks from the wide open spaces in one direction. We like it very much to be away from factories and railroads, and perhaps most important, it will be much better for our little boy. He is now eleven months old, weighs about twenty-five pounds, and is in splendid health.

"A few days ago while hurrying up Wisconsin avenue, our busiest street, I ran into O. D. Skrukrud, '25C, for the first time since 1925 and, oddly enough, recognized him. We'll get together some this summer, no doubt!

Bartholomew is still working for the C. M. St. P. & P. R. R.

'27—Murray—H. E. Murray is now working with the Management and Engineering corporation of Dubuque, Iowa. His little daughter Peggy Jean is now 18 months old.

'29—Eggen—Carl M. Eggen who has been with the United States Coast and Geodetic Survey at San Francisco since leaving Duluth, Minnesota, will now be employed at Washington, D. C. Recently the engagement of Dorothy Milne to Mr. Eggen was announced by Mr. and Mrs. W. J. Milne. Carl will spend two weeks in Minneapolis visiting his parents and Miss Milne before continuing on to Washington and his new job.

'29—Schaller—Louis M. Schaller now has offices in the Baker Bldg., Minneapolis. He is in the insurance business and says that it is very interesting work.

'30—Skidmore—John G. Skidmore is now located in the New York office of the Carrier Engineering corporation. He writes: "I am in the New York office, coming here direct from the training course which lasted from July 1 to January 1. George Meffert is now in the Chicago office, going there straight from the training course.

"There were about twenty fellows from ten different colleges and universities, most of which are in the East and South. The course was divided into two parts, the entire group taking the first part and a selected group intended primarily for sales engineering taking the remainder. There were men in the course from such well known schools as Cornell, Georgia Tech and Purdue. 'Meff' and I did not have to take a back seat for any of them, which speaks pretty well for Minnesota when you consider that we were both working under what might be called a handicap in that we were Civils while the rest of the fellows had all been trained as mechanical engineers."

John states he would be interested in receiving a little news from the class of '30.

Electrical Engineering

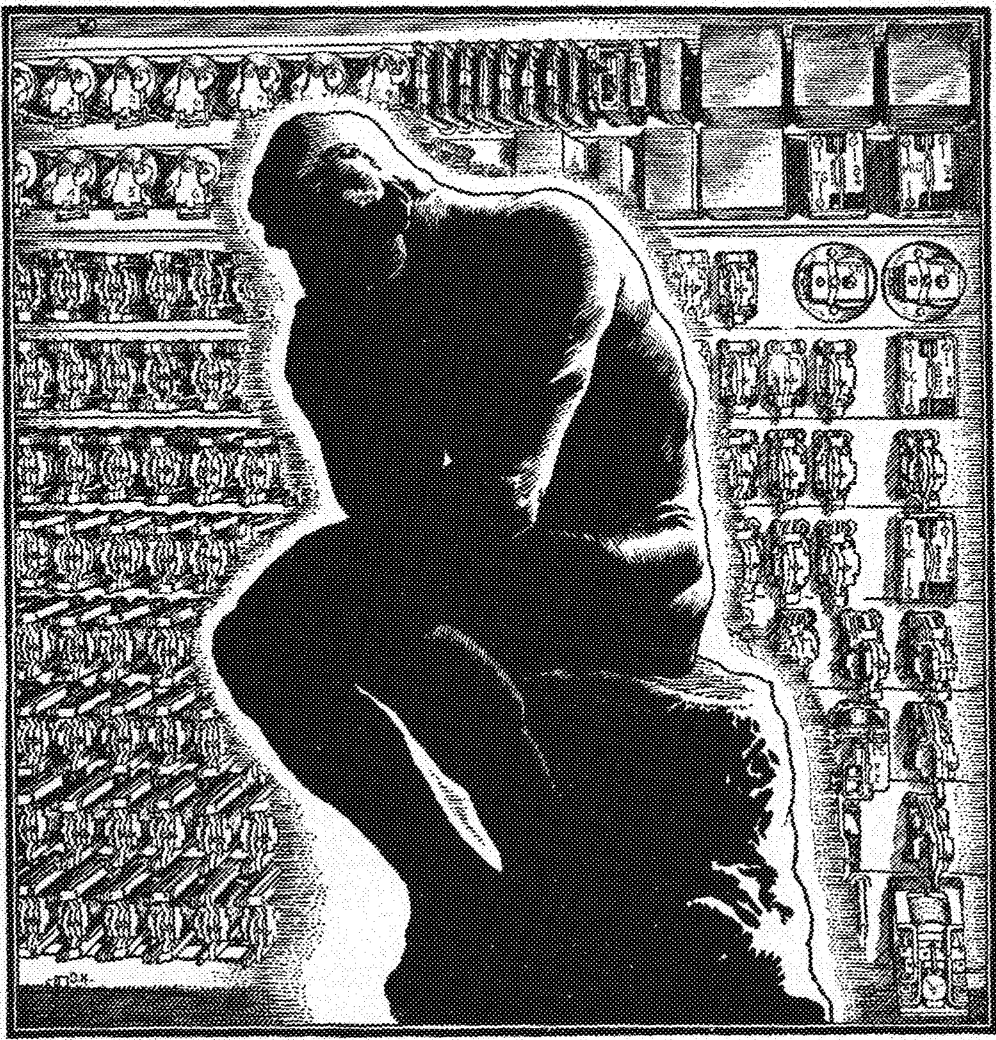
'16—Bleecker—George W. Bleecker is still working for the Electrical Machinery Manufacturing company, but his new home is at 4944 Russell Ave. So., Minneapolis.

'25—Holmes—Roland Holmes is now located at 60 West Girard Blvd., Kenmore, New York. He formerly made his residence at Wilmerding, Pennsylvania.

'25—Winkenwerder—E. C. Winkenwerder is now manager of the Chicago office of the Acme Wire company. His office is located at 840 North Michigan Ave., Chicago, Ill. Winkenwerder is now married—possibly that is the reason for his success.

'27—Volkenant—Gordon Volkenant is now stopping at the Hotel Savoy in London. He states that he has been leading a "life of travel." He has been doing experimental radio research for the Sparks-Withington company of Jackson, Michi-

(Continued on page 226)



The Aircraft Diesel Engine

(*Continued from page 203*)

ever, uses two valves per cylinder. Since the intake gas is pure air and is withdrawn from the surrounding atmosphere, there is no reason why the same valve may not be used for the incoming air as the outgoing gases, but the single valve does not allow an exhaust manifold and muffler nor the use of a supercharger. It is said that a supercharger is not so vital for the Diesel engine at high altitudes. These engines are operated normally with excess air so that there should still be sufficient oxygen to combine with the normal amount of fuel at higher altitudes where the air is lighter. The ignition depends upon the temperature of the air after compression and that in turn is a function of the volume change during compression and the inlet air temperature, and is not affected by the initial air density. Thus, the Diesel engine may be expected to function quite satisfactorily at high altitudes without supercharging the inlet air.

Perhaps the greatest difficulty encountered in developing a high speed Diesel is the injection of the fuel in the proper amounts and at the proper time. About six drops of light fuel oil are required for a single full load cylinder charge in an engine having the displacement of the Packard Diesel. At half load, this should be cut to three drops. Therefore, a fuel pump is required which will meter from one to six drops of fuel oil accurately under a pressure of several thousand pounds per square inch. This small quantity of fuel must be so injected into the clearance space in the engine cylinder that it is uniformly distributed throughout. It must be subdivided in droplets small enough so that combustion is not delayed. The smaller the droplets the less will be the penetration. Larger droplets produce greater lag in combustion. The designer must select a pressure and injection nozzle bore such that penetration is obtained and the fuel subdivided so that combustion will be completed in the vailable time. With an engine running at 2,000 r. p. m., the time of injection and combustion will be about .001 seconds. Rapid motion of the air in the combustion chamber is a material aid to the distribution of the fuel charge. The shape of the inlet ports and of the combustion chamber itself is designed to create turbulence in the air stream. The combustion chamber in the Packard engine is formed mainly in the piston head, and shaped to produce turbulence and to obtain uniform penetration of the fuel spray. A fuel pump is provided for each cylinder, with a plunger operated from a rocker arm which contracts with a set of cams similar to those operating the push rods for the valves. These may be seen in Fig. 3. It will be noted that the push rod which transmits the motion from the rocker arm to the pump plunger may be moved in a slot in the rocker arm so that the length of the pump plunger stroke can be varied at will. All of the push rods may be moved in or out from the center of their respective rocker arms by the throttle. For this purpose, the push rods are connected to an annular ring actuated by the hand throttle. As these push rods are moved toward the center of the rocker arms, the length of the pump stroke is shortened and hence the amount of fuel injected is reduced. A great deal of research work with respect to the action of injection nozzles has been done at Langley Field, and additional work is now being carried out at Pennsylvania State College, looking forward to improvements which will allow more general development of high speed Diesel engines.

Aircraft engines are loaded with a propeller; hence, are never obliged to carry full load at low r. p. m. The characteristics of engines designed for this class of work are quite different than are required for use in trucks, tractors, or motor cars. This explains in part why the Diesel engine has been developed for aircraft work, but is not yet developed for motor car work.

High speed Diesels may properly be called compression ignition engines rather than Diesel engines. The true Diesel cycle introduces the fuel just rapidly enough so that the compression pressure is maintained by the burning of the fuel during the first part of the working stroke, and the cylinder pressure does not rise above the compression pressure at any point in the cycle. The working stroke of the true Diesel engine is similar to that of a steam engine where the boiler pressure steam is introduced back of the piston and is cut off after the piston has traveled a short part of its stroke, the balance of the work being done by the expansion of the steam. So far, it has not been possible to accomplish this result with the high speed Diesel engine. In order to complete the burning process in the short time available, it is necessary to inject the fuel before dead center, and consequently, a portion of it is burned while the piston is at dead center and the explosion pressure rises above the compression pressure; in fact, it rises to a little more than twice the compression pressure in the Packard engine. The combustion is completed as the piston moves down its stroke. The actual gas cycle is a combination of the Otto or ordinary gasoline engine cycle and the Diesel engine cycle. It corresponds to what has been known as the semi-Diesel cycle, but most semi-Diesel engines use a low compression ratio and depend for the ignition of the fuel on a hot bulb, hot plate, or hot tube, and only partially on the compression temperature. The actual efficiency of the semi-Diesel cycle is greater than that of the full Diesel cycle when the same compression ratio is used. The Packard Diesel has demonstrated that the high pressures resulting from this type of cycle are practical when using a compression ratio high enough to produce ignition without the assistance of hot surfaces.

The engine is started with the ordinary inertia starter. For cold weather starting, electric glow plugs may be used to add to the compression temperature until the cylinder walls are heated.

It is reasonable to suppose that the same progress will be made in the development of high speed Diesels as has been made in the gasoline engines. The Diesel is now offering very keen competition to the gasoline engines, moreover it has possibilities that cannot yet be evaluated. One may not be far wrong if he prophesies that another ten years will find it almost the sole survivor in the aircraft field.

Conservation of Our Oil Reserves

(*Continued from page 201*)

What Lawyers Must Face

Since 1875—due to modern engineering — we have made more physical changes in our living environment than all changes in all preceding historic time combined. Petroleum development helped this acceleration which has changed us from a nation of individuals and individual rights to a nation of interdependent groups with clearly defined duties towards each other. In this 55 year period the lawyers have failed to create either a sound property right relation for underground oil or gas, or a surface working plan based on justice to individuals and protection of the public interest. In brief, the legal thinking has simply not kept pace with the facts. The legal ideas that have been evolved follow false analogies instead of known facts and set up legal fictions that reflect the heat of militant litigation rather than the light of calm judicial reasoning and social justice.

We have not appreciated that a precedent hunting mind can never be a forward looking mind. While precedent following makes for stability, it does not have anything that is creative and when the facts move on it makes for stagnation.

Today we need law-minded leaders to solve the problems arising from our machine civilization. We need to create a sound property right relation of underground oil or gas and a surface working plan based on justice to individuals and protection of the public interest. Then if the lawyers will not lead, they may be driven by law-minded laymen.

The Alaska Railroad

(*Continued from page 208*)

of the river below, is a solid mass of glacial ice of indefinite origin which is gradually melting on the face and thus requires that the track be moved back away from the river into the side of the mountain. Eventually this chasm, left by the melting of the glacier, will have to be bridged.

Rock slides in this district are of common occurrence in the rainy season and a ditcher is kept in the vicinity to clean the tracks with as little delay as possible. Rock slides also occur at other points where, sometimes due to rains or other natural causes, large quantities of rock fall down and block the tracks for several hundred feet, but a ditcher is soon dispatched to the scene of the slide and put to work clearing away the debris.

Snow slides are of common occurrence in the mountain districts where there is a large fall of wet snow or where the snow on the mountain side melts due to rains or melting temperatures and slides down the mountain gathering up trees and rocks in its path.

The physical difficulties encountered in the operation of The Alaska Railroad are a combination of those found on various railroads in the states and in addition, a number of others peculiar to Alaska. The sparsely settled territory and small towns to serve means low revenue even with higher rates than charged in other places. It remains to be seen just when The Alaska Railroad is to become self-supporting if looked at simply from the standpoint of earnings.

Welding Instruction for Undergraduate Engineers

(*Continued from page 205*)

monplace. Buildings like the Carbide & Carbon building in Chicago, forty-two stories in height, and the Chrysler building in New York City, far higher, have been constructed with welded pipe.

Likewise, in all industries the use of welding for joining metal parts has been developed to an enormous extent. Welding practice has been studied and standardized by industrially trained welding engineers the country over.

The problem seems now, and a mighty important problem it is for the engineering profession, particularly those new engineers who are graduating from universities and colleges, to keep up with and understand the continually increasing use of welding. The engineer, now practicing his profession, must step along with it and the educational institution which does not teach the engineering side of this great process can hardly be considered abreast of modern developments

Around the World With Our Alumni

(Continued from page 220)

gan, and has spent some time in the United States, Cuba, Mexico, Canada, Italy, Germany, Switzerland, Holland, England, Belgium, and France.

He writes, "I have kept my eyes and ears open for news of any of my 'side-partners-in-crime,' but only run into them once in a great while. I hope that the TECHNO-LOG or your prominent weekly will see fit to publish a modern directory this season of the whereabouts of 'Ye Minnesotans.' It would help a lot in the elimination of many lonely evenings in what to me are strange cities. I am planning to sail back to the States before long . . . two cents will carry news to me in any part of the world if addressed to the Sparks-Withington company, Jackson, Michigan."

'27—Lee—Albert C. Lee recently visited the E. E. laboratory. He is with the Electrical Machinery and Manufacturing company. Albert's home address is 1736 Wesley Ave., St. Paul, Minn.

'29—Edey—F. D. Edey is now with the Wagner Electric corporation at 1225 La Salle Avenue, Minneapolis, and is living in St. Louis Park.

'29—Stark—Johnny Stark is installing a new 50,000 watt transmitter for the National Battery Station KSTP. He was formerly with the Westinghouse Manufacturing Company.

'29—Specht—James E. Specht was married last June to Myrtle Puhl of Minneapolis. "Jim" is working in the designing department of the Westinghouse Electric and Manufacturing company, and living at 446 South Trenton Avenue, Wilkinsburg, Pennsylvania.

'29—Gray—Wesley Gray is now on the United States cruiser Milwaukee. He writes, "We have been down here in the tropics for about a month now. Most of our time at sea is spent maneuvering in the area just southwest of Balboa. Prior to coming this far south we put in several weeks in and around Guantanamo, Cuba, and Gouaives, Haiti. We went into port every week-end, usually Panama City, and stayed from Friday until Monday.

"The fleet war problem took place about two weeks ago. This problem turned out to be rather exciting as we steamed nearly full power, about thirty-one knots all week. During the maneuvers this ship crossed the equator, so that there was quite a celebration aboard. I am now a full-fledged 'Shellback,' being initiated in a manner considerably more snappy than any fraternity initiation that I have ever seen. We are also doing some interesting flying, mostly scouting and navigational flights. During the 'big war' I crossed the equator about twelve times by plane.

"I hope to visit the University about June 1, to renew old acquaintances."

'29—Ginnaty—J. Robert Ginnaty, former editor of the TECHNO-LOG, writes: "At the present I am working in the advertising department of Westinghouse located in East Pittsburgh. I'm living in Wilkinsburg at 577 Campbell with S. F. Johnson, '28EE, and A. O. Anderson, '29EE, all of whom are employed by Westinghouse. The apartment we keep is a touch of the old Minnesota and of course, all Minnesotans are welcomed joyously. So far I have escaped the dart of cupid and with the depression as is, I perhaps will hibernate and remain in that condition for some time. Good luck!"

'30—Comstock—Roy H. Comstock says that another Minnesota man now makes his home in Milwaukee—Earnest Kron of the class of '30 is now working in the research department of the A. O. Smith corporation. He is working in the new glass research building, but spends the weekends in Minneapolis.

Roy writes, "Karl and I have finished the student course at Cutler-Hammer and are now working in the experimental department. Karl spends most of his time working on our line of control for electric refrigeration. Larry Larson of the class of '29 is also with us in the experimental department, but rumor has it that he will be transferred to the Sales department as soon as there is an opening there. The other '29 man, John Borden, is already in the Sales department. John and Larry are still living together in a house with several other men who have been out of school for about the same length of time. Glendon Brown of '28 is in the Physica Research department where he spends mos

(Continued on page 230)

« « MENTAL TILTS » »

THIS completes the series of MENTAL TILTS for the year 1930-1931. Considerable interest has been evidenced by members of the student body and faculty of the Technical Schools, and everyone is urged to cooperate with the editors of the TECHNO-LOG in an effort to make the Mental Tilts column more interesting and more stimulating during the school year of 1931-1932.

ANSWERS TO LAST MONTH'S TILTS

SQUARES: 0 and 1, 3 and 4, 20 and 21, and 119 and 120. Five larger sets may also be found.

AND SQUARES: The figures should read from left to right: top row, 3, 4, 5, 1, 2; second row, 2, 3, 4, 5, 1; middle row, 1, 2, 3, 4, 5; fourth row, 5, 1, 2, 3, 4; bottom row, 4, 5, 1, 2, 3.

News from the Technical Campus

Many Changes Made in Chemistry Curriculum

(Continued from page 219)

The following courses have been added as requirements for all chemists: Industrial Inorganic and Organic Chemistry, Electro-metric Titrations, Application of Indicators, Special Analytical Apparatus, Aromatic Compounds, and Radio Chemistry. The undergraduate thesis and the courses in advanced analytical chemistry and food analysis become elective instead of required. The requirements for graduation remain as heretofore, 210 quarter-credits, that is an average of 17½ per quarter. Of these, 38 are elective.

To meet the needs of students who may later wish to do graduate work in certain related fields of science, provision has been made whereby the chemistry student may in his junior and senior years elect a minor sequence in geology, bacteriology, or biochemistry. Each one of these groups of minors occupies most of the elective time in the regular curriculum, and covers the requirements necessary for entering upon graduate work in that field. For example, the graduates from the chemistry-geology combination may enter the Graduate School with the requirements for the beginning of graduate work in geology fully satisfied. Students graduating with any one of these combinations will receive the degree of Bachelor of Chemistry, the same as students who take the regular course in chemistry. In order that the necessary prerequisite work may be obtained, the student who wishes to elect one of these minor groups must do so at the beginning of his junior year. For this purpose, elective time is provided for one regular course in the junior year.

ENGINEERS' DAY COMMITTEES

(Continued from page 219)

DECORATION COMMITTEE

Raymond A. Pemey, chairman; Edward G. Whitman, Charles V. Russel, John Appert, George B. Townsend, Judson J. Holden, Jerome W. Larson, Charles Budge.

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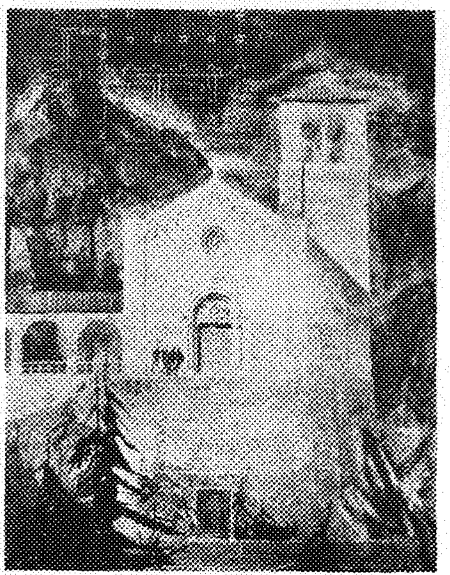

A ROCKY MOUNTAIN MONASTERY

Junior Architects Design Monastery

This Junior problem, which is somewhat similar to the Senior problem, "A Monastery in the Rocky Mountains," printed in the TECHNO-LOG last fall, treats only the chapel.

Following is the program: "A Monastic Order, devoted to giving food and shelter to the traveler, has established their monastery in an isolated region of the Rocky Mountains. The site is of rugged nature and is situated upon a small plateau about one hundred feet above a pass. They propose to erect their chapel upon the plateau and directly over a shrine, but not necessarily conencting. Their shrine, dedicated to their Patron Saint, is located in plain view from the pass. The Chapel upon completion will form the connecting link for the Cloister. The chapel will seat one hundred persons, fifty monks and lay brothers and fifty travelers."

Architects Hear Bosworth

Dean Bosworth of the College of Architecture at Cornell University, recently gave a short lecture in the Engineering Auditorium.

The theme of his talk, which was given in his first sentence was "My ideas are of no good to you." He explained this by saying that each person must have his own ideas with conviction and that these cannot come from someone else, although they may be "someone else's rehashed." "We are now throwing off tradition and other men's thoughts. We should not throw away the basic thinking of these past centuries in this modern move; but there is only one thing that is fixed and eternal — that is change."

BAILEY METERS

Brains for Boilers

A few years ago when a steam power plant underwent a heavy load demand, grimy firemen would work feverishly to keep pace with the cry for more steam. By their back breaking labor, six men could bring twelve 100 H. P. boilers from bank to full load in one hour. Coal and air were fed to the furnaces with little regard to combustion efficiency.

In modern central stations, the conditions are vastly different. The huge pulverized fuel fired boilers need practically no human aid when equipped with Bailey Automatic Control. As the load changes, the correct speed changes are made on fans, fuel feeders and pulverizers. A 3000 H. P. boiler can be brought from minimum load to full load in less than 10 minutes time when necessary. Most important, however, Bailey Meter Control constantly maintains highest combustion efficiency consistent with economical operation.

Modern boilers can think—their brains are the Bailey Meter Control System.

Write for Bulletin No. 12

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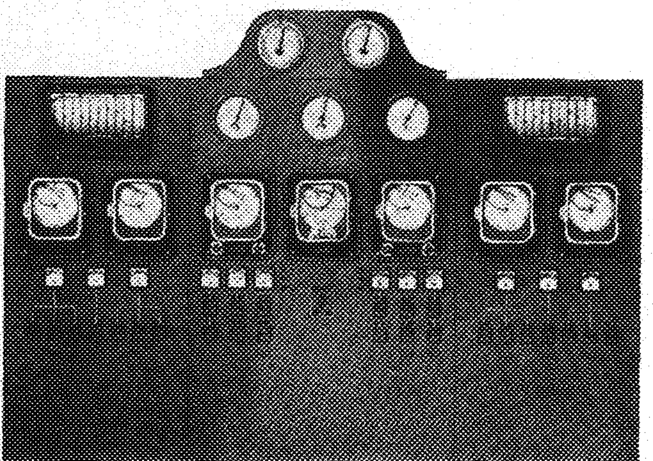
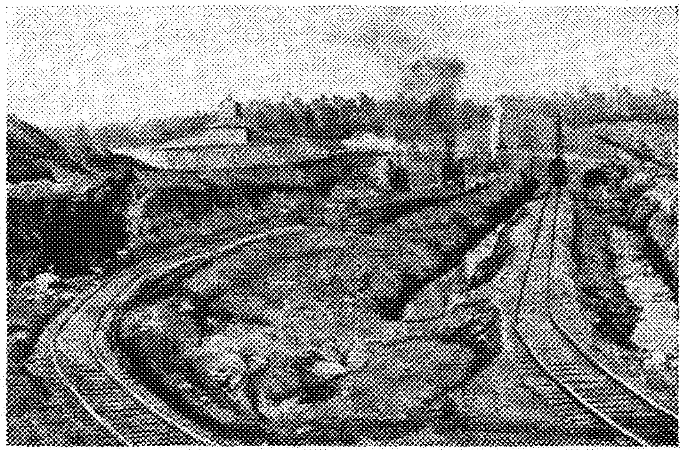


BAILEY METERS AND CONTROL ON A 1350 LB. PRESSURE BOILER

DYNAMITE CLEARS THE WAY FOR MODERN ENGINEERING WONDERS



During the early stages of the excavation for the penstocks

How du Pont Explosives helped to build the

LARGEST EARTH DAM IN THE WORLD

The gigantic barrier, built on the Saluda River near Columbia, South Carolina, is capable of backing up 750 billion gallons of water for hydro-electric power. Eleven million cubic yards of earth were poured into the dam to make this possible.

In building this great dam, the first task was to construct three miles of railroad to the site. Next came excavation for the penstocks. Thirty-three thousand yards of rock had to be removed. Here, particularly, explosives proved invaluable. Du Pont Explosives were on the job.

This is but one of hundreds of great engineering marvels that are made possible through Dynamite. The engineer of tomorrow needs to know all there is to know about dynamite . . . the tool that helps to build skyscrapers, bridges, dams, subways, tunnels, roads and railroads.

How can you know more . . . now . . . while you're still in college? Write the du Pont Company for a copy of *The Blasters' Handbook*. This book contains a wealth of information about explosives . . . information gathered in one hundred and twenty-eight years' experience in making and improving explosives. It is compact . . . handy. It is used in the class-rooms of leading technical institutions. *The Blasters' Handbook* is awaiting your request. Write for it.

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EXPLOSIVES

E. I. DU PONT DE NEMOURS & CO., INC., Explosives Dept., Wilmington, Del.

WITH OUR ALUMNI

(Continued from page 226)

of his time in working out practical applications for the vacuum tube in the control field. Just recently the department has been moved to a new building where they have plenty of room to work and are away from disturbing influences. That gives the atmosphere so much desired by a research man. Marvin Cook of the same class is with the Milwaukee sales office and is living in Shorewood."

He continues: "Last month I had the opportunity of an inspection of the A. O. Smith factory. At the time they were engaged in the manufacturing of frames for the Chevrolet car. The story of what I saw would cover several pages. The steel goes in one end of the plant and comes out the other as a Chevrolet frame complete even to the paint. During that time practically no work is performed on the frame by the human hand. The final assembly and riveting of the frames was especially interesting. The only operations which are performed by the workmen on that line are those of placing the various pieces in place on the conveyor. The rivets are put in place by compressed air and riveted by machines which approach the conveyor, perform their operation, and back away, in much the manner as a group of people dancing the square dance. Those machines take the element of human carelessness out of manufacture."

'29—Rollin—Vern G. Rollin writes: "I am still with the N. A. C. A. as is M. P. Miller, '28ME. Some time ago I completed a test on the effect of increased carburetor pressure on engine performance. I am secretary of the Hampton Roads Reserve Officers' School, a bunch of wide-awake reserve officers. We have three meetings a month and get in some horseback riding at Fort Monroe.

"I took a boat trip to Washington several months ago and saw Gordon Reed, '29ME, Smilo, '29ME, Dybvig, '29EE, and Bill Norley, 29ME. Reed and Norley are working at the Model Basin, and Smilo and Dybvig are in the Patent Office. I'd be glad to hear from any of the boys."

'28—Angell—Glenn H. Angell is now working for Hart-Parr and is living in Charles City, Iowa. He formerly lived in Austin, Minnesota.

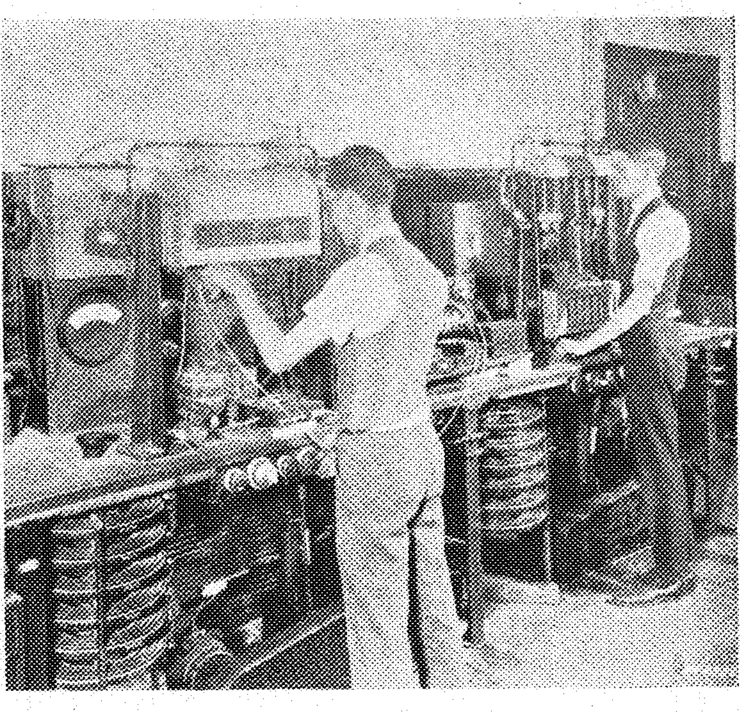
'29—Peterson—Roy C. Peterson has given up further defence. He was married in January. Roy is now inspector in the tire division of the B. F. Goodrich company and lives at 640 Sackett St. Cuyahoga Falls, Ohio.

'24—Langman—Harley R. Langman writes that he has been with the Procter and Gamble company, since graduation. He states that there are a number of other Minnesota graduates there and all like their work very well. Mr. Langman is plant superintendent at St. Bernard, Ohio. His home is at 127 Mills Ave., Wyoming, Ohio.

'29—Tanner—Elo Tanner, who until recently has been kept busy at Wilkinsberg, Pennsylvania, is now in Springfield, Massachusetts, showing the New Englanders engineering. He writes: "I am with the Westinghouse Electric and have just been transferred from the Railway Motor department to the Refrigeration department. This is my first venture into New England and so far I find it very much to my liking. The weather here is somewhat similar to that in Minnesota, and I enjoy the sight of some real clean snow. You know, snow in the Pittsburgh district is very close to black. I recently drove from Wilkinsburg to Springfield and was fortunate in encountering only a few stretches of ice. Crossing the Allegheny mountains in winter is usually a rather risky proposition, but I got through with only a few skids to disturb my peace of mind.

"In Allentown, Pennsylvania, I located Maynard Watland, '29 Mech., and spent a pleasant evening exchanging news of the '29 ME's with him. Maynard is with the Fuller-Lehigh Company and says he is enjoying his work. He has done quite a bit of traveling and says Texas is a great place. If any of you boys are interested in details, ask Maynard."

'30—Conner—Henry F. Conner has finally stopped moving. He writes: "Since graduation I have been traveling in the east for the Worthington Pump and Machinery corporation, but am now located permanently in the Chicago office. Heretofore it has been almost impossible for mail to catch up with me, but now that I am going to be in one place more than a week, I'm looking forward to hearing a lot from everyone and getting reacquainted with my classmates and friends." Why not let Henry know you're still an engineer.



Here's How—AND How!

(Continued from page 215)

and being able to see neither hide nor hair of anything that resembled even an earth worm, I was moved nearly to distraction, and so leaving the man for crazy, I continued on my walk around the city. Suddenly, a drunken mob swept by in a panic, apparently trying to ward off the attack of strangely colored serpents which I could not see.

Thoroughly aroused, I called on the headman, Mayor O'Shay, and begged him to tell me what strange malady had descended on the city. He was as nonplused as I, and replied that he had never seen any of the visitations that oppressed the others, but that they undoubtedly existed, since everyone else saw them.

I was indeed sorely perplexed as I lay down that night and tried to compose myself in slumber. During my troubled sleep, the fiery words again appeared upon the wall: "o oo oof oofa oofah . . . clicky." After considerable study, I interpreted this to mean "Drive out whisky from Ireland and the snakes will leave." My mission was now clear, and early in the morning, I called the inhabitants of Ireland together for a mass meeting. Relying upon all the versatility of my gifted tongue, I extolled the virtues of prohibition to all the sons and daughters of the auld sod.

I talked for twenty-four hours stopping only for an occasional sip of water. Two thousand men with wheel barrows were kept in a state of frenzied activity carrying away the flowing oration and the Imhoff tanks,—twenty of one million gallons capacity each, were filled to overflowing. In the end, the drops of wisdom from my words fell on fertile soil and a nearly unanimous vote was cast for prohibition, the dissenters all going to America.

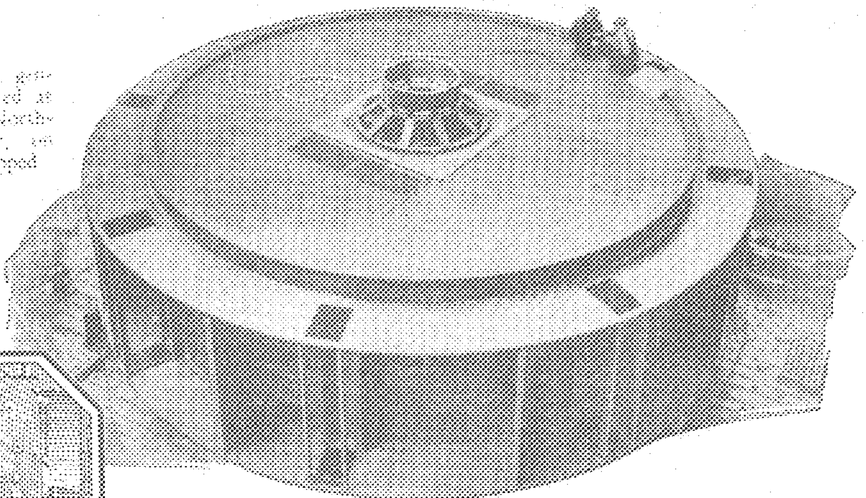
The populace aroused by my words, swept down on the distilleries and warehouses and sent them up in flames. Two days after the passing of the law there was not a drop of whisky to be had in Ireland and four days later, by actual count, the last of the snakes was seen. The people delivered of their suffering and looking to me as their deliverer gave me the title of Saint Patrick.

Upon returning to my peaceful village, I learned that the anti-prohibitionists had stolen the famed blarney stone and removed it in their emigration to America, so I hied myself to that distant land and learned that the drunkards had established themselves in a Swede village at the head of that great body of water known as the Mississippi. Arriving at that town, which I learned was called Minneapolis, I found that the stone was in the possession of a great cathedral of learning. Calling upon the president of the institution, I told my tale and explained the desire to continue my work in the cause of temperance, telling him that in return for his cooperation I would present him with the Blarney stone. After due consideration, he assured me that the only man who would be qualified to assist me in this undertaking were the engineers. And so it came to pass that during the middle of May a holiday was declared, the celebration was held and the engineers were enlisted into the cause of sobriety and enrolled in the mystic order of the Knights of St. Patrick.

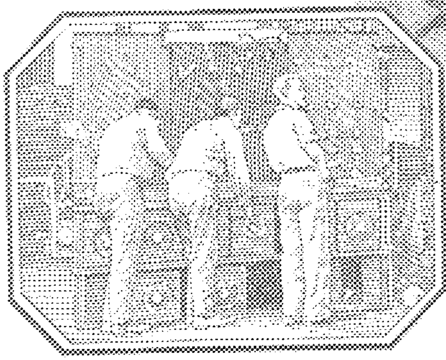
And now dear children you have heard the true story of how I drove the snakes out of Ireland and why engineers today look to me as the founder of their profession,—for it was indeed a very fine worm drive that I effected.

And now dear children, before you tuck yourselves in bed for the night, I want you to promise me never to kick a good little fairy over a fence because he might be a policeman.

Nightie night, high ho!



56,250-kv-a. hydroelectric generator now being installed at the Ariel Plant of the Northwest Electric Company, on "test" before being shipped



One Power Giant for a *Million* Lamps

WHEN the waters of the great Northwest turn the wheels of this vast machine—and at only two revolutions per second—enough energy will be furnished to light a million lamps. The huge 56,250-kv-a. hydroelectric generator is 37 feet in diameter and weighs 440 tons. After being set up, this generator was balanced, tested for losses and overspeed, and was adjusted—all by recruit engineering graduates, supervised by experienced "Heads of Test."

Each year many college men discard their caps and gowns for the experience to be gained by actual test of major G-E apparatus in the different factories. Having completed this postgraduate course, which helps fit them for future responsible positions, these men will be largely intrusted with the research, design, planning, supervision of construction, and sale of this equipment.

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THE MINNESOTA TECHNO-LOG

The 1931 Alumni Directory

The Chute à Caron Development

A Page Concerning Those Honored

Vol. XI JUNE, 1931 No. 9

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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VOLUME XI — MINNEAPOLIS, MINN., JUNE, 1931 — NUMBER 9

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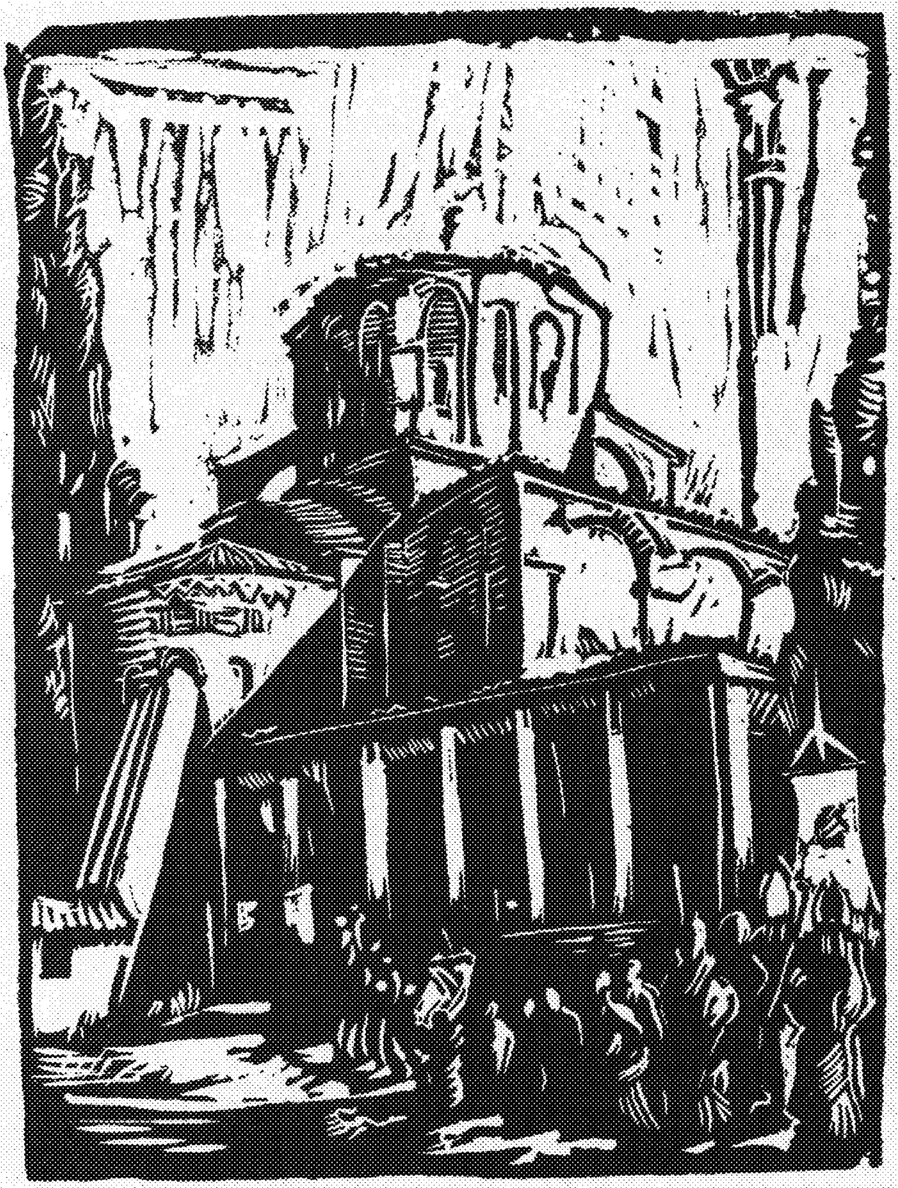


Saint Elias, Saloniki

THE MINNESOTA TECHNO-LOG
UNIVERSITY OF MINNESOTA

Volume XI — JUNE, 1931 — Number 9

The Chute à Caron Development

By D. J. BLEIFUSS, '20
Hydraulic Engineer, Aluminum Company of America

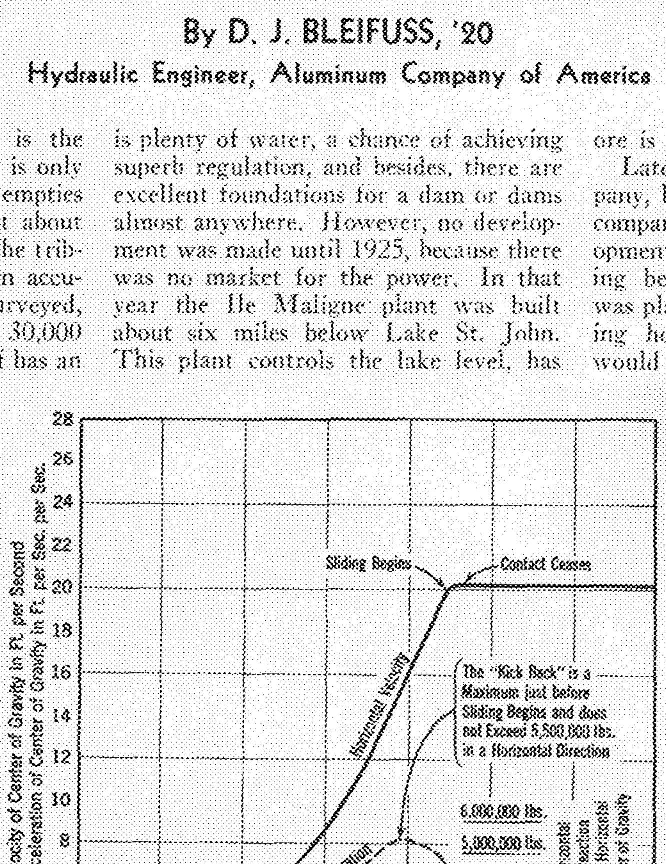
THE Saguenay River which is the main outlet of Lake St. John is only about 100 miles long, and empties into the St. Lawrence at a point about 120 miles below Quebec City. The tributary drainage area is not known accurately, since it has never been surveyed, but it is estimated to be about 30,000 square miles. Lake St. John itself has an area of about 400 square miles when full, and the water surface fluctuates 17.5 feet, providing 220,000,000,000 cubic feet of storage. The maximum flood occurring since 1913 was 326,000 c. f. s. in 1928. Old inhabitants can recall no greater flood. If Lake St. John had no regulating works, the minimum natural outflow would be about 20,000 c. f. s., while the firm regulated flow, which can be depended on day after day, year after year, is abut 35,000 c. f. s.

Both the Saguenay and the St. Lawrence might be termed estuaries; the St. Lawrence is navigable for ocean-going vessels to Montreal, and the Saguenay to Ha Ha Bay. In the Saguenay, there are no rapids for twenty miles above Ha Ha Bay, so that the 322 feet of fall are concentrated in the 30-mile stretch of river immediately below Lake St. John. As one might deduce from such a rapid descent, the channel is rocky, consisting principally of anorthosite, which is closely akin to granite. Along the river, the outcrops are practically continuous while elsewhere the rock outcrops frequently, or is overlain by swamps, lakes, fine rock flour of glacial origin know as Leda clay, or the usual gravel and other deposits found in glaciated districts.

Considering the foregoing data, it is apparent that here are all the essentials for the development of an enormous hydro-electric power supply, if construction difficulties could be overcome. There is plenty of water, a chance of achieving superb regulation, and besides, there are excellent foundations for a dam or dams almost anywhere. However, no development was made until 1925, because there was no market for the power. In that year the Ile Maligne plant was built about six miles below Lake St. John. This plant controls the lake level, has a maximum head of 120 feet, and an ultimate capacity of 540,000 h.p. in twelve units, eleven of which have been installed.

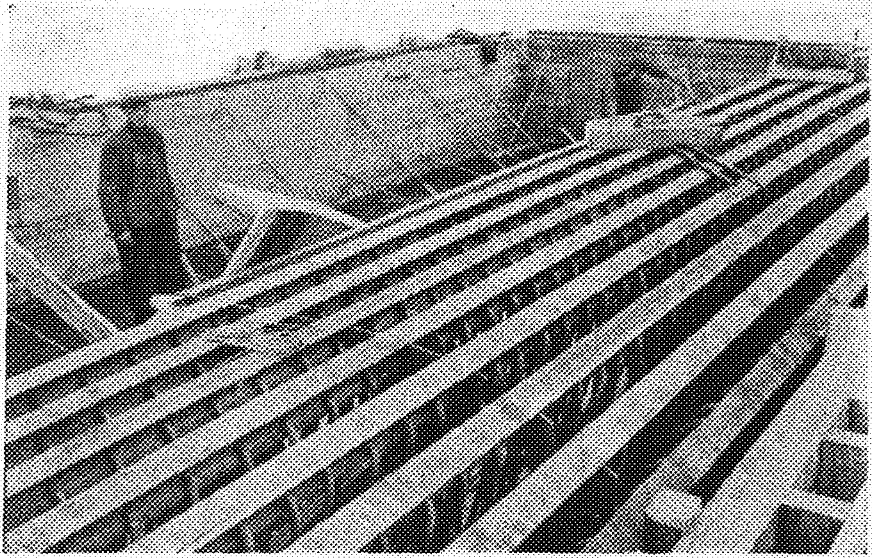
Attracted by the comparatively cheap power available, and by the proximity of tide-water the Aluminum company of Canada (then a subsidiary of the Aluminum company of America) built a reduction plant six miles up-stream from Chicoutimi, and around it a new city called Arvida. The bauxite ore from which aluminum is obtained comes from South America, and ocean-haul almost to the back door of the plant reduces transportation costs to a minimum. The ore is reduced to aluminum electrically.

Late in 1927, the Alcoa Power company, limited, a subsidiary of Aluminum company of America, began the development of a portion of the head remaining below Ile Maligne. Originally it was planned to develop the total remaining head in one plant. This project would have consisted of a dam across the Saguenay at Chute à Caron (Caron's Rapids), diverting the river into a canal running two miles across country to a power-house site on the Shipshaw River, which is tributary to the Saguenay at practically tide-water level. This would have made available about 800,000 h.p. of prime power, which would be an unreasonably large block of power to be absorbed at one time. It was therefore decided to build the dam at Chute à Caron as originally planned, but not to build the canal nor the power-house on the Shipshaw River, replacing these by an intake and smaller power-house built integrally with the dam. This work has been called the Chute à Caron project, and is now nearing completion. The head developed is 150 feet, and only 260,000 h.p. is being installed, in four units. The entrance for the Shipshaw canal has been excavated, and an earth dam built across it. The rest of the canal can be built at any time in the future that it is decided to carry out the Shipshaw development, and the earth dam removed. When this is done, all the present construction will form an essential part of the Shipshaw development, except Chute à Caron power-house, which will become a stand-by plant, to be operated only in periods of excess water or when there is trouble at the Shipshaw power-house. It should be here stated, however, that Chute à Caron power-house has been designed and built with as great care as though it were the main



DETERMINATIONS FOR FALLING TIME OF OBELISK

*Illustrations by courtesy of Civil Engineering.



ICE WAS FORMED BY CONDENSATION OF STEAM DURING WINTER CONSTRUCTION OF OBELISK.

power-house, to be operated continuously for all time.

In laying out a hydro plant, economy and practicability of construction are prime considerations, controlled by certain governing and limiting conditions. Chute à Caron dam had to be capable of passing an extreme flood of 600,000 c. f. s.; normal head water was limited to El. 238.0 (tail water at Ile Maligne); a flood of 500,000 c. f. s. should not rise higher than El. 250.0. It was decided that since Chute à Caron could use only 16,000 c. f. s. of the 35,000 available, it would not be economical to design for highest efficiency in penstocks, tailrace, etc., since construction costs would be increased thereby. The site selected must permit a suitable entrance to the Shipshaw canal, must permit a spillway long enough so that flood gates would not be overly large. Foundation conditions must be considered, and the method of building the dam across the main channel determined in advance of finally deciding on the site.

Fig. 1 shows a general plan of the project. Eleven flood gates were used, each 45 feet long. Gate sills are at El. 210.0, and a 5-foot freeboard above the normal pond level of El. 238.0 makes the gates 33 feet high. The number of gates, of course, determines the length of the main spillway.

The tailrace was located as shown because:

1. It could be dug in the dry.
2. It could be used during the construction as a diversion channel.
3. Just about enough excavated rock would be obtained to provide coarse aggregate for the concrete, after crushing.

Since it was necessary to divert 50,000 c. f. s. during the construction period, the tailrace was designed for this quantity rather than the 16,000 c. f. s. which would be discharged from the water wheels after the plant had been put in operation.

The question of unwatering the main channel to permit the construction of this section of the dam was a knotty one.

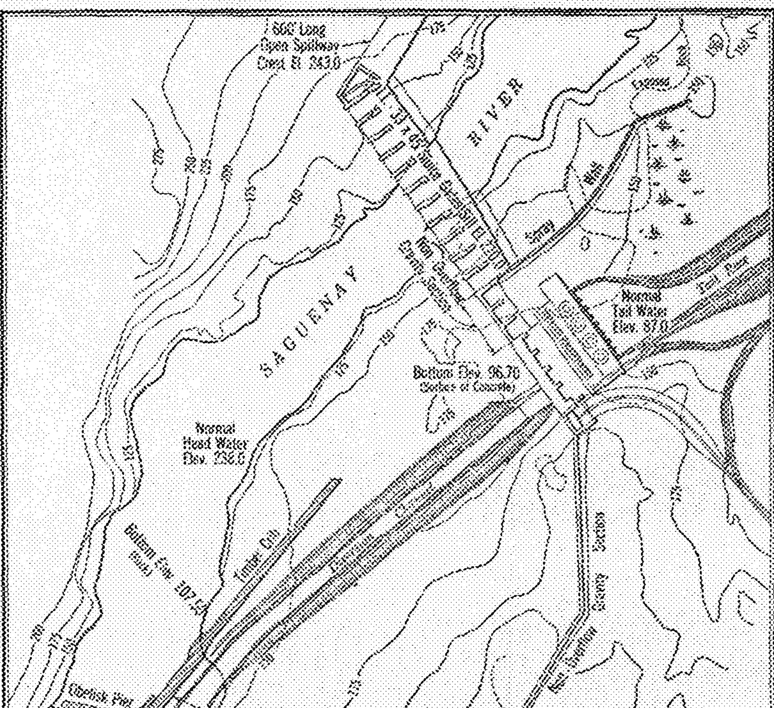
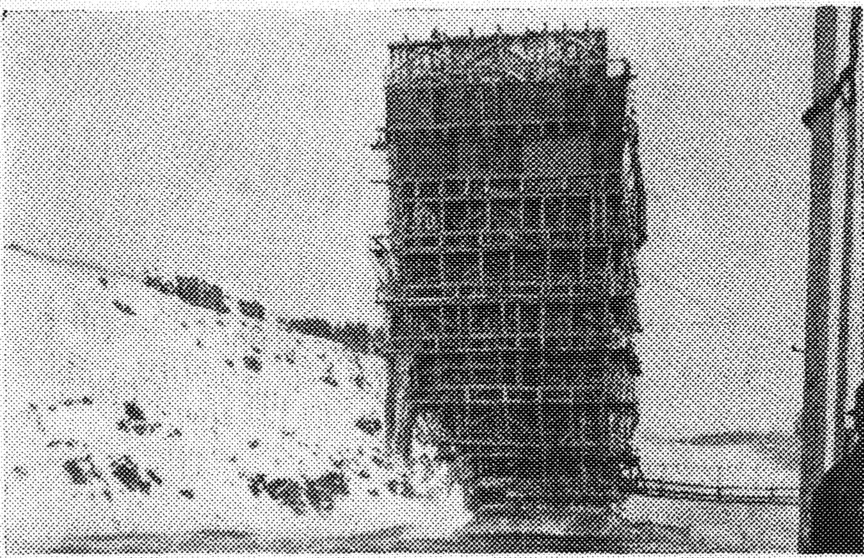


FIG. 1. CONTOUR MAP OF DAM SITE

Even though release from Lake St. John is limited to plant use at Ile Maligne, the discharge would be about 35,000 c. f. s. for six days each week, and 15,000 c. f. s. on Sundays, and these amounts could not be reduced because of power contracts. Take a look at the Mississippi under the Washington Avenue bridge when it is passing 35,000 c. f. s., imagine this amount of water traveling twenty feet per second in a rocky channel, and you have some idea of what coffer-damming would involve. Obviously, diversion was indicated. So a diversion channel was laid out as an up-stream extension of the tailrace.

Then the question arose as to how the river should be turned into this channel. The channel might be made deep so that its entrance would be below the bed of the river, a comparatively thin barrier of rock might be left across the entrance and finally blasted away to let the river enter. But deep excavation in solid rock is expensive. If the diversion channel were at the same elevation as the river bed, an obstruction in the main channel below the diversion point would be necessary in order to turn the river. Apparently, a coffer-dam would be necessary after all. Finally, Mr. James W. Rickey, Chief Hydraulic Engineer of the Aluminum company of America, suggested that instead of building the usual type of coffer-dam we should build a concrete dam standing on end beside the main channel, and that this be tipped over into the main channel when ready to divert the river. In this way, a mass so large that it could not be swept away could be placed in the river in a few seconds, and the small openings necessarily left at the ends could be sealed by more usual methods. Also, the prostrate mass could be overtopped by floods, which were almost certain to occur, without damage, where a timber crib coffer-dam might be wrecked. This suggestion was adopted; the concrete mass was built and christened the "obelisk." It contained over 5,000 cubic yards of concrete, weighed about 11,000 tons, had a maximum cross-section of forty by forty-five feet, and was ninety-two feet high before tipping. It was tipped on July 23, 1930, and landed within one inch of its calculated position. Ninety per cent of the flow was diverted into the diversion channel in six seconds. The remaining ten per cent was diverted by sealing the end openings in the ensuing three days.

The diversion channel was about 1300 feet long, ending at the fact of the intake, on the same line as the face of the dam. The water was conducted under the instake and through the power-house in two huge, concrete-lined sluice tubes. In passing under the intake, these tubes dropped 41.7 feet. Each was 20 feet wide by 40 feet high at the upper end, and provided with a Stoney-type steel gate. When the dam had been built across the main channel of the Saguenay, and it was desired to fill the reservoir, it was only necessary to close these gates, and fill the tubes with concrete behind them. At the lower ends of these tubes, the water had a velocity of about 50 feet per second, traveling at very nearly this speed for four hundred feet below the power-house, then rising through a tremendous hydraulic jump to a higher stage with less velocity.



OBELISK FOUNDATION USING RAILROAD RAIL FACING ON ROLLWAY U-SHAPED REINFORCING WAS WELDED IN PLACE.

The various parts of the dam are all straight gravity sections, i.e., dependent on their weight alone to resist the water thrust. In designing, two conditions were assumed, and the one giving the greatest stresses governed. The two conditions were:

(a) Water at El. 238.0, with an ice thrust of 20,000 pounds per linear horizontal foot concentrated at El. 237.0.

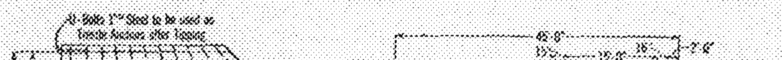
(b) Water at El. 250.0, with no ice thrust.

In either case, uplift was assumed, varying parabolically from full head at the heel to zero at the toe of the dam. After the dam was built the rock at the heel was grouted to a depth of 30 feet with cement grout under a pressure of 500 pounds per square inch. Besides, drainage tunnels were provided under the dam, so we believe the uplift assumption to have been conservative.

The spillway sections are so designed that the downstream faces project into the lower nappe of the overflowing water. Therefore, no vacuum can be formed under the jet. Vacuum formation causes a greatly increased resultant thrust on the dam, and increased erosion of the concrete.

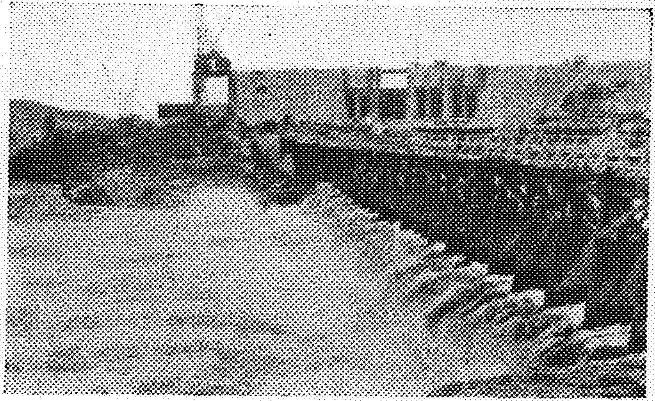
In building the power-house a portion of the substructure under Unit No. 1 was temporarily omitted to leave room for the sluice tubes previously mentioned. After the Stoney gates were closed, this portion was built and Unit No. 1 installed. The power-house is concrete and steel throughout, and is designed to give a massive architectural effect. Otherwise, it is as simple as we could make it.

In designing a power-house, first comes provision for the generating units, their spacing, arrangement, handling and ventilation; next, provision for other electrical apparatus; and finally, provision for auxiliaries and incidentals. The Chute à Caron units are spaced 52 feet apart center to center, all in one row. Two cranes, each of 125-ton nominal capacity, travel over the units, both being required to lift one assembled generator rotor. Each generator requires a maximum of 125,000 cubic feet of air per minute to keep it cool. This air comes in through the down-stream wall of the power-house, through windows on the turbine floor at El. 110.0, goes through tunnels in the generator foundation, and up through the monitor in the roof. In winter, when less air is required, the monitor and windows may be closed, wholly or partially, and the air recirculated, thus keeping the power-house warm. The electrical apparatus is quite simple. The main leads go from the generator through an oil circuit breaker, through a low tension disconnecting switch to the transformer. From the transformers, high tension leads go up through roof bushings, through high tension disconnecting switches up to the transmission line overhead. Each unit has its own individual transmission line; there are no transfer busses. Such simplicity made the superstructure correspondingly simple and easy to build.



ILLUSTRATING VARIOUS SECTIONS THROUGH OBELISK.

Canadian Westinghouse generators are used. They are rated at 56,000 kv.-a., at 13,200 volts, are over 30 feet in diameter, and the rotor weighs about 300 tons. On an extension of the generator shaft are mounted an exciter and a pilot exciter. The pilot exciter furnishes the field for the exciter, and the exciter furnishes the field for the main generator. In units of large size this arrangement permits quicker and more accurate voltage control. The windings of the pilot exciter are tapped to give 8-cycle power



TRESTLE ON COFFERDAM SHOWING SLIGHT DISCHARGE OVER COFFERDAM AND THROUGH TRESTLE.

OBELISK JUST BEFORE TIPPING WITH PROFILE DESIGNED TO FIT RIVER BOTTOM.

at 250 volts for driving the Woodward governor fly balls.

The turbines rotate at 120 r.p.m. and will develop a maximum of 68,000 h.p. at 150 feet head. The runner is 155 inches in diameter.

The generator rotor, both exciter rotors, the generator and turbine shafts (34 inches in diameter), and the turbine runner, are all hung from a Kingsbury thrust bearing mounted near the top of the generator. This single bearing must carry load as follows:

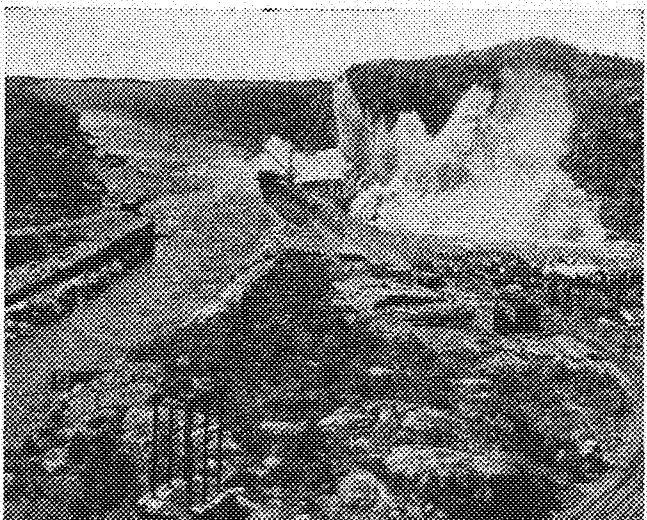
Generator rotor	600,000 lbs.
Turbine shaft	65,000 lbs.
Turbine runner	95,000 lbs.
Hydraulic thrust	380,000 lbs.
Total	1,140,000 lbs.

The main transformers are single-phase, rated 18,750 kv.-a., 13,200-154,000 volts. Each weighs about 65 tons.

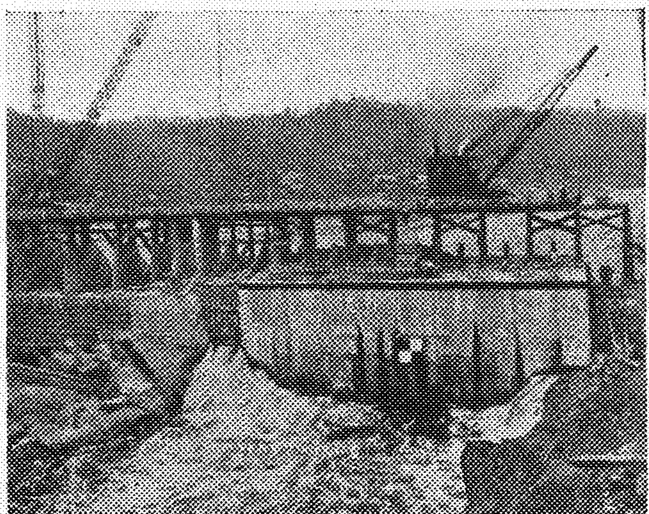
Auxiliaries comprise one motor-generator set, 350 kv.-a. capacity; two air compressors, 100-pound pressure, 250 cu. ft. per minute each; one air compressor, 200-pound pressure, 25 cu. ft. per minute; one oil filtering and centrifuge unit; one D. C. motor driven oil pump, 200-pound pressure, 30 g.p.m.; one vertical shaft, direct-connected motor-driven sump pump, capacity 3,000 g.p.m against a 40-ft. head; two sump eductors; miscellaneous fire protective and other small equipment. The M-G set furnishes power for the cranes and can be used in emergency as a spare exciter. The two larger compressors will furnish air for various repair work around the power-house and for the air bubbling system to keep intake and flood gates ice-free. The small compressor furnishes air for the generator brakes, and can be used to keep the correct amount of air in the governor accumulator tanks. The oil filtering unit and centrifuge is used to remove water and dirt from transformer, switch and lubricating oil. The D. C. driven oil pump is used to get up oil pressure in the governors for starting should there be no other source of power; it is operated from the power-house battery. The sump pump and eductors are used to drain the power-house sump, into which all leakage in the power-house area is conducted by an elaborate series of drains.

The intake has eight gates, two for each unit. Each gate is about thirteen by thirty feet, and contains about 37,000 pounds of steel, with 11,000 pounds of concrete ballast added to insure that it will seat under pressure. Each gate has its own individual hoist, of a new and unique design. The hoist drum is connected through a housed-in unit reducer to a 15 h.p., 550 volt, A. C. motor. On the motor shaft are a solenoid brake with both A. C. and D. C. windings, and a centrifugal fan. In an emergency, the operator in the power-house control room may close an intake gate by pushing a button. This puts power into the D. C. winding of the solenoid, releasing it. The gate falls, driving its motor and the centrifugal fan. The fan impeller is mounted so that under these conditions it runs backward, hence it is very inefficient and absorbs considerable power. When the gate reaches a descent speed of about nine feet per minute (three times hoisting speed), the power absorbed by the fan balances that developed by the falling gate, and the gate's speed will not increase. The fan acts as a very positive and simple brake; there are no clutches or complicated mechanical devices.

On this job about 700,000 yards of loose material and 600,000 cubic yards of solid rock were excavated, and about 530,000 cubic yards of concrete placed. Note that I say "placed," not "poured." *Good* concrete cannot be poured.



OBELISK FALLING INTO PLACE.



OBELISK IN POSITION

Famous American Architects

CASS GILBERT

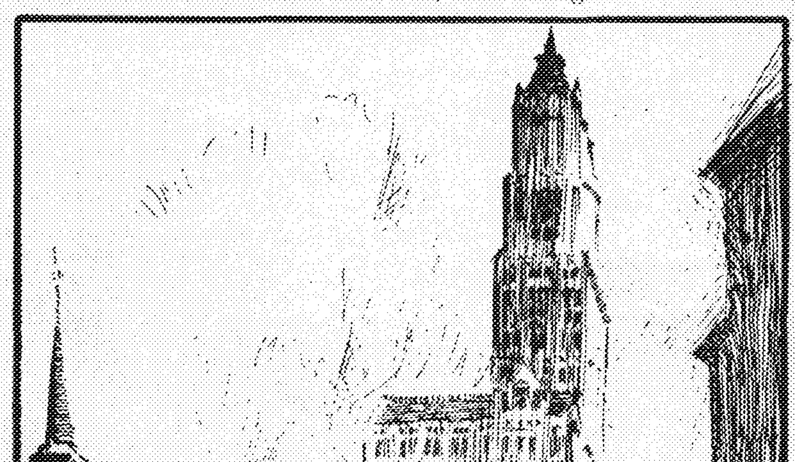
By DEAN L. WITCHER, Arch. '31

IN this day of industrialization and standardization, when uniformity of product seems to be the slogan and the criterion of a man's success the "guinea stamp," there is at least one profession that exempts its products from the monotony of standardization, the bonds of unknown freedom, because its artificers have as their ideal the expression of a purpose, of a function.

Thus it is that architecture with its products each as different as typography, comes as a relief to our mechanical perfections. And thus it is that the men who delve not in mass production but in beauty of production, find that their products become objects of beauty, rhythm, and balance, to command our attention. Buildings are landmarks of achievement, they show or do not show progress; they depict the designers craftsmanship, they interest us because of their silhouette. Their character or their proportions, have about them something which makes us look a second time, a third time, until we want to see the whole architectural masterpiece.

In crowded New York with its great hustle and bustle, there looms up an architect's dream in full realization, a building thusting itself eleven hundred feet into the sky, and in the rush of our industrial program we stop to marvel and ask ourselves who conceived the idea. We ask a bystander, and we are promptly told Cass Gilbert.

We immediately want to know more about this architectural genius, this man whose hand has produced monuments of time, that are encompassed only by continents, this master craftsman whose achievements cover half a century, and whose recognition has been universal, even from kings. In our quest for information we chance to meet a friend of Mr. Gilbert's, a draftsman who has worked in the great drafting rooms under the hand of this American architect.



THE WOOLWORTH BUILDING, NEW YORK CITY

Mr. Gilbert is tall, and strong of build, and upon his well modeled face rests a habitually jovial, pleasant expression. Descendant of a family with an enviable position in our national life for generations, he is a true son of American soil. Ohio lists him in her imposing roster of distinguished sons; his father having been General Samuel August Gilbert. Born in Zanesville, Ohio, in November of 1859, but before completing his grade education his family moved to St. Paul, where his public school education was finished.

After receiving his first degree from Macalester College of Minneapolis, he became vitally interested in architecture. With desires to achieve success and create noteworthy buildings, he began the study of architecture in 1876 at the Massachusetts Institute of Technology and later on the continent. At the conclusion of his studies in America and abroad Mr. Gilbert entered the offices of the famous firm of McKim Mead and White.

His employment there proved to be a most fortunate circumstance. He was first given the design of a base for a statue by St. Gaudens. Experiencing a great deal of difficulty with the base, the task seemed almost impossible of a good solution to the young architect. Just then St. Gaudens himself entered the room. Pausing at young Gilbert's desk, he noticed his distress and took up the problem with him and it was indeed a difficult one. When two hours of unrewarded studies had elapsed, Mr. White chanced to enter the draughting office, and immediately saw the condition of affairs. The three of them then worked out a satisfactory base, but the mutual contact was most beneficial to Mr. Gilbert for it made him two life enduring friends.

In 1883 Mr. Gilbert entered the architectural profession for himself, and in a relatively short time worked up a good practice, which became almost phenomenal a few years later. Probably the greatest attribute towards Mr. Gilbert's success has been his personality,—his broad outlook on the future, the conviction with which his manners instill others. Possessing an inherent professional skill Mr. Gilbert has re-

(*Continued on page 302*)

THOSE HONORED

Many technical students are included in the annual announcement of prizes, awards and elections to scholastic fraternities

Alpha Tau Sigma

Alpha Tau Sigma, honorary engineering journalistic fraternity, has elected Howard Helgerson, Roy Wiprud, Earl Cone, Robert Ceruy, Robert Lommen, and Ray Odell to membership.

A. S. C. E. Prizes

The northwestern section of the American Society of Civil Engineers offers annually to the members of the student chapter submitting the best prizes. They were won by Philip Kilpatrick.

Pi Tau Sigma

Pi Tau Sigma, honorary society in the department of mechanical engineering, elected the following men: F. F. Christoffer, W. E. Gartner, C. O. Anderson, O. J. Anderson, H. D. Watson, N. J. McDonald, A. E. Lilja, R. F. Erickson, and J. M. Appert. R. W. Wright, president of the A. S. M. E. and a Minnesota graduate, was elected to an honorary membership.

Tau Beta Pi

Tau Beta Pi, all engineering honorary fraternity, has elected the following men, during the last year:

The Tau Beta Pi Prize

The Tau Beta Pi Prize awarded on the basis of high scholarship and merit to a freshman in the College of Engineering and Architecture, the School of Chemistry or the School of Mines and Metallurgy was given to Arthur Sanford of the School of Mines.

Grey Friars

Grey Friars, senior men's honorary organization, have elected Nelson Anderson, Gordon Bodien, Cecil March, and Paul Salo.

Architectural Awards

Lyell C. Halverson has won the Moorman Prize.

Earle R. Cone and Milton L. Hoglund have won first and second, respectively, for the prizes awarded by the Minnesota chapter of the American Institute of Architects.

The American Institute of Architects medal has been awarded Arthur E. Monthey.

The Scarab prize has been awarded to Harvey S. Daley.

G. W. McLaughlin and L. C. Halverson have been awarded the Magney and Tusler prizes.

The School of Architecture faculty prizes have been awarded to Gordon Wall, first, and George Townsend, second.

Beatrice Johnson and Margaret Ebeling have been awarded first and second respectively for the prizes given by the Northern States Power Co.

The Alpha Alpha Gamma prize has been awarded to Hubert H. Swanson.

Norma E. Edwards, first, and Marjorie Mailand, second, have been awarded the French prizes in interior decorating.

The Alpha Rho Chi Medal was given to Milton L. Hoglund.

Arthur E. Monthey received the American Institute of Architecture Medal.

Pi Tau Sigma Prize

The Pi Tau Sigma Prize was awarded to Donald E. Leslie.

Tau Sigma Delta

Tau Sigma Delta, national honorary fraternity in architecture, elected the following men: Gilbert Green, Melvin Stenrud, and George Townsend.

Board of Publications

Jack Tews has been elected to represent the College of Engineering and Architecture and School of Chemistry on the board in control of student publications for next year.

Bookstore Board

Engineers who have been elected to the Bookstore Board for the coming year are Harvey Daley, William Watson, Walter Gartner, Wilfred Darling, and Lloyd Kempe.

The Dupont Fellowship

The Dupont fellowship in Chemistry has been awarded this year to Charles Rosenbloom.

Alpha Chi Sigma Prize

The Alpha Chi Sigma prize, awarded each year to the male sophomore in the School of Chemistry having the highest scholastic average at the end of the winter quarter, has been won by Archie Japs.

All-University Council

Gordon Bodien, John Bailey, and Cecil March were elected to represent the School of Chemistry and the College of Engineering and Architecture respectively on the All-University Council.

Chi Epsilon

New members initiated during the past year in Chi Epsilon, honorary Civil Engineering fraternity, are: Gordon Bodien, Wilfrid Darling, Laurence Hallin, Robert Kriess, Charles Russell, Milton Schmidt, and Leonard Snell.

Chemistry Faculty Prize

O. J. Swenson has won the School of Chemistry Faculty prize. The prize is awarded to the student maintaining the highest average in the work of the sophomore and junior years and the first two quarters of the senior year.

Phi Lambda Upsilon Prize

The Phi Lambda Upsilon prize was awarded this year to Archie Japs.

Plumb Bob

Plumb Bob is an organization of senior men in the technical colleges who have assisted in the promotion of the general welfare of the university. The following men have been elected: O. J. Swenson, F. K. Honey, M. L. Hoglund, C. C. Winding, R. W. Stoebe, F. V. Laska, H. D. Watson, R. M. Hanson, C. A. Hearn, R. C. Ramsdell, C. J. Olsen, and R. C. Cady.

Phi Lambda Upsilon

New members elected to Phi Lambda Upsilon, honorary chemical society, are: Archie Japs, Kenneth Johnson, William Allen, Arthur Garvey, Norton Midtlien, Charles Winding, Donald Blumer, Henry Davis, Donald Fuller, Robert Hamilton, Jr., Clarence Moyle, John Rehner, Jr., Charles Kimpila, Feliciano de Leon Roduta, Charles Roe, William Tomsicek, and August Willman.

Phoenix

Phoenix, a junior men's honorary organization, has elected Conrad Katzenmeyer, Robert Lillyblad, Bearnard McDermott, and John Bailey.

The Shevlin Fellowship

S. Yuster has been awarded the Shevlin fellowship in Chemistry.

Techno-Log Prize

The prizes in the Techno-Log Article Contest were awarded as follows:

First Prize: Laddy Markus for the story, *Installation of a New Transmitter at KSTP.*

Second Prize: Richard Nickolson for the story, *Sewage Disposal.*

Iron Wedge

Iron Wedge, a senior honorary organization, has elected John Bailey, Steve Gadler, Howard Nichols, and J. P. Shirley.

Iota Sigma Pi

A national honorary chemical society for women has elected the following members: Helen Lasby, Grace Taylor, Martha Boutt, Jean Setterburg, Lucille Bishop, Edith Quamme, and Inez Mason.

Silver Spur

Silver Spur, a junior men's honorary organization, has elected Steve Gadler.

Eta Kappa Nu

Elections to Eta Kappa Nu, honorary electrical engineering fraternity included: Laurence E. Hendrickson, Robert M. Lommen, Milton P. Olsen, Harold A. Sanderson, Cledo Brunetti, Scott E. Linsley, Walter A. Specht, Everett W. Christoferson, Albert F. Hopkins, Edward S. Loye, and Leon A. Rovelsky.

Tau Beti Pi

Tau Beta Pi, all engineering honorary fraternity, has elected the following men during the last year: Eugene Pfleiderer, Walter A. Specht, Gordon E. Bodien, Nelson E. Anderson, Kenneth C. Johnson, David B. Anderson, Scott E. Linsley, Walter Gartner, H. A. Sanderson, Cledo Brunetti, Forton Christoffer, Paul Jerabke, O. Jalmer Anderson, Linwood J. Brighthill, Cedric L. Cowan, Willar W. Fryhofer, Arthur H. Garvey, Howard D. Giese, Albert F. Hopkins, William L. Kinzell, Edward S. Loye, Norton Midtlien, Leon A. Rovelsky, Russell M. Thayer, Oswald J. Wiggins, Kenter L. Wilson and Charles Winding.

DRIPPINGS FROM THE OIL CAN

"Wer war die Dame mit der ich dich gestern Abend gesehen habe?"
"Das war keine Dame; das war meine Frau."

He (about to hang up receiver): Good-night dear, sleep tight."

She: "Snark. You know I don't drink."

"Quae erat mulier quacum vos postera nocte videbam?"
"Haec non mulier erat; haec mea uxor erat."

The "Dekes" don't drink any more—but they drink just as much.

Just before exams one feels very much as if he had swallowed something out of a medicine cabinet in the dark.

Every one has probably heard the old gag about the Scotsman who married a half-witted girl because she was fifty per cent off.

They say that European noblemen are now marrying American girls on the mere chance that the brides' fathers *may* get rich.

Possibly Edison will now turn his attention to bed-rock wheat in an effort to produce cheaper rubber.

Three men, an equestrian, a pedestrian, and an automobilist saw a girl standing at an intersection, which one knew her?

Why, the horse man knew 'er.

Int. Dec.: "Whenever my sweetie calls I get a terrible feeling. What will I do?"

Int. Dec.: "Slap him."

Then there was the young lady who went horseback riding with her gentleman friend and got sore and walked home.

"Qui etait la dame avec laquelle je vous ai vu hier soir?"
"El'e n'etait point dame; elle etait ma femme."

Baby: And I'm the first girl you've kissed?

Bozo: Now that you mention it, you do look familiar.

The teacher had just explained to the kindergarten class the different symbols to be used when one wished to leave the room.

After a few minutes of silence Johnnie burst into a loud fit of laughter.

Teacher: "Well, Johnnie, what are you laughing at?"

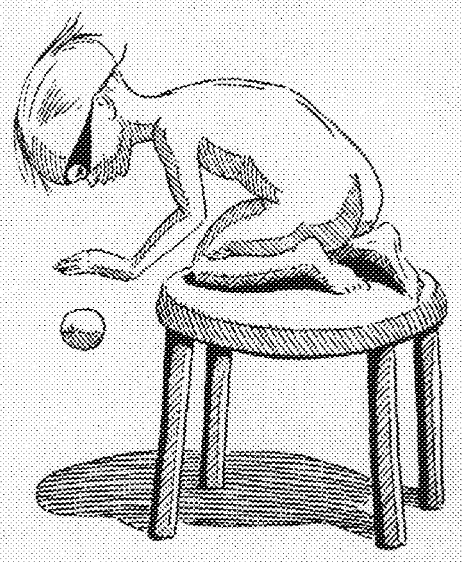
Johnnie: "Oh, Teacher,—I'm laughing at Joey,—he wants to leave the room but he forgot how many fingers to raise."

"Augi idi o Hanim Ki siz beraber idiuiz?"
"O Hanim degilidi fakat Benira Kari idi."

Slide: Gosh, my girl is awfully skinny.

Rule: Don't say skinny, that isn't used in the best of places.

Slide: Yea, but that's just where she happens to be skinny.



Little Oscar, the Engineer's delight is here shown at the tender age of three playing with his only ball. The remarkable progress that the little lad has made in the world may readily be imagined when one compares his present condition of Engineer Pre-eminent, Club man, etc., with the period of his babyhood. At that time his papa and mama were accustomed to leave little Oscar without food or clothing, perched on the top of a stool, bouncing his ball,—while papa and mama entered into the gay night life of Wahoo Junction, or was it Anoka?

In early childhood, Oscar was told by a doting mother to "play ball," and play he did. The picture shows Oscar after the 1001st bounce which broke the previous world record of 1,000 bounces held by Oscar Fegas. He attributes his success to the clever expedient of wearing goggles while under the stimulating rays of an ultra-violet lamp.

"Quien era la senora que vi con vd.anoche?"
"No era una senora; era mi majer."

"Can your girl keep a secret?"

"Can she? We were as good as married seven weeks before I knew it."

"Hvem var den damen jeg saa dig ute med igaar Kveld."
"Det var ingen dame; det var min hustru."

"Who was the lady with whom I saw you last night?"

"That was no lady, that was my wife."

Just try to imagine a congressman expressing himself in a ten word telegram.

Soanso Knocks Out Whoozis in 21st Round

The seething mass of humanity had come with bated breath to see the two magnificent specimens of humanity in pugilistic encounter. One was the proud possessor of a goodly number of medals, and there was method in his madness. As luck would have it the man with whom he came in contact showed that the exception proves the rule. At one fell swoop he was doomed to disappointment because a strong right arm met his eye and his budding genius dropped to the floor with a dull thud. The silence was broken only by feathered songsters and the scene beggared description. The people were too full for utterance and our mutual friend was absent.

With the last sad rites he was launched into eternity. The trees stood like sentinels along these lines of his last home in the sun-kissed meadows. Last but not least the people wended their way sadder but wiser, feeling that a long felt want had been nipped in the bud. They were tired, but happy, but did justice to a good dinner and are sure that every happy pair may sometimes be green with envy, but they must keep abreast of the times. After this I am rather the worse for wear.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

The Tools—The Graduate

AND just what tools does the graduate carry with him? He has a number of formulae at his finger tips—and a great mass of memorized information. But the world does not want such unproductive stuff,—it demands knowledge and skill,—knowledge and skill APPLIED if the possessor will make his mark. And this application,—it is the keynote of success and demands judgment, courage and will power,—or according to F. W. Springer, "Intestinal Fortitude."

Until the graduate is able to coordinate to a high degree his memorized information, until he is able to apply his knowledge and skill, and until he can summon judgment, courage and will power to his aid,—success is but a pleasant dream, —to be realized by some other person.

A Silver Lining

HERE it is. Every man many definitely expect during his life time to pass through at least two or three periods of depression. Look at the story of history. Men that graduate today, and tomorrow coming into their first conflict with the world find economic conditions arrayed in battle against them. Well, if everyone must find such a situation two or three times during his life,—it is better that a person learn while young and independent. The mind is then open, and lessons are learned more easily. Study this depression well, take its hard knocks with a laugh,—it will give you much in return, —EXPERIENCE.

And do not let self-pity blind your eyes. You are fortunate that you were not graduated a few years ago,—that you have no wife and children to support. Those are the men for whom to be sorry, for whom the future looks bad,—their homes and cars partly their own, their jobs uncertain, their salaries low.

But you graduates of today with no incumbrances. Why, the whole world awaits to first give you a left hook with the strong arm of depression and then urge you to summon Judgment, Courage and Will Power to your assistance in following the path to success.

An Outline for Progress

THOUGHTS while blowing smoke and reminiscing on the First Annual Technical Student-Faculty Banquet:

In brief the evening was a startling success,—its primary purpose that of fostering a closer relationship between the faculty and the student body was accomplished beyond the shadow of a doubt. A wholesome, progressive spirit characterized the speeches and the response.

Constructive was the plea advanced for more English and Speech for engineers,—especially today when the profession has advanced to the stage where the engineer is valuable as much because of his administrative ability as because of his technical skill. But in either capacity the worth of a man depends upon his ability to convince others of the practicability of his ideas. In other words, if he is not able to SELL himself, he is very seriously handicapped. Possibly the most brilliant argument for more English was offered by the very nature of some of the student speeches,—halting, incoherent, every word showing lack of self-confidence,—yet sincere and eager.

Constructive was the plan advanced for a five year engineering course. Such a plan would permit of more English and Speech, and would offer other electives to increase the breadth of the engineering curriculum.

Constructive were the pleas for raising the standards in the Technical Schools. With higher standards more time and money could be spent on students of truly worthwhile capabilities.

Constructive were the ideas of a senior regarding forced cribbing, lack of faculty cooperation, and half-hearted student reaction.

In fine, constructive was the evening. Many problems were brought forward which merit and even demand that immediate steps be taken toward their solution. But whether or not definite action is forthcoming at the present, the fact remains that a better understanding was obtained between the two groups, and that an event took place which will inevitably become one of the most cherished traditions of Minnesota engineers.

For the Future

THE outgoing Board and the graduating members of the Techno-Log staff offer their best wishes for a successful year to those men who will guide the magazine throughout the year 1931-1932.

In Thanks

BRIEF though it may be, the editors of the Techno-Log wish to express their most sincere thanks to all those who have assisted us in the production of this year's volume of the magazine.

THE 1931 ALUMNI DIRECTORY

of the

Technical Colleges *of the* University *of* Minnesota

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.

*Deceased

CHRONOLOGICAL DIRECTORY

College of Engineering and Architecture

FROM 1875 to 1896 inclusive, the first degrees awarded for the regular four-year courses were Bachelor of Civil Engineering (1875), Bachelor of Architecture (1877), Bachelor of Mechanical Engineering (1878), and Bachelor of Electrical Engineering (1891). In this period, also, a few professional advanced degrees were given, as Civil Engineer in 1888, Mechanical Engineer in 1894, and Electrical Engineer in 1896.

From 1897 to 1911 inclusive, the degrees of Civil Engineer, Electrical Engineer, and Mechanical Engineer were regularly awarded at the close of the four-year courses, and a few were given in 1912 and 1913. In 1908, however, five-year courses were established and at the end of the first four years, the degree of Bachelor of Science in Engineering was awarded for each of the three courses, civil, electrical, and mechanical, and also for a general course in engineering, which last had begun in 1900. Upon completion of the fifth year's work the professional degrees, Civil Engineer, Electrical Engineer, and Mechanical Engineer were given, the first being awarded in 1913.

In 1921, the first degree became Bachelor of Science in Civil Engineering, Electrical Engineering, or Mechanical Engineering. The degree of Bachelor of Science in Architecture was established in 1916. The general engineering course was discontinued in 1923. The new requirements for the professional degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer were adopted in 1921 and these degrees were placed in the Graduate School.

In 1928, the form of the Bachelor's degree in this college was changed to the original one used prior to 1878, namely, Bachelor of Architecture, Bachelor of Civil Engineering, etc., and this form was used in June, 1928, and thereafter. Similar action was taken in the School of Chemistry.

New Courses were established as follows: Agricultural Engineering in 1926; and Aeronautical Engineering and Landscape Architecture in 1928. 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

Lee, 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)
Hahn, 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 F.
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 R.
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.
Chapman, Leslie H.
*Casseday, George A.
Shenehon, Francis C. (C. E. 1900)

Bachelor of Electrical Engineering

Adams, George F.
Ford, Robert E.
*Bishman, Adam E. (E. E. 1903)
Eddy, Horace T. (E. E. 1896)
Rounds, Fred M.
*Tanner, Harry L.
Von Schlegell, Frederick

Bachelor of Mechanical Engineering

Shepherd, Burchard P.
Weaver, Albert C.
*Tilderquist, William M.

1896

Bachelor of Civil Engineering

*Beyer, Adam C.
*Jones, C. Paul
Burch, Albert M.
Long, Fred W. (C. E. 1898)

Bachelor of Electrical Engineering

Erikson, Henry A. (Ph. D. 1908)
Magnuson, Carl E. (M. S. 1897, E. E. 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 E.
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.
McKusick, Elwood M.
Graling, Verney
Pratt, Arthur K.
Hildebrandt, Henry A.

Mechanical Engineer

Bayless, Harry C.
Wennerlund, Elias C.
Richardson, Wilbur P.

ADVANCED DEGREES

Civil Engineer

Douglas, Fred L. (B. C. E. 1891)

Electrical Engineer

Huntoon, Milton B.

Mechanical Engineer

Lang, James S. (B. M. E. 1896, E. E. 1897)

1900

Civil Engineer

Grime, Edwin N.
Whitman, Edward A.
*Prendergast, Paul S.

Electrical Engineer

Dow, James C.
Stussy, William T.
*Johnson, Frank E.
Thaler, James A.
Kinsell, William L.
Thompson, Roy E.
Parkhurst, Harleigh
*Tracy, Fred G.
Shumway, Ernest J.
Wiltgen, Edward

Mechanical Engineer

Ashbaugh, Lewis E. (C. E. 1907)
*Higgins, Charles C.
Johnston, William W.
Daniel, T. Lester
Newhall, William R.

ADVANCED DEGREE

Civil Engineer

Shenehon, Francis C. (B. C. E. 1895)

1901

Civil Engineer

Everington, James W.
Quense, John H. (M. E. 1902)
Gunstad, Paul I.
Klemer, Frank H.
Strate, Thomas H.
McKittrick, James

Electrical Engineer

Anderson, Martin E.
Houts, Guy J.
Blake, Henry R.
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.
Cook, Robertson
Ramstad, Edward C.
Grimshaw, William E.
Stone, Melvin O.
Herrick, Carl A.
*Sudheimer, Edwin L.
Taylor, Ralph G.

Bachelor of Science (in Engineering)

Graham, Eugene C.

ADVANCED DEGREES

Mechanical Engineer

Couper, George B. (B. M. E. 1893)
Quense, John (C. E. 1901)

1903

Civil Engineer

Barlow, Harry E.
Oltman, Charles A.
Bennett, Walter J.
Prendergast, Arthur A.
Beyer, Theodore A.
Robbins, Orison B.
Carr, Harvey C.
Smith, Leighton H.
Davison, Joseph H.
Smith, Paul S. (B. S. 1901)
Grow, Harry A.
Madden, Francis
Stewart, Clarence H.
*Novig, Ole S.

Electrical Engineer

Benedict, George F.
*Miller, Lucius W.
Dibble, Barry
Page, Mark L.
Eberhardt, Otto I.
Rask, Louis G.
Erickson, Carl G.
Rosok, Ingwald A.
Ireland, Roy R. (B. S. 1901)
Schumacher, John H.
Vincent, Jay C.
Laird, Lee R.

Mechanical Engineer

Hughes, Frank C.
Williams, Edward H.
Kjosness, 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 E.
Fernald, Frank O.
Ruthi, 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 R. (E. E. 1908)
Harris, Sigmund
Johnson, Austin G.
Tuck, George A.

Bachelor of Science (in Engineering)

Gregg, Treshame D. (C. E. 1906)

ADVANCED DEGREE

Electrical Engineer

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

1906

Civil Engineer

Adams, Elmer E.	Hayward, George I.
Alrick, Bannona G.	Malloy, Charles J.
Alsop, Ernest B.	*Murphy, John G.
Bowen, Fred P.	Norelius, Lewis M.
Childs, Hervey B.	Reed, Arthur L.
Childs, John C.	Wiesner, Frederick E.
Hausauer, Monroe H.	

Electrical Engineer

Albrecht, George M.	Lang, Charles A.
Bunce, Paul F.	Mowry, Harry W.
Calmeyer, John P.	Payne, Harold G.
Cohen, Nathan	Roepke, Otto B.
Cooper, Leo H.	*Schow, Harry A.
Cornelius, Martin	Schwedes, Walter F.
Dunn, Andrew P.	Shuck, Gordon R.
Englin, Charles F.	Stenger, Laurence A.
Finchy, Jacob O.	(M. S. 1916)
Glasscock, Henry H.	Stone, Harris G.
*Gunther, Albert N.	Ungerman, Carl M.
Haeberle, Elmer H.	Weber, Erwin L. F.
Hoff, Christopher	(M. E. 1908)
Hokanson, Clarence E.	Wiggins, Gerald G.
Hubbard, Robert T.	Zimmer, William A.

Mechanical Engineer

Armstrong, Thomas S.	*Matteson, Frank E.
Crawford, Wallace T.	Ringsred, Arthur C.
Garber, Gabriel E.	Roze, Norman W.
Love, Benjamin W.	

Bachelor of Science (in Engineering)

Swensen, Karl P. (M. S. 1907)

ADVANCED DEGREE

Civil Engineer

Gregg, Tresham D. (B. S. Eng. 1905)

1907

Civil Engineer

Batson, Charles D.	Hobart, Walter B.
Blomquist, Hjalmer F.	Huston, David E.
Cram, Clyde M.	Jones, Lewis A.
*Dougherty, Joe	Kelly, Earl W.
Dunham, John A.	Swenson, Charles A.
Grant, James A.	(L. L. B. 1910)
Green, Fred H.	Tandell, Mandel G.
Haverson, Henry D.	VanCleve, Horatio P.
Hawley, Harry G.	Yager, Louis

Electrical Engineer

Alton, Herbert D.	Pearce, John H.
Andrus, Raymond J.	Rezab, John J.
Baer, Louis E.	Schow, William F.
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.
Krog, Walter C.	

ADVANCED DEGREES

Civil Engineer

Ashbaugh, Lewis E. (B. S. in Eng. 1900)

Master of Science

Swensen, Karl P. (B. S. in Eng. 1906)

1908

Civil Engineer

Ash, James W.	Hustad, Andrew P.
Bergoust, Oscar J.	Knowlton, Herbert H.
Borrowman, LeRoy F.	Krauch, William L.
Brenchley, Harry E.	Lang, Fred C.
Comstock, John W.	Longfellow, Dwight W.
Dallimore, Arthur N.	McCall, Harry J.
Doeltz, William F., Jr.	McCree, Andrew A.
Dougan, Henry K.	Mowery, Clarence W.
Fleming, Douglas R.	Norelius, Lewis M.
Furber, Pierce P., Jr.	Okes, Day I.
Gage, Hugh N.	Olson, Melvin S.
Quinn, John I.	Widell, Gustaf F.
Robertson, Charles N.	Willis, Roy
Schlattman, Edward C.	Woodrich, Oscar F.
Walker, George W.	

Electrical Engineer

Anderson, Frank A.	Peterson, Clarence A.
Bachrach, Alfred	Prentice, Robert S.
Brown, George J.	Schildt, William F. H.
Carter, Robert J. S.	Schoepf, Alfred W.
Casberg, James W.	Scobie, Francis G.
Currie, Neill, Jr.	Sperry, Leonard B.
Frahm, Alfred R.	(M. E. 1905)
Hoppin, Glenn H.	Sturtevant, Percy G.
*Hovelson, Henry	Svendsen, George F.
Kauffman, Roy	Swanstrom, Frank N.
King, Alfred B.	Sweningsen, Oliver
McAfee, Allan L.	Weibeler, William M.
Pancratz, Frank J.	Zimmerman, Louis P.

Mechanical Engineer

Anderson, Ole A.	Hetherton, Percival
Bingham, Stanley E.	Morris, Thomas C.
Councilman, Halstad P.	Norelius, Emil F.
(B. S. Eng. 1909)	Norton, Clyde W.
Cox, Richard F.	(M. E. 1909)
Estep, Harvey C.	Peterson, George T.
Fleming, Frank R.	Priedeman, George W.
(E. E. 1909)	Walsh, James
*Frary, Hobart D.	(E. E. 1909)
(M. S. 1909)	Weber, Erwin L. F.
Harwood, Stanley G.	(E. E. 1906)

Bachelor of Science (in Engineering)

Clarke, Charles P. (C. E. 1909)
Fruen, Arthur B. (C. E. 1909)
King, Robert N.
McKeehan, Louis W. (M. S. '09, Ph. D. '11)
Rowe, Harry B.
Schmid, Robert J.

1909

Civil Engineer

Childs, James A.	King, Lawrence W.
Ellison, Jay T.	Mitchell, John B.
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.	Robison, Archer R.
(M. E. 1908)	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
Hornibrook, James W.	(M. E. 1908)
Japs, Bernard G.	Williams, Fred M.
	(B. A. 1905)

Mechanical Engineer

Beery, Charles B.	Mark, Walter J.
*Bieri, John B.	Morris, John E.
Birnberg, Zingel C. J.	Moyer, Malcolm B.
Buck, Frederick W.	Nemec, Frank L.
Buhl, John E.	Shippam, Willis
Forfar, Donald M.	Souba, William H.
Holmgren, Charles E.	Starrett, Howard M.
Kircher, Frank J.	Udell, Carl D.
Kircher, George A.	Williams, Wilbur S.
Knopp, William B.	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.
Boime, Ole M.	Meyer, Carl F.
Bayum, Benjamin C.	Mott, 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, Jeness B.	Westbrook, 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.
Ellstrom, Axel E.	Orbeck, Martin J.
Enger, Edward H.	Roth, Lewis M.
Fieldman, David P.	Siverson, Sigvel J.
Hodnett, Ralph M.	Smith, Sydney H.
Hoffman, Michael J.	Swedberg, M. Roy
Johnson, Carl A.	Walby, Arthur C.
Kvitrud, Ingvald	

Electrical Engineer

Ashworth, Roy H.	Lyford, Dartt H.
Blossom, George W.	McCoy, Ira C.
Burrows, Robert P.	McQuillin, Raymond E.
Butterworth, Allan C.	Markuson, Oscar S.
Chapman, Arthur G.	Mittag, Albert H.
Demarest, Charles S.	Nebel, Walter H.
Drinkall, Leon R.	O'Brien, Raymond J.
Emerson, Lynn A.	Pengilly, Joseph H.
Forsberg, William P.	Riegel, Louis F.
Fredrickson, Harry R.	Shepard, Donald D.
Hansen, Maurice J.	Soulek, Joseph H.
James, Henry C., Jr.	*Stinson, Will V.
Johnson, Edward J.	Walker, William A.
Jones, Watkin W.	Wilson, Glenn W.

Mechanical Engineer

Barnum, Marvin C.	Olstad, Oscar A.
Bishop, Ira L.	Oram, Robert C.
Farnam, Julian P.	Owens, Leo E.
Kasper, Walter F.	Sneve, Jack S.
Larsen, 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)
Jurgens, Charles R. Danevin (C. E. 1913)
Kapphahn, Raymond J. (C. E. 1913)

Bachelor of Science in Engineering (Civil)

King, Forest V. (C. E. 1913)
Kriz, Joseph J. (C. E. 1913)
Pagenhart, Clarence C.
Pease, Raymond A. (C. E. 1913)
Peterson, Barney J. (C. E. 1913)
Ryan, Loiel S. (C. E. 1913)
South, Willard A. (C. E. 1913)
Souther, Morton E. (C. E. 1913)
Swenson, Hjalmer S. (C. E. 1913)
Torgerson, Irving E. (C. E. 1913)
Wangaard, Oscar H. (C. E. 1913)
Welin, Arthur G. (C. E. 1913)
Wolff, Henry E. (C. E. 1913)

Electrical Engineer

Anderson, Arthur R.
Bill, Earl McM.
Dorrance, Albert F.
*Purves, Leland E.
Streich, Harry C.
Young, Charles N.

Bachelor of Science in Engineering (Electrical)

*Avis, Samuel L. (E. E. 1913)
Benham, Claude F. (E. E. 1913)
Brewster, William E. (E. E. 1913)
Daum, H. Arno
Hedenstrom, Ernest A.
Herrmann, Raymond R. (E. E. 1913)
Hillman, Charles K.
Hoorn, Frederick W. (E. E. 1914)
Hovden, Conrad D. (E. E. 1913)
Knapp, Lester H.
Mathes, Robert C. (E. E. 1913)
Merriell, Elmer W. (E. E. 1913)
*Nelson, George A. (E. E. 1913)
Pardee, Charles A. (E. E. 1913)
Ringstrom, Ivan G. (E. E. 1913)
Swenson, Theodore J. M.
Thuras, Albert L. (E. E. 1913)
Towle, Neal C. (E. E. 1913)

Mechanical Engineer

Boyce, Leonard F.
Brown, William P.
*Johnson, Frank
Markoe, James C. P.
Thompson, Herbert L.

Bachelor of Science in Engineering (Mechanical)

Chapin, Harold S. (M. E. 1913)
Clark, William G. (M. E. 1913)
Crane, Eugene C. (M. E. 1913)
Crawford, Allen S.
Dinsmore, Arthur T. (M. E. 1913)
Donaldson, Frank A.
Hirleman, Clark W. (M. E. 1913)
Mikesh, Martin A. (M. E. 1913)
Morton, Harold S. (M. E. 1913)

Bachelor of Science in Engineering (Mechanical)

Rand, Lars (M. E. 1913)
Ruemmele, Albert E. (M. E. 1913)

Bachelor of Science in Science and Technology

Johnson, Paul A. (Lawrence)

1913

Bachelor of Science in Engineering (Civil)

Bergquist, John E.
Bradley, Byron H. (C. E. 1914)
Chilton, Edward G. (C. E. 1914)
Curtis, Benjamin J. (C. E. 1914)
Hewett, Maurice W. (C. E. 1914)
Koepke, Walter E. (C. E. 1914)
Kruse, Helmer V. (C. E. 1914)
Lovering, Harry D. (C. E. 1914)
Montgomery, Albertus
Morse, George A. (C. E. 1914)
Quiggle, Arthur W. (C. E. 1914)
Rolfe, West A.
Thurston, Harold H. (C. E. 1914)
Webster, Donald W. (C. E. 1914)
Wilk, Benjamin (C. E. 1914)

Electrical Engineer

White, Charles W.

Bachelor of Science in Engineering (Electrical)

Dewars, Allen G. (E. E. 1914)
Dow, Clarence A. (E. E. 1914)
Everett, William R. (E. E. 1915)
Goebel, Rudolph C. (E. E. 1914)
Goetzenberger, Ralph L. (E. E. 1914)
Haines, Allen K.
Irwin, Vincent H. (E. E. 1914)
Lagaard, Alexander S. T. (E. E. 1914)
Mahoney, William L. (E. E. 1914)
Miller, Hollis DeW.
Ramm, Theodore D.
Taylor, Lyman D. (E. E. 1916)
*Wilcox, Leslie W.

Bachelor of Science in Engineering (Mechanical)

Buenger, Albert (M. E. 1914)
Critchett, Edward F. (M. E. 1914)
McCartney, Floyd A.
Ovestrud, Melvin (M. E. 1914)
*Robertson, Soren M.
Sausen, Bert R.

ADVANCED DEGREES

Civil Engineer

Anderson, Harvey B. (B. S. Eng. 1912)
*Bailey, William H. (B. S. Eng. 1912)
Bingen, Wm. J. (B. S. Eng. 1912)
Cummings, Elmer F. (B. S. Eng. 1912)
Giertsen, Marcus O. (B. S. Eng. 1912)
Haberle, Edward L. (B. S. Eng. 1912)
Jorgens, Charles R. D. (B. S. Eng. 1912)
Kapphahn, Raymond J. (B. S. Eng. 1912)
King, Forest V. (B. S. Eng. 1912)
Kriz, Joseph J. (B. S. Eng. 1912)
Pease, Raymond A. (B. S. Eng. 1912)
Peterson, Barney J. (B. S. Eng. 1912)
Ryan, Loiel S. (B. S. Eng. 1912)
South, Willard A. (B. S. Eng. 1912)
Souther, Morton E. (B. S. Eng. 1912)
Swenson, H. Seymour (B. S. Eng. 1912)
Torgerson, Irving E. (B. S. Eng. 1912)
Wangaard, Oscar H. (B. S. Eng. 1912)
Welin, Arthur G. (B. S. Eng. 1912)
Wolff, Henry E. (B. S. Eng. 1912)

Electrical Engineer

*Avis, Samuel L. (B. S. Eng. 1912)
Benham, Claude F. (B. S. Eng. 1912)
Brewster, Wm. E. (B. S. Eng. 1912)
Herrmann, Raymond R. (B. S. Eng. 1912)
Hovden, Conrad D. (B. S. Eng. 1912)
Mathes, Robert C. (B. S. Eng. 1912)
Merriell, Elmer W. (B. S. Eng. 1912)
*Nelson, George A. (B. S. Eng. 1912)
Pardee, Charles A. (B. S. Eng. 1912)
Ringstrom, Ivan G. (B. S. Eng. 1912)
Thuras, Albert L. (B. S. Eng. 1912)
Towle, Neal C. (B. S. Eng. 1912)

Mechanical Engineer

Chapin, Harold S. (B. S. Eng. 1912)
Clark, Wm. G. (B. S. Eng. 1912)
Crane, Eugene C. (B. S. Eng. 1912)
Dinsmore, Arthur T. (B. S. Eng. 1912)
Hirleman, Clark W. (B. S. Eng. 1912)
Mikesh, Martin A. (B. S. Eng. 1912)
Morton, Harold S. (B. S. Eng. 1912)
Rand, Lars (B. S. Eng. 1912)
Ruemmele, Albert E. (B. S. Eng. 1912)

1914

Civil Engineer

Larson, Albin

Bachelor of Science in Engineering (Civil)

Brenchley, Walter C. (C. E. 1915)
Burnett, Harold V.
Dimond, Harvey G.
Doolittle, William Y.
Ekberg, Carl E. (C. E. 1915)
Hustad, John C. (C. E. 1915)
Johnson, Edgar W. (C. E. 1915)
Lagaard, Maurice B. (C. E. 1915)
Larson, Louis (C. E. 1915)
Mitchell, Lester M. (C. E. 1915)
Nordstrom, Carl T.
Ott, Leonard E. (C. E. 1915)
Price, John R.
Rankin, Renville S.
Rockwell, Harvard S.
Sears, Dow L.
Weatherill, Cedric S. (C. E. 1915)
Weigel, Howard N. (C. E. 1915)

Bachelor of Science in Engineering (Electrical)

Adler, Eugene H. (E. E. 1915)
Black, Peter P.
Chapman, Wendell P.
Dunham, Roy O. (E. E. 1915)
Elliott, A. Douglass (E. E. 1915)
Fallon, Eugene L. (E. E. 1915)
*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)
Westherill, Cedric S. (B. S. Eng. 1914)
Weigel, Howard N. (B. S. Eng. 1914)

Electrical Engineer

Adler, Eugene H. (B. S. Eng. 1914)
Dunham, Roy O. (B. S. Eng. 1914)
Elliott, A. Douglass (B. S. Eng. 1914)
Everett, William R. (B. S. Eng. 1913)
Fallon, Eugene L. (B. S. Eng. 1914)
Harris, Harold R. (B. S. Eng. 1914)
Jackson, Otto E. (B. S. Eng. 1914)
Johnson, Carl J. (B. S. Eng. 1914)
Johnson, Elmer W. (B. S. Eng. 1914)
Jones, George R. (B. S. Eng. 1914)
Loeffler, Henry S. (B. S. Eng. 1914)
Putz, John H. (B. S. Eng. 1914)
Robertson, Burton J. (B. S. Eng. 1914)
Schroeder, Carl W. (B. S. Eng. 1914)
Tallmadge, Everett S. (B. S. Eng. 1914)
*Wuest, Karl F. (B. S. Eng. 1914)

Mechanical Engineer

Colvin, James A. (B. S. Eng. 1914)
Gemmell, John H. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hartney, James L. (B. S. Eng. 1914)
Hubbell, Arthur C. (B. S. Eng. 1914)
Mayer, Harris J. (B. S. Eng. 1914)
Petersen, 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.
Blecher, 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. 1915)
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) — Rickman, 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.
Carlson, Chauncy M. — *Melby, Einar C.
Dunlap, Lemuel J. — Scott, Willard W.
*Ebert, Solomon B. — Swenson, George W. (E. E. 1921)
Eckenbeck, Evertt E.
Jacobs, Arthur R. — Thomas, William A.
Jevrud, Edwin C. — Wheeler, Herbert H.
Lilly, Clarence W. — Williams, Frederick J.
Malmstrom, Axel L. — Willis, Benjamin S.

Bachelor of Science in Engineering (Mechanical)

Andersen, Edward L. (M. E. 1919) — Hvoslef, Frederik W. (M. E. 1919)
Boehnlein, Charles (M. E. 1919) — Jones, Edwin F.
Knutson, Harry
Bros, Ernest T. — Larson, Victor F.
Brown, Homer L. — Murray, John H.
Carlson, Arvid P. — Nelson, Otis S.
Ek, Gustav A. — Romero, Cirilo L. P. Y. (M. E. 1918)
Eustis, Irving N. (M. E. 1918) — Rosenbloom, Abraham E.
Gerlach, Arthur C. — Swenson, Clarence O.
Guggisberg, Charles F. (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 B. (B. S. Eng. 1915, University of Washington)
Tallmadge, Hiram (B. S. Eng. 1916)
Teberg, Ernest J. (B. S. Eng. 1916)
Thompson, Jesse L. (B. S. Eng. 1916)
Turnquist, Axel A. (B. S. Eng. 1916)

Mechanical Engineer

Johnson, Ira L. (B. S. Eng. 1916)
Moody, Chester S. (B. S. Eng. 1916)
Ritchie, John R. (B. S. Eng. 1916)
Stone, Charles W. (B. S. Eng. 1916, M. S. 1919)

1918

Bachelor of Science in Architecture

Forsberg, Enock E. — 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.
Eliassen, Sigurd — (B. A. 1914)
*Gould, Reed D. — Smolensky, Martinian G.

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 R. — Greenberg, Morris
Anderson, Hilder A. — Hagerman, Oliver S.
Bierman, George H. (M. E. 1919) — Kivley, Ray C.
Muller, Carl C.
Francis, Paul E.

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.
Cotton, Ernest H.
Drinkall, John F.
Duncan, George R.
Grimes, David
Hartman, Walter K.
Heinemann, John R.
Jordan, Frank W.
Klass, Frederick
Langland, Harold S.
Lee, Oscar C.
Marshall, Donald E.
Nelson, Gustav A.
Olson, Richard H.
Peterson, Albert E.
Peterson, Arthur P.
Petrich, Alfred C.
Pierson, Joe W.
Reeve, Charles H.
Sander, Theodore, Jr.
Swanson, Edwin W.

Bachelor of Science in Engineering (Mechanical)

Baker, Arthur W.
Bros, Raymond J. (M. E. 1920)
Cash, Richard A.
Dowd, Archie J.
Elliot, Harry C.
Feltz, Ross M.
Hartzberg, Edward M.
Moffat, *George N. (M. E. 1920)
Pavek, William J. (M. E. 1920)
Williams, Arthur H.
Wunderlich, Milton S. (M. E. 1920)

Bachelor of Science in Engineering

Briggs, Hiram K.
Gee, Harry J.
Kapphahn, Ernest H.
Kroeze, Herbert A.
Lewis, Carroll E.
Lilly, Eugene

ADVANCED DEGREES

Mechanical Engineer

Andersen, Edward I. (B. S. Eng. 1917)
Bierman, George H. (B. S. Eng. 1918)
Bucholein, Charles (B. S. Eng. 1917)
Hvoslef, Fredrik W. (B. S. M. E. 1917)

Master of Science

Stone, Charles W. (B. S. Eng. 1916, M. E. 1917)

1920

Bachelor of Science in Architecture

Anderson, Milton J.
Kleinschmidt, Florian A.
Korslund, Harry J.
Lin, Shu M.
Love, Edwin M.
Lyon, Glenn H.
Raugland, Arnold I.

Bachelor of Science in Engineering (Civil)

Alexander, George D.
Beneke, Walter E.
Berg, Karl A. E.
Bernt, Hans E.
Bleifuss, Donald J.
Dever, Francis A.
Fitzgerald, William J.
Friar, Floyd M.
Gilbert, Roy
Gould, Edward S.
Hanke, Carl C.
Hansen, Carlos C.
Holm, Edwin R.
Johnson, Byron F.
Larson, Amandus C.
Lebeck, Carl E.
Lende, Henry M.
Malmberg, Victor A.
Nelson, Donald O.
Neville, Earle L.
Pless, Arnold G. M.
Purdy, Irving B.
Seemann, Ernest W.
Sherwood, Edward B.
Staehle, Gilbert C. (M. S. Eng. 1922)

Bachelor of Science in Engineering (Electrical)

Aske, Irving E.
Bauer, Ruben B.
Carlson, Victor H.
Ellsworth, Charles D.
Engquist, Victor E.
Goss, Harold R.
Groth, Arthur W.
Hunt, Gates E.
Janzen, William H.
Jules, Harold A.
Kingsley, Norman W.
Knowles, Everett H.
Kruse, Orlin O.
Larson, Walter J.
Lee, Walter J.
Lockwood, Raymond A.
McKenzie, Leonard F.
Mayer, Albert F.
Miller, George W.
Mitchell, Alexander C.
Molskness, Nels S.
Nelson, Clarence L.
Noel, Clay W.
Peterson, Peter I.
Peterson, Richard M.
Peterson, Vance C.
Price, Clarence R.
Siegmann, Chester W.
Strothman, Russell A.
Triem, Ralph H.
Waldron, Ralph E.
Westberg, Russell E.

Bachelor of Science in Engineering (Mechanical)

Anderson, Helmer N.
Ball, Hampton B.
Cerney, Glen C.
Curry, Ezra B. (M. E. 1921)
Czock, Jacob H.
Egilsrud, Fridtjof S.
Fortune, Harry G.
Gerow, Theron G.
Hayes, Edward J. (M. E. 1921)
Joachim, William F. (M. E. 1921)
Merrill, Lewis E. (M. E. 1921)
Odegaard, Harold T.
Powell, Knox A.
*Reasoner, Clayton M. (M. E. 1921)
Rhame, Paul W. (M. E. 1921)
Sheffenberger, Hiram R.
Tuve, George L. (M. E. 1921)
Wallfred, John E.
Waterous, Fred A.
William, Myrl J.

Bachelor of Science in Engineering

Didriksen, Philip H.
Hanrahan, Edmund C.
Harris, Nathan
Madsen, Olav
Moore, Clarence F.
Swenson, Gustav A.
Vallacher, Theodore L.
Wyly, Lawrence T.

ADVANCED DEGREES

Civil Engineer

Douglass, Addison H. (B. S. 1917)

Mechanical Engineer

Bros, Raymond J. (B. S. 1919)
Moffat, George N. (B. S. 1919)
Pavek, William J. (B. S. 1919)
Swenson, Clarence O. (B. S. 1917)
Wunderlich, Milton S. (B. S. 1919)

1921

Bachelor of Science in Architecture

Anderson, Milton L.
Dahl, George L.
Damberg, Rheuben P.
Gewalt, Carl H.
Larson, Edwin
Melander, Albin R.
*Thorshov, Olaf
Wills, Arthur D.

Bachelor of Science in Civil Engineering

Barber, Harold A.
Carpenter, Hugh W.
Christilaw, George M.
Daly, Richard T., Jr.
Dehn, Elmer A.
Del Plaine, Carlos W. (C. E. 1922)
Enke, Fred A.
Grachan, Earl H.
Hallady, Leslie L.
Hanson, Edwin L.
Henry, Burt C.
Jensen, Cyril D.
Johnson, Alphonse N.
Johnson, Carl S.
McCubrey, Everett J.
Mackintosh, William S.
Muessel, Robert W.
Simmonds, Richard R.
Sverdrup, Leif J.
Weis, Wallace D.
Werdenhoff, James H.

Bachelor of Science in Electrical Engineering

Anderson, Edward S.
Austin, Paul D.
Barger, Harold L.
Barnes, Dean M.
Beardmore, Albert E.
Berg, Samuel A. (B. A. 1921) (E. E. 1922)
Briggs, William G.
Carlson, Carl P.
Colson, Lauren G.
Donahoe, Robert E.
Hammerstrom, Aleck A.
Hayward, Laurence W.
Hougan, Sander
Johnson, Edgar F.
Johnston, Charles K.
Larson, Ludvig C. (E. E. 1923)
Love, Percival E.
McKibben, Lloyd S.
McVean, Norman S.
Maine, Basil C.
Manderfeld, Emanuel C.
Mangney, Elmer J.
Miller, Andrew L.
Nelson, Richard L.
Palmer, Roy A.
Pearson, Charles W.
Peterson, Harold W.
Podesin, John
Satori, Roy H.
Shuirman, Gabe
Stanius, Godfrey
Sweet, Ray R.
Wahlquist, Hugo W.
Wessale, George
Wilson, Paul R.

Bachelor of Science in Mechanical Engineering

Arneson, Lloyd O.
Elmer, Lloyd A.
Farmer, John W.
Forsberg, Elmer J. (M. E. 1922)
Gjesdahl, Maurice S.
Hamlin, Lehan H.
Johnson, Carl A. (M. E. 1922)
Lewis, George R.
Luce, Alexander W. (M. E. 1923)
Reuter, Peter T.
Roy, Milo C.
Umbehocker, Frank
Vaule, Sven A.
von Rohr, Herbert H.

Bachelor of Science in Engineering

Beeman, Harry J.
Carlton, Richard F.
Cowin, Clifford C.
Dills, Lyle A.
Godwin, Kenneth A.
Jacobson, Howard C.
Liddle, Ralph W.
McLean, Milton D.
McMeekin, Glenn D.
Martin, Curtis R.
Noble, John F.
Papenthien, Roy O.
Young, Joseph E.

ADVANCED DEGREES

Electrical Engineer

Swenson, George W. (B. S. Eng. 1917)

Mechanical Engineer

Curry, Ezra B. (B. S. Eng. 1920)
Hayes, Edward J. (B. S. Eng. 1920)
Joachim, William F. (B. S. Eng. 1920)
Merrill, Lewis E. (B. S. Eng. 1920)
*Reasoner, Clayton M. (B. S. Eng. 1920)
Rhame, Paul W. (B. S. Eng. 1920)
Tuve, George L. (B. S. Eng. 1920)

1922

Bachelor of Science in Architecture

Bakken, Laurence H.
Croft, Edna K.
Damberg, Paul S.
Dawson, John W.
Gerlach, Henry C.
Graf, Donald T.
Hahn, Stanley W.
Haines, Howard N.
Kreinkamp, Herbert A.
Little, Alice V.
Moorman, Frank S.
Smit, Catherine
Stewart, George A.
Willner, William E.

Bachelor of Science in Civil Engineering

Anderson, Nels S.
Andrus, Harry J.
Bailey, George R.
Berdan, Hubert J.
Chernus, Maurice
Cook, Walter K.
Cray, Seymour R. (C. E. 1923)
Erickson, Edwin C. O.
Espenett, Edward L.
Feder, Max
Fraser, Carlisle G.
Frost, Herbert J.
Greenberg, Jack
Hortskotte, Arthur E.
Johnson, Ellsworth
Keeler, Jasper F.
Kelley, William
Levens, Alexander S. (M. S. in C. E. 1924) (C. E. 1927)
Lund, Earl H. (C. E. 1923)
Markson, Christian O.
Mattson, Dewey F.
Morrison, John E.
Newberry, Lester W.
Ost, Roland E.
Palda, Chas. H.
Palmer, Howard B.
Paulson, Thorwald S.
Peterson, Neander E.
Pinska, Lawrence F.
Reardon, John M.
Rosenthal, Paul
Silverman, Emil M.
Slade, Loring
Sosnoik, Edward J.
Stoutland, Oliver A.
Swanson, Clifford L.
Tarbell, William P.
Teberg, Lawrence E.
Thompson, Claudius A.
Tierney, Festus P.
White, Arden D.
Wilson, Charles A.
Wood, Victor R.

Bachelor of Science in Electrical Engineering

Aultfather, David H.
Bergstrom, Marlow B.
Bisbee, Bertin A.
Bjonerud, Earl S.
Bochus, Gerald H.
Bosshardt, Wilmert C.
Carlson, Richard E.
Cooley, Gilbert
Dahl, Hjalmer A.
Downie, John M.
Drost, Henry F.
Dunnum, Orney E.
Ellestad, Irwin M.
Enger, Arne
Fiske, Harold C.
Forbes, Henry C.
Hagelin, Lawrence W.
Heidelberger, Roy J.
Hendrickson, Arnold B.
King, John E.
Linhoff, Carl H.
McEachin, John
McMillen, James S.
Magnuson, John E.
Mentzer, Clarence A.
Merritt, Alva W.
Mintz, Nathaniel
Nielsen, Walter M.
Nordlien, Berger W.
Olson, Arnim G.
Oscarson, Gerhard L.
Pangburn, Carroll G.
Plank, Howard G.
Ransom, Glen B.
Rome, Robert C.
Rool, Arnold E.
Sannicola, Joseph F.
Selander, Karl W.
Sorensen, John E.
Steffens, Robert A.
Tuve, Merle A.
Wickman, Martin F.
Willard, Arthur C.
Williams, Percival H.
Wilson, Abner W.

Bachelor of Science in Mechanical Engineering

Aure, Roy
Bros, Chester W. (M. S. in M. E. 1924)
Carlson, Ernest F.
Clark, John S.
Curtis, Verne F.
Eddy, Clarence
Fahland, Frank, Jr.
Hemsey, Clayton E.
Hilgedick, Ralph V.
Hoffman, Richard H.
Holmsten, Victor T.
Katter, Calvin K.
Katter, Reuben L.
Kelsey, Howard C.
Kleinschmidt, Armin R.
Kumm, Arthur W.
Mikesh, Edward S.
Nordenson, Arnold
Nordstrom, Ernest A.
Olmstead, Charles F. (M. E. 1923)
Peters, Walter C.
*Rood, Olaf T. (M. E. 1923)
Rosendahl, Harold R.

Bachelor of Science in Engineering

Adams, Edward H.
Brown, Harry
Capstick, Donald
Dock, Chester
Forssell, William
Hayes, Harold
Meili, Rudolph E., Jr.
Olson, Clarence

ADVANCED DEGREES

Civil Engineer

Del Plaine, Carlos W.

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921, B. A. 1921)

Mechanical Engineer

Forsberg, Elmer J. (B. S. Eng. 1921)
Johnson, Carl A. (B. S. Eng. 1921)

Master of Science in Engineering

Stehle, Gilbert C. (B. S. 1920)

1923

Bachelor of Science in Architecture

Backstrom, W. A.
Holien, Edward O.
Johnson, Elving L.
Markuson, Miner J.
Nielsen, Eunice V.
Sime, Theodore L.
Strom, Arthur
Walquist, John A.

Bachelor of Science in Architectural Engineering

Luedeman, Clarence H.
Sutherland, Samuel J.

Bachelor of Science in Civil Engineering

Aasland, Arne
Abramson, Harry W.
Aldrich, Louis W.
Aslakson, Carl I.
Berg, Swan P.
Bergford, Lester M.
Bergford, Rolf E.
Buhr, Leo
Christlieb, Frank R.
Cribbs, Harry E.
Curry, Byron K.
Darrell, James R.

Bachelor of Science in Civil Engineering

DeFreece, Paul R.
Dindorf, Edward C.
Flindt, Richard H.
Hill, Hibbert M.
Hiner, Walter G.
Hosmer, Orville H.
Johnson, Albert W.
Johnson, Nels
Judd, Maurice D.
Kotz, Walter E.
Lazarus, Morris W.
Leonard, Aubrey C.
Maiser, Walter L.
Manger, Henry J.
Meskal, George A.
Mitchell, Lloyd S.
Nelson, Elmer A.
Nelson, Glenn
Odquist, Carl
Olson, Elmer J. E.
Peck, Lloyd A.
Sauer, Arthur A.
Schaller, George C.
Schlenk, John J.
Sclarow, Abraham M.
Spencer, Raymond D.
Stephens, Clifford S.
Swanson, Paul H.
Tennstrom, Carl H.
Thompson, Everett
Villaume, Walter F.
Zimmerman, Arthur C.

Bachelor of Science in Electrical Engineering

Babcock, Vernon M.
Bouquet, Otto T.
Braden, Rene A. (M. S. 1925)
Bumgardner, Louis T.
Burrill, Charles M.
Case, Gerald F.
Clausen, Elmer W.
Dunnavan, Ralph B.
Elwood, Daniel H.
Engstrom, Elmer W.
Fairbanks, George W.
Feeney, Wayne I.
Fischer, Harold W.
Friedman, Edwin A.
Goldberg, Maurice G.
Grettum, LeRoy Atwood
Hargraves, Robert A.
Hawkins, Harvey C.
Heidelberger, Otto F. (M. S. 1925)
Helwig, William F.
Johnson, Gustaf A.
Johnson, James P.
Kannenberg, Walter F. (M. S. 1925)
Kearney, Adrian A.
Koch, Karl L.
Lambie, Horace H.
Lieberman, Henry
Lundquist, John V.
McCullough, Robert T.
Meserve, Ralph H.
Moreno, Gerardo
Nash, Russell O.
Newman, John M.
Nordvall, Glenn W.
Olin, Henry A.
Olson, Roy H.
Pause, Harold A.
Pulver, Richard F.
Rath, Harvey C.
Reeve, Howard E.
Russell, Winfred W.
Ryan, Robert M.
Sampson, Clifford L. (M. S. 1925)
Schottler, George J.
Schweiss, Clifford C.
Scott, Herbert L.
Sickel, Edwin C.
Swift, George E.
Thorne, Donald E.
Trask, Alfred S.
Ward, Alvin C.
Wellisch, Walton
Wiggins, John B.
Williams, Roy N.
Wills, David C.
Wilson, Frank W.
Zimmerschied, Clarence R.

Bachelor of Science in Mechanical Engineering

Acker, Sidney H.
Amidon, Lee L.
Ascher, Raymond C.
Bachmann, Graydon A.
Bergsland, Grant C.
Bros, Bernard M.
Brossard, Edward V.
Copeland, Floyd E.
Cross, Roland E.
Eige, Elmer H.
Gilstad, Arthur
Halden, Herbert O.
Hibbard, Sheldon S.
*Keiser, Karl W. (M. S. in M. E. 1924)
Kuhlman, Rudolph H.
Larson, Glen M.
Lindelien, Eugen
Marshall, Chester R.
Messer, Harold D.
Parkin, Orrin G.
Peckham, Harold E.
Ransom, Ralph W.
Sear, Arthur W.
Swanson, Philip G.
Waby, Delton T.

ADVANCED DEGREES

Civil Engineer

Cray, Seymour E. (C. E. 1922)
Lund, Earl H. (C. E. 1922)

Electrical Engineer

Larson, Conrad L. (B. S. E. E. 1922)

Mechanical Engineer

Luce, Alexander W. (B. S. M. E. 1921)
Olmstead, Charles F. (B. S. M. E. 1922)
*Rood, Olaf T. (B. S. M. E. 1922)

1924

Bachelor of Science in Architecture

Backstrom, Emil F.
Barnum, Charles R.
Bonsall, Wallace C.
Hawkins, Edward W.
Hinman, Charles H.
Johnson, Anton A.
Krait, Edwin W.
Magoon, Herbert A.
Nelson, Mark L.
Nystrom, Paul E.
Rosenberg, Rabil A.
Silverman, Isadore W.

Bachelor of Science in Architectural Engineering

Person, Otto C.
Root, Frank R.
Tvedt, Lawrence A.

Bachelor of Science in Civil Engineering

Bachelder, William H.
Bauer, Roscoe W.
Bergquist, Edwin T.
Bergquist, Philip L.
Bestor, George C.
Bevan, R. Louis
Braddock, Edward
Brody, Mace F.
Bullis, Everard J.
Chapin, S. Caryl
Dedic, Richard J.
Erickson, Carl E.
Garzon, Julian R.
Gillard, Herbert W.
Grant, Elberth R.
Guerin, George V., Jr.
Guesmer, George O.
Gustafson, Reuben W.
Hankins, Nathaniel R.
Harrington, Marzy V.
Hayden, Claude E.
Herberg, Sanford
Holder, Laurance E.
Johnson, Raymond V.
Kaufman, Morris B.
Larson, Peter L.
Liese, Herbert W.
Lund, Roy V.
McCrady, Archie R.
Nelson, Martin E.
Normann, Rolf A.
Olson, C. Milford
Parker, Robert M.
Peterson, Lloyd L. H.
Powell, Louis H.
Ranger, Donald R.
Roos, Frank T. W.
Somero, Waino M.
Sprehn, George H.
Stoddart, Hugh A.
Stoner, Clifford M.
Tews, Arthur W.
Thompson, Theodore S.
Velz, Clarence J.
Wilson, Walter E.

Bachelor of Science in Electrical Engineering

Anderson, Emil G.
Anderson, Fayette C.
Anderson, Matthew A.
Appleman, Frank C.
Arstad, Leonard O.
Carlson, Warren E.
Cass, Hoyt R.
Cassidy, Walter J.
Dahl, Harold W.
Diment, J. Morton
Dunlap, George M.
Ekberg, Curtis R.
Frazee, Leonard M.
Furber, John R.
Garthus, Ira B.
Greene, Alfred B.
Greene, Chauncey L.
Greiner, Harry S.
Grettum, Walter A.
Harrington, Russell A.
Hecht, Henry W.
Heggen, Reuben
Holbeck, John I.
Huseby, Gisle E.
Jacobson, Frank H.
Johnson, Iver W.
Juran, Joseph M.
Kapple, Frederick R.
Kator, Jozef J.
Kline, Frank W.
Krause, Fred E.
Lampher, Murray N.
Lauritzen, Carl W.
Lebeck, Torarin E.
Lewis, John G.
Little, LeRoy C.
McConnell, E. S.
McGregor, F. A.
McLeland, Lyle K.
Mabbott, Leonard E.
Maugney, Hilding O.
Marcroft, Harold C.
Marshman, Irving C.
Mathes, Richard E.
Mayer, Joseph S.
Miller, Archibald T.
Miller, William J.
Monsen, Manley A. B.
Monseth, Ingwald T.
Morton, Lysle W.
Nee, Harold E.
Nelson, Edgar M.
Pelley, Lloyd L.
Schilling, Theodore F.
Schow, Garfield G.
Sheckman, Harvey Z.
Skarolid, Charles T.
Stimart, Elwood L.
Strege, Henry W.
Swift, Donald C.
Taplin, George C.
Teal, Clarence W.
Trcka, Benjamin C.
Tunell, Robert H.
Tyvand, James A.
Waligoski, Adam A.
Warren, Laurence C.
Weber, Hanard P.
Wolfe, George E.

Bachelor of Science in Mechanical Engineering

Anderson, Joseph A.
Berry, George F.
Blodgett, Charles R.
Burst, Wellington L.
Boyd, Paul M.
Collis, Norman S.
Dale, Dallas W.
Darmody, William J.
Earl, Donald F. (M. S. M. E. 1925)
Engh, Harris S.
Erskine, Robert K.
Estabrooks, Clyde F.
Grobel, Lloyd P.
Hiers, Charles R.
Holmstine, Ralph D.
Kiesner, Frank C.
Koehler, Edwin F.
Langford, George, Jr.
Langman, Harley R.
Logue, John F.
Mehandru, Behari L.
Montgomery, Ralph M.
Moore, John H.
Morris, Frank A. (M. S. M. E. 1925)
Nelson, Edward K.
Nelson, Einer
*Olien, Hamlet C.
Olson, Arthur L.
Peterson, Arthur S.
Rathburn, George A.
Ross, Kenneth B.
Rosseau, Clifton C.
Saltwick, Andrew
Sartell, Page M.
Sehn, Arthur O.
Sesseng, Gunnar
Simms, Charles G.
Staehle, Haswell E.
Stauffacher, Edward L.
Thomas, W. Alan
Tuttle, Stanley R.
Wagner, John W.
Willson, Stuart V.
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.
Erickson, Clarence P.
Freeberg, George
Kendall, Walter A.
Lantz, Reuben S.
Lumm, Allan G.
Molander, Edwin W.
Olsen, Edwin E.
Peterson, Everett L.
Rigg, Alwin E.

Bachelor of Science in Architectural Engineering

Brimeyer, Ferdinand J.
Elmburg, LeRoy M.
Grisson, Aubrey H.
Larson, Emil L.
Peack, Cyril P.
Vaudreuil, Lionel H.
Rankin, Dean W.
Wicklund, Paul E.

Bachelor of Science in Interior Decoration

Cote, Rhoda H.
MacGregor, Helen J.
Parker, Helen R.
Slocumb, Mary G.
Smith, Verna G.

Bachelor of Science in Civil Engineering

Auxer, William L.
Banovetz, John A.
Bartholomew, Neal W.
Beese, Harold O.
Berg, Thorsten H.
Bertossi, Clarence F.
Bird, Harold E.
Blue, Clarence W.
Bonner, Donald R.
Brose, William C.
Burns, Dwight T.
Carlbom, Leonard H.
Cornell, George M.
Craig, Hamilton S.
Donahue, Stephen
Dungay, Herbert F.
Duval, Arndt J.
Elers, Baldwin C.
Frantz, Willard F.
Fulton, Edwin G.
Galanter, Samuel S.
Gerdes, Carl H.
Gobeli, Arthur W.
Haims, Mark
Hansen, Arthur A.
Hartman, Philip F.
Hendricks, Clifford L.
Hendrickson, C. Edward
Imsande, Fred L. C.
Jones, Harold W.
Knudsen, Esther M.
Kroll, Arthur J.
LaBonte, Anton E.
Larson, Fred H.
Lushene, Joseph P.
McAndrews, Harry N.
Macgowen, Irvin S.
Mark, Max B.
Moore, Norman R.
Morris, Russell F.
Nelson, Edwin W.
Nelson, George A.
Nichol, Frank E.
Nordstrom, Milton E.
Nutting, Horace W.
O'Brien, Thomas E.
Olson, Kenneth M.
Olson, Vernon H.
Peterson, Clarence R.
Peterson, Harold C. E.
Prichard, Charles E.
Quinn, Edward I.
Quinn, Ursula R.
Schmidt, Roland L.
Skrukrud, Odean M.
Sullivan, Frederick V.
Swanberg, John H.
Thompson, Clarence W.
Walder, N. T.
Ward, John, Jr.
Wold, Milton C.
Youngquist, Eder B.

Bachelor of Science in Electrical Engineering

Albrecht, Ernest G.
Albrecht, Karl J.
Anderson, Arthur P.
Benson, Ikel C. (M. S. E. E. 1927)
Boe, Lester L.
Borchert, Oscar H.
Bordeau, Sanford P.
Brossard, Henry F.
Burlingame, Robert E.
Cameron, Harry D.
Childs, Morris P.
Christensen, Arthur L.
Cosandey, Charles J.
Countryman, M. Alden
Cousins, Van M.
Edwards, Richard G.
Ellis, Carl E.
Franzen, Roy O.
Gilman, Gaylord
Hammer, Harold E.
Hanft, Hugo H.
Heins, Harold H.
Hill, Edward L.
Holmes, Raymond H.
Hussey, Norman W.
Jacobsen, Arthur C.
Johnson, Enan C.
Johnson, Robertson B.
Kauppinen, Heino
Keller, Raymond W.
Knoll, Franklin O. (B. S. C. E. 1922) (St. Thomas)
Koch, Winfield R.
Lewis, Berkeley R., Jr.
Ludlum, Robert V.
Lund, Jeffery L.
McClung, Karl R.
McCully, James P.
McEwen, Alexander D.
Malmgren, Richard V.
Meagher, Joseph E.
Nelson, Carl C.
Nelson, Clarence H.
Nickerson, Edward
Nierling, Grant C.
Parsons, Sidney A.
Petersen, Lewis E.
Postma, John
Reed, Henry R. (M. S. E. E. 1927)
Richardson, Philip E.
Robertson, Kenefick
Schenckloth, Harry H.
Schuck, Roy D.
Shaver, George J.
Smith, Harold D.
Solomonson, Lawrence D.
Steinert, Emil
Taylor, Richard G.
Thomas, Richard L.
Thomson, Andrew
Thyberg, Clarence W.
Tunell, Clement R.
Untinen, August L.
Upton, Albert P.
Westigard, Glenn A.
Wieland, Willard W.
Winslow, Harry J.
Wurzbach, Henry A.

Bachelor of Science in Mechanical Engineering

Algren, Axel B.
Backstrom, Russell E. (M. S. M. E. 1927)
Beseler, Herman F.
Bjerre, Folmar I.
Boss, Ronald W.
Caswell, Thomas B.
Donnelly, William H.
Eggleston, Smith
Erskine, Lawrence F.
Forseth, George O.
French, William O.
Heath, Arthur C., Jr.
Hoisveen, Leonard F.
Holmes, Roland W.
Jacobi, Alfred J.
Jacobson, Reuben A.
Jenkins, Clifford H.
Ludvigsen, Elliot L.
Lundquist, C. D. Vernon
Martinn, Anthony D.
Mills, Hartzel
Pendergast, Webster G.
Peterson, Laurence L.
Robinson, Parke D.
Souba, John I.
Stevens, Everett B.
Whitten, Robert C.
Wilson, Roy A.

ADVANCED DEGREES

Master of Science in Architecture

Dayu, Doon (B. S. 1924)

Master of 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)
Merrill, 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.
Guezmer, Marie W.	

Bachelor of Science in Civil Engineering

Balkin, Samuel W.	Juell, Barton
Bolstad, Roswell C.	Kelly, Raymond R.
Breedon, James R.	Kreiting, Arthur S.
Bunnell, Charles W.	Lewin, Sherman W.
Comfort, Thomas H.	Liese, Carl K.
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, Frankun J.	Ohman, Uno G.
Hoffman, John R.	Peterson, Garvin E.
Jakkula, Arne A. (M. S. C. E. 1927)	Sandberg, Clifford H.
	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.	Johnson, Clarence A.
Anderson, Lowell W.	Johnson, Welton V.
Ayshford, Loren C.	Jones, Richard W.
Barron, John H.	Kelly, William J.
Berglin, Charles J.	Larsen, Einar H.
Bergman, Hilder W.	Lee, Albert A.
Beveridge, Robert A.	LeVesconte, Lester B.
Bullard, Henry M.	Levy, Max L.
Carman, Willard J.	Lindquist, Oliver J.
Christen, Ray L.	Lostrom, Herbert W.
Coon, Lawrence C.	Lyberg, Verele C.
Dahl, Merle G.	Lynskey, Joseph P.
Deinema, George R.	Mackay, Donald H.
Deterling, Edward A.	Mahachek, Ross
Dimmick, Merton A.	Mann, Alvin K.
Etem, Victor	Meader, Glenn S.
Faulkner, Louis L.	Mindrum, Arthur I.
Feldman, Carl B. H.	Murdoch, George B.
Ferguson, Kenneth R.	Nelson, Paul B.
Fiene, Marcus	Nelson, Robert B. D.
Forsmark, Ulrik E.	Nimmer, Walter R.
Gaalaas, George L.	Orning, Harold
Gemmell, Robert W.	Parry, John E.
Getchell, Earl	Quine, William M.
Graf, Alois W.	Rhoades, Herbert E.
Gross, Leon A.	Robinson, Lawrence T.
Haedecke, August D.	Salstrom, Paul S.
Hafstad, Lawrence R.	Schroeder, Clarence A.
Hammond, Joseph A.	Schweppe, Walter A.
Hargrave, William A.	Scott, Franklin B.
Hart, Maurice W.	Sjoberg, Roy H.
Hartley, Lowell J.	Slaggie, Eucharius L.
Hilgedick, Winfred C.	Tholstrup, Henry L.
Holcomb, Harry S.	Tighe, James S.
Hummel, Carl	Walters, Robert P.
Irons, George R.	Wenrich, James R.
Jensen, Otto L. (B. A.)	Wentz, Edward C.
Joesting, Frederick D.	Williams, William R.

Bachelor of Science in Mechanical Engineering

Anderson, Wesley J.	Bennett, John C. (M. S. M. E.)
Bancroft, Henry K.	
Beek, Hiram D.	Bohannon, George W.
Burt, Paul B.	Maney, James E.
Cole, Ernest C.	Mask, George W.
Comfort, Clifford E.	Norrbom, Oscar E.
Corbett, Theodore R.	Nordenson, Willard H.
Dewaji, Gunaker	O'Donnell, Lawrence
DuBois, N. Warren	Pierce, Walter H.
Forsfeist, Carl H.	Pike, Jay B. (M. S. M. E. 1927)
Grant, Russell S.	
Hanna, Cyril C.	Roberts, Norman A.
Hass, Paul O.	Rollin, Harold E.
Kleinfeld, Leonard S.	Slaby, Louis J.
Letson, Donald E.	Tucker, Carl W.
Lundgren, Carl W.	

ADVANCED DEGREES

Civil Engineer

Coe, Edward H. (B. S. C. E. 1919)
Luxford, Ronald F. (C. E. 1917, M. S. 1925, Wisconsin)

Master of Science in Civil Engineering

Nichol, Frank E. (B. S. C. E. 1925)

1927

Bachelor of Science in Architecture

Anderson, Lawrence B.	Flegal, Al 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.	Melins, 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 R.	

Bachelor of Science in Civil Engineering

Bolnick, Harry Wm.	Lund, Stanley D.
Borne, Floyd O.	Matcroft, John Clifford
Borrowman, John Keeley	Morris, George Edward
Brattlof, Clifford	Murray, Harold E.
Briggs, Luerd E.	Norman, Henry Robert
Brohaugh, Gustave C.	Pajari, Tauno
Campbell, Douglas M.	Paulson, Joseph Bernard
Carlson, Elmer W.	Pearson, Einar Otto
Christianson, Elmer John	Pearson, Harold Theodore
Clark, Kenneth Miles	Peterson, Frederick G.
Crowell, Sidney Howe	Platzer, George John
Engler, Myer	Pohl, Loren Frank
Edlund, Roy Clinton	Preus, Christian K.
Gehring, Lester George	Riedesel, Russell Irving
Hagman, Walter Fred	Rosing, Donald Clay
Hoving, John E.	Ruth, Fred Louis
How, Francis Waldo	Santelman, Ralph Henry
Johnsen, Kenneth A.	Sperling, Abe J.
Johnson, Laurence Victor	Teske, Frederick Carl
Castner, Roy W.	Turrittin, Hugh Lonsdale
Lande, Clarence C.	Wentz, Clarence Arthur
Loethi, Carl Francis	Witt, Edward John
Loucks, Roger Brown	Youngquist, C. Vernon
Lundsten, Frank Rueben	Zuckman, George J.

Bachelor of Science in Electrical Engineering

Anders, Milton F.	Lange, George M.
Anderson, Henry Alvin	Lee, Albert Christian
Asphalt, Filip Johanson	Lee, Paul Raymond
Bailey, Stuart Lawrence	Leider, Albert E.
Barton, James Parker	Lewis, Lloyd W.
Beach, George	McDonnell, Lawrence P.
Berglund, Erick Bernard	McKesson, Lewis James
Berkner, Lloyd Biel	Miller, William S. E.
Byer, Randall K.	Moore, Gordon B.
Bezek, Albert	Moosbrugger, Frank John
Bonner, Arthur Lee	Moses, Marlowe Grant
Bottemiller, Edward L.	Nelson, Clarence Enoch
Boyce, Harold J.	Nergaard, Leon Severin
Brandt, Clifford Alois	Nielsen, Andres H.
Brayden, Giles William	Nolan, George Charles
Brightfelt, John Charles	Norberg, Hans A.
Bucowich, Paul	Ofelt, George R.
Burmeister, Charles H.	Osburn, Roy Wesley
Clark, Charles Stevens	Peters, Charles Max
DuBois, John Harry	Pilger, Clarence L.
Edgar, Robert Ferguson	Prehn, Victor Nicholas
Farmer, Herbert Fred	Rauscher, Paul Frank
Gibson, Robert	Redding, James A.
Heimer, Amos Kingsley	Ringstrom, George H.
Hortberg, Reynold Olof	Robinson, Richard Barton
Hovey, Bertram Kelsey	Rogers, H. Barrett
Johnson, Gustave F.	Scholz, Edmund Henry
Schultz, Albert W.	Ward, Stanley A.
Schulze, LeRoy Edward	Weber, Clyde
Smith, Jerome Conrad	Weeks, Leonard H.
Speer, Paul R.	Wehlitz, Hubert Frank
Sunblad, Everts William	Wenn, Laurel Allan
Swanson, Carl Everett	Whiteley, Howard Orville
Thompson, Niles J.	Witts, Seth Newton
Volkenant, Gordon W.	Woloshin, Boris
Wald, Joseph Harold	

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	Speir, 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, Gordon 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.	Kreger, Lynn S.
Beaudin, Lawrence A.	Lexau, Ole H.
Benson, Mons H.	McDanield, Laren A.
Bergford, John F.	McNally, Lee D.
Bolton, John M.	Matun, Rudolph
Daly, Frank A.	Meseron, Ben
Dreveskracht, Wallace W.	Normann, Olav. K.
	Olson, Clarence C.
Engstrom, LeRoy	Parker, Clyde H.
Erickson, Hugo G.	Prior, Charles H.
Erickson, Lloyd R.	Rinell, Eric A.
Ferguson, George E.	Ringwood, James B.
Frank, Carl W.	Rydeen, James P.
Gard, Donald L.	Schroepfer, George J.
Goldberg, Hymen	Silliman, Paul D.
Gustafson, J. Melvin	Tauber, Joseph H.
Johnson, Ralph P.	Tebo, Frank A.
Knox, Charles E.	Thwing, George Jr.
Kopp, David C.	Varisek, Jerry J.
Kopplin, Charles D.	Wielde, John A.

Bachelor of Electrical Engineering

Ackermann, Robert W.	Corliss, Charles V.
Anderson, Elwool C.	Dahl, Paul E.
Barnes, James C.	Elmburg, John C. W.
Benesovitz, Abe	Engquist, Emil B.
Braaten, Arthur M.	Fisher, George L.
Brown, Glendon C.	Fogelholm, Edward G.
Burris, Arthur P.	Frankovich, John J.
Christopherson, Arnold J.	Fredrickson, Edwin W.
Clousing, Lawrence A.	Froberg, Harold E.
Compton, Milton E.	Furber, Richard D.
Cook, J. Marvin	Grimm, Raymond E.
Cooper, Jack I.	Gustafson, Thor A.

Bachelor of Electrical Engineering

Hamilton, Sam R.
Harwick, Henry C.
Hawkins, George C.
Heywood, George L.
Holt, Gunnard T.
Holt, Leo G.
Hoover, Lloyd H.
Jarchow, Theodore L.
Johnson, Douglas O.
Johnson, Sheldon F.
Klammer, Kalmer K.
Koerner, Allen M.
Ketchevar, Joseph F.
Kriechbaum, John P.
Krieger, Keith M.
Kritzer, Louis W.
Larson, Seymour R.
Lende, Willard H.
Lee, Alfred H.
McCrea, John A.
*McIntire, Elmer E.
Neill, Clarence L.
Nogueria, Frederico P.
Ohman, Leo S.
Peterson, Randall J.
Peterson, Valgas N.
Riddell, Donald J.
Scivone, Anthony P.
Schliep, Carl J.
Seeger, Franklin H.
Sharpless, William M.
Sheire, James B.
Smeby, Lynne C.
Soderhelm, Lauren V.
Stevens, Donald T.
Stevens, Bruce E.
Stuart, Donald M.
Swanson, Carl E.
Sweeney, Frank C.
Thelin, Ruben E.
Towey, James M.
Young, Clifford L.

Bachelor of Mechanical Engineering

Angell, Glenn H.
Arko, Frank W.
Barthelemy, Carl R.
Blackmore, Frank E.
Blackshaw, Joe L.
Bowers, Raymond
Boyer, John
Burke, James J.
Dunning, Robert M.
Elliott, Merle B.
Fritzberg, L. Hilding
Gustafson, Hugo F.
Hathaway, Herbert F.
Hemenway, Edward L., Jr.
Japs, Wilbur H.
Knutson, Melvin I.
Kuznerek, Clement J.
Larson, Werner L.
Libby, Calvin R.
Lundquist, Wilton G. C.
McGladrey, Lyle L.
Mayhugh, Benjamin F.
Miller, Marvel P.
Nelson, Arthur
Ostrowske, Arthur B.
Pettersen, Wilber E.
Roberts, Henry M.
Robertson, Haney M.
Spotts, Herbert J.
Von Stocker, Selmer G.
Wood, Leslie L.

ADVANCED DEGREES

Master of Science in Civil Engineering

McKay, Earle Douglas (B. S. 1913, 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)
Thelstrup, 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.
Ben-Ora, Samuel
Hakenjos, Frederick M.
Hovik, Lawrence E.
Juran, Nathan
Leach, Stowell D.
Melzian, Milton W.
Nelson, Erling W.
Nelson, Lyle
Redmond, Fabian
Santo, Louis
Shiffett, Glynne W.

Bachelor of Architectural Engineering

Amundson, Leland R.
Anway, Fred L.
Berzelius, Carl E.
Cramsie, Kenneth J.
Dutcher, Lloyd L.
Fergestad, Marvin L.
Hansen, Oliver S.
Johnson, Laurence E.
Kline, Marvin L.
Foss, John A.
Schilken, Donald R.
Youatt, Glen R.

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
Jensen, 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.
Braun, 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.
Mlinarchik, 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.
Vardal, Victor K.
Vigness, Carl I.
Warnecke, 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.
Hever, Robert H.
Hoffman, Walwin H.
Ives, Kenneth S.
Johnson, Roy M.
Kuempel, Leon L.
Leegard, Clifford
Lockhart, Harold A.
Motzke, Walter W.
Moisesku, William
Nelson, Chester L.
Nickey, William E.
Norley, William H.
Peterson, Roy C.
Pfeifer, Otto L., Jr.
Read, Leland B.
Reed, Gordon
Reutiman, F. Rudolph
Rollin, Vern G.
Rowell, Lester J.
Sanders, Paul
Shannon, Harold R.
Sinnett, Irvine G.
Skanse, C. Theodore
Smilow, Leo
Smith, Rolf M.
Swanstrom, Carl Wm.
Tanner, Elo C.
TenBrook, Charles S.
Tiller, Louis
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 Delmer
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
Thien, Helen Marguerite
Wood, Inez Caroline

Bachelor of Civil Engineering

Antilla, George W.
Anderson, Rex Smith
Campbell, Vernon K.
Cheney, Russell S.
Chloupek, William V.
Clausen, Harold Luther
Crippen, Curtiss E.
Dimmitt, Bruce Stevens
Dominick, Karl H.
Hertel, Raymond Ernest
Hill, Erwin George
Johnson, Arthur R.
Kah, Benjamin J.
Kocian, Charles J.
Lieske, Harold William
Look, 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
Corvell, Harry Bahn
Cotton, Richard John
Diedrich, Erwin H.
Edgell, Earnest Ensign
Effertz, Orman George
Elmquist, Melvin Leslie
Elmstrom, Raymond E.
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 Boswell
Kloski, Leonard A.
Knauss, Edison Alton V.
Knudson, Manches Edward
Langenberg, George Willis
Lehnert, Walter E.
Lethert, Carl William
Lindfors, Onni
Madden, John Sidney
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.
Sieberns, Joseph Vincent
Sommermeyer, Karl H.
Sonial, Roman N.
Sparrow, Hubert T.
Spicola, James A.
Stewart, John F.
Stowe, George Edward
Swanson, Clarence
Thompson, William F.
Viehahn, 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

Schroeder, 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))

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)
*Creasy, 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)
Steppel, 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. 1913)
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)
Creasy, 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. Marr, Horace S.
Durham, Samuel W. Marshall, Olive W.
*Eckman, Lawrence R. Owens, Jay C.
*Egge, Walter Rask, Olaf S.
Markus, Benjamin

Bachelor of Science in Chemical Engineering

Burningham, Foster A. Luft, Oscar W.
(Ch. E. 1918) Strong, Frank D.
Domovsky, Aaron Washburn, Frederick M.
Higburg, William Widell, Gideon
Kuentzel, Ward E.

Chemical Engineer

Bell, Alexander D. (B. S. 1916)

Master of Science in Chemistry

Barrows, Vera (B. A. 1906)
Cade, Arthur R. (B. S. Worcester Polytechnic Inst. 1915)
Joyce, Floyd E. (B. S. 1912, Iowa)
Lauer, Walter M. (B. S. 1913, Ursinus College, Ph. D. 1924)
Ringstrom, Hugo (B. S. 1914, B. S. 1915)
Seyfried, Lillian M. (B. A. 1915)

Doctor of Philosophy

Daniels, Elmer A. (B. S. 1912, M. S. 1913)

1918

Bachelor of Science in Chemistry

Joselowitz, Goodwin Nelson, Harry G.
Kesselman, Leo Pan, Wen Ping

Bachelor of Science in Chemical Engineering

Donauer, Max (Ch. E. 1925)
Hogness, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 1919)
Kessel, Herbert (Ch. E. 1919)
Neilson, Chris

Chemical Engineer

Burningham, Foster A. (B. S. 1917)

Master of Science in Chemistry

Schultz, Peter D. (B. A. 1914, Bethel College)

Doctor of Philosophy

Pettijohn, Earl (B. A. 1906, B. S. 1911, M. S. 1912)
Sternberg, Woldemar M. (B. S. 1908, Petrograd, Russia)
Woollett, Guy H. (B. S. 1910, M. S. 1916)

1919

Bachelor of Science in Chemistry

Beckel, Arthur C. Heck, Frank J.
Brooks, Leslie C. Thorson, Stuart J.
Engstrom, Leslie G.

Bachelor of Science in Chemical Engineering

Fischer, Earl B. (Ch. E. 1923)
Greenlaw, Charles E.
Hawkey, Harold K. (Ch. E. 1919)
Koch, Arthur
Reu, Albrecht H. (Ch. E. 1920)
Winslow, Raymond (Ch. E. 1920)

Chemical Engineer

Hogness, Thorfin R. (B. S. 1918)
Hawkey, Harold K. (B. S. 1919)
Johnson, Donald Lee (B. S. 1918)

1920

Bachelor of Science in Chemistry

Hoff, John E.
Korfhage, Roy F.
Matthews, Glenn E. (M. S. 1921)
Moe, Claude P.
Pippel, Herbert A.

Bachelor of Science in Chemical Engineering

Anderson, Minton M. (Ch. E. 1921)
Busch, John S.
Fieger, Ernest A. (Ch. E. 1921)
Hammer, George E.
Jones, Ernest J. (Ch. E. 1921)
Kracek, Frank C. (Ph. D. 1924)
Mitchell, Donald F. (Ch. E. 1921)
Parrett, Arthur N. (Ch. E. 1921)
Pearson, Elmer A. (Ch. E. 1921)
Reck, Robert C. (Ch. E. 1921)
Sternberg, Heime A. (Ch. E. 1921)
Stoppel, Arthur E. (Ch. E. 1921, Ph. D. 1924)
Wallfred, Carl L. (Ch. E. 1921)
Weber, Ludwig J. (Ch. E. 1921, Ph. D. 1924)

Chemical Engineer

Reu, Albrecht H. (B. S. 1919)
Winslow, Raymond M. (B. S. 1919)

Master of Science in Chemistry

Morse, Minerva (B. A. 1915, Ph. D. 1925)
Plummer, Clayton E. (B. C. E. 1914, Michigan)

1921

Bachelor of Science in Chemistry

Cori, Cady S. Riley, Philip J.
Epstein, Hymen (M. S. 1924)
Kryger, Edward R. Seymour, Merrill W.
Nygard, Edwin M. Westerberg, Carl G.

Bachelor of Science in Chemical Engineering

Aronovsky, Samuel I. (Ch. E. 1922)
Boxell, Morris L.
Cornell, Reuben W. (Ch. E. 1922)
Lee, Melville R. (Ch. E. 1922)
Leerskov, Gerhard W.
Nicholson, Harry G.
Peterson, Marshall A. (Ch. E. 1922)
Ramsey, Selmer
Riddington, Frederick W. (Ch. E. 1922)
Roberts, Wesley J. (Ch. E. 1922)
Ruchhoft, Clarence
Schermer, Oscar C. (Ch. E. 1922)
Swart, Richard H.

Chemical Engineer

Anderson, Minton M. (B. S. 1920)
Fieger, Ernest A. (B. S. 1920)
Jones, Ernest J. (B. S. 1920)
Mitchell, Donald F. (B. S. 1920)
Nicholson, Harry G. (B. S. 1921)
Parrett, Arthur N. (B. S. 1920)
Pearson, Elmer A. (B. S. 1920)
Reck, Robert C. (B. S. 1921)
Sternberg, Heime A. (B. S. 1920)
Stoppel, Arthur E. (B. S. 1920, Ph. D. 1924)
Wallfred, Carl L. (B. S. 1920)
Weber, Ludwig J. (B. S. 1920, Ph. D. 1924)

Master of Science in Chemistry

Hauge, Sigfred M. (B. A. 1918, St. Olaf)
Hovland, Clifton R. (B. A. 1919, St. Olaf)
Kohlhase, Arthur H. (B. S. 1919, Hamline, Ph. D. 1924)
Matthews, Glenn E. (B. S. 1920)

1922

Bachelor of Science in Chemistry

Darling, Stephen F. (M. S. 1924)
Ellestad, Reuben (M. S. 1924)
Hammond, Kathryn D. (Mrs. K. E. Kelley)
Sullivan, Betty
Tappan, Ruth W. (Mrs. Joseph Dowling)

Bachelor of Science in Chemical Engineering

Barrett, Joseph O. (Ch. E. 1923)
Busch, William A.
Cassel, Norman S. (Ch. E. 1923)
Chadbourne, L. Rodney (Ch. E. 1923)
Halvorson, Halvor O. (Ch. E. 1923)
Langseth, Axel O. (Ch. E. 1923)
Livermore, Harvey J.
Luger, Karl E.
Manuel, Douglas R.
Morin, William T. (Ch. E. 1923)
Morken, Carl H.

Bachelor of Science in Chemical Engineering

Schwartz, Marcel M.
Stone, Leslie F. (Ch. E. 1923)
Wyman, LeRoy L. (Ch. E. 1923)

Chemical Engineer

Aronovsky, Samuel I. (B. S. 1921)
Cornell, Reuben W. (B. S. 1921)
Lee, Melville R. (B. S. 1921)
Peterson, Marshall A. (B. S. 1921)
Riddington, Frederick W. (B. S. 1921)
Roberts, Wesley J. (B. S. 1921)
Schermer, Oscar C. (B. S. 1921)

Master of Science in Chemistry

Fulermer, Jervis M. (B. S. 1920, Washington State College)
Harris, Elmin E. (B. S. 1921, Hamline)
Heisig, Lucille Krantz (B. A. 1919)

Doctor of Philosophy

Hartshorn, Elden B. (B. S. 1912, Dartmouth)

1923

Bachelor of Science in Chemistry

Kamps, 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. 1915, 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.
Haugerud, Parmelee 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, Vion 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.)
Fagel, 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

Blasjo, Herbert Helmer
Goldberg, Will Mordecai
Hansen, Theodore Bruce
Hargrave, 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.
Studola, 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 Dolan
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

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Hanke, Carl C. '20 C
Hart, Maurice W. '26 E
Hartman, Philip F. '25 C
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
Hortberg, Reynold '27 E
Houston, Cecil C. '09 C
Howatt, John '04 E
Hubbell, Arthur C. '14 M, '15 ME
Husebv, Gisle E. '24 E
Irons, Roy C. '27 M
Johnson, Albert W. '23 C
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
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
Kuefler, E. L. '29 E
Lambie, Horace '23 E
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
Lindquist, O. J. '26 E
Linhoff, Carl H. '22 E
Lipchick, A. A. '26 C
Little, Fred W. '27 M
Lonie, James '97 M
Lund, Clarence V. '26 C
Lynskey, Joseph P. '26 E
McConnell, Edmund S. '24 E
McCrady, Archie R. '24 C
McCrea, John A. '28 E
McGimsey, Wm. J. '28 AE
McLean, Milton '21 G
McMillan, Franklin R. '05 C
Manuel, Earle V. '07 Ch
Martin, Edmund W. '12 Ch.E.
Mayeron, Ben '28 C
Meagher, Joseph '25 E
Meffert, George H. '30 C
Messer, Harold D. '23 M
Miller, William S. E. '27 E
Moosbrugger, Frank J. '27 E
Moreno, Gerardo '23 E
Morris, John O. '88 M, '03 ME
Nelson, Paul E. '26 E
Nelson, W. K. '13 Ch
Newbery, Lester W. '22 C
Nielson, Andres '27 E
O'Brien, John E. '97 M
O'Brien, Thomas E. '23 C
Olson, Armin G. '22 E
Olson, Kenneth M. '25 C
Olson, Roy H. '23 E
Overholt, Harley G. '10 C
Owens, Jay C. '17 Ch
Park, James L. '27 AE
Peterson, Albert E. '19 E
Peterson, Clarence R. '25 C
Pierson, Joe W. '19 E
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
Rickman, Herman W. '17 C
Roberts, Henry M. '28 M
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
Russell, Winfred W. '23 E
Sandberg, Clifford H.
'26 C, '29 MS (CE)
Sauzen, 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
Sheckman, Harvey Z. '24 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
Stoner, Clifford M. '24 C
Strate, Thomas H. '01 C
Sundblad, Everts W. '27 E
Swanson, Carl W. '29 M
Swenson, C. O. '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
Treka, 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
Weeks, Wm. C. '94 E
Wehlitz, Hubert F. '27 E
Wheeler, R. B. '27 ChE
Williams, Myrl J. '20 M
Williams, Percival H. '22 E
Wills, Arthur D. '21 A
Wills, David C. '23 E
Winkenwerder, E. E. '25 E
Wyly, Lawrence T. '20 G
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
Johnson, 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
Eckenbeck, Everett E. '17 E
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
Highland Park
Pardee, Charles A. '12 E, '13 EE
Hinsdale
Holmstine, Ralph D. '24 M
Homewood
Sommerfeld, Adolph A. '10 C
Teberg, Ernest J. '16 E, '17 EE
Joliet
Davis, Charles A. '05 E
Halbkat, F. J. '26 C
McCoy, Ira C. '11 E
Merritt, Alva W. '22 E
Peck, Lloyd '23 C
Pierce, Walter H. '26 M
Lanark
Hoffman, John R. '26 C
Maywood
Peoples, John S. '14 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
Peoria Heights
Letson, Donald E. '26 M
Riverside
Williams, Arthur H. '19 M
Robinson
Uzzell, George W. '07 E
Rockford
Underhill, Edith '25 MS Ch
Rock Island
Franks, Geo. E. '29 E
Springfield
Braga, Felix J. '30 E
Gard, Donald L. '28 C
Norelius, Emil F. '08 M
Peterson, Neander E. '22 C
Zuckman, Geo. J. '27 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
Winnetka
Bruce, G. Norman '23 ChE
Wood River
Anderson, Alvin P. '23 Ch

INDIANA

Booneville
Johnson, Clarence C. '26 E
East Chicago
Spotts, Herbert '28 M
Evansville
Johnson, Roy M. '29 M
Olson, C. Milford '24 C
Fort Wayne
Bayers, Donald R. '30 E
Beveridge, Robert A. '26 E
Ellis, Carl E. '25 E
Fisher, Geo. '28 E
Langenberg, George W. '30 E
Larson, Seymour R. '28 E
Lee, Alfred H. '28 E
Richardson, Philip E. '25 E
Shannon, Harold R. '29 M
Soderholm, Lauren V. '28 E
Warneke, Roman '29 E
Gary
Cottingham, William P. '11 C
Frederickson, Hubert M. '22 ChE
Helzeth, Paul A. '29 C
Indiana Harbor
Merten, Howard V. '14 Ch
Indianapolis
Abrahamson, Arthur L. '29 E
Highburg, Wm. '17 ChE
Kedols, Hugo V. '30 M
Prentice, Robert S. '08 E
Skytte, Ernest E. '10 E
Wagner, Adolph '98 E
LaFayette
Hauge, Sigfred M. '21 Ch
W. LaFayette
Heyer, Robert H. '29 M
South Bend
Mehandru, Behari L. '24 M
Muessel, Robert W. '21 C
Speedway
O'Brian, Maurice '30 M
Valparaiso
Lauritzen, Carl W. '24 E
Whiting
Malmgren, Richard C. '25 E
Selund, Robert B. '30 ChE

IOWA

Algona
Young, Clifford L. '28 E
Ames
Willis, Benjamin S. '17 E
Boone
Lantz, Reuben '25 A
Cedar Rapids
Blomquist, Hjalmar '07 C
Stanius, Godfrey '21 E
Triem, Ralph H. '30 E

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 F. '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
Schweppe, Walter A. '26 E, '28 MS (EE)
Eldora
Cribbs, Harry E. '23 C
Humboldt
Christen, Ray L. '26 E
Independence
Dunlap, Geo. M. '24 E
Iowa City
Nelson, Martin E. '24 C
Janesville
Wild, Carl D. '15 C, '16 CE
Marion
Christianson, Hilmer B. '15 C
Marshalltown
Weatherill, Cedric '14 C, '15 CE
Ottumwa
Smith, Leighton H. '03 C
Sioux City
Autilla, George W. '30 C
Arzt, Emmanuel A. '97 E, '99 EE
Donner, Max '18 ChE
Kah, 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

Arkansas City
Kerakamp, Lloyd F. '30 Ae
Atchison
Hastings, Clive '96 M
Baxter Springs
Black, Peter P. '14 E
Kansas City
Rodert, Lewis A. '30 Ae
Manhattan
Graham, Eugene C. '02 E
Pittsburg
Woodman, Howard H. '97 C
Wichita
Schultz, Peter D. '18 Ch
Winfield
Beck, Vernon S. '10 E

KENTUCKY

Ashland
Porter, Ralph E. '13 ChE
Barbourville
Dyer, Walter S. '25 OCh
Dublin
Donahue, Stephen '25 C
Louisville
Ernst, Robert C. '23 ChE
King, Harvey '18 A
Smith, Allan S. '26 ChE

LOUISIANA

Baton Rouge
Fieger, Ernest A. '20 ChE
Marrero
Fleming, Douglas R. '08 C
New Orleans
Hilgedick, W. C. '26 E
Schleuk, Hugo '18 E

MAINE

Portland
Ferguson, K. R. '26 E

MARYLAND

Annapolis
Winslow, Harry J. '25 E
Baltimore
Billau, Lewis S. '05 E
Grambos, 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
Groat, Benjamin '08 LLB, '11 LLM, '01G
Grossman, Frederic B. '28 A
Nebel, Walter H. '11 E
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
Darling, Stephen F. '22 Ch
Fuson, R. C. '24 PhD
Huchthausen, Walter '28 A
Ludwig, L. G. '24 Ch
Plowman, George T. '92 A
Sternberg, W. M. '18 PhD
Chicopee Falls
Briggs, Maynard K. '29 E
Barton, James P. '27 E
Tholstrup, Henry L. '26 E, '28 MS (EE)
Franklin
Tomlinson, L. C. '04 E
Lynn
Freeman, R. C. '29 E
Lilja, Oscar L. '30 M
Suhr, Fred W. '29 E
Northampton
Morse, Minerva '20 Ch
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
Walpole
Forssell, William O. '22 G
Winthrop
McVean, Norman S. '21 E

MICHIGAN

Ann Arbor
Badger, W. L. '08 Ch
Dow, William G. '16 E, '17 EE
Jakkula, Arne A. '26 C, '27 MS (CE)
Orbeck, Martin J. '11 C
Rogers, Marvin '26 ChE
Dearborn
Hoppin, Glenn H. '08 E
Detroit
Ascher, Raymond C. '23 M
Babcock, Vernon M. '23 E
Baldock, Fred C. '29 M
Brewster, William E. '12 E, '13 EE
Brooke, Harold L. '18 E
Bull, Alvah Stanley '27 A
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
Hunsoon, Milton B. '99 E
Kuehler, Edwin F. '24 M
Loye, Benjamin W. '06 M
Lundquist, Reuben A. '05 E
Malmstrom, Axel L. '17 E
Mitchell, L. Morris '14 C, '15 CE
Nelson, Elmer A. '23 C
Peterson, Garvin E. '25 C
Rand, Lars '12 M, '13 ME
Richardson, Ralph A. '27 M
Riddington, Fred W. '22 ChE
Shepard, Donald D. '11 E
Souba, John I. '25 M
Stoehle, Haswell E. '24 M
Swart, Richard H. '21 ChE
Vorisek, Jerry '28 C
Walker, Geo W. '89 Ch
Webster, Cora Helen '23 Ch
Wennerlund, Elias K. '99 M
Wilk, Benjamin '13 C, '14 CE
Flint
Anderson, Joseph A. '24 M
Lemon, Harold J. '27 M
Murray, John H. '17 M
Rhame, Paul W. '20 M
Shuirman, Gabe '21 E
Simms, Charles G. '24 M
Grand Rapids
Benson, Mons '28 C
Lyon, Glenn H. '20 A
Mahoney, William L. '13 E, '14 EE
Nelson, Edwin W. '25 C
Tallmadge, Hiram '16 E, '17 EE
Houghton
Reed, Henry R. '25 E, '27 MS (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
Kalamazoo
Blodgett, Chas. L. '24 M
Laurium
Swanson, Philip C. '23 M
Midland
Edmunds, Alvin M. '25 ChE
Lux, Albert R. '28 Ch
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
Annandale
Seegar, Franklin H. '28 E
Anoka
Reed, Arthur L. '06 C
Thurston, Harold H. '13 C, '14 CE
Atwater
Molin, Kenneth '29 C
Swenson, Charles A. '07 C
Austin
Crippen, Curtiss E. '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
Croswell, Leslie D. '26 C
Hallady, Leslie L. '21 C
Hendrickson, C. Edward '25 C
Jones, Harold W. '25 C
Breckenridge
Brataas, Mark '17 C
Holmgren, Charles E. '09 M
Buhl
Anderson, Ole A. '93 M, '98 ME
Butterfield
Roney, Donald '29 E
Campbell
Gran, Conrad L. '29 E
Carlton
Nickerson, Neal C. '18 C
Center City
Porter, Earl L. F. '31 C
Kingstrom, 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
Olson, Elmer J. '23 C
Cloquet
Aronovsky, S. I. '22 ChE
Carlson, Clifton C. '27 M
Glenn, Harry W. '24 ChE
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
Crosby
Wood, Victor R. '22 C
Delano
Brunkow, Herbert E. '12 ChE
Detroit Lakes
Chilton, Edw. G. '13 C, '14 CE
Shepard, Lewis S. '31 C
Duluth
Anderson, Milton J. '20 A
Bishop, Ira L. '11 M
Bradbury, Margaret R. '28 IA
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
Ellefson, Selmer '16 E
Fee, E. Franklin '07 M
Fredrickson, F. C. '29 C
Friedman, Edwin A. '23 E
Grabek, Rosabelle '29 IA
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
Hoffman, Walwin H. '29 M
Hustad, Byron F. '10 E
Jaques, Robert '09 C
Johnson, Donald L. '15 Ch E
Kapphahn, R. J. '12 C, '13 CE
Kelly, Earl W. '07 C
Knutson, Harry '17 M
Kusmierek, Cleset J. '28 M
Larson, Victor F. '17 M
Lostrom, Herbert W. '26 E
Luft, H. L. '24 Ch MS
McEachin, John L. '22 E
Matzke, W. W. '29 M
Melander, Albin R. '21 A
Mork, Geo. W. '26 M
Nelson, Edward K. '24 M
Nelson, Einer '24 M
Olin, Henry A. '23 E
Ostrouske, Arthur B. '28 M
Pawlak, Frank J. '30 E
Peterson, Floyd D. '30 AE
Peterson, George T. '08 M
Pulver, Richard F. '23 E
Quinn, John '08 C
Ringsted, 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
Solarow, Abraham '23 C
Simmonds, Richard R. '21 C
Sneve, Jack S. '11 M
Spring, Willis W. '07 M
Swift, Donald C. '24 E
TenBrook, Charles '29 M
Tennstrom, Carl H. '23 C
Tondell, Mandell '07 C
Turnquist, Axel A. '16 E, '17 EE
Waits, James G. '29 C
Weber, Eugene W. '30 C
Williams, Roy N. '23 E
Wilson, Walter E. '24 C
East Grand Forks
Dahlberg, A. V. '05 AC
Elk River
Deegan, Raymond C. '26 C
Longfellow, Dwight W. '08 C
Normann, Rolf A. '24 C
Ely
Boccowich, Paul '27
Brouillette, Theodore R. '31 A
Kauppinen, Heino '25
Pearson, Elmer A. '20 Ch

EVELETH
Nastlund, Gustave A. '26 A
Ohman, Leo S. '28 E
EXCELSIOR
Schneider, Frank M. '27 M
Schuck, Roy D. '25 E
FAIRMONT
Coult, Lyman H. '25 ChE
Curtis, Thomas H. '12 C
Eustis, Irving N. '17 M, '18 ME
Kasper, Walter '11 M
Katz, 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
Frankovitz, John J. '05 E
Hallan, Christian '02 C
Johnson, Carl J. '14 E, '15 EE
Steiner, Edmund F. '29 E
Straub, Wm. '29 ChE
Young, Jos. E. '21 G
GAYLORD
Deterling, Edward W. '26 E
GLENCOE
Hankenson, John J. '92 C
GRACEVILLE
Hartnett, John G. '11 Ch
GRAND MEADOW
Grimm, Raymond E. '28 E
GRAND RAPIDS
Skagerberg, Rutcher '15 E, '16 EE
GRANITE FALLS
Lende, Henry M. '20 C
HALSTAD
Forseth, George O. '25 M
HASTINGS
Solberg, Mirl C. '29 C
HENDRICKS
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
HOMER
Ramsden, A. M. '29 Ch
HOPKINS
Anderson, Harvey R. '12 C, '13 CE
Knuth, Lloyd V. '30 Ae
Norman, Allan K. '28 C
Shellenbarger, L. R. '30 C
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
Wilson, Roy A. '25 M
JACKSON
Berner, John A. '30 E
JANESVILLE
Santo, Lewis W. '29 A
KEEWATIN
Bingen, William J. '12 C, '13 CE
Leech, Edward W. '10 C
LAKE CITY
Christilaw, George '31 C
Martin, Curtis K. '31 G
Tews, Arthur W. '24 C
LAKE PARK
Watland, Maynard B. '29 M
LANESBORO
Ellestad, R. B. '24 MS
LE ROY
Meyers, Clare '28 AE
LESUEUR
Crowell, Sidney '27 C
Odquist, Carl '23 C
Weis, Wallace D. '21 C
LITCHFIELD
Gehring, Lester G. '27 C
LITTLE FALLS
Donahoe, Robert E. '21 E, '22 EE
Grettum, Walter '24 E
Ryan, Loiel S. '12 C, '13 CE
LONG LAKE
Kelley, William '22 C

MADISON
Clausen, Elmer W. '23 E
MANKATO
Gerlach, W. D. '26 A
Kleinschmidt, Armin R. '22 M
Neilson, Chris '18 ChE
MANTORVILLE
Brossard, Henry F. '25 E
Meskal, George '23 C
MAPLE PLAIN
Compton, Milton '28 E
MAPLETON
Borchert, Oscar H. '25 E
MARINE-ON-ST. CROIX
Gray, Wesley '29 E
MARSHALL
Neill, Clarence L. '28 E
MAYNARD
Johnson, Alexander B. '93 C
MILACA
Johnson, Nels '23 C
MINNEAPOLIS
Aasland, Christopher '15 C
Aasland, Arne '23 C
Abbott, Amos H. '16 E, '17 EE
Abramson, Harry W. '23 C
Adams, Edward H. '22 G
Adams, John W. '12 C
Affleck, Dean H. '28 AE
Akins, Clifford M. '27 M
Alderson, Anthony D. '29 C
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
Andrus, Raymond J. '07 E
Arstad, Leonard O. '24 E
Asfalt, Filip J. '27 E
Aske, Irving E. '20 E
Adeson, Hans '10 C
Austin, Paul D. '21 E
Ayers, E. B. '25 Ch
Bacheider, William H. '24 C
Bachmann, G. A. '23 M
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
Barber, Hervey H. '26 PhD
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
Bester, George C. '24 C
Bevan, R. Louis '24 C
Bleecker, George W. '16 E
Bliven, Paul '27 M
Blosjo, Herbert '23 Ch
Blue, Clarence W. '25 C
Bochnlein, Charles '17 M, '19 ME
Boerner, Francis C. '11 C
Bordeau, Sanford P. '25 E
Boyce, H. J. '27 E
Boyce, John '28 M
Boyce, Norman '27 E
Boyum, Irvin '17 E
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
Brose, W. C. '23 C
Brown, Floyd W. '17 A
Brown, Homer '30 E
Brownell, Otto E. '10 C
Bruce, Hjalmar N. '16 C, '17 CE
Brunet, James A. '30 A
Bullis, Everard J. '24 C
Burch, Albert M. '96 C
Burch, Edward P. '92 E, '98 EE
Burlingame, Robert E. '25 E
Burnett, H. V. '14 C
Burris, Arthur '28 E
Burt, Paul R. '26 M
Burtis, Wm. '92 E
Busch, J. S. '20 ChE
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
Caribum, Leonard H. '25 C
Carlson, Loraine A. '30 IA
Carlson, Clifton C.
'27 M, '29 MS (ME)
Carlson, C. Philip '21 E
Carr, Harvey '03 C
Carter, Robert J. '08 E
Carter, Ruth '29 IA
Caswell, Thomas B. '25 M
Cayola, Chester L. '28 A
Cerney, Glen C. '20 M
Chadbourne, L. R. '23 ChE
Chalek, Isadore '30 E
Chalmers, Charles H.
'94 E, '03 EE
Chermus, Maurice C.
Christensen, Arthur L. '25 E
Clark, John S. D. '22 M
Close, Winston '27 A
Clousing, Lawrence A. '28 E
Cohen, Lillian '00 Ch
Collins, Stewart G. '04 G
Colvin, James A. '14 M, '15 ME
Comb, Fred R. '10 M
Cooper, Leo H. '06 E
Corbett, Theodore R. '26 M
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. '95 C
Dahlstrom, Raymond E. '10 E
Damberg, Paul S. '22 A
Danielson, Thomas Lester '00 M
Davidson, Henry A. '27 AE
Davies, Edwin T. '07 ChE
Davies, Ralph M. '09 E
DeVaney, Grace M. '26 Ch
DeVoy, Wm. T. '29 E
Deane, George B. '19 A
Del Plaine, Carlos W.
'21 C, '22 CE
Deneen, Davis J. '19 A
Dewars, Allen G. '13 E, '14 EE
Dimeut, J. Morton '24 E
Doell, Charles E. '16 C, '17 CE
Doepke, Chris '29 M
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, 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, '05 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
Fergestad, Marvin L. '29 AE
Firth, Charles V. '23 ChE
Fischer, Earl B. '19 ChE
Fischer, Harold W. '23 E
Fitzgerald, W. George '30 E
Fitzgerald, William J. '20 C
Flaaten, Percy H. '26 C
Flindt, Richard H. '23 C
Foker, Leslie W. '28 ChE
Ford, Robert E. '95 E, '03 EE
Forfar, Donald M. '09 M
Forsberg, Enock E. '18 A
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
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
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, John W. '29 C
Gray, William I. '92 E, '98 EE
Green, Chauncy L. '24 E
Greiner, Harry S. '24 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
Halvorson, Halvor O. '22 ChE
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 F. '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
Harwood, S. G. '08 M
Hawkins, Harvey C. '23 E
Hayden, John F. '90 C
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
Hibbard, Truman '97 E
Hickok, Mrs. Harvey
(Miss Jesse E. Stevens)
'96 G, '04 MS

MINNEAPOLIS
Hildebrandt, H. A. '99 E
Hill, Edward L. '25 E
Hirleman, Clark W. '12 M, '13 ME
Hobart, Walter B. '07 C
Holcomb, Harry S. '26 E
Holien, Gilman '28 A
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
Hulin, 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
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
Jakkula, Arne A. '26 C, '27 MS (CE)
Jarchow, Theo. '28 E
Jennings, Gordon J. '31 C
Jensen, John A. '03 C
Jerabek, Henry S. '26 ChE
Johnson, Alphonse N. '21 C
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, 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, Theodore B. '29 C
Johnston, Charles K. '21 E
Jones, Edwin F. '17 M
Jones, E. J. '21 ChE
Jones, George R. '14 E, '15 EE
Judd, Maurice D. '23 C
Kameda, Tohru '26 ACh
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
Katter, Reuben L. '23 M
Kendall, Donald B. '30 E
Kinsell, William L. '00 E
Klass, Fred '19 E
Kline, Frank W. '24 E
Kline, Marvin L. '29 AE
Kloski, Leonard A. '30 E
Knauss, Edson A. V. '30 E
Knoll, Franklin O. '25 E
Knutson, Melvin I. '28 M
Kobe, Kenneth A. '26 ChE
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
Krohn, Henry J. '31 C
*Kritzer, Louis M. '28 E
Kronick, T. Gerald '26 A
Kuempel, Leo L. '29 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
Langseth, Karl H. '27 Ch
Larson, Amandus C. '20 C
Larson, Carl '16 C
Lauer, Walter M. '24 PhD
Laurence, Paul A. '13 G
Lavine, Irwin '24 Ch
Leach, Stowel D. '29 A
Lebeck, Carl E. '20 C
Lebeck, Torstin 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
Lethert, Carl W. '30 E
Leveus, Alexander S. '22 C, '24 MS (CE), '27 CE
Levin, Jake M. '18 E
Lewis, George R. '21 M
Lewis, Lloyd W. '27 E
Liebenberg, J. J. '16 A
Lindstedt, Philip G. '26 C
Liu, Maolin '29 E
Lohn, Robert N. '29 C
Loudon, William '29 E
Lowther, Wilfred W. '27 M
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. '13 E
Lux, Lester L. '27 Ch
McClung, Karl '25 E
McCullough, Bruce M. '16 C
McDonnell, L. P. '27 E
McGladrey, Lyle '28 M
McIlvaine, Wm. D., Jr. '29 E
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
Martino, A. D. '25 M
Mattison, Oliver '05 C
Mayer, Harris J. '14 M, '15 ME
Meili, Rudolph E. '22 G
Melkus, L. A. '30 A
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
Mowery, Clarence W. '08 C
Moyer, A. F. '10 M
Mullen, Francis E. '30 AE
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, Neal N. '27 AE
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
Nielsen, Eunice V. '23 A
Nissenson, Phineas F. '29 E
Noble, John F. '21 G
Noble, Theodore G. '30 AE
Nordenson, Arnold '22 M
Nordlien, Berger W. '22 E
Nordstrom, Milton E. '25 C
Nordvall, Glenn '23 E
Norman, Vernon R. '30 E
Norman, Henry '27 C
Northom, Oscar '26 M
Northfield, Glenn H. '30 M
Nygard, E. M. '21 Ch
Nyvall, Clifton S. '26 C
Olmstead, Charles '22 M, '23 ME
Olsen, Leslie R. '15 Ch
Olsen, Melvin S. '08 C
Olson, Edwin E. '25 A
Oman, Lloyd I. '29 E
Orning, Harold '26 E
Orr, George M. '15 M
Osburn, Roy W. '27 E
Otterstein, Earl F. '13 Ch
Ovestrud, Melvin '13 M, '14 ME
Pagel, H. A. '23 MS Ch
Parker, Robert M. '24 C
Parry, John E. '26 E
Parten, Carl D. '27 M
Patterson, Donald M. '31 Ae
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
Pfeifer, Otto J. '29 M
Pilger, Clarence L. '27 E
Powell, Louis H. '24 C
Pratt, B. A. '15 C
Prendergast, Arthur '03 C
Prichard, Charles E. '25 C
Priedeman, George W. '03 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
Reidhead, Frank E. '93 E, '98 EE
Reiter, A. A. '25 Ch
Rhoades, Herbert E. '26 E
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, Melner '30 E
Ryan, Robert M. '23 E
Ryan, W. T. '05 E
Rykken, Nordahl T. '29 C
Salisbury, Willis B. '10 G
Sandness, Erling '30 C
Sarver, Landon A. '15 BA, '19 MA, '24 PhD
Saxon, Paul M. '29 E
Scandling, Joseph E. '25 ChE
Schavone, Anthony P. '28 E
Schaller, Louis M. '29 C
Schilling, Theodore '24 E
Schlaige, Wm. H. '26 ChE, '27 KE
Schleuk, John J. '23 C
Schow, Garfield G. '24 E
Schultz, Albert W. '27 E
Schumacker, Maurice J. '31 C
Schweiso, Clifford C. '23 E
Scott, Leonard D. '30 ChE
Scott, Herbert L. '23 E
Sebo, Arthur O. '24 M
Seeman, Ernest '20 C
Seyfried, Lillian M. '17 Ch
(Mrs. W. H. Hunter)
Shavor, George J. '25 E
Shenehon, Francis '95 C, '00 CE
Shepley, Charles R. '02 C
Shifflet, Glynne W. '29 A
Shippam, Willis '09 M
Shoemaker, Douglas H. '29 C
Sieberns, Joseph '30 E
Siegmann, Chester W. '20 E
Silverman, Emil '22 C
Silverman, Isadore W. '24 A
Sinnott, I. G. '29 M
Siverson, Sigvel J. '11 C
Siverts, Samuel A. '09 C
Skurdalsvold, P. '15 C, '16 CE
Skanse, C. Theo. '29 M
Smoby, Lynne C. '28 E
Smith, Harold D. '25 E
Snyder, Dorothy E. '26 M
Solomonson, Lawrence D. '25 E
Sorenson, B. E. '24 MS
Sosbnik, Edward J. '22 C
South, W. A. '12 C, '13 CE
Sparrow, Hubert T. '30 E
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. '31 ChE
Stewart, John P. '30 E
Stevens, Everett R. '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
Swanson, Paul H. '23 C
Swanstrom, Frank N. '08 E
Swedberg, M. Roy '11 C
Swenson, Gustav A. '20 C
Swenson, H. Seymour '12 C, '13 CE
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
Tindall, Jesse E. '25 ChE
Tinkham, Willis M. '14 ChE
Todd, Milo E. '09 E
Terrance, 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. '08 E
Untinen, August L. '25 E
Upton, Albert '25 E
Vaule, Sven A. '21 M
Vigness, C. Irwin '29 E
Vincent, Jay C. '03 E
Walby, Arthur C. '11 C
Walker, George W. '08 C
Wall, Cyril T. '30 E
Wallace, Bruce V. '30 A
Wallfred, Carl L. '30 ChE
Walling, Benjamin B. '09 E
Wang, Clarence '30 A
Wanless, Lynn A. '12 Ch
Warren, Robert E. '30 E
Watson, Fred O. '16 C
Webber, Fredrick W. '97 ChE
Weber, Ludwig J. '24 PhD
Webster, Cora H. '23 C
Webster, Donald W. '13 C, '14 C
Weigel, Howard N. '14 C, '15 C
Wentz, Walter W. '14 E, '16 E
Werdenhoff, James H. '21
Wessel, Hans J. '30
West, Jane '29 I.
Westerberg, Carl George '21 C
Westigard, Glenn A. '25
Weyer, H. R. '29
Wherland, Fred C. '30
White, Robert H. '23 Ch
Whited, Orie O. '98 C
Whitney, Alfred C. '03
Wilcox, Hugh B. '14 E, '16 M
Wilhoit, Albert D. '06 C
Wilkinson, Gladness E. ID '2
Wilson, Charles A. '22
Wilson, Eliel '01 M, '02
Windus, Ray F. '30 Ch
Witts, Seth N. '27
Winslow, Raymond M. '19 Ch
Woehler, William L. '07
Wood, Inez C. '30 I
Wood, Leslie L. '28
Woodrich, Oscar '08
Young, Donald '29
Young, Edward F. '26
Zeidlik, William J. '25
Zeuthen, Victor C. '29
Ziegler, Mildred R. '15
Ziegler, R. Dale '30 C
Zima, Albert G. '24 C
MONTEVIDEO
Hecht, Henry W. '24
Lewis, Berkeley R. '25
Scott, Lawrence '15 E, '16
MONTGOMERY
Soulek, Joseph H. '1
MOORHEAD
Hopeman, Albert M '0
MOOSE LAKE
Handschu, C. E. '1

Mora
- Hanna, Cyril C. '26 M

Morris
- Thompson, Claudius A. '22 C

Newport
- Knight, Ralph J. '15 C

New Ulm
- Backus, 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
- Hosfield, Raleigh '12 C
- Sweeney, Frank C. '28 E

Pelican Rapids
- Ranger, Donald R. '24 C

Perham
- Pancratz, Frank J. '08 E

Pine City
- Peterson, Volgar '28 E

Pine Island
- Fahy, Francis M. '31 C

Plainview
- Askew, Thomas A. '16 C

Proctor
- Bohannon, George W. '26 M
- Swanson, Clarence '30 E

Red Wing
- Cook, Harry C. '10 M
- Gustafson, R. F. '27 A
- Josephson, Eliot B. '10 E
- Wiescke, Reuben C. '30 C

Red Wood Falls
- Burmeister, Charles '27 E
- Carsberg, Edgar '30 E
- Clipfell, Carroll D. '05 M

Rochester
- Aldrich, Louis W. '23 C
- Boyce, Ellsworth R. '17 C
- Bross, Peter F. '25 A
- Buenger, Edgar '19 A
- Heck, Frank J. '19 Ch, '24 MS
- Leonard, Aubrey C. '23 C
- Nelson, Mark L. '24 A
- Pagenhart, Clarence C. '12 C
- Stromberg, Hans R. '29 ChE

Rush City
- Strom, Arthur '23 A

Rushford
- Engh, Harris S. '24 M

Sauk Rapids
- Gross, Leon A. '26 E

St. Cloud
- 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
- Slaby, Louis J. '26 M
- West, John C. '15 C

St. Paul
- Abrahamson, Howard B. '17 M
- Albrecht, Ernest G. '25 EE
- Anderson, H. M. '20 M
- Andrews, George L. '05 M
- Arnesen, Herbert P. '11 C
- Angell, Glenn H. '28 M
- Aure, Roy '22 M
- Backe, Edmund '24 ChE
- Baker, Russel E. '11 ChE
- Banovetz, John A. '25 C
- Barlow, Harry E. '03 C
- Barnaby, William E. '09 Ch
- Barrett, Joseph O. '22 ChE
- Barthelemy, Carl R. '28 M
- Beauden, Lawrence '28 C
- Beck, Hiram D. '26 M
- Beese, Harold U. '25 C
- Bennett, John C. '26 M
- Bennett, Walter J. '03 C
- Bertossi, Clarence F. '25 C
- Bessler, Herman F. '25 M
- Bingham, Stanley E. '08 M
- Bishee, Bertin A. '22 E
- Biskup, Wm. F. '16 C
- Bohland, John A. '15 C
- Borne, Floyd '27 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
- Brownell, Edward '26 C
- Bruess, Edward C. '29 M
- Buenger, Albert '13 M, '14 ME
- Bumgardner, Louis T. '23 E
- Burch, Cecil J. '29 C
- Carlson, Arvid P. '17 M
- Carlson, Ernest '22 M
- Carlton, Richard P. '21 C
- Chapman, Leslie H. '95 C
- Chapman, Wilbur J. '27 M
- Childs, James A. '09C
- Christlieb, Frank B. '23 C
- Clark, Kenneth M. '27 C
- Coffin, N. Stuart '24 M
- Comfort, Clifford E. '26 M
- Corl, Cady S. '21 Ch
- Countryman, M. Alden '23 E
- Crawford, Allen S. '12 M
- Crimmins, John F. '30 A
- Curry, Ezra Benham '20 M, '21 ME
- 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
- Dehn, Elter '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
- Edzell, 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
- Felton, Elmer T. '13 Ch
- Feyder, William H. '05 C
- Finley, Joseph E. '05 C
- Fiske, Frederick W. '09 C
- Fleming, Frank R. '08 M, '09 EE
- Flygare, August L. '12 C
- 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
- 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
- Goldberg, Maurice '21 E
- Goldberg, W. M. '28 Ch
- Goodkind, Leo '92 A
- Greenberg, Morris '18 M
- Grime, Edwin M. '08 C
- Guerin, George V. '24 C
- Guesmer, George O. '24 C
- Guesmer, Marie W. '26 ID
- Gustafson, I. M. '28 C
- Haberle, Edward '12 C, '13 CE
- Haeberle, E. H. '06 E
- Haims, Mark '25 C
- Halvorson, Henry A. '11 Ch
- Hamilton, Sam '28 E
- Hansen, Carlos C. '20 C
- 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
- Heinemann, G. '29 ChE
- 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, Michael J. '11 C
- 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
- Hoving, John E. '27 C
- How, Francis W. '27 C
- Irons, George '26 E
- Jacobson, Ruben A. '25 M
- Jenson, Theodore R. '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
- Jones, Gordon '25 AE
- Joyce, Floyd E. '17 Ch
- 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
- 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
- Larson, Albin '14 C
- Larson, Martin S. '11 M
- LeBlond, Edmond J. '05 E
- Levy, Max L. '26 E
- Lewin, Sherman W. '26 C
- Lewis, Edward B. '05 M
- Liese, Herbert W. '24 C
- Lieske, Harold W. '30 C
- Lilly, Clarence W. '17 E
- Lilly, Eugene '19 G
- 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
- Lovering, Harry D. '13 C, '14 CE
- Lux, Arthur E. '16 E
- McCartney, Floyd A. '13 M
- McConnell, J. K. '29 ChE
- McCree, Andrew A. '08 C
- McCubrey, Everett J. '21 C
- McMiller, Paul R. '11 Ch
- McNerney, George W. '30 AE
- McPherson, William B. '02 E
- Macgowan, Irvin '25 C
- Mackintosh, William S. '21 C
- Mailand, Marjorie J. '30 IA
- 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
- 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
- Moisesko, Wm. '29 M
- Molstad, Arnold R. '31C
- Moore, Gordon B. '27 E
- Moore, John H. '24 M
- Mourman, Albert J. '18 A
- Mourman, Frank S. '22 A
- Morton, Harold S. '12 M, '13 ME
- Mott, Charles L. '10 C
- Muller, Carl C. '18 M
- Naevik, Adolph '26 C
- Nelson, Edward S. '09 C
- Netherly, George '29 ChE
- Neville, Earle L. '28 C
- 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. '19 Ch
- Okes, Day I. '08 C
- Okes, Sidney R. '09 C
- Olson, Arthur O. '11 Ch
- Olson, Clarence E. '22 G
- Oltman, Charles A. '03 C
- Orth, Robert W. '31 M
- 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
- Pohl, Loren F. '27 C
- Poulsen, George F. '17 A
- Ralphe, W. W. '30 C
- Raven, Theodore '26 ChE
- Rauscher, Paul F. '27 E
- Reardon, John M. '22 C
- Relin, R. K. '26 AE
- Redmond, Fabian '29 A
- Riedesel, George M. '17 A
- Rigg, Alvin E. '25 A
- Ringstrom, Ivan G. '12 ES, '13 EE
- Ringwood, James '28 C
- Rockwood, Ralph H. '12 Ch
- Roe, Chas. F. '29 CH
- Roehrich, Victor '09 ChE
- Roth, Lewis M. '11 C
- Rufsvold, Olav M. '15 C, '16 CE
- Santelman, Ralph H. '27 C
- Schaller, Geo. C. '23 C
- Schroepler, Geo. '28 C, '30 MS (CE)
- Schwager, O. J. '30 M
- Shepard, George M. '09 C
- Sickel, Edwin C. '23 E
- Skon, Herman W. '15 M, '16 ME
- Slade, Loring '22 C
- Smith, Sheldon H. '10 ChE
- Snow, Clarence J. '14 M, '16 ME
- Souther, M. Edwin '12 C, '13 CE
- Speer, Paul B. '27 E
- Spehr, Peter E. '27 M
- Stanton, Raymond E. '04 M
- Stewart, C. H. '03 C
- Streich, Harry C. '12 E
- Swenson, G. W. S. '23 Ch
- Swenson, George W. '17E '21EE
- Swenson, Theodore J. M. '12 E
- Tallmadge, Everett S. '14 E, '15 EE
- Tauber, Jos. '28 C
- Teberg, Lawrence E. '22 C
- Tews, Arthur W. '24 C
- Thian, Helen M. '30 IA
- Thomas, Theodore W. '25 C
- Thomas, William A. '17 E
- Thompson, Niles J. '27 E
- Thompson, Theodore S. '24 C
- Tierney, Festus P. '22 C
- Tonchell, Stanil T. '15 Ch
- Tuchesing, Norman F. '27 M
- Turner, Leslie E. '09 E
- Vievering, Wm. A. '25 Ch
- Villaume, Walter F. '23 C
- Waldor, Ted N. '25 C
- Waldron, Ralph E. '20 E
- Wald, Reuben E. '30 E
- Waterous, Fred A. '20 M
- Weinke, Ernest '16 C, '17 CE
- Welin, Arthur G. '12 C, '13 CE
- Wellisch, Walton '23 E
- Wenm, Laurel A. '27E
- Whitman, Edward A. '00 C
- Wielde, John A. '28 C
- Williams, Fred J. '17 E
- Willis, Roy '08 C
- Wilson, Frank W. '23 E
- Wolf, Milton C. '25 C

St. Paul
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
St. Peter
Skartvedt, Peter M. '06 Ch, '13 Ch
Slayton
Price, John R. '14 C
Sleepy Eye
Hausen, 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
Thief River Falls
Lewis, John G. '24 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
Virginia
Sannicolo, Joseph F. '22 E
Wabasha
Berry, George F. '24 M
Waconia
Wessale, George '21 E
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
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
Winthrop
Larson, Karl O. '30 Ae

MISSISSIPPI

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
Bepenett, Edward L. '22 C
Kansas City
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
Glasscock, Henry H. '06 E
Rolla
Eyberg '29 C
St. Louis
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, Reslino 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
Berg, Karl A. E. '20 C
Coleman, Frank D. '05 E
Bozeman
Thaler, James A. '00 E
Bridger
Coon, Lawrence C. '26 E
Butte
Jordan, Frank W. '19 E
Pratt, Arthur C. '99 E
Rolfe, West A. '13 C
Stussy, William '00 E
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
Weisner, Frederick E. '06 C
Havre
Haverson, Henry D. '07 C
Helena
Kivley, Warren O. '16 C

NEBRASKA

Crete
Hawlick, H. L. '19 C
Omaha
Bunce, Paul F. '06 E
Christensen, Edgar W. '19 E
Eddy, Horace T. '95 E, '96 EE
Sampson, Cliff. L. '23 E, '25 EE
Schneckloth, Harry H. '25 E
Skarolid, Charles T. '24 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
Hanover
Hartshorn, Elden B. '22 PhD

NEW JERSEY

Bloomfield
Robinson, Lawrence T. '26 EE
Widell, E. Gideon '17 ChE
Camden
Berglund, Erick '27 E
Burrill, Charles M. '23 E
Curson, Benjamin L. '17 Ch
Hargrave, W. A. '26 E
Heller, A. Robert '30 E
Koch, Winfield R. '25 E
Painter, William H. '30 E
Smith, Jerome C. '27 E
Carteret
Kerns, Clinton B. '13 M
Cliffwood
Sharpless, Wm. M. '28 E
Deal
French, Edwin C. '30 E
East Orange
Chapman, A. G. '11 E
Wright, Roydon V. '98 M
Elizabeth
Skidmore, John G. '30 C
Harrison
Wyman, L. R. '22 Ch
Hoboken
Gustafson, Thor A. '28 E
Irvington
Prehn, Victor N. '27 E
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
Pangburn, Carroll '22 E
Peterson, Vance C. '20 E
Steffens, Robt. A. '22 E
Vastdahl, Victor E. '29 E
Waligoski, A. Arnold '24 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
Barnum, Marvin C. '11 M
Burke, James '28 M
Cherne, Realto '29 M
Dahl, Paul E. '28 E
Frederickson, Harry B. '11 E
Fritzberg, Hilding L. '28 M
Johnson, Welton V. '26 E
Rose, Anton R. '04 Ch
Paulsboro
Nygard, Edwin M. '21 Ch
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
Phillipsburg
Dey, Phillip S. '29 M
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
Roselle
Boyd, Thompson '29 ChE
Jones, Ivor V. '15 C
West New York
Veltz, Clarence '24 C, '30 CE

NEW MEXICO

Albuquerque
Gilman, Gaylord '25 E
Larson, Fred '25 C

NEW YORK

Albany
Bauer, Roscoe W. '24 C
Arlington
Larson, Harold O. '29 E
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
Steppel, Ernest A. '11 Ch
Sushan, Harry M. '19 C
Buffalo
Anderson, Henry A. '27 EE
Bakken, Adolph C. '23 Ch
Boyd, Paul M. '15 M, '16 ME
Czock, Jacob H. '20 M
Hammer, G. E. '20 Ch
Holmes, Roland W. '25 M
Johnson, Carl S. '21 C
Jules, Harold A. '20 E
Kelsey, Howard C. '22 M
Luft, O. W. V. D. '17 Ch
Pendergast, Webster G. '25 M
Sverdrup, Edward F. '26 ChE
Swanson, Oscar E. '15 C, '16 C

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Plumber, Clayton '20 Ch
Wagner, Otto H. '07 M

Massena
Heath, Arthur C. '25 M

Mt. Vernon
Hiers, Charles R. '24 M
Loye, Edwin M. '20 A

New York City
Abbott, Arthur L. '97 E
Allison, Ralph E. '30 E
Anderson, Fayette C. '24 E
Backstrom, Emil F. '24 A
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 F. '23 E
Case, Gerald F. '23 E
Cheney, Edward J. '04 E
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
Ellestad, Irwin M. '22 E
Elmer, Lloyd A. '21 M
Emerson, Lyon A. '11 E
Field, William J. '30 E
Fox, Claire C. '29 E
Friis, Robert W. '30 E
Gannett, Danforth '16 E, '17 EE
Gerlach, Henry C. '22 A
Gilman, Howard B. '17 A
Goodner, T. C. '29 E
Green, Arthur T. '30 E
Gregg, Treshame D. '05 G, '06 CE
Hakenjos, Fred M. '29 A
Hansen, Oliver S. '29 A
Hastad, C. Jerome '30 E
Heinz, Harold '25 E
Hendrickson, C. T. '10 E
Hilferty, Charles D. '96 M
Holien, Edward O. '23 A
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
Juran, Nathan H. '29 A
Kannenberg, W. F. '23 E, '25 MS (EE), '28 EE
Kuepke, Walter E. '13 C, '14 CE
Koerner, W. M. '28 E
Kokatnur, Vaman R. '14 Ch
Kuhlman, Rudolph H. '23 M
Laird, Lee R. '03 E
Landeen, Arvid G. '10 E
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)
Magoon, Herbert A. '24 A
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
Poss, John A. '29 AE
Rankin, Reuville 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
Simons, Walter W. '16 E
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
Wentz, Clarence A. '27 C
Wheeler, Herbert H. '17 E
Wiggins, Gerald G. '06 E
Williams, Fred M. '05 E, '09 EE
Willner, William E. '22 A
Woodman, J. C. '11 M
Zimmerschied, Clarence R. '23 E

Niagara Falls
Dobrovolny, Frank J. '24 Ch
French, Edwin L. '02 E
Graling, Verney '99 E
Jackman, R. E. '29 Ch
Marr, Horace S. '19 Ch
Schermer, Oscar C. '21 Ch, '22 ChE
Yngve, Victor '17 PhD

Norwich
Moris, Russel F. '25 C

Poughkeepsie
Mann, Alvin K. '26 E

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
Danielson, Ellsworth H. '30 M
Dunham, Roy G. '14 E, '15 EE
Edgar, Robert F. '27 E, '29 MS (EE)
Engstrom, Elmer W. '23 E
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
Haedecke, August D. '26 E
Harris, Gordon C. '29 E
Hartley, Lowell J. '26 E
Hathaway, Herbert F. '28 M
Heinemann, John R. '19 E
Larson, Werner L. '28 M
Marshman, Irving H. '24 E
Mittag, Albert H. '11 E
Murdock, George B. '26 E
Norberg, Hans A. '27 E
Rask, Louis G. '03 E
Redding, James '27 E
Riddell, John D. '28 E
Sheppard, Raymond '30 M
Tunnell, Clement R. '25 E
Warren, Laurence C. '24 E
Williams, W. Glenn '29 E
Wiltgen, Edward '08 E
Wyman, LeRoy L. '23 ChE

Staten Island
Grimes, David '19 E
Marshall, Donald '19 E
Temple, Sterling '17 PhD

Syracuse
Jones, Robert A. '15 E, '16 EE
Moyer, Malcolm B. '09 M

West New York
Velz, Clarence '24 C

White Plains
Adams, George F. '95 E

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

Bismarck
Moses, Marlowe '27 E

Carrington
Lee, Albert C. '27 E

Crosby
Rosseau, Clifton C. '24 M

Elkton
Kelly, William J. '26 E

Fargo
Grafsland, Geneva '27 I
Jones, Paul W. '28 A
Juvrud, Edwin C. '17 E
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
Sunde, Conrad J. '26 OCh
Tarbell, William P. '22 C
von Sien, Ruth '28 ID

Grand Forks
Anderson, Edward X. '08 Ch
Gauger, A. W. '14 Ch
Harris, Elwin E. '22 Ch
Kilpatrick, Porter W. '27 A
Mayer, Joseph S. '24 E
Schulz, Elton A. '16 E

Minot
Huston, David B. '07 C
Melander, Edwin '25 A
Peterson, William W. '16 C
Williams, William R. '26 E

Stanley
McGregor, Frazer A. '24 E

Wilton
Gerow, Theron G. '28 M

Williston
Jackson, Myron B. '05 A. C.

OHIO

Akron
- Gustafson, Hugo P. '28 M
- Morris, Vion N. '26 PhD
- Peterson, Roy C. '29 M
- Pettersen, Wilber E. '28 M
- Rehfeld, Harold '29 ChE
- Tronson, John L. '26 ChE, '28 MS

Ardorton
- Straub, William '29 Ch

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. '29 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
- Balkin, Samuel W. '26 C
- 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
- Dever, Francis A. '20 C
- Drinkall, John P. '19 E
- Etem, Victor '26 E
- Hinman, Charles H. '24 A
- Johnson, Leonard T. '10 E
- Larson, Walter J. '20 E
- Lee, Albert A. '26 E
- Lighter, Clyde W. '26 A
- 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
- Sillman, Paul W. '28 C
- Tuve, George L. '20 M, '21 ME
- Wald, Joseph H. '27 E

Cleveland Heights
- Merriell, Elmer W. '12 E, '13 EE

Columbus
- Berzelius, Carl E. '29 AE
- Curtis, Verne '22 M
- Engstrom, LeRoy '28 C
- 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 '25 ID
  (Mrs. J. P. Barton)
- Forbes, Henry C. '22 E
- Roberts, Dimon A. '27 M

Findlay
- Robison, Archer R. '09 E

Hubbard
- Meyerdick, C. C. E. '26 C

Ivorydale
- Cassel, N. S. '23 ChE
- Hamlin, Leban H. '21 M
- Jewett, Ernest E. '25 ChE
- Krantz, R. W. '25 MS
- 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
- Schiller, Carl J. '28 E
- Thelin, Ruben E. '28 E
- Wieland, Willard '25 E

Marion
- Barron, John H. '26 E

Novelty
- Madsen, Olav '20 G

Salem
- Rosing, Donald C. '27 C

Springfield
- Keller, Raymond W. '25 E
- Moore, Norman R. '25 C

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
- Leidet, A. E. '27 E
- Ramm, Theodore D. '13 E
- Schilken, Donald R. '29 AE
- Van Cleve, Horatio P. '87C

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

Burns
- Herstkotte, Arthur E. '23 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

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 R. '93 M, '02 ME
- Doeltz, William F., Jr. '08 C
- Felthous, Donald G. '29 M
- Hubbard, Fred A. '09 C
- Johnson, Ivar W. '24 E
- Juvrud, I. O. '14 Ch
- Meany, James M. '07 M
- Morton, Lyle W. '24 E
- Nelson, Donald O. '29 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
- Bohrer, Donald M. '29 EM
- Borchardt, Lester F. '29 E
- Burt, Fred R. '16 E
- Brown, Louis M. '16 E
- Farmer, Herbert F. '27 E
- Finch, James B. '30 E
- Finnell, Thomas C. '29 E
- Fischer, A. M. '29 E
- Gemmell, Robert W. '26 E
- Gibson, Charles B. '05 E
- Goss, Harold R. '28 E
- Hanft, Hugo '25 E
- Heidmann, Karl R. '29 E
- Hussey, Norman W. '25 E
- Kaplan, Eugene V. '10 M
- Knudson, Manches E. '30 E
- Levesconte, L. B. '26 E
- Madden, John S. '30 E
- May, Darwin R. '14 ChE
- Rudman, Mirko J. '30 E
- Russ, Lloyd A. '29 E
- Schweppe, Walter A. '26 E, '28 MS
- Sjoberg, Roy H. '26 E
- Soufal, Roman N. '30 E
- Specht, James E. '29 E
- Stark, John '29 E
- Thompson, William F. '30 E
- Viehahn, William W. '30 E
- Warrington, John Lamont '30 E
- Warrington, William G. '30 E
- Westin, Lloyd J. '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. '23 E
- Gibson, Robert '27 E
- Jacobs, Wm. A. '30 E
- Mielke, Warren C. '30 E
- Roth, Harvey C. '23 E
- Sturtevant, Percy G. '08 E

Fullerton
- Spencer, J. Boyd '27 M

Harrisburg
- Didriksen, Philip H. '20 E
- Morse, Geo. '93 A
- Morse, George H. '93 E, '11 EE

Holtwood
- Marcroft, H. C. '24 E

Jenkintown
- Lanie, John M. '08 Ch

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
- Freche, Hertha R. '25 MS
- Pippel, Herbert A. '20 Ch
- Taylor, Cyril S. '13 Ch

Palmerton
- McMillen, E. L. '23 ChE, '27 MS

Philadelphia
- Baskerville, Ralph J. '30 M
- Childs, John C. '06 C

Cross, Roland E. '23 M
Currie, Neill, Jr. '08 E
Dunnum, Orney E. '22 E
Fairchild, Albert R. '87 E
Forbes, Pierce P. '08 C
Guppy, Richard H. '30 M
Hunt, Gates E. '20 E
Jordan, Wallace E. '26 ChE
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
Sarteil, Page M. '24 M
Satori, Roy H. '21 E
Sime, Theodore L. '23 A
Stone, L. F. '22 ChE
Von Rohr, Herbert H. '21 M
Young, Charles N. '12 E

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
Morrison, John E. '22 C
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
Willard, Arthur C. '22 E

POTTSTOWN
Williams, Edward H. '83 M

SCRANTON
Eberhardt, Otto J. '03 E

SHARON
Branch, Harold N. '29 E
Hovey, Betram K. '27 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
Dahl, Hjalmer A. '22 E
Johnson, Douglas O. '28 E
Johnson, Sheldon '28 E
Locklin, R. R. '29 E
Wilson, Abner W. '22 E

WILLIAMSPORT
Briggs, Luard E. '27 C

RHODE ISLAND

PAWTUCKET
Knapp, Lester H. '12 E

PROVIDENCE
Tappan, Ruth W. '22 Ch
(Mrs. Joseph Dowling)

SOUTH CAROLINA

CHARLESTON
James Grant '07 C

GREENVILLE
Kilburn, Elsie I. '27 MS

SOUTH DAKOTA

ABERDEEN
Odegaard, Harold T. '20 M

BROOKINGS
Mark, Reuben A. '11 C
Mark, Walter J. '09 M

LIGHT CAP
Blake, Henry B. '01 E

MITCHELL
Miller, Ralph Harrison '13 Ch

RAPID CITY
Dimmick, Merton A. '26 E

SIOUX FALLS
Boyce, Leonard F. '12 M
Holt, George A. '16 E
Johnson, Ellwood L. '30 M
Ransom, Ralph W. '23 M
Robertson, Kenefick '25 E

WALTERBORO
Mitchell, Lloyd S. '23 C

WATERTOWN
Brown, Harry E. '22 G

TENNESSEE

BRISTOL
Butterworth, Russell L. '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

GUILD
Irwin, Frank H. '16 E, '17 EE

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
Schultz, Alex A. '26 C

TEXAS

AMARILLO
Bolnick, Harry W. '27 C

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

DALLAS
Chestnut, Geo. L. '97 E
Dahl, George '21 B. S. (Arch)
Fernald, Frank O. '84 C
Magnuson, John E. '22 E
Rounds, Fred M. '95 E
Smith, Donald T. '05 C

HOUSTON
Bakke, Oliver M. '03 Ch
Crane, Fremont '86 BS, '87 BCE, '98 CE

LUBBOCK
Kleinschmidt, Floren A. '28 A

NEW GULF
O'Donnell, Lawrence '25 M

SAN ANTONIO
Hansen, Tom W. '30 A

PAMPA
Wolfe, George E. '24 E

PORT ARTHUR
Ost, Roland E. '22 C
Weetman, Bruce '26 Ch

WESLACO
Nutting, Horace W. '25 C

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
Crow, Robert W. '16 C

FORT HUMPHREY
Laplow, Walter D. '17 C

HAMPTON
Wagner, John W. '24 M

HAMPTON ROADS
Joachim, Wm. F. '20 M, '21 ME

HOPEWELL
Smith, Allen S. '26 ChE
Morris, Thomas C. '08 M

LANGLEY FIELD
Rollin, Vern G. '29 M

NEWPORT
Holmstine, Arthur G. '17 M

RICHMOND
Cornell, George M. '35 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

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
McCall, Harry J. '08 C

Puget Sound
Benedict, Geo. F. '03 E

Pullman
Levine, Arthur '23 PhD

Seattle
Bowen, Fred P. '06 C
Bushnell, Chas. S. '78 M
Curtiss, Lindsley B. '09 G
Erickson, Carl G. '24 C
Grimshaw, William E. '02 M
Gustafson, Reuben W. '24 C
Guthrie, J. De Mott '93 E
Hayward, George I. '86 C
Hillman, Chas. K. '12 E
Hoffman, Ralph M. '11 Sc. & Tech.
James, Henry C. '11 E
Jenkins, Clifford H. '25 M
Linton, James H. '97 ChE
Lunm, Gordon '25 A
McKenzie, Lauren F. '09 E
Magnusson, Carl E. '96 E, '97 MS, '05 EE
Markhus, Olaf G. F. '97 E
Nelson, Geo. A. '25 C
Paulson, Joseph R. '27 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
Sternberg, Carl '07 E
Stewart, Geo. A. '22 A
Weber, Erwin L. '06 E, '08 M
Wesbrook, Donald McD. '10 M
Westberg, Russell E. '20 E

Skykomish
Walters, Walter P. '26 E

Spokane
Adams, Elmer E. '06 CE
Alton, Herbert D. '97 E
Manuel, Douglas R. '22 Ch

Tacoma
Blake, Robert P. '97 M

WEST VIRGINIA

Charleston
Eck, Melvin C. '29 C
Giltinan, David M. '15 M, '16 ME

Hinton
Fenton, Paul C. '26 C

Morgantown
Amidon, Lee L. '23 M
Gill, James H. '92 M, '94 ME

Wheeling
Root, Frank R. '24 AE

WISCONSIN

Appleton
Darling, Stephen F. '23 Ch
Holt, Gunnhard T. '28 E
Lewenstein, Abraham '26 ChE
Poppe, Frederick W. '11 Ch

Beloit
Cole, Ernest C. '26 M
Kaplan, Donald J. '30 E
Lindfors, Onni '30 E
Plank, Howard G. '22 E
Spicola, James A. '30 E
Tuttle, Stanley B. '24 M

Brillion
Dawson, Ivan R. '30 Ae

Bruce
Buhr, Leo '23 C

Chatek
Weston, Wm. S. '02 C

Chippewa Falls
Berdan, Hubert J. '22 C
Cray, Seymour R. '22 C, '23 CE
Vaudreuil, Lionel '25 AE

Eau Claire
Bergford, John '28 C
Cotton, Ernest H. '19 E
Dow, Clarence A. '13 E, '14 EE
Fairbanks, Geo. W. '23 E
Frahm, Alfred R. '08 E
Holm, Edwin R. '20 C
McMillan, James S. '22 E
Meyer, Carl F. '10 C
Monsen, Manley A. B. '24 E
Peters, Chas. M. '27 E

Grantsburg
Nelson, Martin E. '24 C

Green Bay
Dimmitt, Bruce S. '30 C
Hartney, James L. '14 M, '15 ME
Moody, Chester S. '16 M, '17 ME

Kohler
Hvoslef, F. W. '17 M, '19 MS

La Crosse
Bergsland, Grant C. '23 M
Harrington, Russell '24 E
Meader, Glenn '26 E
Nordstrom, Ernest A. '22 M
Willson, Stuart V. '24 M

Lynxville
Christenson, Elmer J. '27 C

Madison
Bray, Mark W. '14 Ch
Church, Bruce R. '28 A
Daniels, Farrington '10 Ch
Erickson, Edwin C. O. '22 C
Hubbard, Robert T. '06 E
Knudsen, Esther M. '25 C
Korfhage, R. F. '20 Ch
Larson, Ludvig C. '21 E, '23 EE, '26 CE
Luxford, Ronald F. '17 C
Nystrom, Paul E. '24A
Peterson, C. E. '23 Ch
Reiter, Alfred A. '25 ChE
Turrittin, Hugh L. '27 C

Marinette
Hornbrook, James W. '09 E

Menomonie
Mitchell, Ralph W. '12 Ch

Milwaukee
Albrecht, George M. '06 E
Bartholomew, Neal W. '23 C
Bjerre, Folmar L. '25 M
Borden, John C. '29 E
Borrowman, J. K. '27 C
Brimeyer, Ferdinand J. '25 AE
Brown, Glendon '28 E
Bunnell, Chas. W. '26 C
Chapin, Harold S. '13 M, '13 ME
Clark, Fred '27E
Clarke, Charles P. '08 C, '09 CE
Comstock, Roy H. '30 E
Flegal, A. I. '27 A
Foltz, Ross M. '19 M
Hansen, Maurice J. '11 E
Hart, Maurice W. '26 E
Hemsey, Clayton R. '22 M
Hutchinson, E. T. '27 M
Johnson, Herman R. '09 EE
Kampa, Edmund P. '23 Ch
Kendall, Walter '25 A
Kreger, Stuart S. '28 C
Larson, Louis J. '14C, '15 CE
Lee, Wm. B. '30 M
Ludrigsen, Elliot '25 M
Loethi, Carl F. '27 C
Lundsten, Frank R. '27 C
Marek, Glenn '30 M
Merks, E. Donnel '29 E
Newman, John M. '23 E
Ohman, George U. '26 C
Papenthien, Roy O. '21 G
Peterson, Laurence L. '25 M
Potter, Robert P. '26 A
Price, Clarence R. '20 E
Reed, Albert I. '85 C
Robert, W. J. '22 ChE
Roberts, Earl H. '15 M, '16 ME
Roberts, Norman A. '26 M
Sandler, Theodore T. '30 C
Skrukrud, Odean M. '25 C
Sommermeyer, Karl H. '30 E
Sutherland, Samuel J. '23 AE
Wallin, Stanton E. '29 C

Neenah
Lande, Clarence C. '27 C
Palmer, Howard B. '22 C

Racine
Olson, Arthur L. '24 M
Rood, Arnold E. '22 E
Taylor, Ralph C. '03 M
Tyvand, James A. '24 E

Sheboygan
Abrahamson, Leroy M. '29 EE
Nummer, W. B. '26 E
South Milwaukee
Wallin, Stanton '29 C
Spooner
Putz, John H. '14 BS, '15 EE
Superior
Scobie, Francis G. '08 E
Wausau
Mills, Hartzell '25 M
Wauwatosa
Cross, Chas. H. '97 M
West Allis
Ewy, Albert '30 E
Smart, George A. '16 M

WYOMING

Sheridan
Pearson, Geo. '28 AE
Yellowstone Park
Lindelef, Charles '09 E

ALASKA

Valdez
Smith, Byron E. '07 E

CANADA

Coutts, Alta.
Jallings, K. R. '28 ChE
Edmonton
Morris, Robert '05 E
Ft. Frances, Ont.
Hass, Paul O. '26 M
Fort William, Ont.
Anderson, Edw. S. '21 EE
Macoun, Sask.
Towey, James M. '28 E
Montreal
Adams, Wm. C. '05 C
Beyer, Randell '27 E
Moore, Leonard P. '29 ChE
Spence, William J. '02 E
New Toronto, Ont.
Jones, Idris V. '15 C
Port Arthur
Souba, William H. '09 M
Port Colburn
Kepner, Ben-Hur '11 Ch
St. Catharines
Noel, Clay W. '20 E
Tetford Mine, Quebec
Johnson, Ray V.
Toronto
Anderson, Oscar V. '10 E
Weyburn, Sask.
Casberg, James W. '08 E
Winnipeg
Borrowman, Leroy F. '08 C
Brown, Geo. J. '08 E
Joselowitz, G. '18 Ch
Schumacher, John H. '03 E

CHINA

Peking
Lin, Shu Ming '20 A
Loo, Pank Chuk '28 AE
Wong, Jee K. '16 M
Tientsin
Eliassen, Sigurd '13 C

CUBA

Havana
Romero, Cirilo L. '17 M, '18 ME

ENGLAND

Felstead, Essex
Trouson, Carl A. '10 Ch

GERMANY

Gottingen
Hogness, T. R. '18 ChE

HAWAII

Fort Shafter, Honolulu
Coe, Edward H. '19 C
Haukenson, N. T. '26 C
Scott, Willard W. '17 E

ICELAND

Reykjavik
Gunnarson, Jon '29 C

INDIA

Bengal
Dewaji, Gunaker '26 M
Bombay
Shellenberger, Hiram R. '20 M

MEXICO

Guadalajara
Burt, John L. '90 C
Torreon, Coah
Maine, Basil C. '21 E

PHILIPPINE ISLANDS

Bay, Laguna
Galvez, Nicolas L. '25 Ch
Cavite
Cox, Richard F. '08 M
Fort William McKinley
Linden, Henning '17 C
Malabon, Rizal
Roque, Feliciano T. '24 ChE
Manila
Aslakson, Carl I. '23 C
Morris, Geo. E. '27 C
San Juan
McKeson, L. J. '27 E

SOUTH AMERICA

Brazil

Rio de Janeiro
Nogueira, Frederic P. '23 E
Thompson, Herbert L. '12 M
Sao Paulo
Nierling, Grant C. '25 E
Schoepf, A. W. '08 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.)

TURKEY

Constantinople
Fulmer, Jervis M. '22 Ch

CASS GILBERT

(Continued from page 241)

mained a firm adherent to "Classicist Architecture" for the design of his buildings because it possesses a purity and a quality which is more in the spirit of architectural refinement than many of the wretched attempts at a modern architecture. Even though talented with a fifth sense of architectural expression, Mr. Gilbert has ever remained a practitioner of thoroughness and carefulness of study for any undertaking.

With the idea that there is only one correct solution to every design problem, no amounts of pains are spared to express the proper relation between plan and elevation, disposition of rooms and distribution of masses, and above all "feeling" for the purpose intended. A church must be a church within and without, and a jail a jail, but a house a home, despite the fact that it "takes a heap o' living to make a house a home."

Confronted with a new problem in bridge design, that of the huge Hudson river span, Mr. Gilbert provided himself with first hand information, by consulting the innumerable sketches he had made of the great ancient bridges and aqueducts, the Roman aqueduct of Segovia, the Pont Du Gard and others. This was not mere reproduction, but study of scale, of effect of mass, of proportions and balance. Not haphazard and random, but careful and complete are his preparations.

One of Mr. Gilbert's better known works is the Minnesota State Capitol building built in 1896. Constructed largely of Minnesota marble and other native materials it stands as a monument to its architect's first important work of comparable size, and was incidently awarded to him in a competition. Other landmarks of this architect's hand are the Federal Reserve Bank of Minneapolis, the Customs House and Woolworth Building of New York, the Art Museum and Public Library of St. Louis, the new Treasury Building at Washington, D. C., the new Supreme Court of the United States and innumerable other buildings of lesser note.

Mr. Gilbert's interests have always been sincere and spontaneous emmanations of a man seeking to better his profession. Telling that a great need existed for some type of official body, Mr. Gilbert with two other leaders went to President Roosevelt with their case. Roosevelt granted their request, and what was then called the Council of Fine Arts became existent, later to be known as the Commission of Fine Arts. Mr. Gilbert was its first chairman, and was appointed to a membership in it by President Taft and President Wilson. When a similar commission was formed in England, a delegation was sent to America to study this organization, and was to a large extent modeled after it.

From prestige abroad, Mr. Gilbert has been made a life and charter member of the Academy in Rome, and was at one time honorary corresponding member of the Royal Institute of British Architects. In 1926 he was president of the National Academy of Design. The fact that he has belonged to countless architectural organizations speaks in plain and effective language of a man whose dominant motive in life has been contribution to the development of architecture in all its truthfulness and beauty. Not only has this great designer shown mastery in architectural practice, but also in fields of art. Those who have visited his offices in New York marvel at the water color renderings which his brushes have instilled with what critics call "emotion." To be an artist one must be more than a craftsman, he must be a seer, an interpreter. He must base his appeal upon the fact that he has thoughts in regard to his subject deeper than our thoughts. He must bring out thoughts which were it not for his works we might have missed. This is the secre of the appeal of all great artists. The student is ever dissatisfied with mere representation; he seeks for expression of knowledge of his theme. Appreciatio for a water color drawing is a dynami sort of thing. It either moves us or w remain impassive. In Mr. Gilbert' water colors are depicted the student' attitude, that of creating something new —an expression of an emotion, the conveyance of an idea. His drawings wil in the future be accepted as an indisper sible and inspiring portion of the record of a life of high achievement.

But even more enduring will be th contribution of this foremost architect i the advance and furtherance of archi tecture for architecture's sake. The grea thing, the rare thing, in an architectur composition is the expression of an ide the realization of a purpose and the co veyance of a feeling. To combine the elements in the presentation of a buil ing is every architect's desire,—but sound the key that strikes the harmor ous chord is left only to a Master Arcl tect, a Bramante, a Michelangelo, Leonardo da Vinci, or a Cass Gilbert.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

October, 1930 — Volume XI — June, 1931

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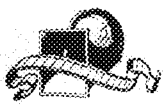
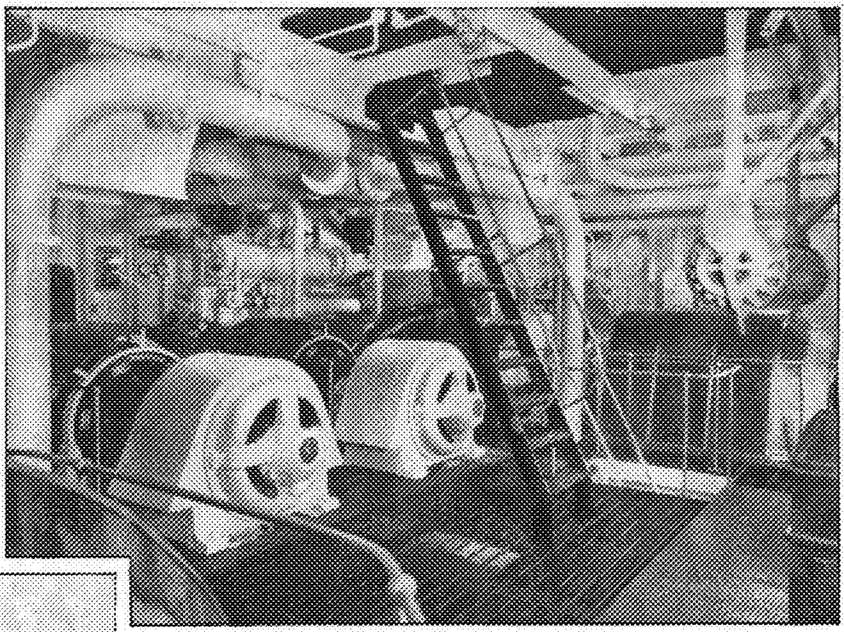
Knee-deep in midstream

The men who make telephones move in the midstream of modern life, where the current flows swiftest . . . Western Electric comes in contact with work of absorbing interest—such as battling floods and  cyclones to provide the materials for restoring communication . . . trekking through the Northwest for just the right kind of  pole timber . . . making a new cable to carry 1818 conversations . . . pioneering in production of police radio, aviation  communication systems, tele-typewriters,  talking picture equipment . . . All this appeals strongly to men who want to be in the center of action—who want to make themselves a vital part of today's varied life.

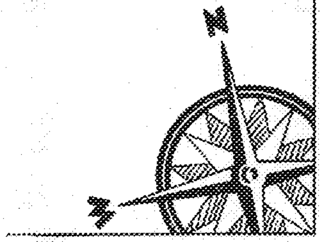
Western Electric

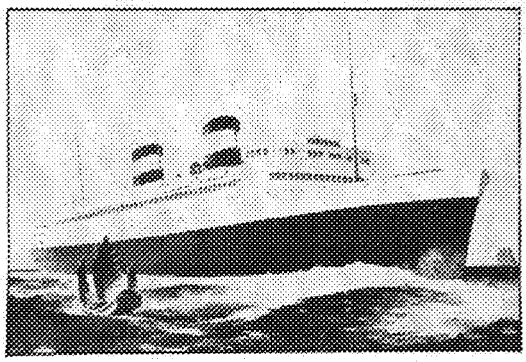
Manufacturers . . . Purchasers . . . Distributors

SINCE 1882 FOR THE BELL SYSTEM



Typical engine room of a modern all-electric ship





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